Bhoj Reddy Engineering College for Women, Hyderabad
Department of Electronics and Communication Engineering
Electrical and Electronics Instrumentation

Academic Year: **2016-17** **III B Tech II Semester** Branch: **EEE**

UNIT-I: Introduction to Measuring Instruments

Classification of Measuring Instruments, deflecting, control and damping torques, Ammeters and Voltmeters, PMMC, moving iron type instruments: Construction, Principle of operation and Torque equation, Errors and compensations and Extension of ranges using shunts and series resistance, Electrostatic Voltmeters: Principle of operation and Torque equation, Types: Electrometer Type and Attracted Disc Type and Extension of range of E.S. Voltmeters.

Text Books:

B1: Electrical & Electronics Measurements & Instrumentation, R.K. Rajput, S. Chand and Company Ltd.

B2: Electrical & Electronics Measurements & Instruments, A.K. Sawhney, Dhanpat Rai & Co. Publications.

List of questions:

1) Give the main classifications of electrical instruments along with the definitions with relevant examples.
2) What are the different types of effects used for the operation of instruments?
3) What are the essentials torqueing for the secondary instruments?
4) Give two differences between MC and MI instruments.
5) Draw and explain the PMMC instrument construction along with operation
6) Draw and explain the MI attraction instrument construction along with operation.
7) Draw and explain the idio-static and hetero static instruments construction along with operation. Derive the torque equation.
8) Derive the torque equation of PMMC instruments.
9) Derive the torque equation of MI instruments.
10) Derive the expression for the shunt and multiplier for extension of the range of PMMC.
11) A moving-coil instrument gives full scale deflection. For a current of 10 mA. the resistance of the instrument is 20 ohms, calculate the approximate value of series resistance needed to enable the instrument to measure up to (a) 20 V (b) 100 V(c) 250 V
12) A meter of resistance 50 ohms has a full scale deflection of 4 mA. Determine the value of shunt resistance required in order that full scale deflection should be (a) 15 mA (b) 20 A (c) 100 A
13) A moving-coil instrument has a full scale deflection of 20 mA and a resistance of 25 ohms. Calculate the values of resistance required to enable the instrument to be used (a) as a 0–10 A ammeter and (b) as a 0–100 V voltmeter. State the mode of resistance connection in each case.
14) A PMMC instrument has a coil dimensions 15mm*12mm. the flux density in the air gap is 1.8 mWb/mm and the spring constant 0.14micro N-m/rad. Determine the

number of turns required to produce an angular deflection of 90degrees when a current of 5mA is flowing through the coil.

UNIT-II: Potentiometers and Instrument Transformers

Introduction to Potentiometers Crompton's Potentiometer: Construction and operation Standardization of D.C Crompton's Potentiometer, Measurement of unknown current, voltage, resistance and power Introduction to A.C. Potentiometers, Standardization and Applications of A.C Potentiometers.

Introduction to Instrument Transformers, Ratios of Instrument Transformers, CT and PT: Phase angle and Ratio errors.

Text Books:

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B2: Electrical & Electronics Measurements & Instruments, A.K. Sawhney, Dhanpat Rai & Co. Publications.

List of questions:

1) Draw the circuit diagram for calibration of ammeter using DC Crompton potentiometer.
2) Draw the circuit diagram for calibration of voltmeter using DC Crompton potentiometer.
3) Draw the circuit diagram for measurement of resistance using DC Crompton potentiometer.
4) Draw the circuit diagram for measurement of power using DC Crompton potentiometer.
5) Define potentiometer and explain the operation of DC Crompton potentiometer with neat sketch.
6) Draw and explain the operation of Drysdale potentiometer.
7) Draw and explain the operation of gal Tinsley potentiometer.
8) Give and explain the applications of AC Crompton potentiometer.
9) Distinguish between DC and AC potentiometer.
10) Explain the process of standardization for DC Crompton potentiometer.
11) Explain the measurement of resistance and power using DC Crompton potentiometer.
12) The potentiometer is operated in conjunction with volt-ratio box; the voltage measured by potentiometer is 0.86 with full scale deflection of 1.6 v. Determine the reading of potentiometer for the range of 75v, 150v, 300v.
13) A simple slide wire is used for measurement of current in the circuit. the voltage across standard resistor of 0.1 ohm is at 75cm. Find the magnitude of current if the standard cell emf if 1.45v is balanced at 50 cm.
14) For the volt-ratio the input and output voltages are 100v and 2v. If the volt-ratio box is of (r1+r2) with 10m ohms. Determine the r1 and r2 values.

15) Calculate the inductance of coil from the following measurement of ac potentiometer.
    Voltage across 0.1-ohm standard resistor in series with coil is 0.613 with 12.6 deg.
    Voltage drop across test coil through 100/1 volt-ratio box is 0.718 with 50.48 deg.
16) Calculate the impedance of the coil voltage across 1-ohm standard resistor in series with coil is 0.238v and -0.085 v are in phase and quadrature voltage respectively
    Voltage drop across test coil through 10/1 volt-ratio box is 0.3375 and 0.232v are in phase and quadrature voltage respectively

UNIT-III: Measurement of Power and Energy

Introduction to the measurement of Power, Construction of Single Phase dynamometer wattmeter, Expression for deflecting and control torques, Errors and compensations, LPF Wattmeter, Extension of range of wattmeter using instrument transformers, Double element and Three element dynamometer wattmeter, Measurement of reactive and active in balanced and Unbalanced Systems

Construction of Single phase induction type energy meter, Driving and Braking torques, Errors and compensations, Testing by Phantom loading & R.S.S. Meter, Three Phase Energy Meter, Tri-vector meter and Maximum demand meters.

Text Books:
B1: Electrical & Electronics Measurements & Instrumentation, R.K. Rajput, S. Chand and Company Ltd.
B2: Electrical & Electronics Measurements & Instruments, A.K. Sawhney, Dhanpat Rai & Co. Publications.

List of questions:

1) Draw and explain the construction and operation of electro- dynamometer wattmeter.
2) What are the errors occurring in the electrodynamometer type Wattmeter and how to compensate these errors.
3) Derive the expression for power factor angle in two wattmeter method for measurement of power.
4) Draw and explain the construction and operation of 2 element wattmeter.
5) Draw and explain the construction and operation of var meter.
6) Prove the power statement in three-phase circuits using two wattmeter methods for unbalanced load.
7) Draw and explain the operation induction type energy meter.
8) Draw and explain the operation of maximum demand meter.
9) Explain the different type adjustments made for smooth working of energy-meter.
10) Draw and explain the two element energy-meter
11) In the two wattmeter method readings are 2000w and 500w respectively. Find the power factor of circuit.
    when the both the readings are positive
    If one of the wattmeter is obtained by interchanging terminals.

12) In the two wattmeter method readings are 7500w and-1500w respectively. Find the power factor of circuit.
    find the power factor of the circuit
    If the voltage is 400v, what is the capacitance must be added such that only one wattmeter reads total power.
13) A 3-ph motor load has power factor of 0.4. The reading of total input is 3-kw. Hence calculate reading of each wattmeter.
14) A wattmeter has a **cc** of 0.1ohm resistance and pc of 6500 ohms resistance. Calculate the percentage in measurement.
    12a, 250v with unity power factor.
    12a, 250v with 0.4 power factor.
15) The cc of wattmeter connected in series with ammeter and inductive load. A voltmeter and pc are connected in parallel with 100hz supply. The readings are 4.5a, 240v and 23w.pc is of r = 2000 ohms and l = 10mh. What is the error in the measurement?
16) A wattmeter is rated at 10a 25v the cc is of (0.06+0.02j). The pc is purely resistive of 6250 ohms. Find the error due to two different types of connections. The load is 10a at a power factor of 0.174 lagging. the voltage across load is 25v
17) The cc of wattmeter connected in series with ammeter and inductive load. A voltmeter and pc are connected in parallel with 100hz supply. the readings are 4.5a, 240v and 23w.pc is of r = 2000 ohms and l = 10mh

UNIT-IV: DC & AC Bridges

Classification of Resistance: Methods of Measuring Medium Resistance, Sensitivity of wheat stone's bridge, Methods of Measuring Low Resistance, Carey foster's bridge, Kelvin's double bridge, Difficulties of Measuring High Resistance, Methods of Measuring High Resistance

Introduction to A.C Bridges, Measurement of Inductance and Q-Factor: Maxwell's Bridge, Hay's Bridge, Anderson Bridge and Owen's Bridge, Measurement of Capacitance and loss angle: De-sauty's Bridge, Schering Bridge and Measurement of frequency: Wien's bridge.

Text Books:

B1: Electrical & Electronics Measurements & Instrumentation, R.K. Rajput, S. Chand and Company Ltd.
B2: Electrical & Electronics Measurements & Instruments, A.K. Sawhney, Dhanpat Rai & Co. Publications.

List of questions:

1) Explain the method of volt-amp for measurement of resistance.
2) Explain the method of substitution method for measurement of resistance
3) Draw and derive the expressions for unknown resistance using wheat stone bridge.
4) In the Wheatstone bridge p= 1000 ohms, q = 100 ohms, r = 2005 ohms and s = 200 ohms. the battery has an emf of 5v. The galvanometer has a current sensitivity of 100mm/ micro amp and internal resistance of 100 ohms. Calculate the current through galvanometer and sensitivity of bridge
5) Draw and derive the expression for unknown resistance using Kelvin double bridge
6) Draw and explain the operation of megger circuit.

7) In a carey foster bridge a resistance of 1.0125 ohms is compared with standard resistance of 1.0000 ohms, the slide wire has a resistance of
8) 0.250 ohms in 100 divisions. the ratio arms nominally each 10 ohms, are actually 10.05 and 9.95 ohms. Slide wire is of 100 cm. find the position of balance.
9) Draw and explain loss of charge method.
10) Explain the basic construction of bridge.
11) Draw and derive the known parameters from Maxwell's inductance- capacitance bridge.
12) Draw and derive the known parameters from HAY'S bridge.
13) Draw and derive the known parameters from ANDERSON'S bridge.
14) Draw and derive the known parameters from OWEN'S bridge.
15) Draw and derive the known parameters from DE-SAUTY'S bridge.
16) Draw and derive the known parameters from CAMPBELL'S bridge.
17) Draw and derive the known parameters from WEIN'S bridge.
18) Draw and derive the known parameters from SCHERING bridge.
19) Draw and derive the known parameters from MAXWELL'S INDUCTANCE bridge.
20) In the volt-ampere method the voltmeter and ammeter readings are 180V and 2A for the second type of connections. Find the error in the measurement.
21) In the Wheatstone bridge p= 1000 ohms, q = 100 ohms, r = 2005 ohms and s = 200 ohms. The battery has an emf of 5v. the galvanometer has a current sensitivity of 100mm/ micro amp and internal resistance of 100 ohms. Calculate the current through galvanometer and sensitivity of bridge.
22) The values of resistors in wheat stone bridge are P = R = 1k ohms, S == 5k ohms, G = 100 ohms, derive the bridge
23) In the given bridge
    Arm ab = l_1 with r_1 in series with r_1
    Arm ad = 47.8 mh in series with 32.7 ohms
    Arm bc = 100 ohms
    Arm cd = 100 ohms
    If balance is obtained for r_1 = 1.36 ohms calculate l_1 and r_1.
    Find the unknown parameters.
    Find the unknown parameters.
24) In the given bridge
    Arm ab = 200 ohms in parallel 1 micro f
    Arm ad = r_2 in series with 2 micro f.
    Arm bc = 400 ohms
    Arm cd = 1000 ohms
    Find the unknown parameters.
25) In the given bridge
    Arm ab = c_1 in series with r_1
    Arm ad = 5.2 ohms in series with 0.5 micro f
    Arm bc = 2000 ohms
    Arm cd = 2850 ohms
    Find the unknown parameters.

UNIT-V: Transducers and Oscilloscopes

Definition and Classification of Transducers, Advantages of Electrical Transducers, Characteristics and choice of Transducer, Principle operation of LVDT and applications, Principle operation of Capacitor Transducers, Strain gauge and its principle of operation, Gauge Factor, Piezoelectric Transducers, Thermistors, Thermocouples, Photovoltaic, Photo conductive diodes and photo diodes.

Cathode Ray Oscilloscope, Cathode Ray Tube, Time base generator, Horizontal and Vertical amplifiers, CRO Probes, Applications of CRO, Measurement of Phase and Frequency, Lissajous patterns.

Text Books:

B1: Electrical & Electronics Measurements & Instrumentation, R.K. Rajput, S. Chand and Company Ltd.

B2: Electrical & Electronics Measurements & Instruments, A.K. Sawhney, Dhanpat Rai & Co. Publications.

List of questions:

1) Draw the block diagram of a general purpose CRO and explain the functions of the following controls.
    a. Intensity (ii) focus (iii) horizontal and vertical positions (iv) synchronization
2) What the different types of amplifiers used for CROs? Describe the basis on which they are classified
3) Describe the principle of working and circuit diagram of digital oscilloscope
4) Describe how the following measurements can be made with the use of CRO (i) Frequency and (ii) phase
5) Explain the principle and working of a dual trace oscilloscope
6) With the help of neat diagram, explain the functioning of delay lines
7) Explain the construction and working of thermistors
8) Explain the principle of resistive transducer
9) Explain the principle of capacitive transducer
10) Explain the principle of inductive transducer
11) Explain the construction and working of resistance thermometer
12) Explain the construction and working of LVDT with a neat sketch
13) Explain the construction and working of piezo-electric transducers
14) Explain the measurement of angular velocity using D.C tachometer generator.
15) A CRT has anode voltage of 2000V and parallel deflecting plates 1.5 cm long and 5 mm apart. The screen is 50 cm from the centre of the plates. Find i) beam speed (ii) deflection sensitivity (iii) deflection factor of the tube
16) Explain in detail the different types of CRO probes
17) A CRT has anode voltage of 2000V and parallel deflecting plates 2 cm long and 5 mm apart. The screen is 30 cm from the centre of the plates. Find the input voltage required to deflect the beam through 3 cm. The input voltage is applied to the deflecting plates through amplifiers having an overall gain of 100.
18) An electro statically deflected cathode ray tube has plane parallel deflecting plates which are 2.5cm long and 0.5cm apart, and the distance from their centre to the

screen is 20cm. The electron beam is accelerated by a potential difference of 2500v and is projected centrally between the plates. Calculate the deflecting voltage required to cause the beam to strike a deflecting voltage and find the corresponding deflection of the screen

19) Explain the classification of transducer in detail
20) Describe the following for a transducer (i) Input characteristics (ii) Transfer characteristics(iii) Output characteristics