MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)
NAAC Accredited with A++ Grade

Flexible Scheme & Syllabus

2021-2022

B.Tech.

in

Electrical Engineering

(III Semester)

Madhav Institute of Technology & Science

Gwalior-474005

Electromagnetic Field Theory: 130311

Course Objectives:

- To provide the knowledge of electromagnetic fields and its use in understanding the working principles of various power apparatus and machines.
- To lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles etc.
- To provide the basic concepts of vectors and fields, electrostatics, electric current flow, magnetic fields, Maxwell's equations, and electromagnetic wave propagation.

Course outcomes focused on employability/entrepreneurship and skill development

S No	Course Outcome (CO)	Mapping
1	**Apply** vector calculus to understand the behavior of static electric fields in engineering configuration	Skill Development
2	**Describe** Maxwell's equations in differential and integral forms and apply them to diverse engineering problem	Skill Development
3	**Formulate** engineering problems of Electromagnetic, Electrostatic and Magnetic to Static circuits using Basic relations	Skill Development
4	**Explain** the nature of Electromagnetic wave propagation and wave polarization.	Skill Development
5	**Solve** engineering problems of Electromagnetic.	Skill Development

Unit I: Electrostatics – I

Sources and effects of electromagnetic fields – Coordinate Systems –Vector fields – Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity –Field due to discrete and continuous charges – Gauss 's law and applications.

Unit II: Electrostatics – II

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization- Dielectric strength- Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

Unit III: Magnetostatics

Lorentz force, magnetic field intensity (H) – Biot Savart's Law -Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.'

Unit IV: Electrodynamic Fields

Magnetic Circuits - Faraday's law – Transformer and motional EMF –Displacement current Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

Unit V: Electromagnetic Waves

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth – Pointing vector – Plane wave reflection and refraction – Standing Wave –Applications.

Recommended Books:

1. Electromagnetic Fields by P.V. Gupta, Dhanpat Rai.
2. Element of Engineering Electromagnetic by N.N. Rao, PHI.
3. Engineering Electromagnetic by William H. Hayt; TMH.
4. Electromagnetic by John D. Kraus, TMH.
5. Electromagnetic Field by S.P. Seth, Dhanpat Rai & Sons

Electrical and Electronic Measurement: 130312

Course Objectives

- To give an overview of current, voltage and power measuring electrical, electronics and digital instruments.
- To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
- To provide the working knowledge of various waveform generators, analyzers and display devices and give an overview of test and measuring instrument

Course outcomes focused on employability/entrepreneurship and skill development

S No.	Course Outcome (CO)	Mapping
1	**Explain** the basic concepts of electrical and electronic measurement and measuring instruments.	Skill Development
2	**Determine** errors in a measurement system	Employability
3	**Suggest** extension of instrument range using shunt and multipliers, CT and PT	Employability
4	**Describe** the construction and working of AC and DC bridges and their applications	Skill Development
5	**Describe** digital measuring instrument, signal Generator, CRO for appropriate measurement	Skill Development

Unit I Basic Measurement Concepts

Static and dynamic characteristics, units and standards of measurements, error analysis, Statistical evaluation of measurement data, Standards and calibration

Unit II Electrical measurements

General features and Classification of electromechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Extension of instrument range: shunt and multipliers, CT and PT. Measurement of Power: Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement

Unit III Measurement of resistance, inductance and capacitance

Low, high and precise resistance measurement, Megger, Ohmmeters, Classical AC bridges: Inductance and capacitance measurements. Detectors in bridge measurement, Measurement of Frequency: Wien's Bridge

Unit IV Electronic and digital measurements

ADC and DAC, Electronic voltmeter, Digital instruments: current, Digital voltmeter, Digital LCR meter, Q-Meter, Digital wattmeter and energy meters. Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers, LED, LCD and Organic LED displays, Oscilloscope.

Unit V Principle of Sensing & Transduction

Mechanical and Electromechanical Transducer, Resistive (potentiometric type), Strain gauge, Inductive Transducer: common types- Reluctance change type, LVDT, Capacitive Sensors, Thermal Sensors, Magnetic Sensors, Proximity Sensor, Piezoelectric Effect

Text and Reference Books:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai & Sons, Jan 2015.
2. J.B. Gupta, "A Course in Electronics & Electrical Measurements & Instrumentation", S.K. Kataria& Sons, 2008.

3. E. W. Golding's &F.C.Widdis, Electrical Measurements and Measuring Instruments, 6th Edition, (Revised & Enlarged): With Solved Examples & MCQ's (In M.K.S. Units), Medtech, Jan 2019.
4. Ernest O Doebelin and Dhanesh N Manik," Measurements systems Application and design", McGraw Hill publication, 5th Edition, 2015.
5. H. S. Kalsi, Electronic Instrumentation, McGraw Hill Education; 3rd Edition, 2017

Electrical and Electronic Measurement Lab: 130312

Course outcomes focused on employability/entrepreneurship and skill development

Course Outcomes:

S No.	Course Outcome (CO)	Mapping
1	**Handle** an instrument and perform basic calibration	Skill Development
2	**Estimate** the deviations in measurements due to possible errors and measures to minimize them based on their characteristics.	Employability
3	**Measure** unknown resistance, inductance and capacitance	Skill Development
4	**Acquire** teamwork skills for working effectively in groups	Skill Development
5	**Prepare** technical report on experiments conducted in the lab.	Skill Development

LIST OF EXPERIMENTS

1. Study of different types of multimeter and measurements of various electrical quantities using them.
2. Handling of CRO and function generator
3. Measurement of low resistance using Kelvin's Double Bridge method
4. Measurement of inductance by Hay's bridge.
5. Measurement of capacitance using De Sauty's Bridge.
6. Measurement of medium resistance using Wheatstone Bridge.
7. Measurement of earth resistance using earth tester.
8. Determination of characteristics of Thermistor using VCL and transducer trainer.
9. Determination of characteristics of RTD using VCL and transducer trainer.
10. Calibration of single-phase AC energy meter by direct loading method.

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Network Analysis: 130313

Course Objectives:

- To make the students capable of analyzing any given electrical network, the balanced and unbalanced three phase circuits,
- understand the graph theory for solving various electrical circuits, understand the concepts of transients and relate two port parameters.

Course outcomes focused on employability/entrepreneurship and skill development

Course Outcomes:

S No.	Course Outcome (CO)	Mapping
1	**Apply** different networks laws & theorems for solving AC and DC electric networks.	Skill Development
2	**Solve** series/parallel resonant and magnetically coupled circuits	Skill Development
3	**Solve** three-phase circuits under balanced & unbalanced conditions	Skill Development
4	**Evaluate** transient response behavior of a network for given initial conditions	Employability
5	**Compute** the two-port parameters for given two port networks	Employability

Unit I: Overview of DC and AC Circuits
Kirchhoff's voltage and current laws, network theorems viz. Thevenin's, Norton's, Superposition, Maximum power Transfer, Reciprocity, Substitution, Compensation, Miliman's and Tellegen's Theorem.

Unit II: Coupled Circuit and Resonance
Magnetic coupling, mutual inductance and its sign convention, coefficient of mutual inductance, transformer as a coupled circuit, singly and doubly tuned circuit, critical coupling, series and parallel resonance, bandwidth selectivity and half power points, Analysis of series and parallel circuit.

Unit III: Two Port Network
The concept of complex frequency, Concept of Ports. Two port parameters e.g. z-parameter, y-parameters, ABCD and inverse ABCD parameters, h and g parameters and their determination, Ladder network, condition for reciprocity and Symmetry in two port parameter representation, Inter-relationships between parameters of two port network, Interconnections of two port networks.

Unit IV: Three Phase Circuit
Unbalanced 3 phase circuit, balanced and unbalanced star (with or without neutral) and delta connected load.

Introduction to Graph theory: Concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrix.

Unit V: Transient
Initial condition, Laplace analysis, Theorem shifting, scaling, initial and final value and convolution theorem. Transient response of RL, RC and RLC circuit, time constant, Equivalents of charged inductor and capacitor, discharge of condenser, damped and

oscillatory circuit Response of the network with impulse, Unit step and Ramp excitation, wave form synthesis, AC transients (RLC circuit response to sinusoidal voltage)

Recommended Books:

1. Network Analysis by ME Van Valkenburg , PHI Publication.

2. Circuit Analysis by A. Chakrawarti,Dhanpat Rai Publication.

3. Network Analysis and Synthesis by C.L. Wadhwa, New Age International Publication. Network Analysis and Synthesis Pankaj Swarnkar, Tech India Publication.

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Analog & Digital Electronics: 130318

Course Objectives:

The course intends to provide an understanding of the principles, operation and application of the analog building blocks like diodes, BJT, FET etc. for performing various functions. Furthermore, the course is likely to impart knowledge of various techniques of digital electronics like K-map for simplified analysis, understanding of combinational & sequential circuits.

Unit- I: Diodes and Transistors

Diodes, their characteristics & applications, clipper, clamper circuits, BJT, transistor biasing, CE, CB, CC configurations, input output characteristics, DC load line, small signal analysis.

Unit-II: Amplifiers& FETs BJT usage as switch & amplifier, Darlington pair, differential amplifier using BJT, Operational Amplifiers their types & applications, JFET, V-I characteristics, MOSFET& its types, ADC & DAC converters, Multivibrators, 555 timer.

Unit-III: Digital Circuits

Digital (binary) operations of a system, OR gate, AND gate, NOT, EXCLUSIVE OR gate, De Morgan Laws, NAND and NOR DTL gates, Comparison of logic families, properties of Boolean Algebra

Unit-IV: Combinational Logic Circuits

K-Map: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-sums Method, Product-of-sums simplifications. Multiplexers, three state buffers, decoders and encoders, Programmable Logic devices

Unit-V: Sequential Logic Circuits

Sequential Circuits, Storage Elements: Latches and flip flops, FLIP-FLOP Timing, SR, JK Masterslave, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Shift Registers, Asynchronous, Ripple& Ring Counters, Synchronous Counters, Random-Access Memory, Read-Only Memory.

Recommended Books:

1. Microelectronics Circuits by A.S. Sedra & K.C. Smith, Oxford University Press (1997)

2. Electronic Principles by A.P. Malvino, Tata Mcgraw Hill Publications

3. Electronic Devices & Circuit Theory by Robert L. Boylestad & Louis Nashelsky,

4. Digital Electronics by William Kleitz, Prentice Hall International Inc.

5. Introduction to Electronic Devices Michael Shur by John Wiley & Sons Inc., 2000.

6. Op-Amps and Linear Integrated Circuits by Ramakant Gayakwad, Pearson

7. Digital Logic and Computer Design by Morris Mano, Pearson

Course Outcomes:

After the completion of this course students will be able to:

CO1. Explain working principles of electronic devices e.g. Diode, Transistor, Amplifier, and OpAmp.
CO2.Categorize the different types of diode, Amplifier, Op-Amp, Flip-flop, logic gates and counters.

CO3.Describe the various mathematical models of transistors
CO4.Apply the various principles of digital electronics to design different types of Digital Electronics circuits for various applications.
CO5.Understand working of various digital electronics circuits like multiplexer, coder circuits, shift registers & counters

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Software Lab: 130315

1. Introduction to MATLAB (Programming) and Simulink
2. To analyze time response of RL, RC and RLC Circuits using MATLAB
3. To model second order differential equation using MATLAB
4. To calculate efficiency and voltage regulation of a single-phase transformerusing MATLAB
5. To implement of Boolean expression using MATLAB Simulink
6. To calculate eigenvalues and eigenvectors of a Matrix
7. Introduction to LabVIEW software
8. To calculate quadratic root of an equation in LabVIEW
9. To create a model to control LED with a switch in LabVIEW environment
10. To design a simple calculator to add, subtract, multiply and divide two numbers in LabVIEW environment

Course Outcomes:

After the completion of this course students will be able to:

- **CO 1.** **Validate** the theoretical concepts by writing MATLAB codes.
- **CO 2.** **Compare** the time responses of series & parallel RLC networks.
- **CO 3.** **Design** engineering problem and validate the results using MATLAB/LabVIEW.
- **CO 4.** **Develop** teamwork skills for working effectively in groups.
- **CO 5.** **Prepare** technical report on experiments conducted in the lab