

## **EA3220: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS**

**UNIT I:– Philosophy Of Measurement:** Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.

**Analog Measurement of Electrical Quantities:** Electrodynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electrodynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter.

**UNIT II: Instrument transformers:** Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.

**UNIT III: Measurement of Parameters:** Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

**UNIT IV: AC Potentiometer:** Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement

**Magnetic Measurement:** Ballistic Galvanometer, flux meter, determination of hysteresis loop, Measurement of iron losses.

**UNIT V: Digital Measurement of Electrical Quantities:** Concept of digital measurement, block Diagram, Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.

### **Text Book:**

1. E.W. Golding & F.C. Widdis, “Electrical Measurement & Measuring Instrument”, A.W. Wheeler & Co. Pvt. Ltd. India.
2. A.K. Sawhney, “Electrical & Electronic Measurement & Instrument”, Dhanpat Rai & Sons, India.

### **Reference Books:**

1. Forest K. Harries, “Electrical Measurement”, Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, “Basic Electrical Measurement”, Prentice hall of India, India.
3. W.D. Cooper, “Electronic Instrument & Measurement Technique”, Prentice Hall International.
4. Rajendra Prashad, “Electrical Measurement & Measuring Instrument”, Khanna Publisher.
5. J.B. Gupta, “Electrical Measurements and Measuring Instruments”, S.K. Kataria & Sons.

## **EA3230: ELECTROMECHANICAL ENERGY CONVERSION-I**

**Unit – 1 : Principles of Electro-mechanical Energy Conversion:-** Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque Generated emf in machines; torque in machines with cylindrical air gap .

**Unit – 2 : D.C. Machines:-** Construction of DC Machines, Armature winding, Emf and torque equation Armature Reaction, Commutation, Interpoles and Compensating Windings, Performance Characteristics of D.C. generators.

**Unit –3: D.C. Machines (Contd.):-** Performance Characteristics of D.C. motors, Starting of D.C. motors; 3-point and 4-point starters, Speed control of D.C. motors: Field Control, armature control and Voltage Control (Ward Leonard method); Efficiency and Testing of D.C. machines (Hopkinson’s and Swinburne’s Test).

**Unit –4 : Review of Single Phase Transformer:** Phasor diagram, efficiency and voltage regulation, all day efficiency, Testing of Transformers: O.C. and S.C. tests, Sumpner’s test, polarity test.  
Auto Transformer: Single phase and three phase auto transformers, volt-amp relationship, efficiency, merits & demerits and applications.

**Unit –5: Three Phase Transformers:** Construction, three phase transformer phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers.

### **Text Books:**

1. P.S.Bhimbra, “Electrical Machinery”, Khanna publication India
2. I.J. Nagrath & D.P.Kothari, “Electrical Machines”, Tata McGraw Hill

### **Reference Books:**

1. Charles Gross, Electric Machines, T & F, Delhi
2. A.E. Fitzgerald, C.Kingsley Jr & Umans, “Electric Machinery” ,6th Edition, McGraw Hill, International Student Edition.
5. Sen , “Principles of Electric Machines and Power Electronics”, 2nd edition, Wiley India

**UNIT-I:**

Special Diodes- LED, Varactor diode, Photo diode, Schottky diode, Tunnel diode; their characteristics and applications. Transistors as a switch.

**UNIT-II**

Frequency Response: Amplifier transfer function, low and high frequency response of common emitter and common source amplifiers.

Feedback: General feedback structure; properties of negative feedback; series-series, series-shunt, shunt-series and shunt-shunt feedback amplifiers.

**UNIT-III:**

Basic principle of sinusoidal oscillator, R-C Phase Shift and Wein Bridge oscillators, tuned oscillators- Collpits and Hartley; Crystal oscillator

**UNIT-IV**

Combinational Logic Circuits: Multiplexers/Demultiplexers, Encoders/Decoders. Sequential Logic Circuits: latches, flip-flops- S-R, T, D, J-K.

Shift Registers: Basic principle, serial and parallel data transfer, shift left/right registers, universal shift register.

Counters: Mode N Counters, ripple counters, synchronous counters, ring/Johnson counters.

**UNIT-V**

OP-AMP applications – Astable, Monostable and Bistable multivibrators, Schmitt trigger, IC555 Timer, A/D and D/A converters.

Voltage Regulators: Series, shunt and switching regulators, op-amp based configurations.

Memories: Introduction to ROM, RAM; Sequential Memory, Memory organization.

**Text Books:**

1. A.S. Sedra and K.C. Smith "Microelectronics Circuits" Oxford University Press ( India)
2. Malvino & Leach, "Digital Principles and applications" Tata Mc. Graw Hill
3. R.A. Gayakwad "Op amps and Linear Integrated Circuits" Prentice Hall of India.
4. Balbir Kumar and Shail B.Jain, "Electronic Devices and Circuits" Prentice Hall of India,2007

**Reference Books:**

1. Taub & Schilling "Digital Electronics"- Tata Mc Graw Hill
2. Anil K. Maini, "Digital Electronics: Principles and Integrated circuits" Wiley India Ltd, 2008.
3. Millman, J. and Grabel A, "Microelectronics" Mc Graw Hill
4. Anand Kumar, "Switching Theory and Logic Design" Prentice Hall of India, 2008. 5. Alope. K. Dutta, "Semiconductor Devices and circuits", Oxford University Press, 2008.

**UNIT-I**

**Thermodynamics:** Thermodynamic equilibrium, cyclic process, enthalpy, Zero, first and second laws of thermodynamics, carnot cycle, concept of entropy, properties of steam, processes involving steam in closed and open systems, Enthalpy.

**Vapour Pressure Cycles:** Rankine cycle, reheat cycle, Regenerative cycle

**UNIT-II:**

**Steam Turbine :** Classification, impulse and reaction turbines their velocity diagrams and related calculations, work done and efficiencies, re-heat factor, staging, bleeding and governing of turbines.

**Gas Turbine:** Classification, Brayton cycle, working principle of gas turbine, gas turbine cycle with intercooling, reheat and regeneration, stage and polytrophic efficiencies.

**UNIT-III**

**Compressors:** Classification, single and multistage reciprocating compressors, isothermal and volumetric efficiencies, centrifugal and axial flow compressors, surging, choking and stalling.

**I.C. Engines:** Otto, Diesel and Dual cycles, introduction to 2-stroke and 4-stroke SI and CI engines, indicator diagram and power measurement.

**UNIT-IV**

**Hydraulic Turbines:** Classification, heads and efficiencies, construction, working, work done and efficiency of impulse and reaction turbines.

**Reference Books:**

1. P.L.Ballany "Thermal Engineering", Khanna Publishers, 2003
2. R.K.Bansal "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications, 2006.
3. Onkar Singh "Applied Thermodynamics" New Age International, 2006
4. R.K.Rajput "A Text Book of Hydraulic Machines" S. Chand & Co., 2008.

**Note: Minimum eight experiments are to be performed from the following list. The department may add 3 to 4 more experiments in the following list.**

1. Verification of principle of superposition with dc and ac sources.
2. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits
3. Verification of Tellegen's theorem for two networks of the same topology
4. Determination of transient response of current in RL and RC circuits with step voltage input
5. Determination of transient response of current in RLC circuit with step voltage input for underdamp, critically damp and overdamp cases
6. Determination of frequency response of current in RLC circuit with sinusoidal ac input
7. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values
8. Determination of image impedance and characteristic impedance of T and  $\Pi$  networks, using O.C. and S.C. tests Write Demo for the following (in Ms-Power point)
9. Determination of frequency response of a Twin – T notch filter.

### **EA3220: MEASUREMENT LAB**

**Note: Minimum eight experiments are to be performed from the following list. The department may add 3 to 4 more experiments in the following list.**

1. Calibration of ac voltmeter and ac ammeter
2. Measurement of form factor of a rectified sine wave and determine source of error if r.m.s.value is measured by a multi-meter
3. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
4. Measurement of power and power factor of a single phase inductive load and to study effect of capacitance connected across the load on the power factor
5. Measurement of low resistance by Kelvin's double bridge
6. Measurement of voltage, current and resistance using dc potentiometer
7. Measurement of inductance by Maxwell's bridge
8. Measurement of inductance by Hay's bridge
9. Measurement of inductance by Anderson's bridge
10. Measurement of capacitance by Owen's bridge
11. Measurement of capacitance by De Sauty Bridge
12. Measurement of capacitance by Schering Bridge
13. Study of Frequency and differential time counter

**Note: Minimum eight experiments are to be performed from the following list. The department may add 3 to 4 more experiments in the following list.**

1. To obtain magnetization characteristics of a d.c. shunt generator.
2. To obtain load characteristics of a d.c. shunt generator and compound generator.
3. To obtain efficiency of a dc shunt machine using Swinburne's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine.
5. To obtain speed-torque characteristics of a dc shunt motor.
6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control.
7. To obtain speed control of dc separately excited motor using Conventional Ward-Leonard/ Static Ward –Leonard method.
8. To study polarity and ratio test of single phase and 3-phase transformers.
9. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using O.C. and S.C. tests.
10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.
11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine excitation phenomenon (B.H. loop) of single phase transformer using C.R.O.
13. To perform parallel operation of single phase transformers.

### **FA3290: ANALOG & DIGITAL ELECTRONICS LAB**

**Note: Minimum eight experiments are to be performed from the following list. The department may add 3 to 4 more experiments in the following list.**

1. To Plot V-I characteristics of junction diode and zener diode.
2. To draw wave shape of the electrical signal at input and output points of the half wave, full wave and bridge rectifiers.
3. To Plot input / output characteristics for common base transistor.
4. To Plot input /output characteristics of FET and determine FET parameters at a given operating point.
5. To determine voltage gain, current gain, input impedance and output impedance of common emitter amplifier.
6. To determine voltage gain, current gain, input impedance and output impedance and frequency response of R-C coupled common emitter amplifier.
7. To design R-C Phase shift / Wein Bridge oscillator and verify experimentally the frequency of oscillation.
8. To study transistor as a switch and determine load voltage and load current when the transistor is ON.
9. To study application of Operational Amplifier as summer integrator and voltage comparator
10. To study operation of Op-Amp based astable and monostable multivibrators.
11. To study operation IC 555 based astable and monostable multibrators.
12. To study operation of (a) multiplexer using IC 74150 (b) demultiplexer using IC 74138.
13. To study operation of Adder / Subtractor
14. To study operation of J K Master – slave flip – flop
15. To verify experimentally output of A/D and D/A converters.

### **Unit I. Synchronous Machine I**

Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, Working principle of synchronous generator, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient

### **Unit II Synchronous Machine II:**

Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, Operating characteristics

*Synchronous Motor:* Working principle of synchronous motor, Starting methods, Effect of varying field current at different loads, V-Curves, Hunting & damping, synchronous condenser.

### **Unit III Three phase Induction Machine – I:**

Constructional features, Rotating magnetic field, Principle of operation , Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator

### **Unit IV Three phase Induction Machine- II**

Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without emf injection in rotor circuit.)

### **Unit V Single phase Induction Motor**

Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor. AC Commutator Motors: Universal motor, Single phase a.c. series compensated motor, stepper motors

### **Text Books:**

1. Dr.P.S.Bhimbra, "Electrical Machinery ",Khanna Publishers India
2. D.P.Kothari & I.J.Nagrath, "Electric Machines", Tata Mc Graw Hill

### **Reference Books:**

1. Sen, "Principles of Electrical Machines & Power Electronics", Wiley India
2. O.C. Taylor, "The performance & design of A.C. Commutator Motors", A.H. Wheeler & Co (P) Ltd.