FOURTH SEMESTER

Electrical Network Analysis and Synthesis (EL20416)

Objectives:

- The subject deals with the various methods of analysis of electrical circuits under transient and steady state conditions.
- To understand the concept of Laplace and Fourier transform and transform circuits using Thevenin's and Norton's theorem.

Syllabus:

UNIT I Networks and Laplace Transform - I
Network equation, formulation of network equations, initial conditions in networks and network solution with Laplace transformation, step, ramp and impulse functions, initial and final value theorem and convolution integral.

UNIT II Networks and Laplace Transform – II
Transform impedance and transform circuits, Thevenin's and Norton's theorem, duality, Fourier transform, discrete and continuous spectrum, relation and Laplace transforms.

UNIT III Network Functions
Network function for one-port and two-port, calculation of network function for ladder and general networks, poles and zeros with restrictions for driving point functions and transform functions, two-port parameters, stability by Routh-Harwitz criterion.

UNIT IV Network Synthesis
Identification of network synthesis, Brune's positive and real function (PRF), properties of PRF, testing of driving point functions, even and odd function, one terminal pair network driving point synthesis with LC elements, RC elements, Foster and Cauer form.

UNIT V Filters
Low pass filters, high pass filters, band pass filters, band reject filters, Gain equalizer and delay equalizers, Butterworth filters, m-derived filters, constant k-filters, design of filters.

Text Books:
1. "Network Analysis", Valkenburg, PHI Pbs.
2. Circuit theory, Kurikose-PHI Pbs.

Reference Books:
1. "Introduction to Network Synthesis", Valkenburg, PHI Pbs.
2. Sudhakar, A. Shyammohan, "Circuits and Network", Third Edition, 2006,Tata McGraw Hill.
3. Kelkar, Pandit, "Linear Network Theory", Pratibha Publication.

4. "Network Analysis And Synthesis", Wadhwa, New Age Pbs.

Course Outcomes:

After the completion of the course the student will be able to :

- Recall basics of electrical circuits with nodal and mesh analysis.
- Illustrate electrical network theorems.
- Develop Laplace Transformed network for steady state and transient analysis.
- Analyse electrical network parameter for different application.
- Determine the elements required to network synthesis methods
- Design different filters

POs / COs	a	b	c	d	e	f	g	h	i	j	k
1	✓	✓	✓	✓	✓	✓					✓
2	✓	✓	✓	✓	✓	✓					✓
3	✓	✓	✓	✓	✓	✓					✓
4	✓	✓	✓	✓	✓	✓					✓
5	✓	✓	✓	✓	✓	✓					✓
6	✓	✓	✓	✓	✓	✓					✓

Electrical Network Analysis And Synthesis Lab (EL20423)
B.TECH. (Electrical Engineering) IVth Semester

LIST OF EXPERIMENTS

1. To verify Maximum Power Transfer Theorem.
2. To verify Superposition Theorem.
3. To verify Thevenin's and Norton's Theorem.
4. To verify Reciprocity Theorem
5. Determination of Z and Y parameters of two port network.
6. Determination of ABCD parameters of two port network.
7. Determination of h parameters of two port network

8. Determination of time constant of RC circuit.
9. To verify RC/RL circuit as a differentiator and integrator.
10. To verify RC/RL circuit low pass and high pass filter.

Course Outcomes (COs):

After the completion of the lab course the student will be able to:

- Illustrate electrical network theorems.
- Analyse electrical network parameter for different application.
- Determine the elements required to network synthesis methods
- Evaluate time constant of RC circuits
- Develop differentiator and integrator circuit
- Design different filters

COs \ POs	a	b	c	d	e	f	g	h	i	j	k
1	✓	✓	✓	✓	✓	✓					✓
2	✓	✓	✓	✓	✓	✓					✓
3	✓	✓	✓	✓	✓	✓					✓
4	✓	✓	✓	✓	✓	✓					✓
5	✓	✓	✓	✓	✓	✓					✓
6	✓	✓	✓	✓	✓	✓					✓

Electrical measurements and Instrumentation (EL20415)

Objectives:

- To study necessity and importance of Measurement and Instrumentation.
- To know about all kinds of electrical parameter measurements.
- To study sensors for measurement of electro-mechanical quantities etc.

Syllabus:

UNIT-I

Electrical Measurements: Standards of Measurement & Errors, Review of indicating and integrating instruments: Voltmeter, Ammeter, Wattmeter, Multimeter and Energy meter.

UNIT-II
Measurement of Resistance, Inductance and Capacitance: Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement.

UNIT-III
Instrument Transformers: Current and Potential transfers, ratio and phase angle errors, design considerations and testing.

UNIT-IV
Electronic Measurements: Electronic voltmeter, multi-meter, wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Spectrum & Wave analyzer. Digital counter, frequency meter, voltmeter, multi-meter and storage oscilloscope.

UNIT-V
Instrumentation: Transducers, classification & selection of transducers, strain gauges, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermisters, thermocouples, photo-diodes & photo-transistors, encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application. Data Acquisition Systems.

Text Books:
1. Jones, B.E., "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.
2. Golding, E.W., "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Issac Pitman and Sons, 1960.

Reference Books:
1. Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint 1988.
2. Buckingham, H. and Price, E.N., "Principles of Electrical Measurements", 1961.
3. A. K. Sawhney "Electrical Measurement and Measuring Instruments" Dhanpat Rai & Sons

Course Outcomes:

After the completion of the course the student will be able to :

1. Utilize the concepts of electrical measurement principles.
2. Illustrate and apply concepts of different transducers.
3. Infer the working of instrument transformers and related industrial metering.
4. Make use of electronic instrumentation.

POs / COs	a	b	c	d	e	f	g	h	i	j	k
1	✓	✓			✓	✓			✓	✓	✓
2	✓	✓	✓		✓				✓	✓	✓
3	✓	✓	✓	✓	✓				✓	✓	✓
4	✓	✓	✓	✓	✓				✓	✓	✓

Electrical Measurement & Instrumentation Lab (EL20415)
B.TECH. (Electrical Engineering) IVth Semester

LIST OF EXPERIMENTS

1. To measure energy using a given single phase induction type Energy Meter.
2. Measurement of high resistance by using Meggar.
3. To determine unknown resistance R by Wheatstone Bridge Method.
4. To determine unknown inductance and Q-factor of a given coil by Maxwell's inductance capacitance Bridge Method.
5. To determine unknown capacitance of a given capacitor by Deasauty's Bridge Method
6. Measurement of earth electrode resistance and soil resistivity by fall of potential Method.
7. To measure temperature using thermocouple.
8. To measure the torque using sensor.
9. To study and understand the measurement of strain using load cell.
10. To study the angular displacement capacitive transducer
11. To measure the speed using magneticpick-up.

Course Outcomes (COs):

- To demonstrate the measurement of L, C, R parameters in AC power circuits.
- To apply transduction principle for measurement of physical qualities.
- To utilize the megger and earth tester for industry applications
- To show and select electrical and electronics measurements.

POs / COs	a	b	c	d	e	f	g	h	i	j	k
1		✓	✓		✓	✓				✓	✓
2		✓	✓	✓	✓	✓				✓	✓
3		✓	✓	✓	✓	✓				✓	✓
4		✓	✓	✓	✓	✓				✓	✓

Electrical Engineering Materials & Semiconductor Device (EL20412)

Objectives

- To learn in depth about electrical and magnetic properties of materials.
- To study properties of dielectric and semiconductor materials.
- To provide knowledge Conductor.
- To provide the concept of semi-conductor material
- To provide Knowledge of Dielectrics and Insulators.
- To give the knowledge of Magnetic Materials.
- To know the basic concepts of Optical Properties of Solids.

Syllabus:

Unit 1: Conducting Materials

Review of energy bands, description of materials, drift velocity, collision time, Mean free path, mobility, conductivity, relaxation time, factors affecting conductivity of materials, types of thermal conductivity, Wiedmann-Franz law, super conductivity, effect of magnetic field, properties and application of high conducting materials, properties and applications high resistive material .

Unit 2: Semiconductors

Review of Si and Ge as semiconducting materials, Continuity Equation, P-N junction, Hall effect, mobility, Drift & Diffusion, Diffusion & Transition capacitances of P-N junction.

Unit 3: Dielectric Materials

Behavior of dielectric materials in static electric field, Dipole moments, Polarization, Dielectric constant, Polarizability, Susceptibility, mechanisms of polarization, behavior in alternating field, dielectric loss, loss tangent, types of dielectric & insulating materials, electrostriction, Piezo-electricity, Properties and Applications of gaseous(H2, N2 ,SF6 etc), liquid (transformer oil, capacitor oil, paints etc) and solid (fibrous, paper board, wood, plastic, mica, ceramic material, rubber etc.) insulators.

Unit 4: Magnetic Materials

Permeability, Magnetic susceptibility, magnetic moment, Magnetization, Dipole moment, types of magnetic materials, Magnetostriction, eddy current & hysteresis losses, applications of silicon steel, soft and hard magnetic material.

Unit 5: Optical properties of Solids

Photo emission, photo emission materials, electro luminescence junction diode, photo emitters, photo transistor, photo resistors, injunction lasers, solar cell, optical properties of semiconductor, application of photo sensitive materials (CRT, Tube light, photo panels).

Text Books:

1. Electrical Engineering Materials: A.J. Dekker; PHI.
2. Electronic Devices & Circuits: Millman&Halkias; MGH.

Reference Books:

1. Electrical Engineering Materials: S.P Seth & P.V Gupta; Dhanpat Rai.
2. Solid State Electronic Devices :StreetMan& Banerjee; Pearson.
3. Electronic Devices & Circuit Theory :Boylestad&Nashelsky; Pearson.
4. Semiconductor devices : Jaspreet Singh; John Wiley.

Course Outcomes:

After the completion of the course the student will be able to :

1. Explain the basic concepts of electrical properties of material.
2. Illustrate the concepts of magnetic properties of material.
3. Analyse the behaviour of different semiconductor materials.
4. Utilize the different properties of dielectrics for various applications.

POs / COs	a	b	c	d	e	f	g	h	i	j	k
1	✓	✓	✓	✓	✓	✓				✓	✓
2	✓	✓	✓	✓	✓	✓				✓	✓
3	✓	✓	✓	✓	✓	✓				✓	✓
4	✓	✓	✓	✓	✓	✓				✓	✓

Digital Electronics and Logic Design (EL20414)

Objectives:

- To know various number systems, codes, logic gates and their application.
- Study of flip-flops, counters, encoders, decoders, multiplexers etc.

Syllabus:

Unit I: Fundamentals of Digital Electronics
Review of number systems - binary, octal and hexadecimal number systems, their conversions and arithmetic, 1's and 2's complements; weighed and non-weighted codes, BCD codes, excess-3 code, Gray code, error correcting and detecting codes; Review of logic gates and logic families such as RTL, DTL, TTL, Schottky TTL, ECL, MOS, CMOS, I2L etc; Boolean algebra.

Unit II: Combinational Logic Circuits
Introduction to Karnaugh map, minterms and maxterms representation of logical functions, sum of product and product of sum form minimization, redundant terms, Quine- Mcklusky method for minimization, design of combinational logic circuits, design of half adder and subtractor, design of full adder and subtractor, binary parallel adder &subtractor, IC 7483, excess-3 adder, BCD to seven segment decoder, IC 7447.

Unit III: Sequential Logic Circuits
Flip-Flops: R-S, D, J-K, T, Master slave flip-flops, their conversion, different flip-flop ICs. Counters: Different types of counters, design of divide by N asynchronous and synchronous counters, design of BCD, decade, up-down counter, ring and shift counters, different counter ICs. Shift Registers: data-in and data-out modes, SISO, SIPO, PISO and PIPO modes, left shift and right shift register; Universal shift register, IC 7495.Multiplexer, cascading of multiplexer; Demultiplexer, cascading of demultiplexer, different multiplexer and demultiplexer ICs.

Unit IV: D/A and A/D Converters
Digital to analog converter (DAC)-weighted register method, R-2R ladder method, analog to digital converter (ADC)- parallel comparator method, counter method, successive approximation method, counting A/D converter, dual Slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion.

Unit V: Memory devices & Programmable Logic Devices
Organisation of RAM and ROM, Memory subsystem,Timing circuits,clock circuit and IC timer Programmable Logic Devices, Programmable Logic Array, Complex Programmable logic Devices(CPLDs), Field Programmable Gate array (FPGA).

Text Books

1.Gothman, "Digital Electronics", Prentice Hall Publications
2. Malvino and Leach, "Digital Principles and Applications", McGraw Hill Publications.

Reference Books

1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publications.
2. Anand Kumar, "Fundamentals of Digital Circuits", Prentice-Hall India

Course Outcomes:

After the completion of the course the student will be able to :

1. Build digital circuits using logic gates.
2. Apply methods to minimize Boolean expressions.
3. Design the various combinational and sequential logic circuits used for processing and transmission of data.
4. Infer and apprise use of memory devices in different applications.
5. Implement logic functions in PLA, PLD and FPGA platform.

POs / COs	a	b	c	d	e	f	g	h	i	j	K
1	√	√	√	√	√	√					√
2	√	√	√	√	√	√					√
3	√	√	√	√	√	√					√
4	√	√	√	√	√	√					√
5	√	√	√	√	√	√			√		√

Digital Electronics And Logic Design Lab
(EL20414)
B.TECH. (Electrical Engineering) IVth Semester

LIST OF EXPERIMENTS

1. To study and verify the truth table of AND and OR gate using diodes.
2. To study and verify the truth table of AND gate and OR gate using transistor IC 7432& IC 7408.
3. To study and verify the truth table of OR, NOT, NOR, AND, XOR gates using NAND gate IC 7400.

4. To perform operation of OR, NOT, NOR, AND, and XNOR gates using NOR gate IC 7402.
5. To verify De-Morgan's theorem.
6. To design and verify half adder circuit using IC 7486 &7408 and full adder circuit using IC 7486, IC 7432 and IC 7408.
7. To design and verify half sub tractor and full sub tractor circuit using IC 7404, IC 7408 &IC 7486.
8. To study seven segment display using IC 7447.
9. Design a binary to gray code converter and gray to binary code converter using IC 7486.
10. To design and implement a 4:1 Multiplexer using IC 74153.
11. To design and implement a 1:4 De-multiplexer using IC 74155.
12. To design and verify the operation of RS and JK flip-flop using logic gates.
13. To verify the operation of shift left and shift right register.
14. To study V/I characteristics of TTL gate.
15. To study V/I characteristics of CMOS gate.
16. To verify 3- bit asynchronous ripple up counter.

Course Outcome (COs):

After the completion of the course the student will be able to :

- Relate the use of various types of logic gates in digital circuits.
- Solve Boolean expressions and implementation them using logic gates and ICs.
- Design the various combinational and sequential logic circuits used for processing and transmission of data.
- Demonstrate and explain the steps involved in the design of the programmable logic devices and processors.

COs / POs	a	b	c	d	e	f	g	h	i	j	k
1	✓	✓	✓	✓	✓	✓			✓	✓	✓
2	✓	✓	✓	✓	✓	✓				✓	✓
3	✓	✓	✓	✓	✓	✓				✓	✓
4	✓	✓	✓	✓	✓	✓			✓	✓	✓

Electrical Power System (EL20411)

Objectives

- **To understand** the structure and operation of power system and appreciate its role in our society

- **To acquire the knowledge of transmission line parameters and their** influence on the operation of transmission line.

- **To analyse the performance of transmission line** and acquire knowledge of different phenomena that effects transmission line performance**s.**
- To interpret the different methods and utility of voltage control in transmission line.
- **To understand the concepts of underground cables** and **travelling waves.**

Syllabus:

UNIT I: Over head lines and cables:
General structure of electrical power system; power transmission & voltage levels; power distribution through overhead lines. single line diagram, Type of overhead conductors, solid conductors,stranded conductors, bundled conductors, skin effect, proximity effects, principle of corona, SAG and TENSION calculation, Types of cables, insulation resistance of cables, capacitance of cables dielectric stress, capacitance grading of cables, use of inter-sheaths,

UNIT II: Transmission Lines:
Inductance and capacitance of single-phase, three-phase single circuit and double circuit lines, concept of GMD, transposition of lines, effect of earth on capacitance of transmission lines., Kelvin's law

UNIT III: Transmission Lines (cont.):
Characteristics and performance of transmission lines, transmission lines as four terminal networks, nominal-T, nominal-π, equivalent-T, and equivalent- π representation of transmission lines, A, B, C, D constants, distributed parameters of long lines, hyperbolic solutions, Ferranti effect, surge impedance loadings.

UNIT IV: VOLTAGE CONTROL METHODS:
Compensation of transmission lines, Voltage regulation,Power flow through a line, power flow equations, Methods of voltage control, on-load tap changing transformer, control of reactive power, basis of selection for line voltage, AC and DC distribution systems.

UNIT V: TRAVELING WAVES:
Transients in power systems, wave equation, characteristic impedance, energy and power surge, velocity, travelling wave phenomenon in open circuited and short circuited lines, lines with series reactive termination, junction of two dissimilar lines, repeated reflections.

Text Books:
1. "*Elements of Power Systems*", Stevenson, 4th Edition
2. "*Power System Engineering*", Nagrath Kothari, TMH Pbs.

Reference Books:
1. "*A Course In Electrical Power*", Soni, Gupta and Bhatnagar, Dhanpat Rai.

2. Electrical power systems, Ashfaq Hussain, CBS Pbs.
3. Electrical power systems, C. L. Wadhwa, New Age Pbs.
4. "Substation Design and Control" by Gupta &Satnam

Course Outcome (COs):

After the completion of the course the student will be able to :

- Outline the structure and operation of power system and appreciate its role in our society
- Infer the significance of different parameters and its influence on the operation of transmission line.
- Asses the performance of transmission line and identify different phenomena that effects transmission line performance
- Asses and compare different methods of voltage control in transmission line.
- Appraise the concepts, advantages and practical applications of underground cables.

COs \ POs	a	b	c	d	e	f	g	h	i	j	k
1	✓				✓				✓	✓	✓
2	✓	✓	✓	✓	✓					✓	✓
3	✓	✓							✓	✓	✓
4	✓	✓							✓	✓	✓
5	✓	✓			✓				✓	✓	✓

Electromagnetic fields (EL20413)

Objectives:

- The objective of this course is to introduce the concepts of electric field and magnetic fields.
- The applications which will be utilized in the development of the theory for power transmission lines and electrical machines.
- Compute force and torque for various current carrying elements.

Syllabus:

UNIT I

Basics of Electromagnetic Fields: Scalars and vectors, vector algebra, the Cartesian, circular cylindrical and spherical coordinate systems, transformations between coordinate

systems, Coulomb's law, electric field intensity, electric field due to several charges, Gauss law and its application, divergence and divergence theorem, Maxwell's first equation, the vector operator and divergence theorem.

UNIT II

Electrostatics :Electric potential, potential at any point due to discrete and distributed charges, principle of superposition potential and field between two coaxial cylinders, potential between two conducting spherical shells, conservative property, potential gradient, electric dipole, current and current density, continuity of current, metallic conductors, conductor properties and boundary conditions for dielectric materials, boundary conditions for perfect dielectric materials, capacitance Poisson and Laplace equation, uniqueness theorem, examples of the solution of Laplace and Poisson's equations.

UNIT III

Magnetostatics :The steady state magnetic field, Biot Savart Law, Ampere's circuital Law, Curl, Stokes theorem, magnetic flux and magnetic flux density, scalar and vector magnetic potentials.

UNIT IV

Magnetic Force And Inductance :Force on a moving charge, force on a differential current element, force between differential current elements, force and torque on a closed circuit, magnetic materials, magnetization and permeability, magnetic boundary conditions.

UNIT V

Time Varying Field And Maxwell's Equations :Modification of Maxwell's equations under time varying conditions, displacement current, source free wave equation, power flow and energy, sinusoidal time varying field, Helmholtz equation, complex pointing vector, Boundary condition, relation between field theory and current theory.

Text Books:

1"Engineering Electromagnetics", Hayt,TMHPbs.
2."Electromagnetic Field theory and transmission lines", Raju, Pearson.

Reference Books:

1.Sadiku, "Electromagnetic Fields"
2."Principle And Application Of Electromagnetic Fields", Robert Polnsey and Robert collin.
3."Fields and wave electromagnetics", Chang.
4.Electromagnetic field, Bhat, CBS Pbs.

Course Outcomes:

After the completion of the course the student will be able to :

- Solve electric field intensity for various charge distribution
- Examine electric flux for various charge distribution
- Analyze potential for different charge distributions.
- Evaluate solution of Laplace and Poisson's equations

- Apply Ampere's circuital Law and Stoke's theorem for determining magnetic field intensity and magnetic flux density.

PO'S / CO'S	a	b	c	d	e	f	g	h	i	j	k
1	√	√	√	√	√	√				√	√
2	√	√	√	√	√	√				√	√
3	√	√	√	√	√	√				√	√
4	√	√	√	√	√	√				√	√
5	√	√	√	√	√	√				√	√