

II Year – II SEMESTER

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ELECTRICAL MEASUREMENTS

Preamble:

This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Learning Objectives:

- To study the principle of operation and working of different types of instruments. Measurement of voltage and current.
- To study the working principle of operation of different types of instruments for measurement of power and energy
- To understand the principle of operation and working of dc and ac potentiometers.
- To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
- To study the principle of operation and working of various types of magnetic measuring instruments.
- To study the applications of CRO for measurement of frequency, phase difference and hysteresis loop using Lissajous patterns

UNIT-I:

Measuring Instruments

Classification – Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type, dynamometer and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations– Extension of range using shunts and series resistance –CT and PT: Ratio and phase angle errors – Numerical problems..

UNIT –II:

Measurement of Power and Energy

Single phase and three phase dynamometer wattmeter – LPF and UPF – Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems – Type of P.F. Meters – Single phase and three phase dynamometer and moving iron type Single phase induction type energy meter – Driving and braking torques – errors and compensations –Testing by phantom loading using R.S.S. meter– Three phase energy meter – Maximum demand meters– Electrical resonance type frequency meter and Weston type synchro-scope.

UNIT – III:

Potentiometers

Principle and operation of D.C. Crompton's potentiometer – Standardization – Measurement of unknown resistance – Current – Voltage.AC Potentiometers: polar and coordinate types – Standardization – Applications.

UNIT – IV:

Measurements of Parameters

Method of measuring low, medium and high resistance – Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance– Loss of charge method for measurement of high resistance – Megger– Measurement of earth resistance – Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge – Anderson's bridge–Measurement of capacitance and loss angle – DesautyBridge – Schering Bridge–Wagner's earthing device–Wien's bridge.

UNIT – V:

Magnetic Measurements

Ballistic galvanometer – Equation of motion – Flux meter – Constructional details– Determination of B–H Loop methods of reversals six point method – AC testing – Iron loss of bar samples– Core loss measurements by bridges and potentiometers.

UNIT – VI:

Digital Meters

Digital Voltmeter–Successive approximation – Measurement of phase difference – Frequency – Hysteresis loop using lissajious patterns in CRO – Ramp and integrating type– Digital frequency meter–Digital multimeter–Digital Tachometer.

Learning Outcomes:

- Able to choose right type of instrument for measurement of voltage and current for ac and dc.
- Able to choose right type of instrument for measurement of power and energy – able to calibrate energy meter by suitable method
- Able to calibrate ammeter and potentiometer.
- Able to select suitable bridge for measurement of electrical parameters
- Able to use the ballistic galvanometer and flux meter for magnetic measuring instruments
- Able to measure frequency and phase difference between signals using CRO. Able to use digital instruments in electrical measurements.

Text Books:

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney DhanpatRai & Co.Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
3. Electrical Measurements – by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements –by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

ELECTRICAL MACHINES – II

Preamble:

This course covers the topics on 3-phase induction motor, 1-phase induction motor and synchronous machines which have wide application in power systems. The main aim of the course is to provide a detailed analysis of operation and performance of 3-phase induction motor, 1-phase induction motor and synchronous machines. In addition, it also covers voltage regulation and parallel operation of synchronous generators.

Learning objectives:

- Understand the principle of operation and performance of 3-phase induction motor.
- Quantify the performance of induction motor and induction generator in terms of torque and slip.
- To understand the torque producing mechanism of a single phase induction motor.
- To understand the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.
- To study parallel operation and control of real and reactive powers for synchronous generators.
- To understand the operation, performance and starting methods of synchronous motors.

UNIT-I

3-phase Induction Motors

Construction details of cage and wound rotor machines - production of rotating magnetic field - principle of operation - rotor emf and rotor frequency - rotor current and pf at standstill and during running conditions - rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram

UNIT-II

Characteristics, starting and testing methods of Induction Motors

Torque equation - expressions for maximum torque and starting torque - torque slip characteristic - double cage and deep bar rotors - crawling and cogging – speed control of induction motor with V/f method – no load and blocked rotor tests - circle diagram for predetermination of performance– methods of starting – starting current and torque calculations – induction generator operation (Qualitative treatment only)

UNIT – III:

Single Phase Motors

Single phase induction motors – Constructional features and equivalent circuit Problem of starting–Double revolving field theory–Starting methods, shaded pole motors, AC Series motor.

UNIT-IV:

Construction, Operation and Voltage Regulation of Synchronous generator

Constructional features of non-salient and salient pole type – Armature windings – Distributed and concentrated windings – Distribution– Pitch and winding factors –E.M.F equation–Improvements of waveform and armature reaction–Voltage regulation by synchronous impedance method– MMF method and Potier triangle method–Phasor diagrams– Two reaction analysis of salient pole machines and phasor diagram.

UNIT –V:

Parallel operation of synchronous generators

Parallel operation with infinite bus and other alternators – Synchronizing power – Load sharing – Control of real and reactive power– Numerical problems.

UNIT–VI:

Synchronous motor – operation, starting and performance

Synchronous Motor principle and theory of operation– Phasor diagram – Starting torque– Variation of current and power factor with excitation –Synchronous condenser – Mathematical analysis for power developed– Hunting and its suppression – Methods of starting – Applications.

Learning outcomes:

- Able to explain the operation and performance of three phase induction motor.
- Able to analyze the torque-speed relation, performance of induction motor and induction generator.
- Able to explain design procedure for transformers and three phase induction motors.
- Implement the starting of single phase induction motors.
- To perform winding design and predetermine the regulation of synchronous generators.
- Avoid hunting phenomenon, implement methods of starting and correction of power factor with synchronous motor.

Text Books:

1. Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald,Charleskingsley,StephenD.Umans, TMH

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth,McGrawHill Publications, 4th edition
2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition
3. Electrical Machinery by AbijithChakrabarthi and SudhiptaDebnath,McGraw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
- 5.Electric Machines by MulukutlaS.Sarma&Mukeshk.Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons

SWITCHING THEORY AND LOGIC DESIGN

UNIT – I

REVIEW OF NUMBER SYSTEMS & CODES:

- i) Representation of numbers of different radix, conversion from one radix to another radix, $r-1$'s complements and r 's complements of signed members, problem solving.
- ii) 4 bit codes, BCD, Excess-3, 2421, 84-2-1 9 's complement code etc.,
- iii) Logic operations and error detection & correction codes; Basic logic operations - NOT, OR, AND, Universal building blocks, EX-OR, EX-NOR - Gates, Standard SOP and POS, Forms, Gray code, error detection, error correction codes (parity checking, even parity, odd parity, Hamming code) NAND-NAND and NOR-NOR realizations.

UNIT – II

MINIMIZATION TECHNIQUES:

Boolean theorems, principle of complementation & duality, De-morgan theorems, minimization of logic functions using Boolean theorems, minimization of switching functions using K-Map up to 6 variables, tabular minimization, problem solving (code-converters using K-Map etc..).

UNIT – III

COMBINATIONAL LOGIC CIRCUITS DESIGN :

Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders, 4-bit binary subtractor, adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit, look-a-head adder circuit, Design of decoder, demultiplexer, 7 segment decoder, higher order demultiplexing, encoder, multiplexer, higher order multiplexing, realization of Boolean functions using decoders and multiplexers, priority encoder, 4-bit digital comparator.

UNIT – IV

INTRODUCTION OF PLD's :

PROM, PAL, PLA-Basics structures, realization of Boolean function with PLDs, programming tables of PLDs, merits & demerits of PROM, PAL, PLA comparison, realization of Boolean functions using PROM, PAL, PLA, programming tables of PROM, PAL, PLA.

UNIT – V

SEQUENTIAL CIRCUITS I:

Classification of sequential circuits (synchronous and asynchronous); basic flip-flops, truth tables and excitation tables (nand RS latch, nor RS latch, RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals). Conversion from one flip-flop to flip-flop. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT – VI

SEQUENTIAL CIRCUITS II :

Finite state machine; Analysis of clocked sequential circuits, state diagrams, state tables, reduction of state tables and state assignment, design procedures. Realization of circuits using various flip-flops. Meelay to Moore conversion and vice-versa.

TEXT BOOKS:

1. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition.
2. Switching Theory and Logic Design by A. Anand Kumar
3. Digital Design by Mano PHI.

REFERENCE BOOKS:

1. Modern Digital Electronics by RP Jain, TMH
2. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers
3. Micro electronics by Milliman MH edition.

CONTROL SYSTEMS**Preamble :**

This course introduces the elements of linear control systems and their analysis. Classical methods of design using frequency response. The state space approach for design, modeling and analysis of simple PD,PID controllers.

Learning Objectives:

- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers
- To investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
- To present the Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
- To discuss basic aspects of design and compensation of linear control systems using Bode plots.
- Ability to formulate state models and analyze the systems. To present the concepts of Controllability and Observability.

UNIT – I:**Mathematical Modeling Of Control Systems**

Classification of control systems, Open Loop and closed loop control systems and their differences, Feed-Back Characteristics, transfer function of linear system, Differential equations of electrical networks, Translational and Rotational mechanical systems, Transfer Function of DC Servo motor - AC Servo motor- Synchro, transmitter and receiver - Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula.

UNIT-II:**Time Response Analysis**

Standard test signals - Time response of first and second order systems - Time domain specifications - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems.

UNIT – III:**Stability and Rootlocus Technique**

The concept of stability – Routh's stability criterion –limitations of Routh's stability –Root locus concept - construction of root loci (Simple problems)

UNIT-IV:**Frequency Response Analysis**

Introduction to Frequency domain specifications-Bode diagrams- transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots, Polar Plots, Nyquist Stability criterion.

UNIT–V:**Classical Control Design Techniques**

Lag, Lead, Lag-Lead compensators, design of compensators – using Bode plots.

UNIT–VI:**State Space Analysis Of LTI Systems**

Concepts of state, state variables and state model, state space representation of transfer function, Diagonalization- Solving the time invariant state equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

Learning Outcome:

- Ability to derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- Capability to determine time response specifications of second order systems and to determine error constants.
- Acquires the skill to analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
- Capable to analyze the stability of LTI systems using frequency response methods.
- Able to design Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
- Ability to represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:

1. Control Systems principles and design, M.Gopal, Tata McGraw Hill education Pvt Ltd., 4th Edition.
2. Automatic control systems, Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

1. Modern Control Engineering, Kotsuhiko Ogata, Prentice Hall of India.
2. Control Systems, ManikDhanesh N, Cengage publications.
3. Control Systems Engineering, I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
4. Control Systems Engineering, S.Palani, Tata McGraw Hill Publications.

POWER SYSTEMS-I

Preamble:

Electrical Power plays significant role in day to day life of entire mankind. The aim of this course is to allow the students to understand the concepts of the generation and distribution of power along with economic aspects.

Learning objectives :

- To study the principle of operation of different components of a thermal power stations.
- To study the principle of operation of different components of a Nuclear power stations.
- To study the concepts of DC/AC distribution systems and voltage drop calculations.
- To study the constructional and operation of different components of an Air and Gas Insulated substations.
- To study the constructional details of different types of cables.
- To study different types of load curves and tariffs applicable to consumers.

UNIT-I Thermal Power Stations

Selection of site, general layout of a thermal power plant showing paths of coal, steam, water, air, ash and flue gasses, ash handling system, Brief description of components: Boilers, Super heaters, Economizers, electrostatic precipitators steam Turbines : Impulse and reaction turbines, Condensers, feed water circuit, Cooling towers and Chimney.

UNIT-II Nuclear Power Stations

Location of nuclear power plant, Working principle, Nuclear fission, Nuclear fuels, Nuclear chain reaction, nuclear reactor Components : Moderators, Control rods, Reflectors and Coolants. Types of Nuclear reactors and brief description of PWR, BWR and FBR. Radiation: Radiation hazards and Shielding, nuclear waste disposal.

UNIT-III Distribution Systems

Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor, stepped distributor and AC distribution, comparison of DC and AC distribution.

UNIT-IV Substations

Classification of substations:

Air Insulated Substations - Indoor & Outdoor substations, Substations layouts of 33/11 kV showing the location of all the substation equipment.

Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – Advantages of Gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations, constructional aspects of GIS, Installation and maintenance of GIS, Comparison of Air insulated substations and Gas insulated substations.

UNIT-V Underground Cables

Types of Cables, Construction, Types of insulating materials, Calculation of insulation resistance, stress in insulation and power factor of cable.

Capacitance of single and 3-Core belted Cables: Grading of Cables-Capacitance grading and Inter sheath grading.

UNIT-VI Economic Aspects of Power Generation & Tariff

Economic Aspects - Load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, Base and peak load plants.

Tariff Methods- Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Desirable Characteristics of a Tariff Method, Tariff Methods: Simple rate, Flat Rate, Block-Rate, two-part, three-part, and power factor tariff methods.

Learning Outcomes:

- Students are able to identify the different components of thermal power plants.
- Students are able to identify the different components of nuclear Power plants.
- Students are able to distinguish between AC/DC distribution systems and also estimate voltage drops of distribution systems.
- Students are able to identify the different components of air and gas insulated substations.
- Students are able to identify single core and multi core cables with different insulating materials.
- Students are able to analyze the different economic factors of power generation and tariffs.

Text Books:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd.
2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.

Reference Books:

1. Electrical Power Distribution Systems by - V. Kamaraju, Tata McGraw Hill, New Delhi.
2. Elements of Electrical Power Station Design by – M V Deshpande, PHI, New Delhi.

MANAGEMENT SCIENCE

Course Objectives:

- *To familiarize with the process of management and to provide basic insight into select contemporary management practices**
- *To provide conceptual knowledge on functional management and strategic management.**

Unit I

Introduction to Management: Concept –nature and importance of Management –Generic Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process-Designing organization structure- Principles of organization – Organizational typology- International Management: Global Leadership and Organizational behavior Effectiveness(GLOBE) structure

Unit II

Operations Management: Principles and Types of Management – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and C-chart) Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).

Unit III

Functional Management: Concept of HRM, HRD and PMIR- Functions of HR Manager- Wage payment plans(Simple Problems) – Job Evaluation and Merit Rating - Marketing Management- Functions of Marketing – Marketing strategies based on product Life Cycle, Channels of distributions. Operationlizing change through performance management.

Unit IV

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems)

Unit V

Strategic Management: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy Alternatives. Global strategies, theories of Multinational Companies.

Unit VI

Contemporary Management Practice: Basic concepts of MIS, MRP, Justin- Time(JIT) system, Total Quality Management(TQM), Six sigma and Capability Maturity Model(CMM) Levies, Supply Chain Management , Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.

Course Outcome:

- *After completion of the Course the student will acquire the knowledge on management functions, global leadership and organizational behavior.**
- *Will familiarize with the concepts of functional management project management and strategic management.**

References:**Text Books**

1. Dr. P. Vijaya Kumar & Dr. N. Appa Rao, '*Management Science*' Cengage, Delhi, 2012.
2. Dr. A. R. Aryasri, '*Management Science*' TMH 2011.

References

1. Koontz & Weihrich: '*Essentials of management*' TMH 2011
2. Seth & Rastogi: Global Management Systems, Cengage learning , Delhi, 2011
3. Robbins: Organizational Behaviour, Pearson publications, 2011
4. Kanishka Bedi: Production & Operations Management, Oxford Publications, 2011
5. Philip Kotler & Armstrong: Principles of Marketing, Pearson publications
6. Biswajit Patnaik: Human Resource Management, PHI, 2011
7. Hitt and Vijaya Kumar: Strategic Management, Cengage learning
8. Prem Chadha: Performance Management, Trinity Press(An imprint of Laxmi Publications Pvt. Ltd.) Delhi 2015.
9. Anil Bhat & Arya Kumar : Principles of Management, Oxford University Press, New Delhi, 2015.

ELECTRICAL MACHINES – I LABORATORY

Learning objectives:

- To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- To control the speed of the DC motors.
- Determine and predetermine the performance of DC machines.
- To predetermine the efficiency and regulation of transformers and assess their performance.

Any 10 of the following experiments are to be conducted

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Brake test on DC shunt motor. Determination of performance curves.
3. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
4. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
5. Speed control of DC shunt motor by Field and armature Control.
6. Retardation test on DC shunt motor. Determination of losses at rated speed.
7. Separation of losses in DC shunts motor.
8. Oc& SC test on single phase transformer.
9. Sumpner's test on single phase transformer.
10. Scott connection of transformers
11. Parallel operation of Single phase Transformers
12. Separation of core losses of a single phase transformer
13. Heat run test on a bank of 3 Nos. of single phase Delta connected transformers

Learning outcomes:

- To determine and predetermine the performance of DC machines and Transformers.
- To control the speed of DC motor.
- To achieve three phase to two phase transformation.

ELECTRONIC DEVICES AND CIRCUITS LAB

Note: The students are required to perform the experiment to obtain the V-I characteristics and to determine the relevant parameters from the obtained graphs.

Electronic Workshop Practice:

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Coils, Gang Condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of active devices, Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT.
3. Soldering Practice- Simple circuits using active and passive components.
4. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. P-N Junction Diode Characteristics
Part A: Germanium Diode (Forward bias & Reverse bias)
Part B: Silicon Diode (Forward Bias only)
2. Zener Diode Characteristics
Part A: V-I Characteristics
Part B: Zener Diode as Voltage Regulator
3. Rectifiers (without and with c-filter)
Part A: Half-wave Rectifier
Part B: Full-wave Rectifier
4. BJT Characteristics (CE Configuration)
Part A: Input Characteristics
Part B: Output Characteristics
5. FET Characteristics (CS Configuration)
Part A: Drain Characteristics
Part B: Transfer Characteristics
6. SCR Characteristics
7. UJT Characteristics
8. Transistor Biasing
9. CRO Operation and its Measurements
10. BJT-CE Amplifier
11. Emitter Follower-CC Amplifier

12. FET-CS Amplifier

Equipment required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components