Scheme and Syllabi of Courses

B.Tech. Second Year-2019 batch

National Institute of Technology Srinagar

DEPARTMENT OF ELECTRICAL ENGINEERING

3rd Semester

S. No.	Course Code	Course Title	Credits	Contact Hours			
				L	T	P	Total
1	EET201	Electrical Measurement & Instrumentation.	4	3	1	0	4
2	ECT201	Electronics-I	4	3	1	0	4
3	ECT202	Network Analysis	4	3	1	0	4
4	PHT201	EMF & Waves	4	3	1	0	4
5	MMT209	Electrical Engg. Materials	4	3	1	0	4
6	MAT204	Mathematics-III	4	3	1	0	4
7	ECL204	Electronics – I Lab	1	0	0	2	2
Total			**25**	**18**	**6**	**2**	**26**

4th Semester

S. No	Course Code	Course Title	Credits	Contact Hours			
				L	T	P	Total
1.	EET250	Electrical Machines-I	4	3	1	0	4
2.	EET251	Control Systems-I	4	3	1	0	4
3.	MET257	Thermal Engineering	4	3	1	0	4
4.	ECT250	Electronics-II	4	3	1	0	4
5.	CVT259	Hydraulics & Hydraulic Machines	3	2	1	0	3
6.	MAT253	Mathematics-IV	3	2	1	0	3
7.	EEL252	Electrical Machines – I Lab.	1	0	0	2	2
8.	EEL253	Electrical Measurement & Instrumentation-Lab	1	0	0	2	1
9.	ECL253	Electronics-II Lab	1	0	0	2	3
		Total	**25**	**16**	**6**	**6**	**28**

ELECTRICAL ENGINEERING DEPARTMENT

<table>
<tr><td rowspan="2">Subject: Electrical Measurement and Instrumentation (Code: EET201)</td><td colspan="2" rowspan="2">Year & Semester: B. Tech. Electrical Engineering 2nd Year & 3rd Semester</td><td colspan="3">Total Course Credit: 4</td></tr>
<tr><td>L</td><td>T</td><td>P</td></tr>
<tr><td rowspan="2">Evaluation Policy</td><td rowspan="2">Mid-Term
30 Marks</td><td rowspan="2">Class Assessment
10 Marks</td><td>3</td><td>1</td><td>0</td></tr>
<tr><td colspan="3">End-Term
60 Marks</td></tr>
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Course Outcomes (COs):

Upon successful completion of the course, student should be able to:

CO1: To study the construction and principle of operation of various electromechanical indicating instruments and their mathematical analysis.

CO2: Evaluation of power, energy, and power factor of single and three phase circuits.

CO3: Determination of small, medium and large resistances using different methods.

CO4: Evaluation of Inductance, Capacitance, and Frequency using AC bridges.

Module 1: Definitions of basic terms used in measurements, errors and their classification.

Module 2: Electro-mechanical indicating instruments basic principles and their classification, various methods of damping, galvanometers (D'Arsonal and Ballistic) Ammeters and Voltmeters (PMMC, Induction, Electrostatic and Dynamometer type), errors in voltmeters and ammeters, extension of instrument ranges.

Module 3: Measurement of power in three phase a.c circuits using single-phase and three-phase watt-meter, Energy measurement using induction type meter, Energy meter testing, Power factor meter.

Module 4: Resistance classification, Measurement of Low resistance using potentiometer method and Kelvin double bridge, Measurement of medium resistance using ammeter-voltmeter method, substitution method, Wheatstone bridge, Measurement of high resistance using loss of charge method, Meggar.

Module 5: Measurement of Inductance, Capacitance and Frequency using a.c bridges. Potentiometers: DC and AC. Introduction to Virtual Instrumentation.

Recommended Book:

S. No	Name of Book	Author	Publisher
1	Electrical Measurements and Measuring Instruments	Golding, Widdis	Pitman
2	Electrical and Electronic Measurements	A.K Sawhney	DhanpatRai

Subject: Electronics I (Code: ECT201)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Course Objective: Familiarize with the basic semiconductor devices and to know about the working and performance of semiconductor devices like diodes, BJTs and FETs. To understand DC analysis and AC models of semiconductor devices

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Familiarization with basic semiconductors

CO2: Understanding the behavior of different types of diodes at circuit level

CO3: Analyze and study the behavior of different types of transistors

CO4: Analysis of low frequency and high frequency amplifiers

S. No.	Particulars
1	**IntroductiontoSemiconductors:**Intrinsicandextrinsicsemiconductorstransportmechanismofcharge carriers, electric properties, Hall effect etc
2	**P-N junction diode: Current components in p-n junction,** Characteristics-piece wise linear approximation, Temperature dependence, Diode capacitance, and switching times, diode circuits' half wave, full wave rectifiers, clipping clamping circuits etc. Circuit operations and applications of Zener, avalanche, Schottky, Photo and tunnel diodes.
3	**BJT: Operation and characteristics,** Ebers-Mollmodel, CE,CB and CC configuration input, outputcharacteristicsandgraphicalanalysisofbasicamplifiercircuits,BiasingandBiasstability,Low frequency,h-parametermodel,AnalysisandDesignoftransistoramplifiercircuitsusingh-parameters. High frequency hybrid–pimodel, analysis and design of transistor amplifier circuits at high frequencies. Multistage amplifiers, phototransistors, Transistor as a switch
4	**JFET's Operation and characteristics,** model Application at low and high frequency, amplifiers, Switching circuits MOSFET types, Operation and characteristics
5	**Introduction to IGBT.**

Recommended Books:

S. No	Name of Book	Author
1.	Fundamentals of Microelectronics	Behzad Razavi
2.	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis, Meyar
3.	Electronic Devices and Circuits	Millman,Halkias,andSatyabrataJit
4.	Analog Electronics	Maheshwari and Anand
5.	Electronic Devices & Circuits	Allan Mottershed
6.	Microelectronics	Sedra& Smith

Subject: Network Analysis (Code: ECT202)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Course Objective:

To introduce students with the basic concepts of Electric Circuit Theory and familiarize them how to analyze the circuits to get transits as well as steady state response of systems and their design, with emphasis on analysis in frequency domain using varioustechniques.

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Comprehensive understanding of difference and network theorems

CO2: Analysis of transient and steady state response of circuits

CO3: Analysis of frequency response of circuits

CO4: Analysis of 2-port network and filters

S. No.	Particulars
1	**Development of the circuit Concept:** Charge and energy, capacitance, inductance and resistance parameters in the light of field and circuit concepts, approximate realization of a physical system as a circuit.
2	**Conventions for describing networks:** Reference directions for currents and voltages, conventions for magnetically coupled circuits, Circuit topology, KVL and KCL equations, Source transformation, Dual networks.
3	**First order differential equation:** Differential equations as applied in solving networks, Application of initial conditions, evaluating initial conditions in networks.
4	**Laplace Transformations:** Solution of Network problems with Laplace transformation, Heavisides expansion theorem.
5	**Wave form analysis and synthesis:** The unit step, ramp and impulse functions and their Laplace transforms, Initial and final value theorems, convolution integral, convolution as summation.
6	**Network theorems and impedance functions:** Complex frequency, transform impedance and transform circuits, series and parallel combinations of elements, Fosters reactance theorem and reciprocity theorem.
7	**Network Functions- Poles and Zeros**: Ports or terminal pairs, Network functions for one port and two port networks (ladder and general networks), Poles and Zeros of network functions, Restriction on pole and zero locations for driving point and transfer functions. Time domain behavior from pole zero plot.

8	**Two port parameters:** Relationship of two port parameters, Admittance, impedance, transmission and hybrid parameters, Relationship between parameter sets, Parallel connection of two port Networks, Characteristics impedance of two port networks.
9	**Filters** : Filter fundamentals – pass and stop band, filter classification, constant K & m derived filters, Behavior of characteristic impedance over pass & stop bands, design of filters.

Recommended Books:

S. No.	Name of Book	Author
1	Network Analysis	M. E. Van Valkenberg
2	Network Analysis and Synthesis	F. F. Kuo
3	Network Analysis and Synthesis	K. M. Soni
4	Network and Systems	Roy Choudhury

Subject: EMF & Waves (Code: PHT201)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Course Objective: To acquaint the students with the behavior of Electromagnetic wave and field and to learn the application of Electromagnetic wave in different modes

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Students will remember the concepts of vector calculus and will be able to apply in Electrodynamics

CO2: Students will understand special techniques and will be able to evaluate potential problems

CO3: Students will understand the concepts of the Magnetostatic Fields

CO4: Students will understand the concept of the Electromagnetic wave and will be able its propagation in conductors and Rectangular wave guide in different modes

CO5: Students will understand the production of Electromagnetic waves i.e. how they radiate?

Unit	Course Content
I	**Introduction to the Electrostatics** Dirac–Delta function, Helmholtz Theorem, Divergence and Curl of Electrostatic field, Poisson Equation and Laplace Equation, Electrostatic Boundary Conditions, Basic Properties of the Conductors, Induced Charges, Surface Charge and Force on a Conductor, Numerical Problems.
II	**Special Techniques for Calculating the Potentials** Laplace's equation in one, two and three Dimensions, Boundary Conditions and Uniqueness Theorem, Conductors and Second Uniqueness Theorem, The Method of Images: The Classic Image Problem, Induced Surface Charges, Force and Energy, Separation of Variables: Cartesian and Spherical Coordinates, Multipole Expansion : Approximate Potential at Large Distances, The Monopole and Dipole Terms, Numerical Problems.
III	**Magnetostatics Fields** The Biot-Savert Law, Divergence and Curl of Magnetic field (**B**), Magnetic Vector Potential and Magnetostatics Boundary Conditions, Multipole Expansion of the

	vector Potential, Torque and Force on Magnetic Dipoles, Effect of a Magnetic Field on Atomic Orbitals, Ampere's law in Magnetic Materials, Numerical Problems.
IV	**Electro Magnetic Wave** Electromagnetic Wave in one Dimension, Sinusoidal Waves, Polarization, Boundary Condition, Reflection and Transmission, Energy and Momentum of Electromagnetic Wave, Propagation Through Linear Media, Reflection and Refraction at Oblique Incidence, Electromagnetic Wave in Conductors, Rectangular Wave Guide, TE and TM Modes Numerical Problems.
V	**Radiation** Dipole Radiation, Electric Dipole radiation, Magnetic Dipole radiation, Radiation from an Arbitrary Source, Power Radiated by a Point Charges, Numerical Problems.

Books Recommended:

1. Introduction to Electrodynamics by David J. Griffith (Prentice-Hall of India Pvt. Limited).
2. Classical Electrodynamics by J.D. Jackson (Wiley-India Private limited).
3. Mathematical Method for Physicists by A. Weber (Harcourt India).
4. Classical Theory & Fields by L.D.Landau , E.M. Lypshitz (Pergman).
5. Principles of Electrodynamics by Melvin Schwartz (McGraw-Hill).

Subject: Electrical Engineering Materials (Code: MMT209)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Course Objective: To acquaint the students with the fundamental knowledge of different kinds of materials used in electrical engineering and their importance in various applications /electrical devices

Course Outcomes (COs): Upon successful completion of the course, student should be able to: Recognise the importance of different kinds of materials in electrical engineering by their applications

CO1: Understand about the crystal structures of different metals and alloys

CO2: Understand the basics of electrical conduction in metal and alloys

CO3: Understand the semiconductor materials and dielectric behaviour of materials

CO4: Discussabout basic principles of magnetic materials and superconductive materials

CO5: Understand about optical properties in metals and non-metals

Unit	Course Content
I	**Crystal Structure** Atomic structure, Electronic configuration, Periodic table, Atomic bonding in solids- Ionic bonding, Covalent bonding, Metallic bonding, Crystalline nature of solids, Lattice Points, Unit Cell, Bravais Lattices, Crystal structure - SC, BCC, FCC and HCP, Atomic packing factor, Theoretical density, Crystallographic direction and planes, Liner and Planar densities, Anisotropy, Transformation in alloys, Polymorphism/Allotropy, Amorphous materials, Single crystal and polycrystalline material.
II	**Electrical Properties** Electrical conduction- Ohm's Law, Electrical resistivity, Electrical conductivity, Current density, Electron energy band, valence band, conduction band, Fermi energy, Electron mobility, Drift velocity, Influence of parameters on electrical resistivity of metals, Matthiessen's rule, Applications of different electrical conduction alloys
III	**Semiconductor Materials and Dielectric behavior** Semiconducting materials – Intrinsic and Extrinsic semiconductor, Concept of hole, n type and p-type extrinsic semiconductor,

	Temperature dependence of carrier concentration, Factors affecting charge mobility, Hall effect, Semiconductor devices – p-n rectifying junction, forward and reverse bias, breakdown phenomenon, Transistor – Junction transistor (n-p-n and p-n-p configuration), The MOSFET. Dielectric Behaviour – Capacitance, Dielectric constant, Electric dipole, polarization, Surface charge density, dielectric displacement, Types of polarization, Dielectric strength, Dielectric materials, Piezoelectricity
IV	**Magnetic Properties** Basic concept- Origin of magnetic dipole, Bohr magnetrons, Magnetic field vectors, Magnetic fulx density, Magnetic field strength, permeability, Magnetization, magnetic susceptibility, Types of Magnetism-Diamagnetic, Paramagnetic and Ferromagnetism, Curie temperature, Domains and Hysteresis, Hysteresis Curve, Remanence, Coercivity, Magnetic anisotropy Soft Magnetic Materials and their applications, Hard Magnetic Materials and their applications, some important carbon steels and precipitation hardening type magnet and their applications Super conductivity, Classification of superconductors- Meissner effect, Applications of superconducting materials
V	**Optical Properties** Electromagnetic radiations, Photon, Light Interactions with solids, Atomic and Electronic Interactions – Electronic polarization and Electron transitions, Optical properties of Metals – Photon absorption and reemission during excitation of electron (valence and conduction band), Optical properties of Non-metals – Refraction, Reflection, Absorption and Transmission. Application of Optical phenomena – Luminescence, Fluorescence, Phosphorescence, Light emitting diodes, Photoconductivity, Lasers, Optical fibers in communication

Recommended Books:

Text Books	1. William D. Callister, Jr. David G. Rethwisch : Material Science and Engineering – An introduction, 8th Edition John Wiley & Sons, Inc. 2. V. Raghavan: Material Science and Engineering , 8th Edition PHI Learning Private Limited, New Delhi 3. Dekker A. J: Electrical Engineering Materials, Prentice Hall India Learning Private Limited (1970) 4. Indulkar C. S.: An Introduction to Electrical Engineering Materials, Revised Edition S Chand & Co Ltd 5. Banerjee G.K: Electrical and Electronics Engineering Materials, Prentice Hall India Learning Private Limited (17 December 2014).
Reference Books	1. L. Solymar, D. Wash, & R. R. A. Syms: Electrical Properties of Materials, 9th Edition Oxford University Press 2. N Alagappan: Electrical Engineering Materials, 1st Edition McGraw Hill Education

Subject: Mathematics-III (Code: MAT204)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Objectives: To understand various transformation techniques and their use to solve boundary value problems, and various linear differential equations.

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

CO1 Evaluate Laplace and Inverse Laplace transforms of various functions and related problems.

CO2 Evaluate Fourier and Inverse Fourier transforms of various functions and related problems.

CO3 Apply the methods of Laplace and Fourier transforms in solving ODE, PDE and Integral equations.

CO4 Evaluate Z-transforms and Inverse Z- transforms of various functions and apply these concepts to solve difference equations.

Unit	Course Content
I	**Laplace Transforms:** Laplace transform, Condition for the existence of Laplace transform, Laplace transform of some elementary functions, Properties of Laplace transform, Differentiation and Integration of Laplace transform. Laplace transforms of periodic functions and other special functions, Unit Impulse function, Dirac-delta function and its Laplace transform, Heaviside's expansion theorem, Inverse Laplace transform, Initial and Final value theorems, Convolution theorem and properties of Convolution, Evaluation of definite integrals by Laplace transforms, Use of Laplace transforms in the solution of linear differential equation.
II	**Fourier Transforms:** Definition of Fourier transform, Fourier Integral Theorem, Properties of Fourier transform, Fourier sine and cosine, Convolution Theorem, Parseval's Identity for Fourier transform, Solution of Integral equations, Evaluation of definite integrals using Fourier transform, Applications of Fourier transforms to Ordinary and Partial differential equations.
III	**Z-Tranforms:** Definition, Linearity property, Z- transform of elementary functions, Shifting theorems, Initial and Final value theorems, Convolution theorem, Inversion of Z- Transforms, Use of Z- transforms in solving difference equations.

Recommended Books:

Text Books	1. L. Debnath and D. Bhatta,*Integral Transforms and their Applications*, 2nd Edition, CRC press, (2007). 2. M. R. Spiegel, *Schaum's Outlines Laplace Transforms*, Tata Mc-Graw Hill Edition, (2005).
Reference Books	1. R.K Jain and S.R.K Iyengar, *Advanced Engineering Mathematics*, 3rd Edition, Narosa Pub. House, (2008). 2. I.N. Sneddon, *The use of Integral Transforms*, 2nd Edition, Mc-Graw Hill Pub.,(1972).

Subject: Electronics-I Lab (Code: ECL204)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 3rd Semester	Total Course Credit: 1		
		L	T	P
		0	0	2
Evaluation Policy	Mid-Term/Class Assessment (40 Marks)	Final-Term (60 Marks)		

Course Objectives: To acquire knowledge and become familiar with the different characterization techniques to analyze, synthesize basic electronic networks to get desired output.

Course Outcomes (COs):	Upon successful completion of the course, student should be able to:
CO1:	Familiarization and working of different electronic equipment
CO2:	Choose testing and experimental procedures on different types of electronic circuit and analyze their operation under different operating conditions
CO3:	Identify relevant information to supplement the Electronics I course
CO4:	Experimental characterization of diodes , BJT, and FETs

List of Experiments:

S. No.	Particulars
1	Study of CRO-Measurement of Voltage frequency and Phase of a given waveform
2	To obtain diode characteristics. Half wave and a full wave rectifier and to study their performance .Clipping and Clamping circuits
3	Comparison of Zener diode and Avalanche diode characteristics and to use Zener diode as a voltage regulator.
4	To obtain transistor characteristics in the following configurations. c) Common base d) Common emitter
5	To assemble a CE amplifier and observe its performance
6	To obtain frequency response of a RC coupled CE amplifier
7	To obtain JFET characteristics and to observe performance ofa source follower
8	JFET as a voltage variable resistor
9	Transfer and Output Characteristics of MOSFET

ELECTRICAL ENGINEERING DEPARTMENT

Subject: Electrical Machines-I (Code: EET250)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

Course Objective: To study and understand different types of DC generators, motors and transformers, their construction, operating characteristics and applications.

Course Outcomes (COs): Upon successful completion of the course, students should be able to:

CO1: Describe the constructional details of a transformer, Apply the principles of electromagnetics to understand the operation of transformers and develop phasor diagrams.

CO2: Develop the equivalent circuit of a transformer and analyse the operating performance like voltage regulation, losses and efficiency

CO3: Evaluate the performance of autotransformers and three-phase power transformer connections.

CO4: Describe the principle of operation, constructional details, winding layout, magnetic field, emf induced and torque development in dc machines.

CO5: Analyse the operating performance and application suitability of dc generators

CO6: Investigate the starting and running performance of dc motos and determine their suitability for various applications,

Unit - I D.C. Generators:

Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings- E.M.F Equation. Armature reaction – Cross magnetizing and de-magnetizing AT/pole – compensating winding – commutation – reactance voltage – methods of improving commutation. Methods of Excitation – separately excited and self-excited generators – build-up of E.M.F - critical field resistance and critical speed - causes for failure to self-excite and remedial measures. Load characteristics of shunt, series and compound generators.

Unit – II D.C Motors:

Principle of operation – Back E.M.F. - Torque equation – characteristics and application of shunt, series and compound motors – Speed control of D.C. Motors - Armature voltage and field flux control methods. Motor starters (3-point and 4-point starters) - Losses – Constant & Variable losses – calculation of efficiency – condition for maximum efficiency.

Unit - III Testing of DC Machines:

Methods of Testing – direct, indirect, and regenerative testing – Brake test – Swinburne's test – Hopkinson's test – Field's test - separation of stray losses in a d.c. motor test.

Unit - IV Single Phase Transformers:

Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no load and on load - phasor diagrams Equivalent circuit - losses and efficiency – regulation - All day efficiency - effect of variations of frequency & supply voltage on iron losses.

Unit - V Testing of Transformers and Poly-Phase Transformers:

OC and SC tests - Sumpner's test - determination of efficiency and regulation-separation of losses -parallel operation with equal and unequal voltage ratios - auto transformers-equivalent circuit - comparison with two winding transformers. Poly-phase transformers – Poly-phase connections - Y/Y, Y/Δ, Δ/Δ,Δ/ Y and openΔ.

Text Books:

1. Electrical Machines, I.J Nagrath& D.P Kothari, Tata McGraw-Hill.
2. Electrical Machines, P.S. Bimbra, Khanna Publishers.

Reference Books:

1. Electric Machinery, Fitzgerald, Kingslay, Umans, Tata McGraw-Hill
2. Electric Machines Vincent Del Toro, Prentice Hall
3. Electric Machinery and Transformer, Guru, Hiziroglu, Oxford University press
4. Electric Machinery Fundamentals, Chapman, McGraw-Hill.

Subject: Control Systems-I (Code: EET251)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Introduction to continuous control systems open/closed loop, Automatic/manual.

CO2: Mathematical modeling transfer functions block diagrams and signal flow graphs.

CO3: To determine the time response analysis of first and second order systems to various standard test inputs.

CO4: Stability studies of control systems, absolute and relative stability analysis.

CO5: Study of PID controllers, lead-lag Compensators, Introduction to modeling of dynamic systems in state space.

Module I: Introduction to continuous control systems:

Definition of a control system, open-loop, closed loop (automatic and manual) control.

Module II: Mathematical modeling:

Transfer functions, block diagrams, signal flow graphs

Module III: First and second order system:

Example of first and second order systems, responses of these systems to step, ramp, parabolic and sinusoidal inputs, transient, steady state and error analysis

Module IV: Stability studies:

Definition of stability, stability and pole locations, stability and Routh Table, stability and frequency response bode plot, polar plot, root locus.

Module V: Study of PID controllers, lead-lag Compensators

Proportional, Integral, Derivative (P.I.D) control. Compensator design Lead – lag compensators, Modeling of dynamic systems in state space (Introduction).

Text Books:

1.Control Systems Engineering, Norman S. Nise, John wiley.

2.Control Systems (Principles and Design), M. Gopal, Tata McGraw-Hill Publishing.

Reference Books:

1.Control systems, A. Anand Kumar, PHI Learning Private Limited.

2. Feedback control of dynamic systems, Franklin and Powel, Prentice Hall.

3. Design of feedback control systems, Stefani, Oxford university, press.

Subject: Thermal Engineering (Code: MET257)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

- **CO1:** Analyze and apply the laws of thermodynamics.
- **CO2:** Identify the properties of steam, steam table, property diagrams, and apply the vapor power cycle.
- **CO3:** Understand the working of Refrigeration and Air condition system.
- **CO4:** Understand the operations of Steam Turbine and Hydraulic Turbine.
- **CO5:** Understand the operations of I C Engine and Gas Turbine.

Unit- I

Fundamental Concepts & Definitions of Thermodynamics. Temperature as an important property. Work and Heat transfer. Pure substance, simple compressible substances. Laws of Thermodynamics, steady state-steady flow energy equation, Heat engine, Cornot Engine, Principle of increase of entropy.

Unit- II

PROPERTIES OF STEAM

Generation of Steam & Steam Table Pure Substances, Representation of pure substance properties on p-T, h-S and p-V diagrams, Introduction of Boiler.

VAPOUR POWER CYCLES: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Unit -III

REFRIGERATION & AIR CONDITIONING

Applications of Refrigeration, Thermal Principles for Refrigeration, Vapor Compression Refrigeration System, Psychometric properties, Wet bulb temperature, Psychometric chart, mixing process.Applications of Air-conditioning.

Unit -IV

STEAM TURBINE / HYDRAULIC TURBINE: Impulse turbine, Reaction turbine, work output, Losses and efficiency, degree of reaction, Modern steam power cycles, Regenerative and Reheat cycles, Governing of steam Turbines, Fields of Application.

Unit –V

I.C. ENGINES: Otto, Diesel and Dual cycles, Introduction I C Engine parts, Octane Number, various I.C engines fuels, Carburation and Injection , Lubrication, Cooling, Governing of I.C Engines.

GAS TURBINES: Present status and future trends, Basic types and Cycles, Thermal refinements, jet propulsion, fields of Application.

Text Books:

1. Nag, P. K., Basic and Applied Thermodynamics', , McGraw Hill, 2010, 2nd Edition

Reference Books:

1. Cengal, Y., Boles, "Thermodynamics", Mc-Graw Hill, 2001.
2. Van-Wylen, G.J., "Fundamentals of Classical Thermodynamics", John Wiley, 2001.
3. Moran, M.J., Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley, 2005.
4. Rajput, R.K., Thermal Engineering, Laxmi Publication,7th edition book, 2008.

Subject: Electronics-II (Code: ECT250)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

Course Objective: To make students aware about the effects of feedback in electronic amplifiers, to analyze the amplifiers under different feedback configuration, to design different sinusoidal oscillators; To understand operational amplifier basics and its application in electronics, to design various wave shaping circuits, to understand power amplifiers and design power supplies.

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Develop the concept of feedback analysis of different feedback topologies

CO2: Analysis and design of sinusoidal oscillators and multi vibrators

CO3: Understanding the basic concept of power amplifiers and IC regulated power supplies

CO4: Understanding basics of op-amps, its linear and non-linear applications and circuits of basic gates using various logic families

1 Feedback Basics:
Negative feedback, Effect of negative feedback on the performance of amplifiers e.g. on Gain, Bandwidth. Types of feedback amplifiers, current shunt, current series, voltage shunt, and voltage series feedback. Analysis of feedback amplifiers circuits

2 Sinusoidal Oscillators:
Basic operations, Positive feedback, analysis of general oscillator circuit, Barkhausen's criteria, various types of oscillator circuits and their analysis, Design of practical oscillator circuits.

3 Power Amplifiers and Power Supplies
Classification of power amplifiers, Class A, Class B, Class AB and Class C power amplifiers; analysis and design. Power supplies and IC regulators.

4 Operational Amplifiers:
Operational amplifiers stages, Differential amplifier, CMRR, Cascade amplifier, Ideal and practical operational amplifier characteristics and properties OP amp applications, inverting and non-inverting amplifiers, difference amplifier, summer differentiator and integrator, rectifiers etc. OP-AMP in analog computation. Frequency response, Gain Bandwidth product, Signal to noise ratio. Active Filters.

5 Multivibrators and Wave Form Generators
Bi-stable, Monostable and astable multivibrator circuits, and their analysis. Wave form generators, triangular and square wave generators.

6 Logic families:

DTL, TTL, ECL, RTL

Recommended Books:

1	Fundamentals of Microelectronics	Behzad Razavi
2	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis, Meyar
3	Electronic Devices and Circuits	Millman, Halkias, and SatyabrataJit
4	Analog Electronics	Maheshwari and Anand
5	ElectronicDevices&Circuits	Allan Mottershed
6	Microelectronics	Sedra& Smith

Subject: Hydraulics and Hydraulic Machines (Code: CVT259)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 3		
			L	T	P
			2	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

Course Objective

To impart the knowledge of basic principles of hydraulics and fluid flow in closed conduits, open channels and through hydraulic machinery. Also, introduce the students to planning and layout of hydro-electric power plant.

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

- **CO1:** Understand the concept of real fluids, ideal fluids and various physical properties of fluids
- **CO2:** Tounderstand and apply the concepts of Fluid Statics, Kinematics and Dynamics
- **CO3:** Understand the basic hydraulics and carry out computations of flow through pipes and Open channels
- **CO4:** Appreciate the flow characteristics and selection of hydraulic turbines and pumps
- **CO5:** Have a general idea about planning and layout of power house of hydro-electric power plants

S. No	Contents
1.	**Introduction to Fluid Mechanics**: Engineering definition of Fluids, Evolution of the subject of Modern Fluid Mechanics, a brief historical overview, Real and Ideal Fluids.
2.	**Physical Properties of Fluids**: Mass Density, Specific weight, Viscosity, Compressibility, Surface tension, capillarity, etc.
3.	**Fluid Statics**: Pressure intensity, Pascal's law, pressure-density-height relationship, pressure measurement, manometers, pressure on plain and curved surfaces, centre of pressure.
4.	**Kinematics of Fluid Flow**: Types of flow, streamlines, path lines, streak lines, continuity equation or mass conservation principle.
5.	**Dynamics of Fluid Flow**: Equations of Motion- Derivation of Euler's equation along a streamline and it's integration to yield Bernouli's equation, Flow Measurement: Pitot tube, prandtl tube, venturimeter, orificemeter, orifice and mouth piece, notches and weirs.
6	**Flow Through Pipes**: Concepts of turbulent flow through pipes, hydraulic grade line, Darcy-Weisbach formula, Pipes in series and parallels, Design of pipes, power transmission through pipes.
7.	**Flow in Open Channels**: Resistance formulae- Chezy's and Manning's formulae, Prismatic Channels, hydraulic design of channels, Economical channel section.

8.	**Hydraulic Machinery**: Types of turbines, description and principles of Impulse and Reaction turbines, unit quantities and specific speed, runaway speed, turbine characteristics, selection of turbines, governing of turbines; Centrifugal pumps, specific speed, power requirement, reciprocating pumps.
9.	**Power House Planning**: General layout and arrangement of various hydro-mechanical and electrical units in surface and underground hydro-power plants.

Recommended Books:

1. Kumar, D.S. (2009) Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons.
2. Garde, R.J. and Mirajgoaker A.G. Engineering Fluid Mechanics, Scitech Publications(India) Pvt. Ltd.
3. Bansal, R.K. (2018) A text book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

Subject: Mathematics-IV (Code: MAT253)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester		Total Course Credit: 3		
			L	T	P
			2	1	0
Evaluation Policy	Mid-Term (30 Marks)	Class Assessment (10 Marks)	Final-Term (60 Marks)		

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

- **CO1** Solve problems related to Differentiation of complex functions, Analytic functions, harmonic functions and conformal mapping.
- **CO2** Solve problems related to Integration of complex functions.
- **CO3** Expand complex functions in terms of Taylor series, Laurant series and classify singularities of a complex function and calculation of residues.
- **CO4** Apply the concepts of Complex Analysis in Boundary value problems and potential theory.
- **CO5** Solve problems related to Legendre and Bessel functions.

Unit-I: Analytic Functions

Function of a Complex variable, Limit, Continuity and Differentiablity of complex function. Cauchy-Riemann Equations, Polar Coordinates, Analytic function, Harmonic functions and Properties of Analytic functions, Construction of Analytic function whose real or imaginary part is given, Elementary function, Reflection Principle, Conformal Mapping, Angle of Rotation, Mapping by Elementary functions. Bilinear Transformation.

Unit-II: Complex Integration

Derivatives of functions w(t), Definite Integrals of functions w(t), Contours and Contour Integrals, ML Theorem, Cauchy Integral Theorem, Antiderivatives and Definite Integrals, Cauchy Integral Formula, Cauchy Integral formula for Derivatives, Evaluation of Improper Definite Integrals by Contour Integration, Liouville's Theorem and its consequences.

Unit-III: Taylor and Laurant Series- Residue Theorem and Applications

Taylor Series, Laurant Series, Classification of Singularities, Residues, Cauchy's Residue Theorem and its Applications, Zeros of Analytic functions, Rouche's Theorem and its consequences, Gauss Lucas Theorem.

Unit-IV: Boundary Value Problems and Potential Theory

Laplace's Equation and Conformal Mappings, Standard Solution of Laplace equation, Two Dimensional Electrostatics.

Unit-V: Special Functions

Legendre's functions, Rodrigue's formula, generating functions for Legendre's Polynomials and recurrence formulae. Bessel's functions, Recurrence formulae and Bessel's functions of integral order.

Text Books:

1. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, 8th Edition, Mc-GrawHill, (2009).
2. R.K Jain and S.R.K Iyengar, *Advanced Engineering Mathematics*, 3rdEdition, Narosa Publications, (2008).

Reference Books:

1. Alan Jeffrey, *Complex Analysis and Applications*, 2ndEdition , CRC Press (2005).
2. T Needham, *Visual Complex Analysis*, Oxford University Press. (1998)

Subject: Electrical Machines-I Lab. (Code: EEL252)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester	Total Course Credit: 1		
		L	T	P
		0	0	2
Evaluation Policy	Mid-Term/Class Assessment (40 Marks)	Final-Term (60 Marks)		

Course Objective:
To familiarize the students with the operation and performance of transformers and DC machines, and perform various tests on them.

Course Outcomes (COs): Upon successful completion of the course, students should be able to:

CO1: Determine the parameters of the equivalent circuit of a transformer.

CO2: Determine the performance indices of a transformer like voltage regulation and efficiency.

CO3: Connect single-phase transformers banks for three-phase power transformation.

CO4: Run a dc machine as a generator and understand the voltage build up.

CO5: Determine the external characteristics of various types of dc generators.

CO6: Run a dc machine as a motor and determine its performance under load.

List of Experiments:

The students will conduct a minimum of 10 experiments out of the following list:

S. No.	Name of the experiment
1	To perform open-circuit and short-circuit tests on a single-phase transformer
2	To perform polarity test on a single-phase transformer
3	To determine the efficiency and voltage regulation of a single-phase transformer
4	To perform Sumpner's test on two identical transformers
5	To study three-phase connections on a bank of three single-phase transformers
6	To study various parts of a dc machine and draw sketches of the same
7	To plot the saturation curve of a dc machine
8	To plot the external characteristics of a separately-excited dc generator.
9	To study the voltage build-up of a dc shunt generator

10	To plot the external characteristic of a dc shunt generator and compare the characteristics with that of a separately-excited generator
11	To plot the external characteristics of a dc series generator
12	To plot the external characteristic of a dc compound generator and run it as shunt, over-compound, flat-compound, under-compound generator and differentially-compounded generator
13	To study the methods of speed control of dc shunt motor.
14	To study the methods of speed control of dc series motor.
15	To plot the torque-speed characteristics of dc shunt and series motors

Subject: Electrical Measurement & Instrumentation Lab. (Code: EEL253)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester	Total Course Credit: 1		
		L	T	P
		0	0	2
Evaluation Policy	Mid-Term/Class Assessment (40 Marks)	Final-Term (60 Marks)		

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Measurement of power in single phase and three phase circuits using single phase and three phase Wattmeter.

CO2: Energy measurement using watt-hour meter as well as using wattmeter and stop watch.

CO3: To study the constructional details of an electromechanical indicating instrument with the help of demonstration type of instrument.

CO4: Measurement of inductance and capacitance using Bridge technique (Anderson's bridge, Wheat-stone bridge).

CO5: Measurement of resistance by different methods (Loss of charge method, substitution method, Kelvin's double bridge).

CO6: To study RC and LC models of a transmission line and observe the variation of voltage magnitude and phase along the line.

List of Experiments:

Expt. No.	Name of the Experiment
1	Measurement of power in single phase and three phase circuits using single phase and three phase watt meters.
2	Energy Measurement using watt-hour meter as well as using wattmeter and stop watch.
3	To study the constructional details of electromechanical indicating instrument with the help of demonstration type of instrument.
4	Measurement of Inductance and Capacitance using a.c bridges (Anderson's Bridge, Wheat Stone's Bridge).
5	Resistance measurement using Loss of charge method, substitution method, Kelvin's double bridge.

Subject: Electronics II Laboratory (Code: ECL253)	Year & Semester: B. Tech Electrical Engineering 2nd Year & 4thSemester	Total Course Credit: 1		
		L	T	P
		0	0	2
Evaluation Policy	Mid-Term/Class Assessment (40 Marks)	Final-Term (60 Marks)		

Course Objectives: To acquire knowledge and become familiar with the different characterization techniques to analyze, and synthesize electronic feedback networks, operational amplifiers, and power amplifiers.

Course Outcomes (COs): Upon successful completion of the course, student should be able to:

CO1: Identify relevant information to supplement the Electronics II course

CO2: Experimental characterization of negative and positive feedback circuits

CO3: Experimental characterization and study of different applications of OPAMP's and 555 timer chip

CO4: Experimental Analysis of different topologies of Power Amplifiers

List of Experiments:

S. No.	Particulars
1	Feedback a. To assemble current series feedback amplifier and study its performance. b. To assemble a voltage shunt feedback amplifier and study its performance.
2	To assemble an RC phase shift oscillator.
3	To assemble a differential amplifier and obtainits CMRR.
4	To study different applications of OPAMPS. e. OP-AMP as an inverting amplifier. f. OPAMP as a non-inverting amplifier g. OPAMP as an integrator h. OPAMP as a differentiator
5	To measure the following parameters ofa typical OP-AMP. e. I/P Impedance f. O/P Impedance g. Slew rate h. CMRR
6	Obtain frequency response of an OP-AMP & hence find its band width.
7	Study performance of multivibrator circuits using 555 chip in following modes: **a.** Bistable **b.** Astable **c.** Monostable **d.** Useof555 chipas a timer circuit
8	To assemble a Schmitt trigger Circuit and to obtain its characteristics and to use it as squaring circuit.
9	To assemble a Class A Power amplifier and to determine its power gain
10	To study the performance of a voltage regulator IC Chip.

ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT

Subject: Electronics-I (Code: ECT201)	Year & Semester: B. Tech Electronics and Communication Engineering 2nd Year & 3rd Semester		Total Course Credit: 4		
			L	T	P
			3	1	0
Evaluation Policy	Mid-Term	Class Assessment	End-Term		
	30 Marks	10 Marks	60 Marks		

Objectives: Familiarize with the basic semiconductor devices and to know about the working and performance of semiconductor devices like diodes, BJTs and FETs. To understand DC analysis and AC models of semiconductor devices.

Course Outcomes:

CO1 Familiarization with basic semiconductors

CO2 Understanding the behavior of different types of diodes at circuit level

CO3 Analyze and study the behavior of different types of transistors

CO4 Analysis of low frequency and high frequency amplifiers

Details of the Syllabus:

S. No.	Particulars
1	**IntroductiontoSemiconductors:**Intrinsicandextrinsicsemiconductorstransportmechanismofcharge carriers, electric properties, Hall effect etc
2	**P-N junction diode: Current components in p-n junction,** Characteristics-piece wise linear approximation,Temperaturedependence,Diodecapacitance,andswitchingtimes,diodecircuits'half wave, full wave rectifiers, clipping clamping circuits etc. Circuit operations and applications of Zener, avalanche, Schottky, Photo and tunnel diodes.
3	**BJT: Operation and characteristics,** Ebers- Mollmodel, CE,CB and CC configuration input, outputcharacteristicsandgraphicalanalysisofbasicamplifiercircuits,Biasing and Bias stability, Low frequency,h-parametermodel,AnalysisandDesignoftransistoramplifiercircuitsusingh-parameters. High frequency hybrid–pi model, analysis and design of transistor amplifier circuits at high frequencies. Multistage amplifiers, phototransistors, Transistor as a switch
4	**JFET's Operationand characteristics,** model Application at low and high frequency, amplifiers, Switchingcircuits MOSFETtypes, Operationandcharacteristics
5	**Introduction to IGBT.**

Recommended Books

S. No.	Name of Book	Author
1.	Fundamentals of Microelectronics	BehzadRazavi
2.	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis, Meyar
3.	Electronic Devices and Circuits	Millman, Halkias, and SatyabrataJit
4.	Analog Electronics	Maheshwari and Anand
5.	ElectronicDevices&Circuits	Allan Mottershed
6.	Microelectronics	Sedra& Smith