

I-SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE01	Professional Communication-I	2	0	0	2	30	70	100
2	20FE03	Differential Equations	2	1	0	3	30	70	100
3	20FE07	Applied Physics	2	1	0	3	30	70	100
4	20CE04	Basic Civil and Mechanical Engineering	3	0	0	3	30	70	100
5	20EE03	Electronic Circuits and Devices	2	1	0	3	30	70	100
Laboratory Courses									
6	20FE54	Applied Physics Lab	0	0	3	1.5	15	35	50
7	20CE53	Basic Civil and Mechanical Engineering Lab	0	0	2	1	15	35	50
8	20EE53	Electronic Circuits and Devices Lab	0	0	3	1.5	15	35	50
9	20ME51	Engineering Workshop	0	0	3	1.5	15	35	50
Total			11	3	11	19.5	210	490	700

II-SEMESTER

S.No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE02	Professional Communication-II	2	0	0	2	30	70	100
2	20FE04	Linear Algebra and Transformation Techniques	2	1	0	3	30	70	100
3	20FE05	Applied Chemistry	3	0	0	3	30	70	100
4	20CS01	Programming for Problem Solving using C	3	0	0	3	30	70	100
5	20EE04	Fundamentals of Electrical Engineering	2	1	0	3	30	70	100
6	20MC01	Constitution of India	2	0	0	0	30	70	100
Laboratory Courses									
7	20FE51	Professional Communication Skills Lab	0	0	2	1	15	35	50
8	20FE52	Applied Chemistry Lab	0	0	3	1.5	15	35	50
9	20CS51	Programming for Problem Solving using C Lab	0	0	3	1.5	15	35	50
10	20ME53	Computer Aided Engineering Drawing	0	0	3	1.5	15	35	50
Total			14	2	11	19.5	240	560	800

III SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE10	Numerical Methods and Integral Calculus	2	1	0	3	30	70	100
2	20CS03	Data Structures	3	0	0	3	30	70	100
3	20EE05	Electrical Circuit Analysis	2	1	0	3	30	70	100
4	20EE06	Digital Electronics	2	1	0	3	30	70	100
5	20EE07	Electric and Magnetic Fields	2	1	0	3	30	70	100
6	20MC02	Environmental Science	2	0	0	0	30	70	100
Laboratory Courses									
7	20CS53	Data Structures Lab	0	0	3	1.5	15	35	50
8	20EE54	Electrical Circuits and Simulation Lab	0	0	3	1.5	15	35	50
9	20EE55	Digital Electronics Lab	0	0	3	1.5	15	35	50
10	20EES1	Skill Oriented Course – I PCB Design	1	0	2	2	-	50	50
Total			14	4	11	21.5	225	575	800

IV SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20HS01	Universal Human values 2: Understanding Harmony	3	0	0	3	30	70	100
2	20EE08	Power Systems-I	2	1	0	3	30	70	100
3	20EE09	Control Systems	2	1	0	3	30	70	100
4	20EE10	Analog Electronics	2	1	0	3	30	70	100
5	20EE11	Electrical Machines-I	2	1	0	3	30	70	100
Laboratory Courses									
6	20AD53	Programming Using Python Lab	1	0	2	2	15	35	50
7	20EE56	Analog Electronics Lab	0	0	2	1	15	35	50
8	20EE57	Electrical Machines-I Lab	0	0	3	1.5	15	35	50
9	20EES2	Skill Oriented Course– II PLC Based Industrial Automation	1	0	2	2	-	50	50
Total			13	4	9	21.5	195	505	700
Honors/Minor Courses						4			

V - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20EE12	Power Systems-II	2	1	0	3	30	70	100
2	20EE13	Electrical Machines-II	2	1	0	3	30	70	100
3	20EE14	Power Electronics	2	1	0	3	30	70	100
4		PROGRAM ELECTIVE – I	3	0	0	3	30	70	100
	20EE15	Electronic Instrumentation and Measurements							
	20EE16	Linear and Digital IC Applications							
	20EE17	Energy Conservation and Management							
5		OPEN ELECTIVE – I	3	0	0	3	30	70	100
Laboratory Courses									
6	20EE58	Control Systems Lab	0	0	3	1.5	15	35	50
7	20EE59	Electrical Machines-II Lab	0	0	3	1.5	15	35	50
8	20EES3	Java Programming / Certification course	1	0	2	2	-	50	50
9	20PI01	Summer Internship	0	0	0	1.5	-	50	50
TOTAL			13	03	08	21.5	180	520	700
Honors/Minor Courses						4			

VI - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20EE18	Power Systems-III	2	1	0	3	30	70	100
2	20EE19	Solid State Drives	2	1	0	3	30	70	100
3	20EE20	Basic Micro Processors and Micro Controllers	3	0	0	3	30	70	100
4		PROGRAM ELECTIVE – II	3	0	0	3	30	70	100
	20EE21	Intelligent Control Systems							
	20EE22	Classical and Meta heuristic Optimization Techniques							
	20EE23	Digital Control Systems							
5		OPEN ELECTIVE – II	3	0	0	3	30	70	100
Laboratory Courses									
6	20EE60	Power Electronics and Drives Lab	0	0	3	1.5	15	35	50
7	20EE61	Basic Micro Processors and Micro Controllers Lab	0	0	3	1.5	15	35	50
8	20EE62	Power Systems Lab	0	0	3	1.5	15	35	50
9	20HSS1	Soft Skills Course	1	0	2	2	-	50	50
TOTAL			14	02	11	21.5	195	505	700
Honors/Minor Courses						4			

VII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		PROGRAM ELECTIVE - III	3	0	0	3	30	70	100
	20EE24	Power System Protection							
	20EE25	Renewable and Distributed Generation Technologies							
	20EE26	High Voltage Engineering							
2		PROGRAM ELECTIVE - IV	3	0	0	3	30	70	100
	20EE27	Hybrid Electric Vehicles							
	20EE28	Smart Grid							
	20EE29	HVDC and FACTS							
3		PROGRAM ELECTIVE - V	3	0	0	3	30	70	100
	20EC16	VLSI Design							
	20EC31	Embedded Systems							
	20EE30	Analog and Digital Signal Processing							
4		OPEN ELECTIVE- III	2	0	2	3	30	70	100
5		OPEN ELECTIVE- IV	2	0	2	3	30	70	100
6	20HS02	Management Science for Engineers	3	0	0	3	30	70	100
Laboratory Courses									
7	20PI02	Industrial/Research Internship	0	0	6	3	-	50	50
8	20EES4	Internet of Things / Certification course	1	0	2	2	-	50	50
TOTAL			17	0	12	23	180	520	700
Honors / Minor Courses						4			

VIII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Laboratory Courses									
1	20PI03	Project Work	0	0	0	12	60	140	200

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20AD81	Introduction to Artificial Intelligence	ASE, CE, ECE, EEE, & ME
20AD82	Introduction to Data Science	ASE, CE, ECE, EEE, & ME
20AD83	Introduction to Machine Learning	ASE, CE, ECE, EEE, & ME
20AD84	Fundamentals of Deep Learning	ASE, CE, ECE, EEE, & ME
20AE81	Principles of Flight	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE82	Space Science	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE83	Aircraft Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE84	Air Transportation Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE81	Basics of Civil Engineering	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE82	Disaster Management	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE83	Fundamentals of Geospatial Technologies	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE84	Environmental Sanitation	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CS81	Unix and Shell Programming	ASE, CE, ECE, EEE, & ME
20CS82	Introduction to Algorithm Techniques	ASE, CE, ECE, EEE, & ME
20CS83	Principles of Computer Architecture	ASE, CE, ECE, EEE, & ME
20CS84	PHP Programming	ASE, CE, ECE, EEE, & ME
20CS85	Object Oriented Software Engineering	ASE, CE, ECE, EEE, & ME
20EC81	Satellite Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC82	Elements of Communication Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC83	Microprocessors and Interfacing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC84	Analog and Digital Communications	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC85	Systems and Signal Processing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC86	Cellular Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20EE81	Linear Control Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE82	Basics of Electrical Measurements	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE83	Utilization of Electrical Energy	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE84	Electric Vehicles	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20IT81	OOP through JAVA	ASE, CE, ECE, EEE, & ME
20IT82	Web Technologies using PHP	ASE, CE, ECE, EEE, & ME
20IT83	Mobile Application Development	ASE, CE, ECE, EEE, & ME
20IT84	Cyber Security & Digital Forensics	ASE, CE, ECE, EEE, & ME
20ME81	Renewable Energy Sources	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME82	Robotics in Automation	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME83	Operations Research Techniques	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME84	Elements of Automobile Engineering	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT

B.Tech. (I Sem.)

20FE01—PROFESSIONAL COMMUNICATION-I

L	T	P	Cr.
2	0	0	2

Pre-requisites: Nil

Course Educational Objectives: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

Course Outcomes: At the end of the course, the student will be able to

- CO1** : Write sentences and paragraphs using proper grammatical structures and word forms (**Remember – L1**)
- CO2** : Comprehend the given text by employing suitable strategies for skimming and scanning and draw inferences (**Understand – L2**)
- CO3** : Write summaries of reading texts using correct tense forms & appropriate structures (**Remember – L1**)
- CO4** : Write Formal Letters, Memos & E-Mails (**Apply – L3**)
- CO5** : Edit the sentences/short texts by identifying basic errors of grammar/vocabulary/syntax (**Understand – L2**)

Unit - I

Exploration - ‘A Proposal to Girdle the Earth – Nellie Bly’; Reading: Skimming for main idea; Scanning for specific information; Grammar & Vocabulary: Content Words; Function Words; Word Forms: verbs, nouns, adjectives and adverbs; Nouns: Countable and Uncountable, Singular and Plural forms; Wh - Questions; Word Order in Sentences; Writing: Paragraph Analysis; Paragraph Writing; Punctuation and Capital Letters

Unit – II

On Campus- ‘The District School as it Was by One Who Went to it – Warren Burton’; Reading: Identifying Sequence of Ideas; Grammar & Vocabulary: Cohesive Devices: Linkers/Signposts/Transition signals, Synonyms, Meanings of Words/Phrases in the context; Writing: Memo Drafting.

Unit – III

Working Together- ‘The Future of Work’

Reading: Making basic inferences; Strategies to use text clues for comprehension; Summarizing; Grammar & Vocabulary: Verbs: Tenses; Reporting Verbs for Academic Purpose; Writing: Rephrasing what is read; Avoiding redundancies and repetitions; Abstract Writing/ Summarizing.

Unit – IV

‘A.P.J.Abdul Kalam’; Grammar & Vocabulary: Direct & Indirect Speech; Articles and their Omission; Writing: E-Mail Drafting.

Unit – V

‘C.V.Raman’; Grammar & Vocabulary: Subject-Verb Agreement; Prepositions; Writing: Formal Letter Writing.

Text Books:

1. Prabhavati. Y & et al, “English All Round – Communication Skills for Undergraduate Learners”, Orient BlackSwan, Hyderabad, 2019.
2. “Panorama – A Course on Reading”, A collection of prose selections, Oxford University Press, New Delhi, 2016.

Reference Books:

1. Swan, M., “Practical English Usage”, Oxford University Press, 2016.
2. Kumar,S and Latha, P, “Communication Skills”, Oxford University Press, 2018.
3. Rizvi Ashraf M., “Effective Technical Communication”, Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, “Professional Communication”, I.K. International Publishing House Pvt. Ltd., New Delhi, 2008.
5. Wood, F.T., “Remedial English Grammar”, Macmillan, 2007.

L	T	P	Cr.
2	1	0	3

Pre-requisites: Nil

Course Educational Objective: The objective of this course is to introduce the first order and higher order differential equations, functions of several variables. The students also learn solving of first order partial differential equations.

Course Outcomes: At the end of this course, the student will be able to

CO1: Apply first order and first-degree differential equations to find orthogonal trajectories.

(Apply– L3)

CO2: Distinguish between the structure and methodology of solving higher order differential Equations with constant coefficients. (Understand–L2)

CO3: Apply various Numerical methods to solve initial value problem. (Apply –L3)

CO4: Generate the infinite series for continuous functions and investigate the functional Dependence. (Understand–L2)

CO5: Solve partial differential equations using Lagrange’s method.(Apply– L3)

UNIT–I:DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE

Differential equations of first order and first degree – Exact and Non-Exact differential Equations, Applications of differential equations – Orthogonal Trajectories.

UNIT–II: LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Homogeneous and Non-Homogeneous Linear differential equations of second and higher order with constant coefficients with R.H.S. functions e^{ax} , $\sin(ax+b)$, $\cos(ax+b)$, x^m , $e^{ax}V(x)$, $xV(x)$, Method of variation of parameters.

UNIT–III: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Numerical solution of Ordinary Differential equations, Solution by Taylor’s series-Picard’s Method of successive approximations.

Euler’s Method-Runge-Kutta Methods.

UNIT–IV:FUNCTIONS OF SEVERAL VARIABLES

Generalized Mean Value Theorem (without proof), Maclaurin’s series, Functions of several variables, Jacobians (Cartesian and polar coordinates), Functional dependence. Maxima and Minima of function with two variables.

UNIT–V:PARTIAL DIFFERENTIAL EQUATIONS

Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions. Solution of first order and first degree linear partial differential equation – Lagrange’s method

TEXTBOOKS:

1. B.S.Grewal, “HigherEngineeringMathematics”, 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B.V.Ramana, “HigherEngineeringMathematics”, 1st Edition, TMH Publications, New Delhi, 2010

REFERENCEBOOKS:

1. M.D.Greenberg,“AdvancedEngineeringMathematics”,2ndEdition,TMHPublications,New Delhi,2011.
2. ErwinKreyszig,“AdvancedEngineeringMathematics”,8thEdition,JohnWiley&sons,New Delhi,2011.
3. W.E. Boyce and R. C. Dprima, “ Elementary Differential Equations”, 7th Edition, JohnWiley & sons, New Delhi,2011.
4. S. S.Sastry, “IntroductoryMethodsofNumericalAnalysis”,5thEdition, PHI Learning Private Limited,NewDelhi,2012.

B.Tech. (I Sem.)

20FE07—APPLIED PHYSICS

L	T	P	Cr.
2	1	0	3

Pre-requisites: Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts of optics, quantum mechanics, free electron theory of metals, semiconductors, dielectrics and their applications.

Course Outcomes: At the end of this course, the student will be able to

CO1: Define the nature of interference and diffraction. (**Remember-L1**).

CO2: Apply the lasers and optical fibers in different fields. (**Apply - L3**).

CO3: Estimate the electrical conductivity of metals. (**Understand-L2**).

CO4: Analyze the properties of semiconducting materials. (**Understand-L2**).

CO5: Classify the different types of magnetic and dielectric materials.

(**Understand-L2**).

UNIT-I

Wave Optics

Interference: Principle of superposition, Conditions for Interference, Interference in thin parallel film by reflection, Newton's rings(reflection), working principle of Interferometer.

Diffraction: Introduction, Fraunhofer diffraction at single slit - Diffraction due to circular aperture, Diffraction Grating-Resolving power of Grating.

UNIT-II

Lasers and optical fibers

Lasers: Introduction – Principle of laser (absorption, spontaneous and stimulate demission of radiation), Einstein Coefficients– Nd-YAGlaser, Helium Neonlaser - applications.

Optical Fibers: Optical Fiber principle, Structure of optical fiber, numerical aperture and acceptance angle, types of optical fibers-applications.

UNIT-III

Principles of Quantum Mechanics & Free electron theory

Principles of quantum mechanics: de Broglie Hypothesis, Davisson–Germer experiment, Schrodinger time independent and dependent wave equations, physical significance of the wavefunction–particleina box.

Free electron theory

Classical free electron theory- Postulates, Advantages and Draw backs, Fermi-Dirac distribution function-Temperature dependence of Fermi- Dirac distribution function, Classification of Solids on the basis of Band theory.

UNIT-IV

Semiconductor physics

Conductivity of Intrinsic and Extrinsic semiconductors, Drift and Diffusion Current, Einstein relation, Hall Effect, Differences between direct and indirect Band Gap semiconductors, Solar Cell, Applications of Solar Cells.

UNIT-V:

Magnetic & Dielectric materials

Magnetic parameters, Classification of magnetic materials-Diamagnetic, paramagnetic and ferromagnetic materials, Hysteresis loop, soft and hard magnetic materials, Applications of Ferromagnetic materials

Dielectrics: polarization-Electronic and ionic polarization, orientate on polarization (Qualitative), Local field, Claussius Mosotti equation, Applications of dielectric materials.

TEXTBOOKS:

1. V.Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition, 2014.
2. M.N. Avadhanulu, P.G. Kshirsagar, "*Engineering Physics*", S.Chand & Co., 2nd Edition, 2014.

REFERENCEBOOKS:

1. M.N. Avadhanulu, TVS Arun Murthy, "*Applied Physics*", S.Chand & Co., 2nd Edition, 2007.
2. P.K. Palani Samy, "*Applied Physics*", Sci. Publ. Chennai, 4th Edition, 2016.
3. P. Sreenivasa Rao, K. Muralidhar, "*Applied Physics*", Him. Publi. Mumbai, 1st Edition, 2016.
4. Hitendra K. Mallik, A.K. Singh "*Engineering Physics*", TMH, New Delhi, 1st Edition, 2009.

B.Tech. (I Sem.)

**20CE04 -
BASICCIVILANDMECHANICALENGINEERING**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Nil

Course Education Objective: The main objective of this course is to know the system of forces, Centre of Gravity, Centroid principles in Engineering Mechanics, fluid mechanics concepts in basic civil engineering and thermodynamic, IC engines, steam and gas turbine principles in mechanical engineering fundamental concepts.

Course Outcomes: At the end of the course student will be able to:

CO1: Compute the center of gravity and Centroid in simple basic structures and resolve the system of forces from free body diagrams while designing any component. **(Apply-L3)**

CO2: Differentiates the fluid statics and kinematic principle in fluid flows. **(Understand-L2)**

CO3: Understand the working principles of hydraulic turbines. **(Understand-L2)**

CO4: Understand the laws of thermodynamics and working principles in Internal Combustion engines. **(Understand-L2)**

CO5: Comprehends the working principles of steam and gas turbines. **(Understand-L2)**

UNIT-I**ENGINEERING MECHANICS**

Introduction, Basic concepts of mechanics, Resultant of system of forces: Resultant of Coplanar Concurrent Force System-Moment of a Force, Couple, Varignon's Theorem, Resultant of Coplanar, Non-Concurrent Force System, Equilibrium of a Body Subjected to Concurrent Forces and Non-concurrent Forces, Free Body Diagrams, Lami's Theorem, Concept of Centroid and Centre of gravity for simple bodies **(Problemson simple figures from basic concepts)**.

UNIT-II**FLUID MECHANICS**

FLUID STATICS: Introduction, Dimensions and Units: Physical Properties of Fluids- Specific Gravity, Viscosity, Surface Tension, Vapour Pressure and its influence on Fluid Motion, Atmospheric Gauge and Vacuum Pressure-Measurement of Pressure-Piezometer, U-Tube and Differential Manometers **(Simple and basic pressure measurement problems)**.

FLUID KINEMATICS: Introduction, Stream Line, Path Line, Streak Line, Stream Tube, Classification of Flows-Equation of Continuity for One Dimensional Flow **(Theory only)**.

UNIT-III**HYDRAULIC TURBINES**

Introduction, Classification of Turbines, Working of Pelton Wheel, Francis Turbine, and Kaplan Turbine, Draft Tube Theory and Cavitation **(Theory concepts only)**, Derivation and numerical problems on specific speed of hydraulic turbines.

UNIT-IV**APPLIED THERMODYNAMICS**

BASICS OF THERMODYNAMICS: Introduction, System, Property, State, Path, Process, Cycle, Laws of thermodynamics, Energy, Internal Energy, Enthalpy, Specific heat, Latent heat -Heat Engines, Refrigerator and Heat Pump **(Theory questions)**.

INTERNAL COMBUSTION ENGINES: Introduction, classification, I.C engine parts and their functions, I.C engine Nomenclature, working of 4-stroke petrol & diesel engines, working of 2-stroke petrol & diesel engines and comparison-Valve and Port timing diagrams-Application of IC engines **(Theory question only)**.

UNIT-V

TURBINES

STEAM AND GAS TURBINES: Introduction, Classification of impulse and reaction steam turbines, comparison of impulse and reaction steam turbines and applications, Classification of Gas Turbines, difference between open and closed cycle gas turbines and applications (**Theory questions only**).

TEXT BOOKS:

1. S.S.Bhavikatti, Engineering Mechanics, 4th Edition, New Age International (P) Ltd, 2012.
2. R.K.Rajput, Thermal Engineering, 6th Edition, 2007
3. R.K.Bansal, "Fluid Mechanics and Hydraulic Machines", 9th Edition, Lakshmi Publications.

REFERENCE:

1. D.S.Bedi, MP Poonia, Elements of Mechanical Engineering, 2019
2. N.H.Dubey, Engineering Mechanics, McGraw Hill, 2013.

L	T	P	Cr.
2	1	0	3

Pre-requisites: Nil

Course Educational Objective: This course enables the student to interpret the concepts of basic and special semiconductor devices and their applications.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Illustrate the working of different types of diodes and their characteristics.

(Understand-L2)

CO2: Analyze the operation of diode rectifiers with filters. **(Understand-L2)**

CO3: Understand the working and characteristics of various transistor configurations.

(Understand-L2)

CO4: Analyze the transistor biasing, stabilization and amplification circuits.

(Understand-L2)

UNIT-I: JUNCTION DIODE CHARACTERISTICS

Review of semiconductor Physics—n and p—type semiconductors, Mass Action Law, Continuity Equation, Hall Effect, Fermi level of semiconductors, Energy band diagram of PN diode, PN diode-biasing, The current components, Diode equation, V-I characteristics, Temperature dependence of V_I characteristic, Transition and Diffusion capacitances, Breakdown Mechanisms in p-n Diode, Zener diode, Tunnel Diode, Varactor Diode.

UNIT-II: RECTIFIERS AND FILTERS

Half wave rectifier, Full wave rectifier, Bridge rectifier, Ripple factor Harmonic components in a rectifier circuit, Inductor filter, Capacitor filter, L-section filter, π - section filter, Multiple L-section and Multiple π - section filter, and comparison of various filter circuits in terms of ripple factors, basics of regulators

UNIT-III: TRANSISTOR AND FET CHARACTERISTICS

Junction transistor, Transistor current components, Transistor as an amplifier, Transistor construction, Current components in a transistor, Input and Output characteristics of transistor in Common Base, Common Emitter, and Common collector configurations, Relation between Alpha, Beta and gamma, Small signal model of Transistor, Comparison of Transistors, FET Characteristics.

UNIT-IV: BIASING AND STABILISATION

BJT biasing, DC equivalent model, criteria for fixing operating point, Fixed bias, Collector to base bias, Self bias techniques for stabilization, Stabilization factors, (S, S', S''), Compensation techniques, (Compensation against variation in V_{BE}, I_{co}), Thermal runaway, Thermal stability FET Biasing.

UNIT -V: AMPLIFIERS

Small signal low frequency transistor amplifier circuits: h-parameter representation of a transistor, Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input impedance and Output impedance. Comparison of transistor configurations in terms of A_I, R_i, A_v, R_o, FET Amplifier (CD and CS).

TEXT BOOKS:

1. R.L.BoylestadandLouisNashelsky,ElectronicDevicesandCircuits,Pearson/PrenticeHall,9th Edition,2006
2. JacobMillman,ChristosCHalkiasandSatyabrataJit,Millman’sElectronicDevicesandCircuits,T ata McGraw Hill,SecondEdition,New Delhi,2008.

REFERENCE:

1. SSalivahanan,N.SureshKumarandAVallavaraj,ElectronicDevicesandCircuits,McGraw Hill,5thedition,2010.
2. J.BGuptaElectronicDevicesandCircuits,S.K. Kataria&Sons,2ndEdition,2013.

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: Nil

Course Educational Objective: This course enables the students to acquire theoretical ideas, analytical techniques, and graphical analysis, by completing a host of experiments with the procedures and observational skills for appropriate use of simple and complex apparatus.

COURSEOUT COMES : At the end of the course, the student will be able to:

- CO1:** Analyze the wave characteristics of light. (**Understand-L2**)
- CO2:** Estimate the magnetic field using Stewart's and Gee's apparatus. (**Understand -L2**)
- CO3:** Verify the characteristics of semiconductor diodes. (**Apply-L3**)
- CO4:** Determine the acceptance angle and numerical aperture of optical fiber. (**Apply-L3**)
- CO5:** Improve report writing skills and individual team work with ethical values. (**Understand -L2**)

LISTOFEXPERIMENTS

(Any of the 10 experiments are required to be conducted)

GENERALEXPERIMENTS:

1. Determine the energy band gap of a semiconductor Diode.
2. Study the characteristics of Zener Diode.
3. Study the magnetic field a long the axis of acurrent carrying circular coilusing Stewart's & Gee's apparatus and to verify Biot-Savart's law.
4. Study the characteristics of Solar cell
5. Determination of dielectric constant by charging and discharging method.
6. Study the characteristics of Photo diode.
7. Determination of resistivity of semiconductor by four probe method.

OPTICSLABEXPERIMENTS:

1. Determine the wave length of a laser radiation.
2. Determine the width of a single slit by forming diffraction pattern.
3. Determine the Radius of Curvature of a Plano-Convex lens by forming Newton's Rings.
4. Determine the Wave lengths of various spectral lines by using diffraction grating.
5. Resolving power of grating.
6. Determine the acceptance angle and numerical aperture of a fiber.
7. Measure the bending losses in the optical fiber cable at different wavelengths.

**20CE53-BASIC CIVIL AND MECHANICAL
ENGINEERING LAB**

L	T	P	Cr.
0	0	3	1.5

B.Tech. (I Sem.)

Course Education Objective: To learn the concept of Radius of Gyration, different types of Viscometers, valve timing and port timing diagrams in I.C engines, performance parameters in Hydraulic Systems.

Course Outcomes: At the end of the course student will be able to:

CO1: Find the Viscosity of different oils using Viscometers.(**Apply -L3**)

CO2: Analyze valve and port timing diagrams in I. Cengines. (**Apply-L3**)

CO3: Determine the performance parameter sof hydraulic turbines. (**Apply-L3**)

CO4: Conduct the Reynolds experiment to decide the flow classification. (**Apply -L3**)

CO5: Evaluate Bernoulli's principles in pipe flows.(**Apply-L3**)

LISTOFEXPERIMENTS

(Atleast10 experiments are to be conducted)

1. Determination of Radius of Gyration using compound dpendulum.
2. Determination of Radius of Gyrationusing bifilar suspension.
3. Determination of viscosity of given oil using Redwood viscometer
4. Determination of viscosity of give noil using Engler's Viscometer.
5. DeterminationofFlashandFirepointsofagivenoilusingABEL'Sapparatus.
6. Valvetiming diagram for single cylinder, four stroke water cooled Diesel engine.
7. Porttiming diagram for single cylinder, two stroke air cooled Diesel engine.
8. Verification of Bernoulli's Theorem
9. Impact of jetson Vanes.
10. Performance Teston Pelton Wheel.
11. Performance Teston Kaplan Turbine.
12. Reynolds experiment.
13. Flow Visualization study using Water Flow Channel
14. Determination of loss of head due to sudden contraction in a pipeline

**20EE53-ELECTRONIC CIRCUITS AND DEVICES
LAB**

L	T	P	Cr.
0	0	3	1.5

B.Tech. (I Sem.)

Pre-requisites: Nil

Course Educational Objective: This lab course enables the student to demonstrate characteristics of semiconductor devices.

Course Outcomes: At the end of the course, the student will able to:

CO1: Analyze the characteristics of diodes. (**Understand-L2**)

CO2: Examine the performance of rectifiers with filters. (**Apply-L3**)

CO3: Analyze the characteristics of BJT and FET. (**Understand-L2**)

CO4: Design various transistor amplifier circuits. (**Apply-L3**)

LIST OF EXPERIMENTS

(At least 10 experiments are to be conducted)

1. Study the characteristics of PN junction diode.
2. Study the characteristics of Zener diode.
3. Calculation of Ripple factor and regulation of Half wave rectifier with & without filters.
4. Calculation of Ripple factor and regulation of Bridge rectifier with & without filters.
5. Determination of h-parameters of transistor from CE characteristics.
6. Determination of h-parameters of transistor from transistor CB characteristics.
7. Determination of h-parameters of transistor from FET transfer characteristics.
8. Calculation of Bandwidth of CE Amplifier.
9. Calculation of Bandwidth of CC Amplifier.
10. Calculation of Bandwidth of CB Amplifier.
11. Calculation of Bandwidth of Common Source FET Amplifier.
12. Calculation of Bandwidth of CDFET amplifier

20ME51-ENGINEERING WORKSHOP**B.Tech. (I Sem.)**

L	T	P	Cr.
0	0	3	1.5

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE: The objective of this course is to get familiarized with various trades used in Engineering Workshop and learn the safety precautions to be followed in the workshops while working with the different tools.

COURSE OUTCOMES: After completion of the course students will be able to:

CO1: Develop different prototypes in the carpentry section. **(Understand-L2)**

CO2: Fabricate various basic prototypes in fitting trade. **(Understand-L2)**

CO3: Demonstrate various operations related to plumbing, tinsmithy and black smithy. **(Understand-L2)**

CO4: Perform various basic house wiring techniques. **(Apply-L3)**

(Conduct atleast 4 Trades with 2 exercises from each Trade and demonstrate about 2 Trades)

Trade-1: CARPENTRY SHOP

Introduction to various types of wood such as Teak, Sal, Oak, Beach, Neam, Walnut Mango, Shisham, Deodar, Babul. demonstration, function and use of carpentry hand-tools and their safety precautions. Introduction to various types of wooden joints, their relative advantages and uses. Job I-Marking, sawing, planing and chiselling operations. Job II -Preparation of half lap-joint Job III- Preparation of Mortise and Tenon Joint

Trade-2: FITTING SHOP

Introduction to fitting shop tools, common materials used in fitting shop, description, demonstration, care, use of tools and safety precautions.

Job I- Making a L-Fit from a rectangular piece of Mild Steel Flat (MS). Job II-Making a T-Fit from a rectangular piece of MS Flat.

Job III-Making a V-Fit from a rectangular piece of MS Flat

Job IV-Making a Half round fit from a rectangular piece of MS flat.

Trade-3: TIN-SMITHY SHOP

Introduction to tin smithy, specification and use of hand tools, accessories and the safety precautions.

Job I-Preparation of a rectangular tray using GI sheet.

Job II-Preparation of an open scoop / funnel using GI sheet.

Job III - Preparation of a Single Seam Joint and Double Seam Joint using GI sheet.

Job IV-Preparation of a Corner Seam Joint using GI sheet.

Trade-4: PLUMBING SHOP

Introduction to plumbing-demonstration, use of hand tools, accessories and safety precautions.

Job I- preparation of pipe layout.

Job II-Pipe threading.

Trade-5: BLACKSMITHY

Introduction-demonstration of tools, equipment and safety precautions.

JobI–Preparation of S–Hook.

JobII –Preparation of Chisel

REFERENCES:

1. LBRCE Workshop Lab Manual.
2. S.K.Hajra Choudary and A.K.Choudary,–Workshop Technology-I&II, Media Promoters and PublishersPvt.Ltd.,Mumbai,2012.
3. B.S.Raghuvamsi,–WorkshopTechnology-I&II,Dhanpatraibandcompany,New Delhi,2014.
4. P.Khannaiah,K.L.Narayana,–WorkshopManualI,ScitechPublicationsIndiaPvt.Ltd, 2015.

20FE02-PROFESSIONAL COMMUNICATION-II

L	T	P	Cr.
2	0	0	2

B.Tech. (II Sem.)

Pre-requisites: Nil

Course Educational Objective: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

Course Outcomes: At the end of the course, the student will be able to

- CO1:** Produce a coherent paragraph interpreting a figure/graph/chart/table (**Understand – L2**)
- CO2:** Comprehend the given texts thoroughly by guessing the meanings of the words contextually (**Understand – L2**)
- CO3:** Use language appropriately for describing /comparing/contrasting/giving directions & suggestions (**Remember – L1**)
- CO4:** Write formal/informal dialogues with an understanding of verbal/non-verbal features of communication. (**Understand – L2**)
- CO5:** Write well structured essays; Reports & Résumé (**Apply – L3**)

UNIT - I

Fabric of Change- ‘H.G. Wells and the Uncertainties of Progress – Peter J. Bowler’; Reading: Studying the use of Graphic elements in texts; Grammar & Vocabulary: Quantifying Expressions; Adjectives and adverbs; Comparing and Contrasting; Degrees of Comparison; Writing: Information Transfer

UNIT - II

Tools for Life - ‘Leaves from the Mental Portfolio of a Eurasian – Sui Sin Far’; Reading: Global Comprehension; Detailed Comprehension; Grammar & Vocabulary: Active & Passive Voice; Idioms & Phrases; Writing: Structured Essays using suitable claims and evidences

UNIT - III

‘Homi Jahangir Bhabha’;

Grammar & Vocabulary: Words often confused; Common Errors; Writing: Incident & Investigation Reports

UNIT - IV

‘Jagadish Chandra Bose’; Grammar & Vocabulary: Use of Antonyms; Correction of Sentences; Writing: Dialogue Writing

UNIT - V

‘Prafulla Chandra Ray’; Grammar & Vocabulary: Analogy; Sentence Completion; Writing: Writing a Résumé

TEXT BOOKS:

1. Prabhavati. Y & et al, “English All Round – Communication Skills for Undergraduate Learners”, Orient Black Swan, Hyderabad, 2019.
- 2 “The Great Indian Scientists” published by Cengage Learning India Pvt. Ltd., Delhi, 2017

REFERENCE BOOKS:

1. Swan, M., “Practical English Usage”, Oxford University Press, 2016.
2. Kumar,S and Latha, P, “Communication Skills”, Oxford University Press, 2018.
3. Rizvi Ashraf M., “Effective Technical Communication”, Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, “Professional Communication”, I.K.International Publishing House Pvt.Ltd., New Delhi, 2008.
5. Wood,F.T., “Remedial English Grammar”, Macmillan, 2007.

B.Tech. (II Sem.)

**20FE04 - LINEAR ALGEBRA AND
TRANSFORMATION TECHNIQUES**

L	T	P	Cr.
2	1	0	3

Pre-requisites: Nil

Course Educational Objective: In this course, students learn Matrix Algebra and introduced with transformation techniques such as Laplace Transforms and Z – Transforms.

Course Outcomes: At the end of the course, the student will be able to

CO1: Investigate the consistency of the system of equations and solve them. **(Apply – L3)**

CO2: Determine the eigen vectors and inverse, powers of a matrix using Cayley-Hamilton theorem. **(Apply – L3)**

CO3: Use the concepts of Laplace Transforms to various forms of functions. **(Understand – L2)**

CO4: Solve ordinary differential equations by using Laplace Transforms. **(Apply – L3)**

CO5: Apply Z - Transforms to solve difference equations. **(Apply – L3)**

UNIT – I**System of Linear Equations**

Matrices - Rank- Echelon form, Normal form, PAQ form– Solution of Linear Systems – Homogeneous system of equations and Non-Homogeneous system of equations.

UNIT – II**Eigen Values and Eigen Vectors**

Eigen values – Eigen Vectors – Properties – Cayley-Hamilton Theorem – Inverse and Powers of a matrix by using Cayley-Hamilton Theorem.

UNIT – III**Laplace Transforms**

Laplace transforms of standard functions – Linear Property - Shifting Theorems, Change of Scale Property

Multiplication and Division by 't' - Transforms of derivatives and integrals – Unit step function – Dirac's delta function.

UNIT – IV**Inverse Laplace Transforms**

Inverse Laplace transforms– Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – V**Z-Transforms**

Z-transform – properties – Damping rule – Shifting rule – Initial and final value theorems - Inverse Z –transform - Convolution theorem – Solution of difference equation by Z-transforms.

Text Books:

1. B.S. Grewal, “*Higher Engineering Mathematics*”, 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, “*Higher Engineering Mathematics*”, 1st Edition, TMH Publications, New Delhi, 2010.

Reference Books:

1. M. D. Greenberg, “*Advanced Engineering Mathematics*”, 2nd Edition, TMH Publications, New Delhi, 2011.
2. Erwin Kreyszig, “*Advanced Engineering Mathematics*”, 8th Edition, John Wiley & sons, New Delhi, 2011.
3. W.E. Boyce and R. C. DiPrima, “*Elementary Differential Equations*”, 7th Edition, John Wiley & sons, New Delhi, 2011

L	T	P	Cr.
3	0	0	3

B.Tech. (II Sem)

20FE05 - APPLIED CHEMISTRY

Pre-requisites: Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts of chemistry and to provide them with the knowledge of industrial problems and finding the solutions. It helps to strengthen the basic concepts of water, fuel technologies, electrochemistry, corrosion and advanced materials used in technologies.

Course Outcomes: At the end of the course, students will be able to,

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications. (**Understand - L2**)

CO2: Understand the issues related to conventional fuels, biofuels and photo-voltaic cells in energy production. (**Understand - L2**)

CO3: Apply Nernst Equation for calculating electrode cell potentials and compare batteries for different applications. (**Apply - L3**)

CO4: Apply principles of corrosion for design and effective maintenance of various equipment. (**Apply - L3**)

CO5: Analyse the suitability of engineering materials like polymers, lubricants, nano materials and composites in technological applications. (**Understand - L2**)

UNIT – I**Water Technology**

Sources of water and quality; Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantages of hard water in industries. Boiler troubles - Reasons, disadvantages and methods of prevention for Scale and sludge formation, caustic embrittlement, boiler corrosion and carry over (priming and foaming), W.H.O standards of potable water; Water softening: Ion- Exchange Process, merits and demerits; Desalination of brackish water - Electro dialysis and reverse osmosis; Treatment of industrial waste water.

UNIT – II**Fuel Technology**

Classification of fuels (solid, liquid and gaseous fuels, merits and demerits) and characteristics of a good fuel; Calorific value - Definition, gross and net calorific values (definition only). Solid fuels - Coal – origin, proximate analysis of coal and significance; Liquid Fuels - Petroleum-origin, types of crude oil and refining of petroleum. Cracking - moving bed catalytic cracking and synthetic petrol – Fischer Tropsch's process; Gaseous fuels - Natural gas composition and C.N.G - advantages. Bio fuels - Characteristics of bio fuels, sources of bio mass and advantages - Production of biodiesel from rape seed oil; Photo-voltaic Cell - Design, working, schematic diagram, advantages and disadvantages.

UNIT – III**Electro Chemistry & Batteries**

Types of Electrodes - Calomel Electrode, Glass Electrode, Calculation of EMF of Cell, Applications of Nernst Equation, Applications of Electro chemical Series

Batteries - Lead-acid Battery, Lithium ion Battery, H₂- O₂ Fuel Cell, Mg-Cu reserve battery.

UNIT – IV**Science of Corrosion**

Dry Corrosion (Direct Chemical corrosion) - Types of dry corrosion-oxidative corrosion, Pilling Bed worth rule, corrosion by other gases and liquid metal corrosion; Wet Corrosion (Electro Chemical corrosion) - Mechanism- oxygen absorption, hydrogen evolution, types of wet corrosion, Galvanic Corrosion, Concentration Cell Corrosion, passivity and Galvanic series; Factors Influencing Corrosion -Nature of metal (purity, position in galvanic series, relative area of cathode & anode, nature of surface film) and nature of environment (temperature, humidity, atmospheric pollution and nature of ions in the medium); Control of Corrosion -Cathodic Protection - Sacrificial anode and impressed current methods, electro plating and metal cladding.

UNIT – V**Chemistry of Engineering Materials**

Polymers - Differences between thermoplasts and thermosets, Types of polymerization with examples, Preparation properties and engineering applications of PVC, Teflon, BUNA-S and Polyurethane; Lubricants -Characteristics of a good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications; Nano Materials -Introduction, definition, extraordinary changes observed at nano size of materials and reasons, types of nano-materials, Gas-Phase Synthesis of nanomaterials, Applications; Composites -Advantageous characteristics of Composites, Constituents, Fibre reinforced composites (GFRP, CFRP), Reasons for failure of composites.

TEXT BOOKS

1. Shashi Chawla, “A Text book of Engineering Chemistry”, Dhanpat Rai Publishing Company, New Delhi, 3rdEdition, 2003.
2. Jain, Jain, “A Text book of Engineering Chemistry”, Dhanpat Rai Publishing Company, New Delhi, 16th Edition, 2015.

REFERENCE BOOKS

1. Shikha Agarwal, “A text book of Engineering Chemistry”, Cambridge University Press, New Delhi, 1st Edition, 2015.
2. S.S. Dara, S.S. Umare, “A Text book of Engineering Chemistry”, S. Chand Publications, New Delhi, 12th Edition, 2010.
3. Y. BharathiKumari, Jyotsna Cherukuri, “A Text book of Engineering Chemistry”, VGS Publications, Vijayawada, 1st Edition, 2009.

B.Tech. (II Sem.)

20CS01 - PROGRAMMING FOR PROBLEM SOLVING USING C

L	T	P	Cr.
3	0	0	3

Pre-requisite : Nil

Course Educational Objective: The Objective of the course is to make learn the basic elements of C programming, control structures, derived data types, Modular programming, user defined structures, basics of files and its I/O operations.

Course Outcomes: At the end of this course, the student will be able to

- CO1:** Familiar with syntax and semantics of the basic programming language constructs. (**Understand - L2**)
- CO2:** Construct derived data types like arrays in solving problem. (**Apply - L3**)
- CO3:** Decompose a problem into modules and reconstruct it using various ways of user-defined functions. (**Apply - L3**)
- CO4:** Use user-defined data types like structures and unions and its applications to solve problems. (**Apply- L3**)
- CO5:** Discuss various file I/O operations and its application. (**Understand - L2**)

UNIT – I

Introduction to Problem solving through C-Programming: Problem Specification, Algorithm / pseudo code, flowchart, examples.

C-Programming: Structure of C program, identifiers, basic data types and sizes, Constants, variables, Input-output statements, A sample c program, operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.

Control statements: if, if else, else if ladder and switch statements, while, do-while and for statements, break, continue, go to and labels.

UNIT – II

Arrays- concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.

Character Arrays: declaration, initialization, reading, writing strings, string handling functions, pre-processor Directives, and macros.

Applications of Arrays: Linear search, Binary search, Bubble Sort.

UNIT – III

Pointers- concepts, declaring & initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character arrays, pointers to pointers.

Functions: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, Standard library functions, dynamic memory management functions, command line arguments.

Storage classes - auto, register, static and extern.

UNIT – IV

Derived types- structures- declaration, definition, and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef.

UNIT – V

Files – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling.

Textbook:

1. ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015

Reference books:

1. Jeri R.Hanly, Elliot B.Koffman, Problem Solving and Program Design in C, Pearson Publishers, 7th Edition, 2013
2. E Balagurusamy, Computer Programming, McGraw Hill Education, 8th Edition.
3. C: The Complete Reference, McGraw Hall Education, 4th Edition.
4. PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011.
5. Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 2005.

**20EE04-FUNDAMENTALS OF ELECTRICAL
ENGINEERING**

B.Tech. (II Sem.)

L	T	P	Cr.
2	1	0	3

Pre-requisites: Applied Physics and Differential Equations

Course Educational Objective: The objective of this course is to introduce the basic concepts of electrical circuits which is the foundation for all courses in Electrical and Electronics Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits and theorems.

Course Outcomes: At the end of the course student will be able to:

CO1: Apply network reduction techniques to simplify electrical circuits. **(Apply-L3)**

CO2: Analyze the electrical circuits using fundamental laws. **(Apply-L3)**

CO3: Analyze magnetic circuits. **(Understand-L2)**

CO4: Identify a suitable measuring instrument to measure electrical variables. **(Understand-L2)**

CO5: Determine the circuit parameters using AC and DC bridges. **(Apply-L3)**

UNIT-I

INTRODUCTION TO ELECTRICAL CIRCUITS

Basic Concepts of passive elements of R, L, C and their V-I relations, sources (dependent and independent), Kirchoff's laws, network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent sources.

UNIT-II

SINGLE PHASE AC CIRCUITS

R.M.S, average values and form factor for different periodic wave forms - steady state analysis of R, L, C (in different combination) with sinusoidal excitation - concept of reactance, impedance, susceptance and admittance. phase and phase difference, concept of complex power, real and reactive power and power factor. Series and parallel resonance, bandwidth and quality factor

UNIT-III

MAGNETIC CIRCUITS

Basic terminology, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction, concept of self and mutual inductance - dot convention - coefficient of coupling, analysis of series and parallel magnetic circuits.

UNIT-IV

INTRODUCTION TO MEASURING INSTRUMENTS

Errors in measurement, Classification - deflecting, control and damping torques - ammeters and voltmeters - PMMC, moving iron type instruments, shunts and multipliers. Construction and principle of operation of DC Potentiometer, Current Transformer & Potential Transformer, Single phase dynamometer wattmeter, Single phase induction type energy meter.

UNIT-V

DC & AC BRIDGES

Method of measuring low, medium and high resistance - Wheat-stone's bridge, Kelvin's double bridge, loss of charge method. Measurement of inductance - Maxwell's bridge, Anderson's bridge. Measurement of capacitance and loss angle - Wien's bridge - Schering Bridge.

TEXT BOOKS:

1. William Hayt and Jack E. Kemmerley, "Engineering Circuit Analysis", McGraw Hill Company, 9th edition, 2019.
2. "A.K. Sawhney", "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.

REFERENCE:

1. Van Valkenburg, "Network Analysis and Synthesis", Pearson publication, 3rd edition, 2015.
A. Sudhakar, Shyam Mohan, S. Palli, "Electrical Circuits Analysis-2" Tata McGraw-Hill, 5th edition, 2015.
2. N.C. Jagan, C. Lakshmi Narayana, "Network Analysis", BS publications 2nd edition, 2008.
3. Charles K. Alexander, Mathew. N. O. Sadiku, "Fundamentals of Electric Circuits", Tata McGraw-Hill, 6th edition, 2019.
4. Chakrabarti A, "Electric Circuits Analysis & Synthesis" Dhanpat Rai & Co (p) Ltd, 6th edition, 2014.

B.Tech. (II Sem.)

20MC01 - CONSTITUTION OF INDIA

L	T	P	Cr.
2	0	0	0

Pre-requisites: Nil

Course Educational Objectives

- To enable the student to understand the importance of constitution.
- To understand the structure of Executive, Legislature and Judiciary.
- To understand Philosophy of fundamental rights and duties.
- To understand the autonomous nature of constitution bodies like Supreme Court and High Court Controller and Auditor General of India and Election Commission of India.
- To understand the Central and State relation, financial and administrative.

Course Outcomes: *At the end of the course, the student shall be able to*

- CO 1: Understand history and philosophy of constitution with reference to Preamble, Fundamental Rights and Duties (**Understand – L2**).
- CO 2: Understand the concept of Unitary and Federal Government along with the role of President, Prime Minister and Judicial System (**Understand – L2**).
- CO 3: Understand the structure of the state government, Secretariat, Governor and Chief Minister and their functions (**Understand – L2**).
- CO 4: learn local administration viz. Panchayat, Block, Municipality and Corporation (**Understand – L2**).
- CO 5: learn about Election Commission and the process and about SC, ST, OBC and women (**Understand – L2**).

UNIT – I:

Introduction to Indian Constitution: ‘Constitution’ meaning of the term, Indian Constitution – Sources and Constitutional History, Features – Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT – II:

Union Government and its Administration Structure of the Indian Union: Federalism Centre – State relationship, President: Role, Power and Position. Prime Minister (PM) and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. The Supreme Court and High Court: Powers and Functions.

UNIT – III:

State Government and its Administration Governor – Role and Position – Chief Minister (CM) and Council of Ministers. State Secretariat: Organization, Structure and Functions.

UNIT – IV:

A Local Administration -- Role and Importance, Municipalities – Mayor and Role of Elected Representative, Panchayati Raj: Functions of Panchayati Raj Institution, Zilla Panchayat, Elected Officials and their roles, Village level – Role of Elected and Appointed officials.

UNIT – V:

Election Commission: Election Commission – Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions and Commissions for the welfare of SC/ST/OBC and Women.

Reference Books

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt.Ltd., New Delhi.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.A. Siwach, Dynamics of Indian Government and Politics.
4. D.C. Gupta, Indian Government and Politics.
5. H.M.Sreevai. Constitutional Law of India, 4th edition in 3 volumes (Universal LawPublication).
6. J.C. Johari, Indian Government and Politics Hans.
7. J.Raj, Indian Government and Politics.
8. M.V. Pylee, Indian Constitution, Durga Das Basu, Human Rights inConstitutional Law, Prentice – Hall of India Pvt. Ltd., New Delhi.
9. Noorani, A.G. (South Asia Human Rights Documentation Centre), Challenges to Civil Right). Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

E-Resources:

1. nptel.ac.in/courses/109104074/8.
2. nptel.ac.in/courses/109104045.
3. nptel.ac.in/courses/101104065.
4. www.hss.iitb.ac.in/en/lecture-details.
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indianconstitution

**20FE51-PROFESSIONAL COMMUNICATION
SKILLS LAB**

L	T	P	Cr.
0	0	2	1

B.Tech. (II Sem.)

Pre-requisites : Nil

Course Educational Objective: To improve the proficiency of students in English with an emphasis on better communication in formal and informal situations; Develop speaking skills required for expressing their knowledge and abilities and to face interviews with confidence.

Course Outcomes: At the end of this course, the student will be able to

- CO1:** Introduce oneself and others using appropriate language and details (**Understand – L2**)
- CO2:** Comprehend short talks and speak clearly on a specific topic using error free English(**Understand – L2**)
- CO3:** Report effectively after participating in informal discussions ethically (**Remember –L1**)
- CO4:** Interpret data aptly, ethically & make oral presentations (**Apply – L3**)

Syllabus: Professional Communication Skills Lab (PCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self- study by learners.
- **Interactive Communication Skills (ICS) Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

Exercise – I

CALL Lab: Understand - Sentence structure

ICS Lab: Practice - Listening: Identifying the topic, the context and specific information
Speaking: Introducing oneself and others

Exercise – II

CALL Lab: Understand - Framing questions

ICS Lab: Practice - Listening: Answering a series of questions about main idea and supporting ideas after listening to audio text

Speaking: Discussing in pairs/small groups on specific topics; Delivering short structured talks using suitable cohesive devices (JAM)

Exercise – III

CALL Lab: Understand - Comprehension practice – Strategies for Effective Communication

ICS Lab: Practice - Listening: Listening for global comprehension and summarizing

Speaking: Discussing specific topics in pairs/small groups, reporting what is discussed

Exercise – IV

CALL Lab: Understand- Features of Good Conversation – Strategies for Effective Communication.

ICS Lab: Practice -Listening: Making predictions while listening to conversations/transactional dialogues with/without video

Speaking: Role – plays – formal & informal – asking for and giving information / directions / instructions / suggestions

Exercise – V

CALL Lab: Understand - Features of Good Presentation, Methodology of Group Discussion

ICS Lab: Practice - Introduction to Group Discussions

Listening: Answering questions, identifying key terms and understanding concepts

Speaking: Formal Oral & Poster presentations on topics from academic contexts without the use of PPT

Lab Manual:

1. Prabhavati. Y & et al, “English All Round – Communication Skills for Undergraduate Learners”, Orient BlackSwan, Hyderabad, 2019.

Suggested Software:

1. Digital Mentor: Globarena, Hyderabad, 2005
2. Sky Pronunciation Suite: Young India Films, Chennai, 2009
3. Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley, USA, 2001
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, The Learning Company, USA, 2002
6. Learning to Speak English - 4 CDs. The Learning Company, USA, 2002
7. Cambridge Advanced Learners English Dictionary (CD). Cambridge University Press, New Delhi, 2008.

20FE52-APPLIED CHEMISTRY LAB

B.Tech. (II Sem.)

L	T	P	Cr
0	0	3	1.5

Pre-requisites: Nil**Course Educational Objectives:**

This course enables the students to analyze water samples and perform different types of volumetric titrations. It provides them with an overview of preparation of polymers and properties of fuels.

Course Outcomes: At the end of the course, the students will be able toCO1: Assess quality of water based on the procedures given. (**Understand-L2**)CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus. (**Understand-L2**)CO3: Acquire practical knowledge related to preparation of polymers. (**Understand-L2**)CO4: Exhibit skills in performing experiments based on theoretical fundamentals. (**Apply-L3**)**List of Experiments**

(Any of the 10 experiments are required to be conducted)

Model Experiment

- 1) Determination of amount of Na_2CO_3 using standard HCl solution.

Water Analysis

- 2) Determination of alkalinity of water sample.
- 3) Determination of total Hardness of water by EDTA method.
- 4) Determination of permanent hardness of water by EDTA method.

Preparation of Polymers

- 5) Nylon Fibers
- 6) Bakelite

Redox Titrations

- 7) Estimation of Mohr's salt by using potassium permanganate.
- 8) Estimation of Mohr's salt by using potassium dichromate.
- 9) Determination of Copper(II) using standard hypo solution.

Demonstration Experiments

- 10) Determination of pH of the given sample solution/ soil using pH meter.
- 11) Determination of Turbidity of the given sample water.

Estimations

- 12) Determination of ferrous content in the given sample of iron ore against potassium dichromate using potassium ferricyanide as external indicator.
- 13) Determination of Iron(III) by colorimetric method.

Fuels

- 14) Determination of flash and fire points of a given fuel/lubricant.

REFERENCES

Lab manual

**20CS51-PROGRAMMING FOR PROBLEM
SOLVING USING C LAB**

B.Tech. (II Sem.)

L	T	P	Cr
0	0	3	1.5

Pre-requisite : NIL

Course Educational Objective: The objective of the course is to learn the basic elements of C Programming Structures like Data Types, Expressions, Control Statements, and Various I/O Functions and to solve simple mathematical problems using control structures. Design and implementation of various software components, which solve real world problems.

Course Outcomes (CO): *At the end of this course, the student will be able to:*

- CO1:** Apply control structures of C in solving computational problems. (**Apply - L3**)
- CO2:** Implement derived data types & use modular programming in problem solving (**Apply- L3**)
- CO3:** Implement user defined data types and perform file operations. (**Apply- L3**)
- CO 4:** Improve individual / teamwork skills, communication & report writing skills with ethical values.

of modules at most 10 can be taught and all the modules should be in line with theory.

Module 1: Introduction to Raptor Tool.

Module 2: Problem solving using Raptor Tool.

Module 3: Exercise Programs on Basics of C-Program.

Module 4: Exercise Programs on Control Structures.

Module 5: Exercise Programs on Loops & nesting of Loops.

Module 6: Exercise Programs on Arrays & Strings.

Module 7: Exercise Programs on Pointers.

Module 8: Exercise Programs on Functions.

Module 9: Exercise Programs on user defined data types.

Module 10: Exercise Programs on Files.

**20ME53-COMPUTER AIDED ENGINEERING
DRAWING LAB**

B.Tech. (II Sem.)

L	T	P	Cr
0	0	3	1.5

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE:

The main objectives of this course are to familiarize various commands used in Auto-CAD and to visualize the isometric and orthographic views of any solid object.

COURSE OUTCOMES:

After completion of the course students are the able to:

- CO1** Understand the Auto-CAD basics and apply to solve practical problems used in industries where the speed and accuracy can be achieved. **(Understand-L2)**
- CO2** Understand the principle of Orthographic projections of points, lines, planes and solids. **(Understand-L2)**
- CO3** Draw the isometric views of lines, planes and simple solids. **(Understand-L2)**
- CO4** Convert orthographic to isometric vice versa. **(Understand-L2)**

At least 10 Exercises are to be conducted using Auto Cad software:

BASIC AUTO CAD COMMANDS:

1. Basic drawing commands (line, circle, arc, ellipse, polygon, and rectangle).
2. Edit commands (copy, move, erase, zoom).
3. Array commands (polar array, rectangular array, P-edit, divide a line, offset).
4. Hatching & line commands (hatching with different angles& different types of lines).
5. Mirror & trim commands (mirror an object, trim, extend a line, chamfer& fillet, explode).
6. Dimensioning & text commands (linear, angular, radius, diameter& text).

PROJECTION OF POINTS AND LINES:

1. Projection of points (I, II, III, & IV quadrants).
2. Projection of lines parallel to both reference planes.
3. Projection of lines parallel to one reference plane & inclined to other reference plane.

PROJECTION OF PLANES AND SOLIDS:

1. Projection of planes parallel to one reference plane & perpendicular to other reference plane.
2. Projection of planes inclined to one reference plane& perpendicular to other reference plane.
3. Projection of solids in simple position.
4. Projection of solids with axes inclined to one reference plane & parallel to other.

CONVERSION OF ORTHOGRAPHIC PROJECTIONS INTO ISOMETRIC PROJECTIONS & VICE VERSA:

1. Conversion of plane objects.
2. Conversion of circular objects.
3. Conversion of both combination of plane figures and circular objects.

Expt. No.	Type of Drawings	Name of the Experiment
1	Basic drawing Commands	Exercise on Basic Drawing Commands-I
2		Exercise on Basic Drawing Commands-II
3	Modify commands	Exercise on Modify Commands
4	Projection of Lines	Exercise on Projection of Lines-I
5		Exercise on Projection of Lines-II
6	Isometric Diagrams	Exercise on isometric views-I
7		Exercise on isometric views-II
8		Exercise on isometric views-III
9		Exercise on isometric views-IV
10	Conversion of Isometric to Orthographic views	Exercise on conversion of Isometric views into Orthographic views

REFERENCES

1. M. Kulkarni, A.P Rastogi, and A.K. Sarkar, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
2. Bethune, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
3. N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar Publishers, 2012.

**20FE10-NUMERICAL METHODS AND INTEGRAL
CALCULUS**
(Common to AE, CE, EEE, ECE, MECH)

L	T	P	Cr
2	1	0	3

B.Tech.(IIISem.)

Pre-requisites : None

Course Educational Objective: The main objective of this course is to enable the students learn Numerical Techniques for solving the equations and apply interpolation techniques. They will also learn about the Fourier analysis of single valued functions, Multiple Integrals in different coordinate systems and Vector differentiation.

Course Outcomes: At the end of the course, the student will be able to:

- CO1:** Estimate the best fit polynomial for the given tabulated data using Interpolation. **L2**
CO2: Apply numerical techniques in solving of equations and evaluation of integrals. **L3**
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes. **L3**
CO4: Generate the single valued functions in the form of Fourier series and obtain Fourier series representation of periodic function. **L3**
CO5: Evaluate the directional derivative, divergence and angular velocity of a vector function. **L3**

UNIT – I

Interpolation and Finite Differences

Interpolation: Introduction – Finite differences- Forward Differences- Backward Differences- Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-Newton’s formulae for interpolation – Lagrange’s Interpolation formula.

UNIT – II

Numerical Solution of Equations and Numerical Integration

Solutions of Algebraic and Transcendental Equations – RegulaFalsi method and Newton Raphson Method in one variable.

Numerical Integration

Trapezoidal rule – Simpson’s 1/3 Rule –Simpson’s 3/8 Rule.

UNIT – III

Multiple Integrals

Multiple integrals - double and triple integrals (Cartesian, polar, spherical coordinates) – Changing the order of Integration.

UNIT IV

Fourier series

Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series

UNIT – V

Vector Differentiation

Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators

Text Books:

1. B.S. Grewal, “*Higher Engineering Mathematics*”, 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, “*Higher Engineering Mathematics*”, 1st Edition, TMH Publications, New Delhi, 2010.
3. S. S. Sastry, “*Introductory Methods of Numerical Analysis*” 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

Reference:

4. M. D. Greenberg, “*Advanced Engineering Mathematics*”, 2nd Edition, TMH Publications, New Delhi, 2011.
5. Erwin Krezig, “*Advanced Engineering Mathematics*” , 8th Edition, John Wiley & sons, New Delhi, 2011.
6. W.E. Boyce and R. C. DiPrima, “*Elementary Differential Equations*” , 7th Edition, John Wiley & sons, New Delhi, 2011.

B.Tech. (III Sem.)

20CS03-DATA STRUCTURES

L	T	P	Cr.
3	0	0	3

Pre-requisite : Programming Language

Course Educational Objectives:

The objective of the course is to make students familiar with writing algorithms to implement different data structures like stacks, queues, trees and graphs, and various sorting techniques.

Course Outcomes (COs): *At the end of this course, the student will be able to*

CO 1	Write the algorithms for various operations on list using arrays and linked list and analyze the time complexity of its operations. (Understand-L2)
CO 2	Apply linear data structures like stack and queue in problem solving. (Apply -L3)
CO 3	Demonstrate various searching and sorting techniques and compare their computational complexity in terms of space and time. (Understand-L2)
CO 4	Write the algorithms for various operations on binary trees, binary search trees and AVL trees. (Understand-L2)
CO 5	Demonstrate graph traversal techniques and hashing techniques. (Understand-L2)

UNIT - I**Algorithm Analysis:**

Introduction to Algorithm, Algorithm Analysis , Asymptotic Notations.

Introduction to arrays and Abstract Data Type(ADT)

Lists: List using arrays and linked list- Singly Linked List, Doubly Linked List, Circular LinkedList.

UNIT – II

Stacks: Stack ADT, Implementation using arrays and linked list.

Applications of stacks : Infix to postfix expression conversion, Evaluation of Postfix expressions and balancing the symbols.

Queues:

Queue : Queue ADT, Implementation of Queue using arrays and linked list, circular queue, DEQUE

UNIT - III

Sorting: Bubble sort, Insertion Sort, Selection sort, Merge Sort, Quick Sort & Heap Sort

UNIT - IV

Trees: Introduction, Tree traversals, Binary Trees, Binary Search Trees, Balanced Binary search tree - AVL Trees and its operations.

UNIT - V

Graphs: Fundamentals, Representation of graphs, Graph Traversals: BFS, DFS.

Hashing: Hash Table, Hash Function, Collision resolution Techniques- separate Chaining, Open addressing, rehashing.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, 2nd edition [1,2,3 units].
2. Reema Thareja, Data Structures using c, Oxford Publications [3,4,5].

REFERENCES:

1. Langson, Augenstein & Tenenbaum, ‘Data Structures using C and C++’, 2nd Ed, PHI.
2. Robert L. Kruse, Leung and Tando, ‘Data Structures and Program Design in C’, 2nd edition, PHI.

B.Tech. (III Sem.)

20EE05-ELECTRICAL CIRCUIT ANALYSIS

L	T	P	Cr.
2	1	0	3

Pre-Requisites: Applied Physics, Differential equations, Linear Algebra and Transformation Techniques and Fundamentals of Electrical Engineering

Course Educational Objective: The objective of this course is study of three phase circuits, transient analysis, network topology, passive filters and Fourier analysis of electrical systems.

Course Outcomes: At the end of the course, the student will be able to:

CO1:Analyze electrical circuits using theorems (**Apply-L3**)

CO2:Evaluate transient response of electrical circuits (**Understand-L2**)

CO3:Examine the performance of three phase circuits (**Understand-L2**)

CO4:Evaluate the two-port network parameters (**Apply-L3**)

CO5: Apply Fourier series to the electrical circuits excited by non sinusoidal inputs (**Apply-L3**)

UNIT – I: NETWORK THEOREMS(DC & AC EXCITATIONS)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem and Millman's theorem, analysis with dependent current and voltage sources, Concept of duality and dual networks.

UNIT – II: TRANSIENT ANALYSIS

Initial conditions, Laplace transforms methods of solutions. Transient response of R-L, R-C, R-L-C circuits (Series and Parallel combinations) for D.C and sinusoidal excitations. Analysis of electrical circuits with standard test signals (impulse and step).

UNIT – III: THREE PHASE CIRCUITS

Phase sequence, star and delta connection, relation between line and phase voltages and currents in balanced systems, analysis of balanced and unbalanced 3-phase circuits, measurement of active and reactive power.

UNIT – IV: TWO PORT NETWORKS

Two port networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

UNIT – V: FOURIER ANALYSIS OF A.C. CIRCUITS AND FILTERS

Fourier series - Analysis of electrical circuits to non sinusoidal periodic waveforms using Fourier series

Filters-Introduction to filters—low pass, high pass and band pass, constant-k and m-derived filters.

TEXT BOOKS:

1. William Hayt and Jack E. Kemmerley, "Engineering Circuit Analysis", Mc Graw Hill Company, 9th edition, 2020.

2. C.L. Wadhwa, "Network Analysis And Synthesis", New Age International publication, 3rd edition, 2018.

REFERENCE :

1. Van Valkenburg, "Network Analysis and Synthesis", Pearson publication, 3rd edition, 2015.

2. A. Sudhakar, Shyamohan, S Palli, "Electrical Circuits Analysis-2" Tata McGraw- Hill, 5th edition, 2015.

3. Charles K Alexander, Mathew. N. O. Sadiku, "Fundamental of Electric Circuits", Tata McGraw- Hill, 6th edition, 2019.

4. Chakrabarti A, "Electric Circuits Analysis & Synthesis" Dhanpat Rai & Co (p) Ltd, 6th edition, 2014

L	T	P	Cr.
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Pre-Requisites: Applied Physics and Fundamentals of Electrical Engineering.

Course Educational Objective: The objective of this course is to introduce the binary number system, Boolean algebra, Logic gates, Sequential circuits and PLD's.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Interpret the number systems (**Remember-L1**)

CO2: Design logic gates. (**Apply-L3**)

CO3: Analyze combinational and sequential logic circuits (**Understand-L2**)

CO4: Realize Memory Organization and state machines (**Understand-L2**)

UNIT - I: NUMBER SYSTEMS

Number system, complements, signed Binary numbers. Binary Arithmetic, Binary codes –BCD, Excess 3 code, Gray code, Error detecting and correcting code – Hamming code, conversion from one code to another.

Boolean Algebra: Boolean postulates –De-Morgan's Theorem, Principle of Duality, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS)- Minterm and Maxterm, Canonical forms – Conversion into canonical form–Karnaugh map Minimization (up to 4 variables)- Don't care conditions.

UNIT - II: LOGIC GATES

AND, OR, NOT, NAND, NOR, Exclusive OR and Exclusive NOR, positive logic and negative logic, Realization of Boolean Functions using logic gates (Multi level gate implementations) - AND -OR, OR - AND, NAND -NAND, NOR -NOR, NAND-NOR & NOR -NAND realizations. AND, OR, NOT, NAND and NOR gates using Resistors, Diodes and Transistor.

UNIT – III: COMBINATIONAL LOGIC CIRCUITS

Design procedure, Adders and Subtractors – Serial adder/ Subtractor, Parallel adder/ Subtractor- Carry look ahead adder, BCD adder, Magnitude Comparator, Decoder, encoder, Multiplexer, Demultiplexer, Parity checker, code converters. Memories- Read Only memory and types of ROM, Random access Memory and types of RAM; Programmable Logic Devices– Programmable Logic Array, Programmable Array Logic. Implementation of combinational logic using MUX, PROM, PAL and PLA.

UNIT – IV: SEQUENTIAL LOGIC CIRCUITS

Latches, Flip flops-SR, JK, T, D and Master slave – Characteristic and excitation tables, characteristic equations. Modes of triggering – Edge and Level Triggering, Realization of one flip flop using other flip flops, Registers and their operation, synchronous and Asynchronous counters, modulo – n counters, Race around condition.

UNIT – V: ASYNCHRONOUS SEQUENTIAL CIRCUITS

Sequence detector- Finite state machine-capabilities and limitations, Mealy and Moore models- problems-Design of sequential circuits

Algorithmic State Machines: Components of ASM chart-Salient features-Simple examples.

TEXTBOOKS:

1. Morris Mano, Michael D. Ciletti ,“Digital Design with an Introduction to the Verilog HDL”, Pearson Education, New Jersey, 5th edition, 2013.
2. Zvi Kohavi, Niraj K. Jha, “Switching and Finite Automata Theory”, Cambridge University Press, New York, 3rdedition, 2010.

REFERENCE:

1. John F. Wakerly, “Digital Design”, Pearson Education ,New Delhi, 4th edition,2014.
2. Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, New Jersey,11th edition,2015.
3. Charles H. Roth, Larry.L.Kinney, “Fundamentals of Logic Design”, Cengage learning Publishers,7th edition,2015.
4. M.V.Subramanyam, “Switching Theory and Logic Design”, Laxmi Publications(P) Ltd.New Delhi,2011.
5. A. Anand Kumar, “Switching Theory and Logic Design”, PHI Publishers,New Delhi,3rd edition, 2016.
6. Comer, “Digital Logic and State Machine Design”, Oxford Higher Education, 3rd edition 2012.

L	T	P	Cr.
2	1	0	3

Pre-Requisites: Applied Physics, Differential equations and Fundamentals of Electrical Engineering

Course Educational Objective: The objective of this course is to introduce the concepts of electric and magnetic fields and their applications which will be useful in the development of the theory for Electrical Machines and Power Systems.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze static electric fields due to various charge distributions. (**Understand-L2**)

CO2: Apply boundary conditions for electric at dielectric interfaces. (**Understand-L2**)

CO3: Analyze static magnetic fields due to various current carrying elements (**Understand-L2**)

CO4: Develop Maxwell's equation in differential and integral form. (**Apply-L3**)

UNIT – I: ELECTRO STATICS

Review of vector calculus, Electrostatic fields – Coulomb's Law – Electric field intensity (EFI) – EFI due to a point, line and a surface charge – Work done in moving a point charge in an electrostatic field – Electric potential – Properties of potential function – Potential gradient – Gauss's law – Application of Gauss's Law – Maxwell's first law.

UNIT – II: CONDUCTORS, DIELECTRICS AND CAPACITANCE

Current density, conduction and Convection current densities, Ohm's law in point form, equation of continuity. Electric field inside a dielectric material, polarization, Dielectric, Conductor and Dielectric, Dielectric boundary conditions.

Capacitance- Capacitance of parallel plate and spherical and co-axial capacitors with composite dielectrics – Energy stored and energy density in a static electric field.

UNIT – III: STATIC MAGNETIC FIELDS

Biot-Savart Law, Magnetic flux and magnetic flux density. Magnetic field intensity (MFI) due to a straight current carrying filament, circular, square and solenoid. Relation between magnetic flux, magnetic flux density and MFI, Maxwell's second Equation. Ampere's circuital law and its applications, MFI due to an infinite sheet of current and a long current carrying filament, Point form of Ampere's circuital law, Maxwell's third equation. Field due to a circular loop, rectangular and square loops.

UNIT-IV: MAGNETIC FORCES, MATERIALS AND INDUCTANCE

Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic dipole, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic Circuits, inductances and mutual inductances.

UNIT – V: TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

Faraday's laws of electromagnetic induction, Its integral and point forms, Maxwell's fourth equation. Modification of Maxwell's equations for time varying fields, Displacement current, Poynting Theorem and Poynting vector.

TEXT BOOKS:

1. "William Hayt, "Engineering Electromagnetics", McGraw Hill, New York, 7th edition, 2011.
2. Gangadhar.K.A, "Field theory", Khanna Publishers, New Delhi, 15th edition, 2004.

REFERENCE:

1. Matthew. N.O. Sadiku, "Elements of Electromagnetics", Fourth Edition, Oxford University Press, First Indian Edition, 2010.
2. David K Cheng, "Field and Wave Electromagnetics", Pearson Education, 2nd edition, 2004.
3. John D. Kraus, "Electromagnetics" McGraw Hill, 5th Edition, 1999.
4. Narayana Rao.N, "Elements of Engg. Electro Magnetics", Prentice Hall of India, 6th Edition, 2008.

B.Tech. (III Sem.)

20MC02-ENVIRONMENTAL SCIENCE

L	T	P	Cr.
2	-	-	0

Course Objectives:

In this course the student will learn about

- Environmental issues like over population, human health etc related to local, regional and global levels.
- The necessity of resources, their exploitation and sustainable management.
- The interactions of human and ecosystems and their role in the food web in the natural world.
- The global biodiversity, threats to biodiversity and its conservation.
- Environmental problems like pollution, disasters and possible solutions.
- The importance of environmental decision making in organizations through audits.

Course Outcomes:

After the completion of this course, the students will able to

- CO1:** Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions. **L1**
- CO2:** Evaluate local, regional and global environmental issues related to resources and their sustainable management. **L2**
- CO3:** Realize the importance of ecosystem and biodiversity for maintaining ecological balance. **L2**
- CO4:** Acknowledge and prevent the problems related to pollution of air, water and soil. **L3**
- CO5:** Identify the significance of implementing environmental laws and abatement devices for environmental management. **L2**

Unit I**Nature and scope of Environmental Problems**

- Introduction to Environmental Science
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards.
- Role of Information Technology in environmental management and human health

Unit II**Natural Resources and Conservation**

Introduction and classification of Natural Resources

- Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, conflicts over water, interlinking of rivers, dams-benefits and problems, Rain water harvesting
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, soil salinity
- Energy resources: Growing energy needs renewable, non-renewable and alternate energy resources

Unit III

Ecology and Biodiversity

- Structure and functions of an Ecosystem, Food chains and Food webs, Ecological succession, Ecological pyramids, Biogeochemical cycles
- Biodiversity, Values of biodiversity, Bio geographical classification of India. Endangered and endemic species of India, Threats to biodiversity; Man and wild life conflicts, Conservation of biodiversity: In-situ and Ex-situ conservation methods

Unit IV

Environmental Pollution

Introduction to Environmental Pollution Causes, effects and control measures of:

Air pollution, Water pollution, Noise pollution, Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste, Disaster Management.

Unit V

Environmental Management

- Sustainable development and unsustainability
- Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Stockholm Conference
- Environmental Impact Assessment (EIA)
- Green building
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

Text Books:

1. Anubha Kaushik, C.P.Kaushik, “*Perspectives in Environmental Studies*”, 5th edition, New age international publishers, Delhi, 2016.
2. G. Tyler Miller, Scott Spoolman, “*Introduction to Environmental Studies*”, 13th Edition, Cengage Learning, New Delhi, 2009.

Reference Books:

1. M. Anji Reddy, “*Textbook of Environmental Sciences and Technology*”, 2nd Edition, BS Publications, Delhi 2011.
2. Deeshita Dave, P. Udaya Bhaskar, “*Environmental Studies*”, 2nd Edition, Cengage Learning, New Delhi, 2012.
3. S.Deswal, A. Deswal, “*A Basic course in Environmental Studies*”, 2nd Edition, Educational & Technical Publishers, Delhi, 2014.
4. R. Rajagopalan, “*Environmental Studies (From Crisis to Cure)*”, 3rd Edition, Oxford University Press, New Delhi, 2012.
5. De, A.K, “*Environmental Chemistry*”, 5th Edition, New Age International (P) Limited, New Delhi, 2003.
6. Dr.K.V.S.G. Murali Krishna, “*Environmental Studies*”, 1st Edition, VGS Techno Series, Vijayawada, 2010.
7. Mahua Basu, S.Xavier, “*Fundamentals of Environmental Studies*”, 1st edition, Cambridge University Press, Delhi, 2016.

L	T	P	Cr.
0	0	3	1.5

Pre-requisite : Programming Language

Course Educational Objectives :

The objective of this course is to make students familiar with writing algorithms to implement different data structures like stacks, queues, trees and graphs, and various sorting techniques.

Course Outcomes (COs): *At the end of this course, the student will be able to*

CO 1	Implement Linear Data Structures using array and Linked list.
CO 2	Implement Various Sorting Techniques.
CO 3	Implement Non Linear Data Structure such as Trees & Graphs.

I) Exercise Programs on List ADT

- Implementation of List using Arrays.
- Implementation of List using Linked List.

II) Exercise Programs on Stacks & Queue ADT

- Implementation of Stack Operations using Arrays.
- Implementation of Stack Operations using Linked List.
- Implementation of Queue Operations using Arrays.
- Implementation of Queue Operations using Linked List.

III) Exercise Programs on Stack Applications

- Conversion of Infix Expression to postfix Expression.
- Conversion of Infix Expression to prefix Expression.
- Evaluation of Postfix Expression
- Implementation of Balancing Symbols.

IV) Exercise Programs on Types of Queues

- Implementation of Circular Queues Linked List.
- Implementation of Double Ended Queue using Arrays.
- Implementation of Double Ended Queue using Linked List.

V) Exercise Programs on Sorting Techniques.

- Implementation of Insertion Sort and
- Implementation of Selection Sort.
- Implementation of Merge Sort.
- Implementation of Quick Sort.
- Implementation of Bubble Sort.
- Implementation of Heap Sort.

VI) Exercise Programs on Trees

- Implementation of Binary Tree Traversals.
- Implementation of Binary Search Tree Operations.

VII) Exercise Programs on Graph Traversal Techniques.

- Breadth First Search (BFS)
- Depth First Search (DFS)

B.Tech. (III Sem.) 20EE54-ELECTRICAL CIRCUITS AND SIMULATION LAB

L	T	P	Cr.
0	0	3	1.5

Pre- Requisite: Fundamentals of Electrical Engineering

Course Educational Objective: The objective of this lab is to impart hands on experience in verification of circuit laws and theorems, study of circuit characteristics and simulation of time response. It also gives practical exposure to the usage of CRO, power sources and function generator.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Examine the response of AC and DC electric circuits using theorems (**Apply-L3**)

CO2: Analyze the magnetic circuits (**Understand-L2**)

CO3: Design resonance circuits (**Apply-L3**)

CO4: Estimate two port network parameters (**Apply-L3**)

CO5: Analyze the electrical circuit using simulation tools (**Apply-L3**)

List of Experiments

1. Verification of Superposition and Maximum Power Transfer theorem (both AC and DC excitations).
2. Verification of Thevenin's and Norton's theorems.
3. Calculation of Resonance frequency, Band Width, Quality factor for Series and Parallel resonant circuits.
4. Determination of self Inductance, Mutual Inductances and Coefficient of coupling of a coupled coil.
5. Verification of Two port network parameters (Z and Y).
6. Verification of Reciprocity & Compensation Theorems
7. Verification of Kirchhoff's voltage and current laws using digital simulation
8. Simulation analysis of RL, RC & RLC transient circuits
9. Simulation analysis of three phase balanced and unbalanced networks circuits
10. Fourier analysis of circuits using simulation

Additional Experiments

11. Locus diagram of R-L, R-C and RLC circuits
12. Verification of Millman's theorem

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: Digital Electronics

Course Educational Objective: This laboratory course enables the students to demonstrate the design and application of digital logic circuits in day-to-day life.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze simple combinational and sequential logic circuits(**Understand-L2**)

CO2: Demonstrate different application of ICs(**Apply-L3**)

CO3: Design the logic circuits using simulation tools(**Apply-L3**)

LIST OF EXPERIMENTS

- 1.a) Basic Gates Function Verification using truth tables.
 - i) AND Gate using 7408 IC ii) OR Gate using 7432 IC
 - iii) NOT Gate using 7404 IC
- b) Universal Gates Functional Verification
 - i) NAND Gate using 7400 IC ii) NOR Gate using 7402 IC
- c) Special Gates Functional verification
 - i) XOR Gate using 7486 IC
 - ii) XNOR Gate using XOR followed by NOT Gate
2. Realization of following gates using universal gates and its functional verification.
AND, OR, XOR, NOT
3. Design Half-adder and Full-adder circuits and verify its functionality.
4. Design a four bit comparator and verify its functionality using IC 7485
5. Design a four bit binary to Gray code converter and verify its functionality using logic gates.
6. Design and verify the functionality of Decoders with different inputs.
7. Verify the functionality of following Flip-Flops.
 - a) SR Flip-Flop b) JK Flip-Flop c) D Flip-Flop d) T Flip-Flop
8. Design and verify the functionality of multiplexers with different inputs
9. Design and verify UP-Counter with JK Flip-Flops using simulation tools.
10. Design a square wave generator with NAND gates using simulation tools.

Additional Experiments:

11. Design and verify 4-bit Asynchronous counter with JK Flip-Flop using simulation tools.
12. Design and verify BCD to seven segment decoder using simulation tools.

B.Tech.(III Sem.)**Skill Oriented Course-I
20EES1 - PCB Design**

L	T	P	Cr.
1	0	2	2

PCB DESIGN USING 'EasyEDA' SOFTWARE**LIST OF EXPERIMENTS**

1. Design a single-phase Half-wave and Full wave bridge rectifier circuits using diodes.
2. Design the CB and CE configurations of a transistor.
3. Design a sawtooth wave generator circuit using transistor.
4. Design the square wave to sine wave converter circuit.
5. Design an amplitude modulator circuit using transistor.
6. Design the series and parallel resonance circuits.
7. Design a three-phase balanced and unbalanced star networks.
8. Design a three-phase balanced and unbalanced delta networks.
9. Design Wheatstone's and Kelvin double bridge circuits.
10. Design AND, OR, NAND and NOR gates using transistors.

L	T	P	Cr.
3	0	0	3

B.Tech.(IV Sem.)**20HS01 – UNIVERSAL HUMAN VALUES 2:
UNDERSTANDING HARMONY****Pre-requisites:** Nil

Course Educational Objective: To become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

COURSE OUTCOMES: At the end of the course, the student will be able to-

CO1: Apply the value inputs in life and profession (**Apply – L3**)

CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the self, and the Body (**Understand – L2**)

CO3: Understand the role of a human being in ensuring harmony in society (**Understand – L2**)

CO4: Understand the role of a human being in ensuring harmony in the nature and existence. (**Understand – L2**)

CO3: Distinguish between ethical and unethical practices (**Apply – L3**)

UNIT-I: Need, Basic Guidelines, Content and Process for Value Education

‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations; Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity

UNIT-II: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’; Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility; Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer);

Understanding the characteristics and activities of ‘I’ and harmony in ‘I’; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

UNIT-III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship;

Understanding the harmony in the society: Resolution, Prosperity, fearlessness

and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family, Gratitude as a universal value in relationships.

UNIT-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and selfregulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence.

UNIT-V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics, Strategy for transition from the present state to Universal Human Order

Text Book:

Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

L	T	P	Cr.
2	1	0	3

Pre-requisites: Fundamentals of Electrical Engineering & Basic Civil and Mechanical Engineering

Course Educational Objective: This course enables the student to learn different types of non-renewable power generation methods, the economic aspects of power generation, tariff methods and design aspects of transmission lines.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the operation of non-renewable electrical power generating stations (**Understand-L2**)

CO2: Illustrate the economic aspects of power generation (**Apply-L3**)

CO3: Understand the a.c distribution system and performance of insulated cables (**Understand-L2**)

CO4: Evaluate the electrical and mechanical parameters of transmission lines (**Apply-L3**)

CO5: Analyze operation of overhead line insulators and phenomena of corona (**Understand-L2**)

UNIT-I: POWER GENERATION METHODS

Introduction to typical layout of an electrical power system, present power scenario in India, Generation of electric power: non-renewable sources (Qualitative): Hydro station, Steam power plant, Nuclear power plant and Gas turbine plant.

UNIT-II: ECONOMICS OF GENERATION

Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.

UNIT-III: AC DISTRIBUTION & CABLES

AC Distribution: Introduction, AC distribution, Single phase, 3-phase-3wire, 3 phase 4 wire system, bus bar arrangement, Selection of site and layout of substation.

Insulated Cables: Introduction, insulation, insulating materials, extra high voltage cables, grading of cables, insulation resistance of a cable, capacitance of a single core and three core cables, overhead lines versus underground cables, types of cables.

Unit-IV: ELECTRICAL AND MECHANICAL DESIGN OF TRANSMISSION LINES

Transmission line sag calculation: The catenary curve, sag tension calculations, supports at different levels, stringing Chart, inductance and capacitance calculations of transmission lines: line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.

UNIT-V: CORONA& INSULATORS

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines, Numerical problems.

Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators.

TEXT BOOKS:

1. Soni, Gupta & Bahtnagar, Power Systems Engineering, Dhanpat Rai & Sons, 2016.
2. C.L. Wadhwa, Electrical Power Systems, 6th Edition, New AgeInternational,2009.

REFERENCE BOOKS:

1. M.V.Deshpande, Elements of Electrical Power Station Design, 3rd, Wheeler Pub.1997.
2. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, 3rd Edition, New AgeInternational,2015.
3. V K Mehta & Rohit Mehta, Principles of Power Systems (Multicolor Edition), 24/e, S.Chand Publishing, 4th Edition ,2005.
W.D.Stevenson, Elements of Power System Analysis, 4th Edition, McGraw Hill, 1982.

L	T	P	Cr.
2	1	0	3

Pre-requisites: Electrical circuit Analysis and Applied Physics

Course Educational Objective: The objective of this course is to introduce to the students the principles and applications of control systems in everyday life, the basic concepts of block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Develop mathematical models of systems in terms of transfer function and state-space. (Apply-L3)

CO2: Analyze control systems in time domain (Apply-L3)

CO3: Analyze control systems in frequency domain (Apply-L3)

CO4: Understand the concepts of controllers and compensators. (Understand-L2)

UNIT-I: MATHEMATICAL MODELLING OF CONTROL SYSTEMS

Concepts of Control Systems- Open Loop and Closed Loop control systems. Mathematical modeling –Transfer function, Modeling of electrical systems, mechanical systems, Electrical analogy of mechanical systems. Block diagram representation of systems - Block diagram algebra. Signal flow graph – reduction using Mason’s gain formula. Feedback Control System Characteristics- Sensitivity of Control Systems to Parameter Variations, Disturbance Signals in a Feedback Control System.

UNIT – II: TIME RESPONSE ANALYSIS-I

Standard test signals, Step response of first order and second order systems, Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).

UNIT – III: TIME RESPONSE ANALYSIS-II

Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis- Introduction to Root Locus Technique, Construction of root loci.

UNIT – IV: FREQUENCY RESPONSE ANALYSIS

Frequency domain specifications, Frequency response of standard second order system. Bode Plot - determination of frequency domain specifications - phase margin and gain margin, determination of transfer function from the Bode Plot. Polar plot, Nyquist plot- Nyquist Stability criteria. Introduction to Lag, Lead, Lead-Lag Compensator (excluding design).

UNIT – V: STATE SPACE ANALYSIS

Concept of state variables – State models for linear and time invariant Systems – The Transfer Function from the State Equation, Solution of state equation– State transition matrix and it’s properties Concepts of controllability and observability.

TEXT BOOKS:

1. B. C. Kuo , “Automatic Control Systems” John Wiley and Sons ,9th edition,2014.
2. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International (P) Limited Publishers,6th edition,2018.

REFERENCE BOOKS:

1. Katsuhiko Ogata , “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd., 5th edition,2009
2. Norman S. Nise, Control Systems Engineering, 8th Edition, John Wiley, New Delhi,
3. Richard C Dorf, Robert H Bishop, Modern control systems , 12thedition, Prentice Hall (Pearson education, Inc.), New Delhi 2010.
4. Benzamin C. Kuo and Farid Golnaraghi, Automatic Control Systems,10th Edition, John Wiley, New Delhi, 2017.
5. Rao V. Dukupati,”Analysis and Design of Control Systems using MATLAB”, NewAge Publishers, 2e, 2009.

L	T	P	Cr.
2	1	0	3

Pre-requisite :Electronic Circuits and Devices and Network Theory

Course Educational Objective :This course enables the student to analyze various electronic circuits like large signal amplifiers, feedback amplifiers, high pass, low pass RC circuits, clippers, clampers comparators etc.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze different types of feedback amplifiers (**Understand-L2**)

CO2: Design oscillators for different frequencies (**Apply-L3**)

CO3:Analyze High pass, low pass RC circuits (**Apply-L3**)

CO4:Apply passive filters for linear &Non-linear wave shaping (**Apply-L3**)

UNIT – I: TRANSISTOR AT HIGH FREQUENCY

The hybrid Π Common Emitter Transistor model. Hybrid Π conductance in terms of low frequency h parameters- Transconductance, Input Impedance, Feedback conductance, Base spreading resistance, output conductance and hybrid Π capacitances. The CE short circuit current gain obtained with the hybrid- Π model- Bandwidth f_{β} and parameter f_T , Current gain with resistive load.

UNIT – II: LARGE SIGNAL AMPLIFIERS

Classification of large signal Amplifiers, Distortion in Amplifiers- Second harmonic Distortion and Higher order harmonic distortion. Class A power amplifier- Direct coupled and Transformer Coupled Power Amplifier, Class B power amplifier- Push Pull and Complementary Symmetry power Amplifier., Class AB power amplifier, Class C power amplifier, Class D and S power Amplifiers.

UNIT – III: FEEDBACK AMPLIFIERS

Open loop Amplifiers- Voltage Amplifier, Current Amplifier, Transresistance Amplifier and Transconductance Amplifier. Closed loop Amplifiers- Classification of Negative Feedback Amplifiers and their analysis, Characteristics of Negative Feedback Amplifiers.

UNIT – IV: OSCILLATORS

Oscillators-Introduction- Barkhausen Criterion, Classification of Oscillators, RC Oscillators- RC Phase shift Oscillator using FET, RC Phase shift Oscillator using BJT, Wein Bridge Oscillator. LC Oscillators- Hartley Oscillator, Colpitts Oscillator, Clapp Oscillator, Crystal Oscillator, Frequency and Amplitude Stability of Oscillators.(**Qualitative analysis only**).

UNIT – V: LINEAR & NON-LINEAR WAVESHAPING

High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator, integrator and attenuators.

NON-LINEAR WAVE SHAPING: Diode clippers, Transistor clippers, clipping at two independent levels, Zener diode clippers, Comparators, clamping operation, clamping circuits using diode with different inputs, Clamping circuit theorem.

TEXT BOOKS:

1. Jacob Millman, Christos C Halkias and SatyabrataJit, Millman's“ Electronic Devices and Circuits”, Tata McGraw Hill, 3rd Edition, New Delhi, 2010.
2. J. Millman and H. Taub–“Pulse, Digital and Switching Waveforms” - McGraw-Hill, 1991

REFERENCE:

1. R.L. Boylestad and Louis Nashelsky,” Electronic Devices and Circuits”, Pearson/Prentice Hall, 11th Edition,2012.
2. S Salivahanan, N.Suresh Kumar and A Vallavaraj, “Electronic Devices and Circuits”, McGraw Hill, 4th edition, 2017.

L	T	P	Cr.
2	1	0	3

Pre-requisite : Electric and magnetic fields

Course Educational Objective: This course enables the student to learn the principle, construction and performance characteristics of DC Machines and Transformers, methods of speed control of a DC motor and different connections of poly-phase transformers.

Course Outcomes: At the end of the course, the student will be able to:

CO1 : Understand the concepts of construction, operation and performance of dc generators.

(Understand-L2)

CO2: Analyze the operation and performance of dc motors. **(Understand-L2)**

CO3: Evaluate the performance of single phase transformers. **(Apply-L3)**

CO4: Analyze the performance of three phase transformers. **(Understand-L2)**

UNIT – I: D.C. GENERATORS

Construction & Principle of Operation of D.C. Generators – E.M.F Equation- Types of D.C Generators – Armature reaction – Methods of reducing the effects of armature reaction – Compensating winding – Commutation – Methods of improving commutation. – losses in a dc machine – power stages – condition for maximum efficiency – problems.

UNIT – II: CHARACTERISTICS OF DC GENERATORS

O.C.C – Voltage build up in generators – Critical field resistance and critical speed - Causes for failure to self excite and Remedial measures – Load characteristics of shunt, series and compound generators.

UNIT – III: D.C MOTORS

Principle of operation – Back E.M.F. - Torque equation – characteristics and application of shunt, series and compound motors – Armature reaction and commutation – Speed control methods, starters – 3 point and 4 point starters – Constant and Variable losses – calculation of efficiency – condition for maximum efficiency – problems, Test on dc motors – Brake test – Swinburne's test – Hopkinson's test – Retardation Test.

UNIT – IV: SINGLE PHASE TRANSFORMER

Constructional details – core, windings, insulation, bushings, cooling, Transformer types, emf equation - operation on no-load and on-load - phasor diagrams – Equivalent circuit – losses, efficiency and regulation. All day efficiency – effect of frequency & supply voltage on core losses – minimization of hysteresis and eddy current losses. Parallel operation with equal and unequal voltage. Testing – O.C and S.C tests – Sumpner's (back to back) test - predetermination of efficiency and regulation – separation of losses, load test.

UNIT – V: AUTO TRANSFORMERS & POLY PHASE TRANSFORMERS

Auto transformers – comparison with two winding transformers – Poly-phase transformers – Poly-phase connections - Y/Y, Y/ Δ , Δ /Y, Δ / Δ - open Δ – Scott connection - three winding transformers – tertiary windings – off load and on load tap changing.

TEXT BOOKS:

1. P.S. Bimbira, "Electrical Machinery" , Khanna Publishers, 7th Edition, 2014.
2. I.J.Nagrath&D.P.Kothari, "Electric Machines", Tata Mc Graw Hill, 7th Edition.2004

REFERENCE:

1. M.G. Say , "Alternating Current Machines", John Wiley & Sons, 5th edition, 2002.
2. A. E. Fitzgerald, C. Kingsley, S. Umans , "Electric Machinery " , Tata Mc Graw Hill, 7thediton, 2013.
3. Ashfaq Husain, "Electric Machines", Dhanapati Rai & Co, New Delhi, 2nd edition, 2014.
4. Clayton. A.E, "Performance and Design of Direct Current Machines" CBS Publishers, 1st edition, 2004.

B.Tech. (IV Sem.)

20AD53-Programming using Python Lab

L	T	P	Cr.
1	0	2	2

Pre-requisite : Programming languages like C Language.

Course Educational Objective:

The Objective of Python course is to lead the students from the basics of writing and running Python scripts in problem solving and also to design and implement the modules and understands the working of classes and objects in python.

Course Outcomes (COs):At the end of the course, the student shall be able to

- CO 1:** Identify various programming constructs available in Python and apply them in solving computational problems. (**Apply - L3**)
- CO 2:** Demonstrate data structures available in Python and apply them in solving computational problems. (**Apply - L3**)
- CO 3:** Implement modular programming, string manipulations and Python Libraries (**Apply - L3**)
- CO 4:** Improve individual / teamwork skills, communication & report writing skills with ethical values.

Introduction: Language basics and example problems (Two weeks)

Implement Python Script for checking the given year is leap year or not.

Implement Python Script for finding biggest number among 3 numbers.

Implement Python Script for displaying reversal of a number.

Implement Python Script to check given number is Armstrong or not.

Implement Python Script to print sum of N natural numbers.

Implement Python Script to check given number is palindrome or not.

Implement Python script to print factorial of a number.

Implement Python Script to print all prime numbers within the given range.

Implement Python Script to calculate the series: $S=1+x+x^2+x^3+\dots+x^n$

Implement Python Script to print the following pattern:

```

*
* *
* * *

```

Modue 1: Exercise Programs on Lists.

Write a Python script to display elements of list in reverse order.

Write a Python script to find the minimum and maximum elements without using built-in operations in the lists.

Write a Python script to remove duplicates from a list.

Write a Python script to append a list to the second list.

Write a Python script to count the number of strings in a list where the string length is 2 or more.

Module 2: Exercise Programs on Tuples.

Write a Python script to create a tuple with different data types.

Write a Python script to find the repeated items of a tuple.

Write a Python script to replace last value of tuples in a list.

Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]

Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]

Write a Python script to sort a tuple by its float element.

Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')]

Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]

Module 3: Exercise Programs on Sets.

Write a Python script to add member(s) in a set.

Write a Python script to perform Union, Intersection, difference and symmetric difference of given two sets.

Write a Python script to test whether every element in S is in T and every element in T is in S.

Module 4: Exercise Programs on Dictionaries

Write a Python script to sort (ascending and descending) a dictionary by value.

Write a Python script to check whether a given key already exists or not in a dictionary.

Write a Python script to concatenate following dictionaries to create a new one.

Sample Dictionary : dic1={1:10, 2:20} dic2={3:30, 4:40} dic3={5:50,6:60}

Expected Result : {1: 10, 2: 20, 3: 30, 4: 40, 5: 50, 6: 60}

Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys.

Write a Python program to map two lists into a dictionary.

Module 5: Exercise Programs on functions and recursion.

a) Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.

b) Write a program which makes use of function to display all such numbers which are divisible by 7 but are not a multiple of 5, between given range X and Y.

c) Define functions to find mean, median, mode for the given numbers in a list.

d) Define a function which generates Fibonacci series up to n numbers.

e) Implement a python script for factorial of number by using recursion.

f) Implement a python script to find GCD of given two numbers using recursion.

Module 6: Exercise programs on Strings

a) Implement Python Script to perform various operations on string using string libraries.

b) Implement Python Script to check given string is palindrome or not.

c) Implement python script to accept line of text and find the number of characters, number of vowels and number of blank spaces in it.

d) Implement python script that takes a list of words and returns the length of the longest one.

Module 7: Exercise programs on Regular Expressions

a) Write a Python script to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).

b) Write a Python script to check whether password is valid or not.

Conditions for a valid password are:

Should have at least one number.

Should have at least one uppercase and one lowercase character.

Should have at least one special symbol.

Should be between 6 to 20 characters long.

Module 8 : Exercise programs on Matplotlib Library

a) Write a Python program to draw a line with suitable label in the x axis, y axis and a title.

b) Write a Python program to plot two or more lines with legends, different widths and colors.

c) Write a Python program to create multiple plots.

d) Write a Python programming to display a bar chart using different color for each bar.

e) Write a Python programming to create a pie chart with a title.

f) Write a Python program to draw a scatter plot with empty circles taking a random distribution in X and Y and plotted against each other.

L	T	P	Cr.
0	0	2	1

Pre requisite: Electronic Circuits and Devices and Analog Electronics.

Course Educational Objective: This course provides the practical exposure on designing of different single stage and multistage stage amplifiers, effect of capacitances on frequency response, analysis of power and feedback amplifiers.

Course Outcomes: At the end of the course, the student will be able to

CO1: Demonstrate the characteristics of Amplifiers, Oscillators, feedback amplifiers, and Multivibrators. **(Apply-L3)**

CO2: Analyze Timer circuits and its applications. **(Apply-L3)**

CO3: Design of feedback amplifiers, Power amplifiers and waveform generators using Electronic devices and components. **(Apply-L3)**

LIST OF EXPERIMENTS

1. Design and Realization of Low pass and High Pass filters using RC networks.
2. Design of clippers and clamper circuits.
3. Design and Realization of transistorized Astable Multivibrator for the generation of square waveform.
4. Design and Realization of transistorized Monostable Multivibrator for the generation of voltage pulses.
5. Design and Realization of transistorized Schmitt Trigger
6. Determination of Gain and Bandwidth of two stage RC Coupled amplifier from the frequency response using simulation tools.
7. Study of transistorized Current series Feedback amplifier for Bandwidth improvement using simulation tools
8. Analysis of Stability and Gain of transistorized Current shunt Feedback amplifier using simulation tools.
9. Design and Realization of transistorized RC Phase shift Oscillator to generate a sinusoidal signal using simulation tools.
10. Design and Realization of transistorized Colpitts Oscillator to generate a sinusoidal signal using simulation tools.

Additional Experiments

11. Verify conduction angles of Class-A and Class-B Power Amplifiers.
12. Analysis of Stability and Gain of transistorized Voltage series Feedback amplifier.

B.Tech (IVSEM).

20EE57-ELECTRICAL MACHINES - I LAB

L	T	P	Cr.
0	0	3	1.5

Prerequisite: Applied Physics**Course Educational Objectives:** This course enables the student to analyze the operation of dc machines and transformers, Give practical exposure on the performance of DC machines and transformers**Course Outcomes:** At the end of this course, the student will be able to:**CO1:** Analyze the performance of DC generators (**Apply-L3**)**CO2:** Examine the performance of DC motors by conducting different tests (**Apply-L3**)**CO3:** Analyze the performance of transformers (**Apply-L3**)LIST OF EXPERIMENTS

<u>S.No</u>	<u>Name of the Experiment</u>
1	Predetermination of Efficiency & Regulation of 1-phase transformer
2	Predetermination of Efficiency & Regulation of two identical 1-phase transformers
3	Determination of Efficiency & Regulation of 1-phase Transformer by direct test
4	Conversion of Three phase to two phase by using two identical transformers
5	Determination of Stray losses in a DC Shunt Motor by Retardation test
6	Determination of critical resistance and critical speed of D.C. shunt generator
7	Predetermination of Efficiency of D.C. shunt machine & Speed control of D.C. shunt motor
8	Performance characteristics of D.C. shunt motor by direct test
9	Determination of efficiency of DC shunt machine by conducting back to back test
10	Separation of stray losses in a D.C. shunt motor.

Additional Experiments

11	Load characteristics of a separately excited D.C. Generator
12	Calculation of voltage regulation of single phase transformer using Lab view

B.Tech (IVSEM).

Skill Oriented Course– II
20EES2 - PLC BASED INDUSTRIAL AUTOMATION

L	T	P	Cr.
1	0	2	2

List of Experiments

(Any TEN of the following Experiments are to be conducted)

1. Study hardware and software used in PLC
2. Implementation of Logic Gates using PLC
3. Implementation of DOL Starter
4. Implementation of On-Delay Timer
5. Implementation of Off-Delay Timer
6. Implementation of Up-Down Counter
7. Implementation of PLC Arithmetic Instructions
8. Implementation of PID Controller using PLC
9. Solar Tracking system using PLC
10. Temperature Control System using PLC

L	T	P	Cr.
2	1	0	3

Pre-requisites: Power Systems-I, Electrical Circuit Analysis.

Course Educational Objectives: This course enables the student to learn performance of transmission lines, the voltage control and reactive power compensation methods of transmission lines. It also deals with importance of per unit representation of power system, symmetrical components, short circuit studies and protective devices

Course Outcomes: At the end of the course the student will be able to:

CO1: Analyze transmission line performance (**Apply-L3**)

CO2: Apply shunt compensation techniques to control reactive power of the transmission line (**Understand-L2**)

CO3: Determine the fault currents for symmetrical and unsymmetrical faults (**Apply-L3**)

CO4: Illustrate the protective relays and circuit breakers in power system protection. (**Understand-L2**)

UNIT-I: PERFORMANCE OF TRANSMISSION LINES

Representation of lines, short transmission lines, medium length lines, nominal T and π representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect, Power flow through a transmission line, receiving end power circle diagram.

UNIT-II: VOLTAGE CONTROL IN POWER SYSTEM

Introduction, methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase-modifiers.

Compensation in Power Systems: Introduction-Concepts of Load compensation, Loadability characteristics of overhead lines, uncompensated transmission line, Symmetrical line Radial line with asynchronous load, Compensation of lines.

UNIT-III: SYMMETRICAL FAULT ANALYSIS

Per Unit Representation of Power Systems, Symmetrical Fault (LLL) Analysis: Short circuit of synchronous machine unloaded, Short circuit of loaded synchronous machine, Calculation of symmetrical short circuit currents for simple systems, Short circuit current computation through Thevenin's theorem. Reactors and their location, short circuit capacity of a bus, computation of circuit breaker capacities, short circuit current and MVA Calculations, Numerical Problems.

UNIT-IV: UNSYMMETRICAL FAULT CALCULATIONS

Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks of power systems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedance, Numerical Problems

UNIT-V: FUNDAMENTALS OF POWER SYSTEM PROTECTION

Need for protective systems, nature and causes of faults, zones of protection, primary and backup protection, essential qualities of protection. Classification of Protective Relays based on technology and function, over current relays, Distance relays, Impedance, reactance and MHO relays, Buchholz relay, differential relays

Switch Gear: classification of circuit breakers, principle of operation of air blast, vacuum, SF₆ circuit breakers.

TEXT BOOKS:

1. John J.Grainger & W.D.Stevenson, "Power System Analysis", McGraw Hill International, 2017.
2. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis" ,Tata McGraw-Hill Pub. Co., New Delhi, FourthEdition,2011.

REFERENCE:

- 1.C.L. Wadhwa, "Electrical Power Systems", New Age International, 2016.
2. Hadi Saadat, "Power System Analysis", Tata Mc Graw Hill Pub.Co.2002.

3. V K Mehta & Rohit Mehta, “Principles of Power Systems” (Multicolor Edition), S.Chand Publishing, fourth edition,2006
- 4..W.D. Stevenson, “Elements of Power system Analysis”, McGraw Hill International Student Edition,2004

L	T	P	Cr.
2	1	0	3

Prerequisite: Electrical Circuit Analysis and Electrical Machines-I

Course Educational Objective: This course enables the student to understand the analysis and performance of single phase and poly phase Induction motors which are the major part of domestic appliances, control systems, drives and agricultural pump sets . It also deals with detailed analysis of synchronous generators and motors which are the prime sources of electrical power generation.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze the performance of poly phase Induction motors **Apply-L3)**

CO2: Illustrate the operation of single phase induction motor **(Understand-L2)**

CO3: Examine the performance of the synchronous generator. **(Apply-L3)**

CO4: Analyze the performance of the synchronous motor. **(Apply-L3)**

UNIT-I: THREE PHASE INDUCTION MOTORS

Three-phase Induction motors-construction details-Production of a rotating magnetic field - principle of operation - rotor emf and rotor frequency - rotor reactance, rotor current and power factor- equivalent circuit - phasor diagram - crawling and cogging.

UNIT-II: PERFORMANCE OF INDUCTION MOTORS

Power stages -Rotor power input, rotor copper loss , mechanical power developed and their inter relation-torque equation- expressions for starting torque and running torque-condition for maximum torque–torque slip characteristics– losses and efficiency – starting methods-no load and blocked rotor tests –equivalent circuit –operation of induction motor as induction generator.

UNIT-III: SINGLE PHASE INDUCTION MOTORS

Single phase Induction motors – principle of operation - double field revolving theory -split phase induction motor, capacitor start and run induction motors, shaded pole induction motor– equivalent circuit.

UNIT-IV: SYNCHRONOUS GENERATORS

Synchronous generator – construction, working principle- emf equation–types of rotors-armature reaction –phasor diagrams-regulation methods: EMF, MMF,ZPF methods – synchronizing to infinite bus bars – two reaction theory – parallel operation of synchronous generators-synchronous machine constants(X_d , X_q).

UNIT-V: SYNCHRONOUS MOTORS

Synchronous motor – constructional features, principle of operation of synchronous motor – methods of starting - soft starters, Damper winding– power developed by a synchronous motor – synchronous motor with different excitations – effect of increased load with constant excitation, effect of changing excitation with constant load – torque equation – V curve and inverted V curve – hunting.

TEXT BOOKS :

1. P.S. Bimbra, “Electrical Machinery”, Khanna Publishers, 7th Edition, 2014
2. I.J.Nagrath & D.P.Kothari, “Electric Machines”, Tata Mc Graw Hill, 5th Edition.2017

REFERENCE:

1. M.G. Say ,”Alternating Current Machines”, John Wiley & Sons, 1976.
2. A. E. Fitzgerald, C. Kingsley and S. Umans, “Electric Machinery”, Mc Graw-Hill Companies, 6th edition 2017.
3. Ashfaq Husain ,”Electric Machines”, Dhanapati Rai&Co, New Delhi, 3rd edition , 2017.
4. Soft Starter Handbook, ABB Group.

L	T	P	Cr.
2	1	0	3

Prerequisite: Electronic Circuits and Devices, Electrical Circuit Analysis

Course Educational Objective: This course enables the student to study the characteristics of power semiconductor devices and to familiarize the principle of operation & performance of various power electronic converters.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the characteristics of various power semiconductor devices. (**Understand-L2**)

CO2: Analyze the operating principles for single-phase and three phase thyristor based rectifiers (**Apply-L3**)

CO3: Analyze operation of dc-dc converters in steady state in continuous and discontinuous modes (**Apply-L3**)

CO4: Interpret the operation of ac voltage controllers and cyclo converters (**Understand-L2**)

CO5: Understand the operation and performance of inverters (**Understand-L2**)

UNIT – I: POWER SEMI-CONDUCTOR DEVICES

Power semiconductor switches–Characteristics of SCR–Two transistor model- Static and dynamic characteristics–Turn on and Turn off methods-Series and Parallel operation of thyristors-Gate triggering circuits-Rating and protection-Snubber circuits, Characteristics of GTO & IGBT.

UNIT – II: COMMUTATIONS & PHASE-CONTROLLED RECTIFIERS

Commutation circuits: Natural commutation, Forced commutation circuits– Self, Impulse and complimentary commutation

Single phase and three phase- Half wave, Full wave and bridge controlled rectifiers with R and RL loads–continuous and discontinuous modes-effect of freewheeling diode-Dual converters(both single phase and three phase)–Effect of Source impedance, Problems.

UNIT – III: AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS

AC voltage controllers–single phase ac voltage controller with R and RL loads– continuous and discontinuous modes- Principle of operation of Cyclo-converter -Single phase to single phase cyclo converters -Step up and step-down Cyclo converters –Problems.

UNIT – IV: DC TO DC CONVERTERS

Principle of operation-Control Strategies, Buck and Boost converters–Chopper classification-Class A, Class B, Class C, Class D and Class E- Analysis of Class A chopper – Derivation of average load voltage, load current for continuous/discontinuous current operation-Problems.

UNIT – V: INVERTERS

Single phase inverter–Voltage Source Inverter (VSI)-Current source inverters(CSI) - Comparison between VSI and CSI- Analysis with R & RL loads-3-phase inverters–180 and 120 degree mode of operation-PWM Techniques, Single Pulse Width Modulation, Multiple Pulse Width Modulation, Sinusoidal PWM- Applications.

TEXT BOOKS:

1. Md.H.Rashid “Power Electronics Devices, circuits and Applications”, Pearson Education, fourth Edition, 2017.
2. Dr.P.S. Bhimbra, “Power Electronics”, Khanna Publishers, 5th Edition, 2012.

REFERENCE:

1. Ned Mohan, T.M. Undeland and William P.Robbins, “Power Electronic Converters-Applications”, John Wiley & Sons, 3rd Edition, , 2009
2. M D Singh, K B Khanchandani “Power Electronics”, Tata MC Graw Hill Publishers,2nd edition 2006.

B.Tech.(V Sem)

**20EE15-ELECTRONIC INSTRUMENTATION &
MEASUREMENTS**

L	T	P	Cr.
3	0	0	3

Prerequisite: Fundamentals of Electrical Engineering

Course Educational Objectives: This course enables the students to understand the construction and working principle of different types of meters. It provides knowledge with different types of digital voltmeters, signal analyzers, oscilloscopes and transducers

Course Outcomes: At the end of the course, the student will be able to:

CO1: Illustrate types of errors in measurements (**Understand-L2**)

CO2: Understand working principle of various types of digital voltmeters and CRO (**Understand-L2**)

CO3: Illustrate the application of signal analyzers (**Understand-L2**)

CO4: Select appropriate transducers for measurement of physical phenomenon (**Apply-L3**)

CO5: Understand significance of virtual instrumentation and intelligent sensors (**Understand-L2**)

UNIT-I: INTRODUCTION

Static and Dynamic characteristics of instruments, dead zone, hysteresis, threshold, resolution, input & output impedance, loading effects, fundamentals of measurements, Statistical Analysis, Probability of Errors, Limiting Errors, calibration of instruments,.

UNIT-II: DIGITAL VOLTMETERS

Digital voltmeters – Successive approximation, ramp, dual – Slope integration continuous balance type – Micro processor based ramp type DVM digital frequency meter, digital phase angle meter, Digital Energy meter

Oscilloscopes: Review of CRO block diagram, Attenuators and probes of CRO, Dual beam oscilloscope, Dual trace oscilloscope, Measurement of phase and frequency using Lissajous patterns

UNIT-III: SIGNAL ANALYZERS

Wave Analyzers – Frequency selective analyzers, Heterodyne, Application of Wave Analyzers Harmonic distortion, spectrum analyzers, Basic spectrum analyzers, spectral displays, vector impedance meter, Q meter. Peak reading and RMS voltmeters.

UNIT-IV: TRANSDUCERS

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Synchros, Piezo electric transducers. Concept of smart sensors and virtual instrumentation

UNIT-V: INTELLIGENT SENSORS

Cogent sensors, virtual sensors, self-adaptive sensors, self-validate sensors, Temperature compensating intelligent sensor

TEXT BOOKS:

1. Albert D.Helfrick and William D.Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.
2. A. K. Sawhney, “A course in Electrical and Electronic Measurements and Instrumentation”, Dhanpatrai & co,2015

REFERENCE :

1. Earnest Doebelin, “Measurements Systems, Applications and Design”, Mc-GraHill series, 5th edition,2008
2. A. S Morris,“ Measurement and Instrumentation Principles ”, Butterworth-Heinemann,2001
3. D. V. S Murthy, “Transducers and Instrumentation”, Prentice Hall of India, second edition,2012

4.ManabendraBhuyan,“Intelligent Instrumentation: Principles and Applications”, CRCpress,2011

L	T	P	Cr.
3	0	0	3

Pre- requisites: Digital Electronics

Course Educational Objective: This course enables the student to understand the linear and digital integrated circuits and their applications.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze linear IC's for engineering applications (**Apply-L3**)

CO2: Design various filters using their frequency bands (**Apply-L3**)

CO3: Design combinational and sequential circuits using digital ICs (**Apply-L3**)

CO4: Compare various memory devices (**Understand-L2**)

UNIT –I : OPERATIONAL AMPLIFIER

Classification of Integrated circuit and Block diagram of Op-amp, Ideal Op-amp characteristics- DC and AC characteristics, 741 op-amp and its features. Basic applications of op-amp- Adder, Subtractor, Adder-Subtractor, instrumentation amplifier, log and antilog amplifier, sample & Hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators, Schmitt trigger, Multivibrators.

UNIT - II: ACTIVE FILTERS & OSCILLATORS

Introduction, 1st order LPF, HPF filters. Band pass, Band reject and all pass filters. Oscillator types and principle of operation - RC, Wien bridge and Quadrature type, waveform generators- triangular, sawtooth, square wave.

UNIT – III : TIMERS & A/D-D/A CONVERTERS

Introduction to 555 timer, functional diagram, monostable and astable operations and applications, VCO, PLL-introduction, block schematic, principles and description of individual blocks of 565. Converters - Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, different types of ADCs – parallel comparator type ADC, counter type ADC, Successive approximation type and dual slope ADC. DAC and ADC specifications.

UNIT-IV: LOGIC FAMILIES & COMBINATIONAL CIRCUITS

Classification of Logic families, standard TTL NAND Gate- Analysis & characteristics, TTL open collector O/Ps, Tristate TTL, MOS&CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL. Decoder-74X138 IC, Demultiplexer, Encoder, priority Encoder-74X148 IC, multiplexer-74X151 IC and 74X157 IC, parity generators-74X280 IC, Magnitude comparator:74X85 IC & their applications. 4-bit binary adder:74X283 IC.

UNIT-V: SEQUENTIAL CIRCUITS & MEMORIES

74XX series of IC counters ROM architecture, types & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

TEXT BOOKS:

1. D. Roy Choudhury, "Linear Integrated Circuits", New Academic science, 5th Edition, 2017.
2. John F. Wakerly, "Digital Design: Principles and Practices", Pearson education, 5th edition, 2017.

REFERENCE:

1. Robert F. Coughlin and Fredrick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall publisher, 6th edition, 2001.
2. Denton J. Dailey, "Operational Amplifiers and Linear Integrated circuits: Theory and Applications", TMH, 1990.
3. Sergio Franco, "Design with Operational amplifiers and Analog Integrated circuits", McGraw Hill, 3rd edition, 2002.
4. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, 10th edition, 2011.
5. Ramakanth A. Gayakwad, "Op-amps and Linear Integrated Circuits", PHI, 4th edition 2000.

B.Tech.(V Sem)

**20EE17-ENERGY CONSERVATION AND
MANAGEMENT**

L	T	P	Cr.
3	0	0	3

Pre-requisite course: Fundamentals of Electrical Engineering, Electrical Machines-I

COURSE OBJECTIVES: This course enables the student to introduce the need of energy auditing and devise energy efficient control strategies. It also deals with active power management, energy efficient lighting schemes and energy conservation methods.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Illustrate the different parameters for energy auditing (**Understand-L2**)

CO2: Interpret the controlling of energy management and energy efficiency (**Understand-L2**)

CO3: Analyze the Reactive power management strategies. (**Understand-L2**)

CO4: Analyze energy conservation measures for economic aspects. (**Apply-L3**)

UNIT-I: BASIC PRINCIPLES OF ENERGY AUDIT

Energy audit- definitions, concept , types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, building energy audit. Smart Metering, Energy saving through smart metering. Energy conservation in vehicles, energy conservation in buildings

UNIT-II: ENERGY MANAGEMENT

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language.

UNIT-III: ENERGY EFFICIENT MOTORS

Energy efficient motors , factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT-IV: POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS Power factor – methods of improvement, location of capacitors, power factor with non linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control ,lighting energy audit - Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT-V: ECONOMIC ASPECTS AND ANALYSIS

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment .

TEXT BOOKS:

1. W.R. Murphy & G. McKay Butter worth ,“Energy Management”, Elsevier publications. 2012
2. John. C. Andres, “Energy Efficient Electric Motors “Marcel Dekker Inc. Ltd , 2nd Edition, 1995

REFERENCE:

1. Paulo' Callaghan, “Energy management” Mc – Graw Hill Book company.1st edition, 1998
2. W.C. Turner, “Energy management hand book” John wiley and son, 2001.
3. Energy management and good lighting practice: fuel efficiency booklet12 – EEO.
4. S C Tripathy, “Electric Energy Utilization and Conservation”, Tata McGraw hill Publishing Company Ltd, New Delhi,1991
5. K.S.K.Weranga, SisilKumarawadu, D.P.Chandima,“Smart Metering Design and Applications”, Springer Publications, 1st Edition, 2014.

B.Tech.(V Sem)

20EE58-CONTROL SYSTEMS LAB

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: Control Systems

Course Educational Objective: This laboratory course enables the student to implement the mathematical techniques used in linear control systems to solve real world problems through experimentation and simulation tools.

Course Outcomes: At the end of the course, the student will be able to :

- CO1. Simulate the physical control system for stability studies (**Apply-L3**)
- CO2. Demonstrate feedback controllers (**Understand-L2**)
- CO3. Develop logic gates using PLC (**Apply-L3**)

LIST OF EXPERIMENTS

1. Modeling of Physical Systems (Mechanical and Electrical systems).
2. Block Diagram Reduction of Linear Systems
3. Time response analysis of Linear Systems for impulse and step inputs
4. Frequency response analysis of Linear Systems
5. Stability and relative stability analysis of Linear Systems Using (Root Locus, Bode and Nyquist plot).
6. Time Response analysis of Second Order System.
7. Study the effect of P, PD, PI, PID controllers on second order systems.
8. Magnitude and phase plot of Lag and lead compensators.
9. Determination of transfer function and effect of feedback on DC servo motor.
10. Study of logic gates using PLC

Additional Experiments

11. Design of Lag and Lead Compensators for a given system
12. Stepper motor control using Simulation tools.
13. Study the effect of P, PD, PI, PID controllers on DC servomotor system using PLC.
14. Study the effect of P, PD, PI, PID controllers on Temperature control system using PLC.

B.Tech.(V Sem)

20EE59-ELECTRICAL MACHINES - II LAB

L	T	P	Cr.
0	0	3	1.5

Prerequisite: Electrical Machines-II.

Course Educational Objectives: This course enables the student to know the operation of various ac machines and give practical exposure on the performance of various AC machines like induction motors and synchronous machines.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze the performance of single phase transformer and induction motor (**Apply-L3**)

CO2: Examine the performance of three phase induction motor (**Apply-L3**)

CO3: Evaluate the performance parameters of synchronous machines (**Apply-L3**)

CO4: Analyze the performance of AC machines using simulation tools (**Apply-L3**)

LIST OF EXPERIMENTS

1. Plot the circle diagram of three-phase induction motor
2. Performance characteristics of single phase induction motor
3. Calculation of equivalent circuit parameters for a single-phase induction motor
4. Performance characteristics of three-phase slip ring induction motor
5. Separation of core losses in a Single Phase Transformer
6. Determination of efficiency and regulation of three-phase alternator by direct test
7. Regulation of 3-phase alternator by synchronous impedance & MMF and ZPF Method
8. Plot the V & inverted V curves of a synchronous motor
9. Calculation of direct and quadrature axis reactances of a salient pole synchronous machine
10. Torque-Speed characteristics of Induction motors using Simulation tools

ADDITIONAL EXPERIMENTS

11. Performance characteristics of squirrel cage induction motor
12. Speed control of Induction motor using Simulation tools
13. Demonstration of high rating synchronous machine with soft starter using simulation tool.

L	T	P	Cr.
1	0	2	2

Course Educational Objective: Concentrates on the methodological and technical aspects of software design and Programming based on JAVA. Know about the importance of GUI based applications and the development of applications through JAVA.

Course Outcomes:

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

CO1: Understand the software's for writing Java programming and code to accept an integer and print its factorial. (**Understand-L2**)

CO2: Develop the Java code for different applications. (**Apply-L3**)

List of Modules

Cycle-1

- Downloading and installing JDK and JRE. Executing simple java program which prints Hello world.
- Program to accept an integer and prints its factorial.

Cycle-2

- Develop a java program to create class, which contains data and methods (private and public), create an object to access those members.
- Develop a java program which demonstrates method over loading.
- Develop a java program which demonstrates constructor and constructor over loading use this keyword.

Cycle-3

- Develop a java program which creates and Access Static and Non-static members of a class.
- Develop the java program to study different methods provided in String and StringBuffer classes.

Cycle-4

- Develop a java program that demonstrates single inheritance, use super keyword.
- . Develop a java program for abstract class to find areas of different shapes.

Cycle-5

- Develop a java program to achieve multiple inheritance using interfaces.
- Develop a java program to create an interface named Vehicle which contains two abstract methods. (Specifications (), Display ()). Provide two classes named Two-wheeler, Four-wheeler that is implemented by that interface.

Cycle-6

- Develop a java program to create a package and accesses it.
- Develop a java program that demonstrates try, catch and finally.

Cycle-7

- Develop a java program that displays a frame with two Labels, two TextFields and Two Buttons.

L	T	P	Cr.
2	1	0	3

B.Tech.(VI Sem)

20EE18-POWER SYSTEMS-III

Pre-requisites: Power Systems-I, Power Systems-II**Course Educational Objectives:** This course enables the student to learn power flow solution methods, unit Commitment problem and importance of economic load dispatch, concepts of Power system operation and control and importance of frequency control.**Course Outcomes:** At the end of the course the student will be able to:**CO1:** Understand application of load flow methods (**Understand-L2**)**CO2:** Analyze the economic operation of power system (**Apply-L3**)**CO3:** Analyze load frequency control of power system (**Apply-L3**)**CO4:** Determine the stability of power system (**Apply-L3**)**UNIT-I: NETWORK MATRICES**

Graph Theory: Definitions-relevant concepts in graph theory-Network Matrices: Ybus formation by Direct Inspection and Singular Transformation Methods. Zbus Building algorithm. Introduction to Load flow studies-Bus classification

UNIT-II: LOAD FLOW STUDIES

Load flow equations -Iterative methods Gauss-Seidel Method- Newton-Raphson Method-Fast Decoupled method-Merits and demerits of the above methods -System data for load flow study.

UNIT-III: ECONOMIC OPERATION OF POWER SYSTEMS

Economic load dispatch with and without transmission losses -Transmission loss as a function of plant generation, Calculation of loss coefficients -Distribution of load between plants, Unit commitment problem, Priority order scheduling, Hydro-Thermal coordination.

UNIT-IV: LOAD FREQUENCY CONTROL

Synchronous Machine Dynamics, Mathematical model of speed-governing system-Turbine models, division of power system into control areas, P-f control of single control area (the uncontrolled and controlled cases)-P-f control of two area systems (the uncontrolled cases and controlled cases).

UNIT-V: POWER SYSTEM STABILITY

The stability problem-Steady state stability, transient stability and Dynamic stability-Swing equation, Equal area criterion of stability-Applications of Equal area criterion, Step-by-step solution of swing equation-Factors affecting transient stability, Methods to improve steady state and Transient stability, comparison of angle and voltage stability

TEXT BOOKS:

1. John J.Grainger & W.D.Stevenson, "Power System Analysis", McGraw Hill International, 2017.
2. D.P.Kothari and I.J.Nagrath, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Education Private Limited 2011.

REFERENCE:

- 1.C.L. Wadhwa, "Electrical Power Systems", New Age International, 2016.
- 2.Prabha Kundur, "Power System Stability and Control", McGraw-Hill Professional, first edition,2006

L	T	P	Cr.
2	1	0	3

B.Tech.(VI Sem)

20EE19- SOLID STATE DRIVES

Prerequisites: Power Electronics, Electrical Machines-I, Electrical Machines II

Course Educational Objective: This course is an extension of power electronics applications to electric drives. It covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

Course Outcomes: At the end of the course, the student will be able to:

CO1 : Examine the performance of dc motor drive by rectifier and chopper control methods.

(Apply-L3)

CO2 : Understand the controlling mechanisms for squirrel cage induction motors and synchronous Motors .(Understand-L2)

CO3 : Analyze the Slip-power recovery schemes for wound rotor induction motor. (Apply-L3)

CO4 : Analyze the BLDC motor drives. (Apply-L3)

UNIT – I: RECTIFIER & CHOPPER CONTROLLED DC MOTOR DRIVES

Significance of variable speed drives-Single-phase and three-phase, semi-fully controlled rectifier fed separately excited DC motors and DC series motors-Chopper controlled motoring operation-regenerative braking, dynamic braking and plugging of separately excited dc motor and dc series motor - multi quadrant control of chopper fed dc motors-problems.

UNIT – II: CONTROL OF INDUCTION MOTOR DRIVES

stator voltage control-stator frequency control-Open loop V/F control -control of induction motor by ac voltage controller, voltage source inverter, current source inverter and cyclo converter-comparison of voltage source and current source inverter drives-problems.

UNIT – III: SLIP POWER CONTROLLED WOUND ROTOR INDUCTION MOTOR DRIVES

Static rotor resistance control-Slip-power recovery schemes- Static Scherbius and Static Kramer drive drive- Phasor diagram-Torque expression-closed loop speed control of static Scherbius drive-Modes of operation of Static Scherbius –applications, problems

UNIT – IV: CONTROL OF SYNCHRONOUS MOTOR DRIVES

Synchronous motors– variable frequency control-operation of self controlled Synchronous motors-by VSI, CSI and Cyclo converters-Load commutated CSI fed Synchronous Motor-speed-torque characteristics- Closed Loop control operation of synchronous motor drives (Block Diagram Only).

UNIT – V: CONTROL OF BLDC MOTOR DRIVES

Principle of operation of BLDC machine-sensing and logic switching scheme-BLDM as variable speed synchronous motor- methods of reducing torque pulsations- three phase full wave BLDC motor-sinusoidal shape of BLDC motor- current controlled BLDC motor servo drive.

TEXT BOOKS:

1. G K Dubey “Power Semiconductor Drives”, Prentice Hall , 1988.
2. Bimal.K.Bose “Modern Power Electronics and AC Drives”, Prentice Hall India Learning Private Limited , 2005.

REFERENCE:

1. Vedam Subramanyam “Thyristor Control of Electric drives”, Tata McGraw Hill Publications 2017.
2. S K Pillai “A First course on Electrical Drives”, New Age International(P) Ltd. 3rd Edition, 2012.
3. R.Krishnan “Electric motor drives modelling, analysis & control”,pearson education, 2015.

B.Tech.(VI Sem)

20EE20- BASIC MICROPROCESSORS AND MICRO CONTROLLERS

L	T	P	Cr.
3	0	0	3

Pre-requisites: Digital Electronics

Course Educational Objective : In this course student will learn about the Architecture of 8086 Microprocessor and 8051 Microcontroller and their Assembly Language Programming, interfacing Memory and Various Peripherals with 8086 Microprocessor/8051 Microcontroller and concepts of Interrupts and Serial Communication in reference to 8086

Course Outcomes: At the end of the course, students will be able to:

- CO1:** Understand the architecture and operation of 8086 microprocessor & 8051 microcontroller (**Understand-L2**)
- CO2:** Apply the instructions of 8086/8051 for various applications. (**Apply-L3**)
- CO3:** Analyze the operation of peripherals and devices for different applications. (**Understand-L2**)
- CO4:** Develop a system by interfacing memory, peripherals and i/o devices to 8086/8051 (**Apply-L3**)

UNIT – I: MICROPROCESSOR ARCHITECTURE

Introduction to Microprocessors-Purpose of a Microprocessor, different types of Microprocessors, their features and their comparison; 8086 Microprocessor-Architecture , Special functions of General purpose registers, 8086 flag register and function of 8086 Flags, Addressing modes of 8086. **Instruction Set:** Instruction set of 8086, Assembly language programs involving logical, Branch and Call instructions, Sorting, Evaluation of Arithmetic Expressions, String manipulation, Assembler directives, simple programs, procedures and macros.

UNIT – II: 8086 MEMORY AND I/O INTERFACING

Pin diagram of 8086, Minimum mode and maximum mode of operation, Timing diagram, Memory (Static RAM & EPROM) and I/O interfacing to 8086. Interrupt structure of 8086, Interrupt Vector table, Interrupt service routines.

UNIT – III: PERIPHERALS AND DEVICES

DMA Controller 8237, Interrupt Controller 8259 and Cascading, USART 8251 8255 PPI – various modes of operation, Keyboard, D/A and A/D converter interfacing.

UNIT – IV: MICROCONTROLLER

8051 Microcontroller Architecture, Pin Diagram, Addressing modes, Instruction Set and Programs, 8051 Memory and I/O interfacing.

UNIT – V: 8051 INTERFACING

Modes of timer operation, Serial port operation, Interrupt structure of 8051, Interfacing of Seven segment Displays, Stepper Motor and Serial/Parallel Printer.

TEXT BOOKS:

1. Douglas V. Hall, “Micro Processors & Interfacing”, TMH, Third edition,2017.
2. A. K. Ray and K.M. Bhurchandi, “Advanced Microprocessor And Peripherals”,3rd Edition TMH Publishers,2012.
3. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay “8051 Microcontrollers and Embedded System”, Pearson Prentice Hall, 2nd Edition,2005

REFERENCE:

1. Raj Kamal, “Microcontrollers Architecture, Programming, Interfacing and System Design”, Pearson Education India, Pearson Education India, 2nd Edition,2011
2. J. K. Uffenbeck, “The 8088 and 8086 Micro Processors:Programming, interfacing, software ,Hardware and Applications”, Pearson, 4th Edition, 2002.
3. Ajay Deshmukh, “Micro Controllers-Theory and Applications”, Tata McGraw Hill Publishers,2005
4. Kenneth J. Ayala, “The 8051 Micro Controller”, Cengage Learning Publishers, 3rd Edition, 2000.

L	T	P	Cr.
3	0	0	3

B.Tech.(VI Sem)

20EE21- INTELLIGENT CONTROL SYSTEMS

Pre-requisite course: Control Systems

COURSE OBJECTIVES: This course enables the student to familiarize fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications. It also introduce concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: Comprehend the concepts of biological neurons and artificial neurons. (**Understand-L2**)

CO2: Analyze the feed-forward and feedback neural networks and their learning algorithms. (**Apply-L3**)

CO3: Comprehend the neural network training and design concepts (**Apply-L3**)

CO4: Comprehend the concept of fuzziness involved in various systems, fuzzy set theory, membership functions and their Implementation methods and fuzzy logic (**Apply-L3**)

CO5: Apply fuzzy logic to real world problems. (**Apply-L3**)

UNIT-I: ARCHITECTURE OF NEURAL NETWORKS

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks- Potential Applications of ANN -typical Architecture-setting weights-common activations functions, Historical Developments, Mcculloch-Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Basic learning rules (Hebb's rule, perceptron rule, Delta Rule etc.) Basic Problems

UNIT-II: BASIC NEURAL NETWORK TECHNIQUES

Supervised Learning Neural Network : Perceptron Model, Adaline Model, M-adaline Model, Back propagation neural net standard back propagation-architecture algorithm- derivation of learning rules number of hidden layers

Unsupervised Learning Neural Network : Radial Basis Function networks: Topology, learning algorithm; Kohonen's self-organising network: Topology, learning algorithm- and Discrete Hopfield networks.

UNIT-III: NEURAL MEMORY UNIT & RECURRENT NEURAL NETWORK

Neural Memory unit: associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine

Recurrent neural networks: Basic concepts, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

UNIT-IV: INTRODUCTION TO FUZZY LOGIC SYSTEM

Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy arithmetic; composition and inference

UNIT-V: APPLICATIONS OF FUZZY LOGIC AND FUZZY SYSTEMS

Basic structure and operation of fuzzy logic control systems; Design methodology; Applications of fuzzy controllers, control of phase controlled dc motor drive by using fuzzy logic controllers , Simple applications of fuzzy knowledge based controllers like washing machines, home heating system, and train break control.

TEXT BOOKS:

1. Jacek M. Zuarda, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1st edition, 1994.
2. Timothy J Ross, "Fuzzy logic with engineering application", Wiley publications, Third edition, 2011.

REFERENCE:

1. James A Freeman and Davis Skapura, “Neural Networks” , Pearson Education, 2nd edition ,2009.
2. Rajasekharan and Pai, “Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications” ,PHI Publication, 1st edition, 2003.
3. Samir Roy, Udit Chakraborty, “Introduction to Soft Computing: Neuro Fuzzy & Genetic Algorithms”, Pearson Publications, 1st edition , 2013.
4. S.N.Sivanandam, S.Sumathi, S.N.Deepa, “Introduction to neural networks using MATLAB 6.0, TMH, 2nd Edition, 2008

L	T	P	Cr.
3	0	0	3

B.Tech.(VI Sem)

20EE22- CLASSICAL AND META HEURISTIC OPTIMIZATION TECHNIQUES

Pre-requisites: Differential Equations, Linear Algebra and Transformation Techniques

Course Educational Objective: This course enables the student to understand the need of optimization methods, Familiarize with various solution methods of un-constrained and constrained decision-making problems, Solve Meta heuristic optimization problems.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Solve various constrained and unconstrained problems in single variable as well as multivariable (**Apply-L3**)

CO2: Apply the concept of optimality criteria for various types of optimization problems (**Apply-L3**)

CO3: Interpret non-traditional optimization techniques (**Understand-L2**)

CO4: Identify a suitable technique to solve a particular engineering problem (**Apply-L3**)

UNIT – I: INTRODUCTION TO OPTIMIZATION

An overview of optimization problem, concepts and terms related to optimization, necessary and sufficient conditions for a multivariable function, Effects of scaling or adding a constant to an objective function, understanding of constrained and unconstrained optimization problems, local & global optima, properties of convex function and definiteness of a matrix and test for concavity of a function, Numerical examples.

UNIT – II: LINEAR PROGRAMMING (LP)

Simplex method, matrix form of simplex method, solution of linear programming problems in tabular form via simplex method, Two-Phase simplex method, Duality in simplex method, Sensitivity analysis.

UNIT – III: NON-LINEAR PROGRAMMING-I

Lagrange multipliers, gradient descent method, steepest descent method, Newton's method, Davison-Fletcher-Powell method, Exterior point method, Numerical examples.

UNIT – IV: NON-LINEAR PROGRAMMING-II

Karush-Kuhn-Tucker (KKT) conditions, convex optimization, quadratic optimization, numerical examples. Dynamic programming, principle of optimality, concept of optimal control and mathematical formulation of problem, numerical examples.

UNIT – V: HEURISTIC METHODS

Introduction, modern heuristic search techniques, introduction to genetic algorithms, encoding, fitness function, basic operators. Introduction to particle swarm optimization, variations of particle swarm optimization-discrete PSO.

TEXT BOOKS:

1. S.S. Rao, "Engineering Optimization – Theory and Practice", John Wiley & Sons, 5th edition 2019,
2. Kwang Y.Lee, Mohamed A.El-Sharkawi, "Modern Heuristic Optimization Techniques- Theory and Application to Power Systems" John Wiely& Sons, 2008

REFERENCE:

1. K.V. Mittal and C Mohan, "Optimization Methods in Operations Research and Systems Analysis", New Age International Publishers, New Delhi, 3rd edition 2005,
2. Kalyanmoy Deb, "Optimization for Engineering Design - Algorithms and Examples", PHI Learning Private Ltd, New Delhi, 2nd edition, 2012.
3. D.E. Goldberg, "Genetic Algorithms in Search, optimization and machine learning: Reading, Mass", Addison-Wesley, 1989.
4. Jasbir S.Arora, "Introduction to optimum design", Academic press, 4th edition, 2016.
5. Xin-She Yang, "Engineering Optimization: An Introduction with Metaheuristic Applications", John Wiley & Sons, 2010.

L	T	P	Cr.
3	0	0	3

B.Tech.(VI Sem)

20EE23- DIGITAL CONTROL SYSTEMS

Pre Requisite: Control Systems

Course Educational Objective: This course provides the students the adequate knowledge about signal processing in digital control , the importance of modeling and stability analysis of discrete systems and the concept of controllers such as pole-assignment controllers.

Course Outcomes: At the end of the course, the student will able to:

CO1: Identify the basic elements and structures of digital control systems (**Understand-L2**)

CO2: Develop mathematical model of discrete time system (**Apply-L3**)

CO3: Analyze the stability, controllability and observability of digital control systems (**Apply-L3**)

CO4: Design feedback controller and state observer for discrete time system (**Apply-L3**)

UNIT – I : SAMPLING AND Z-PLANE ANALYSIS

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold.

REVIEW OF Z-TRANSFORMS: Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT – II: STATE SPACE ANALYSIS AND THE CONCEPTS OF CONTROLLABILITY AND OBSERVABILITY

State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations – controllability and observability – concepts, conditions and tests, Principle of duality.

UNIT – III : STABILITY ANALYSIS

Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT – IV: DESIGN OF DISCRETE TIME CONTROL SYSTEM

Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane-Design using frequency response in the w-plane for Lag and Lead compensators-digital PID controllers- Root locus technique in the z-plane.

UNIT – V: STATE FEEDBACK CONTROLLERS AND OBSERVERS

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman’s formula. State Observers – Full order and Reduced order observers.

Linear Quadratic Regulators: Min/Max principle, Linear Quadratic Regulators

TEXT BOOKS:

1. Kuo, “Digital Control Systems”, Oxford University Press, 2nd Edition, 2012.
2. M.Gopal, “Digital Control and State Variable Methods”, TMH, 2003

REFERENCE :

1. M. Gopal ,“Digital Control Engineering”, New Age International Private Limited; Second edition , 2014
2. K.Ogata, “Modern control engineering”, Pearson,5th edition , 2009

L	T	P	Cr.
0	0	3	1.5

Prerequisite: Power Electronics

Course Educational Objective: This course enables the student to provide practical exposure to converter circuits, hardware modules and Software tools to simulate various power electronic converters and drives.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Examine the characteristics of Power electronic devices (**Understand-L2**)

CO2: Analyze the performance of different power converters and drives using trainer kits. (**Apply-L3**)

CO3: Evaluate the performance of different power converters and drives using simulation tools (**Apply-L3**)

LIST OF EXPERIMENTS

1. Characteristics of SCR, IGBT & Power MOSFET.
2. Single phase AC voltage controller with R & RL Loads.
3. Single phase IGBT inverter with R and R-L Loads.
4. Single phase Cyclo converter with RL load.
5. Three phase fully controlled bridge converter fed dc motor drive.
6. Four quadrant operation of chopper fed dc drive.
7. Three phase Ac Voltage controller fed Induction motor drive.
8. Three phase slip ring Induction motor by Static Rotor Resistance Control.
9. Single phase fully controlled rectifier with R & RL loads using simulation tools.
10. Single phase inverter with PWM technique using simulation tools.

ADDITIONAL EXPERIMENTS

11. PWM control of Boost converter with R and R-L loads.
12. IGBT based three phase PWM Inverter with R load.
13. Single phase fully controlled bridge converter With R & RL Loads.

B.Tech.(VI Sem)

20EE61-BASIC MICO PROCESSORS AND MICRO CONTROLLERS LAB

L	T	P	Cr.
0	0	3	1.5

Pre-Requisites: Basic Micro Processors and Micro Controllers**Course Educational Objective:** In this course, student will understand working of instructions by practicing programs of 8086 / 8051 and develop applications by interfacing devices.**Course Outcomes :** At the end of the course, students will be able to:

- CO1:** Demonstrate program proficiency using the various instructions of the 8086 microprocessor. (**Apply-L3**)
- CO2:** Demonstrate program proficiency using the various instructions of the 8051 microcontroller. (**Apply-L3**)
- CO3:** Design systems for different applications by interfacing external devices. (**Apply-L3**)

LIST OF EXPERIMENTS**Part-1: 8086 programs:**

1. Program to demonstrate data transfer operation
2. Program to demonstrate arithmetic operation
3. Program to demonstrate logical operation
4. Program to demonstrate shift operation
5. Program to demonstrate string operation
6. Program to demonstrate looping operation
7. Program to demonstrate decision making operations

PART-2: 8051 PROGRAMS:

1. Program to demonstrate data transfer and arithmetic operations
2. Program to demonstrate logical and shift operations
3. Program to demonstrate looping operations
4. Programming timer / counter.
5. Programming Serial communication application.
6. Programs to demonstrate bit-manipulation operations.

PART-3: INTERFACING PROGRAMS (using 8086 & 8051 Kits)

1. Interfacing ADC
2. Interfacing DAC.
3. Interfacing stepper motor.
4. Interfacing 7-segment display.
5. Interfacing Traffic light controller.
6. Waveform generation

L	T	P	Cr.
0	0	3	1.5

B.Tech.(VI Sem)

20EE62- POWER SYSTEMS LAB

Pre-requisites: Power systems-II

Course Educational Objective: This lab course enables the student to verify the theoretical concepts of power and energy systems through experimentation and analyze the same using simulation tools

Course Outcomes: At the end of the course, the student will be able to:

CO1: Analyze transmission systems under steady state and transient conditions (**Apply-L3**)

CO2: Perform fault calculation and network protection (**Apply-L3**)

CO3: Understand the performance of renewable energy systems (**Understand-L2**)

LIST OF EXPERIMENTS

1. Determination of Receiving end quantities and the line performance of a medium/long transmission line using simulation tool.
2. Using Computer code determine:
 - (i) Bus admittance matrix by inspection method for a 3-bus power system and obtain
 - (ii) Power flow solution by Newton-Raphson method.
3. Determination of Sequence components (Positive, Negative and Zero) of an alternator using simulation tool.
4. Transient analysis of a Single Machine Infinite Bus (SMIB) system using simulation tool.
5. Simulation of LG, LL, LLG and LLL faults on a simple power system.
6. Determine steady state frequency error and frequency deviation response for an
 - (i) Isolated power system and (ii) Interconnected power system.
7. Plot the Swing curve for a simple 3 or 4 bus power system using Simulation Tool.
8. Study the Over current protection scheme using numerical relay.
9. Determination of ABCD parameters and performance of a transmission line
10. Determination of Positive, Negative and Zero sequence reactance for a 3-phase alternator

Additional Experiments

11. Plot V-I characteristics of Solar panel at various levels of insolation.
12. Study the performance of a Wind turbine system at different wind speeds and plot the characteristics.
13. Determination of Earth resistance in humid and dry earth conditions.

B.Tech. (VI Sem.)

20HSS1- Soft Skills (SOC)

L	T	P	Cr.
1	-	2	2

Course Educational Objectives:

The Soft Skills Laboratory course equips students with required behavioral, interpersonal & Intrapersonal skills, communication skills, leadership skills etc. It aims at training undergraduate students on soft skills leading to enhanced self-confidence, esteem, and acceptability in professional circles.

Course Outcomes (COs): At the end of the course, student will be able

CO1: To Develop self-awareness and personality traits for professional growth
(Understand – L2)

CO2: Work effectively in multi-disciplinary and heterogeneous teams through knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality.
(Apply – L3)

CO3: Communicate through verbal/oral communication with good listening skills and empathy
(Apply – L3)

CO4: Apply skills required to qualify in recruitment tests, Interviews & other professional assignments (Apply – L3)

Personality Development Skills

Role of language in Personality – How language reflects, impacts Personality – Using gender-neutral language in MNCs – being culturally-sensitive-Personality Traits - Grooming & Dress code

Activities: Group Discussion/Role play/Presentations (authentic materials: News papers, pamphlets and news clippings)

Impactful Communication

Activities : Extempore / Story Telling/ Group Discussion (Case studies/Current affairs etc.)/ Elocution on Interpretation of given quotes/ Critical Appreciation and Textual Analysis/ Writing reviews on short story/videos/book/Social Media profiling/ Pronunciation Practice

Professional Skills:

Career Planning- job vs. career- goal setting- SWOT analysis-Time management – self-management – stress-management.

Activities: SWOT analysis of the self/Goal setting-Presentation/Writing Report/Listening exercises/Effective Resume-Writing and presentation/ Interview Skills: Mock interviews/Video samples.

REFERENCES :

1. Edward Holffman, “Ace the Corporate Personality”, McGraw Hill,2001
2. Adrian Furnham, Personality and Intelligence at Work, Psyc 2. hology Press, 2008.
3. M.Ashraf Rizvi, “Effective Technical Communication”, 1 st edition, Tata McGraw Hill, 2005
4. Ace of Soft skills Gopalaswamy Ramesh, Pearson Education India, 2018
5. Soft Skills for the Workplace, Goodheart-Willcox Publisher · 2020.
6. How to Win Friends and Influence People, Dale Carnegie · 2020

L	T	P	Cr.
3	0	0	3

Pre-requisites: Power system-III

Course Educational Objective: This course enables the student to acquire knowledge on Working of different electromagnetic and static relays, protective schemes for generator and transformers, feeders and bus bars. It also introduces distance protection by Microprocessor and numerical relays.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the working and operation of different types of electromagnetic and static relays. **(Understand-L2)**

CO2: Analyze protective schemes for high power generator and transformers. **(Apply-L3)**

CO3: Assess protective schemes for feeders and transmission lines. **(Apply-L3)**

CO4: Analyse protective schemes for over voltages and grounding systems. **(Understand-L2)**

CO5: Understand the mechanism of microprocessor in numerical protection relays. **(Understand-L2)**

UNIT-I: PROTECTIVE RELAYING

Classification of relays – induction type – principle – inverse time characteristics – directional over-current and power relays – distance relays – definite distance and distance time relays – static relays – basic static relay – block diagram of static over-current, static directional, static distance and static differential relays.

UNIT-II: GENERATOR & TRANSFORMER PROTECTION

External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation.

Transformer protection: Differential protection – over-current and earth fault protection – Buchholz's relay and its operation.

UNIT-III: FEEDER & TRANSMISSION LINE PROTECTION

Protection of radial feeders – protection of parallel feeders – protection of ring mains – differential pilot protection for feeders – Merz Price voltage balance system.

Transmission Line Protection: Definite distance and time distance protection – phase and earth fault protection – carrier current protection

UNIT-IV: PROTECTION AGAINST OVER VOLTAGES AND GROUNDING

Causes of over voltages-Protection against lightning over voltages- Valve type and zinc oxide lightning arresters- Insulation coordination- BIL- impulse ratio- Standard impulse test wave-volt-time characteristics.

Grounding: Grounded and ungrounded neutral systems-Effects of ungrounded neutral on system performance- Methods of neutral grounding - Solid-resistance-Reactance-Arcing grounds and grounding Practices.

UNIT-V: MICROPROCESSOR BASED RELAYS AND NUMERICAL PROTECTION

Introduction – over current relays –impedance relay – directional relay – reactance relay.

Numerical Protection: Introduction - numerical relay - numerical relaying algorithms – Mann Morrison technique - Differential equation technique and discrete Fourier transform technique - numerical over current protection - numerical distance protection.

TEXT BOOKS:

1. Badri Ram and D.N Viswakarma, “Power System Protection and Switchgear”, TMH Publications, 2nd Edition, 2011.
2. T.S.Madhava Rao, “Power system protection- Static Relays with microprocessor applications”, Tata McGraw Hill, 2017.

REFERENCE :

1. C L Wadhwa, “Electrical Power Systems”, New Age International Publisher, 8th edition(Multi Colour), 2022.
2. Paithankar and S.R.Bhide, “Fundamentals of Power System Protection”, PHI, 2010.
3. C R Mason, “Art & Science of Protective Relaying”, Wiley Eastern Ltd.

4. Bhavesh Bhalja, R.P. Maheshwari, NileshG.Chothani, “Protection and Switch Gear”, Oxford University Press, 2011.

B.Tech. (VII Sem.) 20EE25-RENEWABLE AND DISTRIBUTED GENERATION TECHNOLOGIES

L	T	P	Cr.
3	0	0	3

Pre-requisites: Fundamentals of Electrical Engineering, Power System-I

Course Educational Objective: This course enables the students to acquire knowledge on solar radiation data, Maximum power point techniques in solar PV and Wind energy conversion systems. It also introduces the concepts of impact of distributed generation on transmission and distribution system.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand fundamentals of solar energy systems. (**Understand-L2**)

CO2: Understand wind energy conversion systems. (**Understand-L2**)

CO3: Analyze the need of distributed generation in grid integration (**Understand-L2**)

UNIT – I: FUNDAMENTALS OF ENERGY SYSTEMS, SOLAR ENERGY AND SOLAR THERMAL SYSTEMS

Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy – Solar radiation: Outside earth’s atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces. Liquid flat plate collectors: Performance analysis –Transmissivity – Absorptivity product collector efficiency factor – Collector heat removal factor. Introduction to solar air heaters – Concentrating collectors, solar pond, solar thermal plants

UNIT - II: SOLAR PHOTOVOLTAIC SYSTEMS

Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System Design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Incremental conduction Technique.

UNIT - III: WIND ENERGY

Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator (synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

UNIT - IV: NEED FOR DISTRIBUTED GENERATION

Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT – V: GRID INTEGRATION OF DGS AND TECHNICAL IMPACTS OF DGS

Different types of interfaces – Inverter based DGs and rotating machine-based interfaces – Aggregation of multiple DG units – Energy storage elements – Batteries, ultra capacitors, flywheels. DG Impact on - Transmission and Distribution systems, De-regulation – Impact of DGs upon protective relaying –Impact of DGs upon transient and dynamic stability of existing distribution systems.

TEXT BOOKS:

1. John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis -3rd Edition, 2015.
2. H. Lee Willis, Walter G. Scott , “Distributed Power Generation – Planning and Evaluation”, Marcel Decker Press, 2000

REFERENCE:

1. John Andrews and Nick Jelly, “Energy Science: Principles, Technologies and Impacts”, Oxford University Press,4th Edition,2022.
2. S. P. Sukhatme and J. K. Nayak, “Solar Energy: Principles of Thermal Collection and Storage”,4th Edition, TMH, New Delhi,2017
3. Godfrey Boyle, “Renewable Energy”, oxford university press, 3rd edition, 2012.

4. Ahmed and Zobia, Ramesh C Bansal, “Handbook of renewable technology”, World scientific, Singapore,2021
5. Ramesh & Kumar, “Renewable Energy Technologies”, Narosa Publications.
6. Chetong Singh Solanki , “Renewable energy technologies – A practical guide for beginners” , PHI,2008
7. B.H.khan, “Non conventional energy source”, 3rd edition, TMH,2017

L	T	P	Cr.
3	0	0	3

Pre-requisite: Power System-II

Course Educational Objective: This course enables the students to acquire knowledge on electric field distribution and computation in different configuration of electrode systems, HV breakdown phenomena in gases, liquids and solids dielectrics. It also introduces generating and measuring principle of operation and design of HVDC, AC and Impulse voltages and currents.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the performance of high voltages for different configurations of electrode systems. **(Understand-L2)**

CO2: Relate the theory of breakdown and withstand phenomena of all types of dielectric materials. **(Understand-L2)**

CO3: Analyze measurement of high voltage and high current AC, DC and Impulse. **(Understand-L2)**

CO4: Understand dielectric property of material used for HV equipment. **(Understand-L2)**

CO5: Summarize the various equipment testing techniques used in HV engineering. **(Apply-L3)**

UNIT-I: INTRODUCTION TO HIGH VOLTAGE TECHNOLOGY

Electric Field Stresses – Uniform and non-uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation.

UNIT-II: BREAK DOWN PHENOMENON IN GASEOUS, LIQUID AND SOLID INSULATION

Gases as insulating media – Collision process – Ionization process – Townsend’s criteria of breakdown in gases – Paschen’s law – Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of solid dielectrics, composite dielectrics used in practice.

UNIT-III: GENERATION AND MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

Generation of high DC voltages – Generation of high alternating voltages – Generation of impulse voltages and currents – Tripping and control of impulse generators.

Measurement of high voltages and High currents: Measurement of high AC, DC and Impulse voltages – Voltages and measurement of high currents – Direct, alternating and Impulse.

UNIT-IV: NON-DESTRUCTIVE TESTING OF MATERIAL AND ELECTRICAL APPARATUS

Measurement of DC resistivity – Measurement of dielectric constant and loss factor – Partial discharge measurements.

UNIT-V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS

Testing of insulators and bushings – Testing of isolators and circuit breakers – Testing of cables – Testing of transformers – Testing of surge arresters – Radio interference measurements.

TEXT BOOKS:

1. E.Kuffel, W.S.Zaengl, J.Kuffel, “High Voltage Engineering: Fundamentals” ,Elsevier, 2nd Edition,2008

2. Ryan, “High Voltage Engineering and Technology” , IET Publishers,3rd Edition,2012

REFERENCE :

1. M.S.Naidu and V. Kamaraju , “ High Voltage Engineering”, TMH Publications, 6th Edition,2020.

2. C.L.Wadhwa, “High Voltage Engineering”, New Age Internationals (P) Limited, 3rd Edition,2012..

3. RavindraArora, Wolfgang Mosch, “High Voltage Insulation Engineering” ,New Age International (P)Limited,2nd Edition , 2022

L	T	P	Cr.
3	0	0	3

Pre-requisite: Power Electronics

Course Educational Objective: This course enables the students to acquire knowledge on various architectures of hybrid electric vehicles and power management of plug in electric vehicles. It also introduces the concepts of different power converters, different batteries and other storage systems used in electrical vehicles.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the concept of electric and hybrid electric vehicles.(Understand-L2)

CO2: Analyze different configuration of hybrid electric vehicles. (Understand-L2)

CO3: Understand the performance of Plug- in hybrid electric vehicles. (Understand-L2)

CO4: apply the power converters used in hybrid electric vehicles (Apply-L3)

CO5: Analyze different types of batteries and energy storage systems. (Understand-L2)

UNIT– I: INTRODUCTION

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles, advantages and applications of Electric and Hybrid Electric Vehicles, principle of magnetic levitation, different Motors suitable for of Electric and Hybrid Electric Vehicles.

UNIT–II: HYBRIDIZATION OF AUTOMOBILE

Architectures of HEVs, series and parallel HEVs, complex HEVs. Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III: PLUG-IN HYBRID ELECTRIC VEHICLE

PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV: POWER ELECTRONICS IN HEVS

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, standards of charging, charging methods-on board charging, Front end charging

UNIT– V: BATTERY AND STORAGE SYSTEMS

Energy Storage Parameters; Lead–Acid Batteries; Lithium-ion batteries-Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

TEXT BOOKS:

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press,1st Edition 2017.
- 2.. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,3rd Edition 2021.

REFERENCE:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,3rd Edition 2019.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley,2nd Edition 2017.
3. H. Partab Modern Electric Traction – Dhanpat Rai& Co, 2017.
4. Pistoaa G., “Power Sources Models, Sustainability, Infrstructure and the market”, Elsevier 2008
5. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 2nd Edition,2017.
6. Dr. M. Kathiresh, Dr. G. R. Kanagachidambaresan, Dr. Sheldon S. Williamson, “E-Mobility A New Era in Automotive Technology”, Springer Professional,1st Edition,2022

B.Tech. (VII Sem.)

20EE28-SMART GRID

L	T	P	Cr.
3	0	0	3

Prerequisite: Power Systems-I, II & III

Course Educational Objective: This course enables the student to illustrate the functions of smart grid and analyze the Issues for implementing the smart grid Concepts. It also introduces the concepts of communication technologies to smart grid.

Course Outcomes: At the end of the course, the student will be able to

CO1: Illustrate the Smart Grid technologies. (Understand-L2)

CO2: Analyze different smart meters and advanced metering infrastructure.(Understand-L2)

CO3: Analyze LAN, WAN and Cloud Computing technologies for Smart Grid applications. (Understand-L2)

CO4: Understand the performance of micro grid. (Understand-L2)

UNIT - I: INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT – II: SMART GRID TECHNOLOGIES

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control. DMS, SCADA, RTU, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers.

UNIT – III: SMART METERS AND ADVANCED METERING INFRASTRUCTURE

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT - IV: HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

UNIT - V: INTRODUCTION TO MICRO GRIDS:

Concept of micro grid, need & applications of micro grid, formation of micro grid, issues of interconnection, protection & control of micro grid. Islanding, need and benefits, different methods of islanding detection.

TEXT BOOKS:

1. Janaka Ekanayake, Nick Jenkins, “SmartGrid: Technology and Applications”, A John Wiley & Sons, Ltd., Publication, 2012.
2. S. Chowdhury, S.P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks.” Institution of Engineering and Technology, 2009.

REFERENCE:

1. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability ”, Artech House Publishers, 2nd Edition, July 2015
2. Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press July 2012.
3. James.A.Momoh, “Electric Power Distribution, Automation, Protection And Control”, CRC Press, 2007.

L	T	P	Cr.
3	0	0	3

B.Tech. (VII Sem.)

20EE29-HVDC&FACTS

Prerequisite: Power Electronics**Course Educational Objective:** This course enables the student to illustrate the functions of HVDC converter configurations, power flow controlling through DC link, Harmonics, real and reactive power control in transmission systems with FACTS Devices.**Course Outcomes:** At the end of the course, the student will be able to**CO1:** Understand functioning of HVDC transmission system. (**Understand-L2**)**CO2:** Analyze power converter control of HVDC transmission system. (**Apply-L3**)**CO3:** Understand principle and operation of various FACTS devices (**Understand-L2**)**CO4:** Analyze reactive power control using FACTS devices. (**Understand-L2**)**UNIT-I: HVDC TRANSMISSION**

Need for power system interconnections – Evolution of AC and DC transmission systems – Comparison of HVDC and HVAC Transmission systems – Types of DC links – relative merits – Components of a HVDC system – Modern trends in DC Transmission systems – Pulse number – choice of converter configurations – Analysis of Graetz circuit with and without overlap – voltage waveforms – Analysis of two and three valve conduction mode – Converter Bridge characteristics – Inverter mode of operation – voltage waveforms.

UNIT-II: HVDC CONVERTER CONTROL

Principles of DC link control – Converter Control characteristics – system control – Constant current Control – CEA Control – firing angle control of valves - 6 pulse and 12 pulse converters – Starting and stopping of a dc link – Power control – Harmonics & Filters – Ill effects of Harmonics – sources of harmonic generation – Types of filters – Design examples – Power flow

UNIT-III: INTRODUCTION TO FACTS DEVICES

Analysis in AC/DC systems – Modelling of DC links – solutions of AC-DC Power flow Flexible AC Transmission Systems (FACTS): Power flow in AC systems – Relative importance of controllable parameters – Basic types of FACTS controllers – shunt and series controllers – Current source and Voltage source converters – Objectives of shunt compensation – Methods of controllable VAR generation – Static Var Compensator – its characteristics – TCR – TSC – FC – TCR configurations –

UNIT-IV: REACTIVE POWER CONTROL

STATCOM – basic operating principle – control approaches and characteristics – Objectives of series compensator – variable impedance type of series compensators – TCSC – TSSC – operating principles and control schemes – SSSC – Power Angle characteristics – Control range and VAR rating – Capability to provide reactive power compensation – external control.

UNIT-V: UPFC

Introduction to Unified Power Flow Controller – Basic operating principles – Conventional control capabilities – Independent control of real and reactive power

TEXT BOOKS:

1. K.R.Padiyar, “HVDC Power Transmission Systems – Technology and System Interactions”, New Age International Publishers, 2007.
2. Narain G. Hingorani, Laszlo Gyugyi, “Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems” Wiley India publications, 2011.

REFERENCE:

1. B.R.Gupta, "Power System Analysis", S.Chand Publications, Revised Edition, 2017.
2. James.A.Momoh, "Electric Power Distribution, Automation, Protection And Control", CRC Press, 2007.

L	T	P	Cr.
3	0	0	3

Pre-requisites: Electronic Devices and Circuits, Digital Circuits

Course Educational Objective: This course provides the knowledge on IC Fabrication Technologies and gives a complete idea about combinational and sequential sub system CMOS circuit designs used in VLSI Design. This course also gives the complete information regarding design tools and CMOS testing techniques.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand semiconductor technology and MOS fabrication process (**Understand – L2**)

CO2: Apply layout design rules for NMOS, CMOS logic circuit designs. (**Apply - L3**)

CO3: Analyze the IC building blocks. (**Analyze – L4**)

CO4: Apply CMOS testing techniques to test different digital designs. (**Apply - L3**)

UNIT-I

IC fabrication Technology: Silicon semiconductor technology–wafer processing, oxidation, epitaxy, lithography, ion implantation, and diffusion, the silicon gate process; NMOS and CMOS fabrication, BiCMOS technology, Comparison between CMOS and bipolar technologies.

Basic Electrical Properties of MOS and BiCMOS Circuits: $I_{ds} - V_{ds}$ relationships, MOS transistor threshold Voltage, g_m , g_{ds} ; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, BiCMOS Inverters.

UNIT-II

VLSI Circuit Design Processes: VLSI design flow, MOS Layers, Stick Diagrams, Design Rules and Layout, $5\mu\text{m}$ CMOS Design rules for wires, Contacts, Transistor; Layout Diagrams for NMOS, CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Basic Circuit Concepts: Sheet Resistance, Area Capacitance calculations, Inverter Delays.

UNIT-III

Digital IC Building Blocks: Logic gates: combinational logic functions, static complementary gates, switch logic, standard cell based layout, logic and interconnect design, power optimization; Realization of Latches and Flip-Flops using switch logic; Sub system design flow, 4×4 array multiplier, Design of 4bit ALU using adder, synchronous up/down counters, and registers.

UNIT-IV

Analog IC Building Blocks: MOS Diode/Active resistor, Simple current sinks, Basic and Advanced current mirrors, Current and Voltage references, band-gap references; Op-Amp, One Stage OP-Amp. Two Stage OP-Amp, Gain boosting, Common Mode Feedback and Noise in Op Amps.

UNIT-V

Test and Testability: System Partitioning, Layout and Testability, Reset/Initialization, Design for Testability, Testing Combinational Logic, Testing Sequential Logic, Practical Design for Test Guidelines, Scan Design Techniques, Built-In-Self-Test, Future Trends.

TEXT BOOKS

1. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI Publishers, 2005.
2. “Design of Analog CMOS Integrated Circuits”, Behzad Razavi, TMH, 2007.

REFERENCE :

1. Neil. H. E. Weste and Kamaran Eshraghian, Principles of CMOS VLSI Design (2/e), Pearson Education Publishers, 3rdEdition.
2. Wayne Wolf, Modern VLSI Design (3/e), Pearson Education Publishers.

L	T	P	Cr.
3	0	0	3

Pre-requisites: Microprocessors and Microcontrollers.

Course Educational Objective : This course provides the knowledge on typical embedded system design methodologies, characteristics and design metrics, computational models for describing embedded system behavior, standard single purpose processors, various communication protocols and design technology for implementing embedded system.

Course Outcomes: At the end of the course, students will be able to

- CO1:** Understand different design methodologies for embedded system design (**Understand – L2**)
- CO2:** Design Control unit and data path using computational models (**Apply – L3**)
- CO3:** Summarize the features of single purpose processors and interfacing concepts (**Understand – L2**)
- CO4:** Analyze various communication protocols (**Analyze – L4**)
- CO5:** Develop embedded system using IC and Design Technology (**Apply – L3**)

UNIT - I:

Embedded System Introduction: Embedded systems overview, design challenge, processor technology, IC technology, Design Technology, Trade-offs. Single purpose processors RT-level combinational logic, sequential logic (RT level), custom single purpose processor design (RT – level), optimizing custom single purpose processors.

UNIT - II:

State Machine and Concurrent Process Models: Introduction, models Vs languages, finite state machines with data path model(FSMD), using state machines, program state machine model (PSM), concurrent process model, concurrent processes, communication among processes, synchronization among processes, Implementation, data flow model, real-time systems.

UNIT - III:

Standard Single-Purpose Processors: Introduction, Timers, Counters, and watchdog timers, UART, LCD Controllers, Stepper Motor Controllers, Analog-to-Digital Converters, Real-Time Clocks, **Memory:** Common memory types, Memory hierarchy and cache, Advanced RAM

UNIT - IV:

Interfacing: Introduction, Communication basics, Microprocessor Interfacing: I/O Addressing, Interrupts, Direct memory access, Arbitration, Multilevel bus architectures, advanced communication principles, Serial Protocols, Parallel Protocols, Wireless Protocols

UNIT - V:

IC and Design Technology: IC Technology: Full-Custom (VLSI) IC Technology, Semicustom (ASIC) IC Technology, Programmable logic device (PLD) IC technology, Design technology: automation: synthesis, verification: Hardware/Software Co-Simulation, Reuse: Intellectual Property cores, Design Process Models

TEXT BOOKS:

1. Frank Vahid/Tony Givargis, “Embedded System Design A unified Hardware/Software Introduction” John Wiley & Sons, Inc.
2. Raj Kamal, “Embedded Systems Architecture, Programming and Design” Tata McGraw Hill, 3rd Edition.

REFERENCES

1. James K Peckol, “Embedded Systems- A Contemporary Design Tool” John Wiley, 2008
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, Newnes, Elsevier, 2008

L	T	P	Cr.
3	0	0	3

Prerequisites: Differential Equations and linear algebra Transformation techniques

Course Educational Objective: This course enables the student to understand Discrete Fourier Transform and its computation. It also deals with discrete Fourier series, Fast Fourier Series, Z-Transforms and the concepts of filter design.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Classify different types of signals and systems (**Understand-L2**)

CO2: Analyze DFT and FFT(**Apply-L3**)

CO3: Analyze digital filters using different techniques. (**Apply-L3**)

UNIT -I: CLASSIFICATION OF SIGNALS AND SYSTEMS

Types of signals-Continuous time signals (CT signals), Discrete time signals (DT signals)
Classification of CT and DT signals - Deterministic & Random signals, Energy & Power signals.
Types of systems - CT systems and DT systems, Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable, Linear constant coefficient difference equations, Sampling Theorem, Convolution theorem, Z-transforms

UNIT – II: DISCRETE FOURIER SERIES & FAST FOURIER TRANSFORM

Properties of discrete Fourier series, DFS representation of periodic sequences-,Discrete Fourier transforms: Properties of DFT, linear convolution of sequences using DFT- Computation of DFT. Relation between Z-transform and DFS-Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency- FFT Algorithms- Inverse FFT.

UNIT – III: REALIZATION OF DIGITAL FILTERS

Applications of Z – transforms- solution of difference equations of digital filters-Block diagram representation of linear constant-coefficient difference equations- Basic structures of IIR systems- Transposed forms- Basic structures of FIR systems

UNIT – IV: IIR DIGITAL FILTERS

Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples: Analog-Digital transformations.

UNIT – V: FIR DIGITAL FILTERS

Characteristics of FIR Digital Filters-Frequency response- Design of FIR Digital Filters using Window Techniques- Frequency Sampling technique- Comparison of IIR & FIR filters.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”, Pearson Prentice Hall, illustrated 4th edition, 2014.
2. A.V.Oppenheim and R.W. Schaffer, “Discrete Time Signal Processing”, Pearson education, 3rd edition, 2014.

REFERENCE:

1. Andreas Antoniou “Digital Signal Processing”, TATA McGraw Hill edition, 2nd Edition,2018
2. MH Hayes, Schaum’s , “Digital Signal Processing: Outlines”, TATA Mc-Graw Hill professional, 2nd Edition,2011
3. C. Britton, Rorabaugh, “DSP Primer”, Tata McGraw Hill edition, 2005

B.Tech. (VII Sem.)

20HS02– Management Science for Engineers

L	T	P	Cr.
3	0	0	3

Course Description:

In this course, students will learn fundamental concepts and contributions of management. This course also teaches human resources practices which play a vital role in the organisation it gives knowledge about use of improve quality of work and project management.

Course Objectives:

1. To make students understand management, its principles, contribution to management, organization, and its basic issues and types
2. To make students understand the concept of plant location and its factors and plant layout and types, method of production and work study importance
3. To understand the purpose and function of statistical quality control. And understand the material management techniques
4. To make students understand the concept of HRM and its functions
5. To make students understand PERT & CPM methods in effective project management and need of project crashing and its consequence on cost of project

Course Outcomes:

CO1: Understand management principles to practical situations based on the organization structures. (L2)

CO2: Design Effective plant Layouts by using work study methods. (L2)

CO3: Apply quality control techniques for improvement of quality and materials management. (L3)

CO4: Develop best practices of HRM in corporate Business to raise employee productivity. (L2)

CO5: Identify critical path and project completion time by using CPM and PERT techniques. (L3)

UNIT I

Introduction: Management - Definition, Nature, Importance of management Functions of Management - Taylor's scientific management theory, Fayal's principles of management, Contribution of Elton mayo, Maslow, Herzberg, Douglas MC Gregor, Basic Concepts Of Organisation- Authority, Responsibility Delegation of Authority, Span of control, Departmentation and Decentralization - Organisation structures (Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization)

UNIT II

Operations Management: Plant location, Factors influencing location, Principles and types of plant layouts - Methods of production (job, batch and mass production), Work study - Basic procedure involved in method study and Work measurement

UNIT III

Statistical quality control – Concept of Quality & Quality Control – functions, Meaning of SQC - Variables and attributes - X chart, R Chart, C Chart, P Chart, (simple Problems) Acceptance sampling, Sampling plans, Deming's contribution to quality.

Materials management – Meaning and objectives, inventory control – Need for inventory control, Purchase procedure, Store records, EOQ, ABC analysis, Stock levels

UNIT IV

Human Resource management (HRM): Concepts of HRM, Basic functions of HR manager: Man power planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers Separation, performance appraisal, Job evaluation and merit rating.

UNIT V

Project management: Early techniques in project management - Network analysis: Programme evaluation and review technique (PERT), Critical path method (CPM), Identifying critical path, Probability of completing project within given time, Project cost analysis, project crashing (simple problems)

Text Books:

Dr. A.R.Aryasri, Management Science, TMH, 10th edition, 2012

References:

1. Koontz & wehrich – Essentials of management, TMH, 10th edition, 2015
2. Stoner, Freeman, Gilbert, Management, 6th edition Pearson education, New Delhi, 2004
3. O.P. Khana, Industrial engineering and Management L.S.Srinath, PERT & CPM

B.Tech. (VII Sem.)

20EES4-INTERNET OF THINGS

L	T	P	Cr.
1	0	2	2

Course Educational Objective (CEO):

The objective of this course is to explore the interconnection and integration of the physical world and the cyber space. Understand the design concepts in setting up IOT Devices. Study about the setup, configuration and installation of equipment for IOT.

Course Outcomes (COs): At the end of the course, the student will be able to:

CO1: Control different electrical and electronics applications using Arduino (**Apply-L3**)

CO2: Control different electrical and electronics applications using Raspberry Pi (**Apply-L3**)

List of Experiments:

1. Interfacing LED, Push button using Arduino.
2. Interfacing DHT11- Temperature and humidity sensor using Arduino.
3. Interfacing Ultrasonic sensor using Arduino.
4. Interfacing PIR sensor using Arduino.
5. Design of Traffic Light Simulator using Arduino.
6. Interfacing RFID using Arduino/ Raspberry Pi
7. Interfacing of LED, Push button with Raspberry Pi (Python Program).
8. Design of Motion Sensor Alarm using PIR Sensor.
9. Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi.
10. Implementation of DC Motor and Stepper Motor Control with Raspberry Pi.

Project based experiments:

11. Raspberry Pi based Smart Phone Controlled Home Automation.
12. Smart Traffic light Controller.
13. Smart Health Monitoring System.