

**ELECTRICAL & ELECTRONIC MEASUREMENT
(ELEC 2103)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) A set of readings has a wide range and therefore it has
 - (a) low precision
 - (b) high precision
 - (c) high accuracy
 - (d) low accuracy
- (ii) Electrostatic instrument is suitable to measure
 - (a) high current
 - (b) low voltage
 - (c) high voltage
 - (d) low current
- (iii) In an electrodynamicometer type wattmeter
 - (a) the current coil is made fixed
 - (b) the pressure coil is fixed
 - (c) any of the two coils can be made fixed
 - (d) both the coils should be movable
- (iv) The Maxwell's Inductance-Capacitance bridge is not suitable for the measurement inductance of coil if the Q factor is
 - (a) less than 1 only
 - (b) greater than 10 only
 - (c) less than 1 and greater than 10 both
 - (d) Between 1 to 10
- (v) The role of the permanent magnet in a megger is to _____
 - (a) generate power
 - (b) provide voltage
 - (c) balance the circuit
 - (d) provide field
- (vi) Linear ramp technique is based on _____
 - (a) voltage measurement
 - (b) time measurement
 - (c) current measurement
 - (d) time measurement
- (vii) If δ is the loss angle then the dissipation factor is given by
 - (a) $\sin \delta$
 - (b) $\cos \delta$
 - (c) $\tan \delta$
 - (d) $\cot \delta$

- (viii) Phantom loading for testing of energy meter is used
(a) to isolate current and potential circuit
(b) for meter having low current rating
(c) for meter having high current rating
(d) none of the above
- (ix) A 0-300V voltmeter has an error of $\pm 2\%$ of full scale deflection. What would be the range of readings if true voltage is 30V?
(a) 24V-36V (b) 29.4V-30.6V
(c) 20V-40V (d) 28V-32V
- (x) Frequency can be measured by using
(a) Maxwell's bridge (b) Schering bridge
(c) Hay's bridge (d) Wien bridge

Group – B

2. (a) Compare a permanent magnet moving coil (PMMC) instrument with a dynamometer type instrument on the basis of their operation and application.
- (b) Why controlling torque is necessary in an analog indicating instrument? What would happen in the absence of a controlling torque?
- (c) A permanent magnet moving coil instrument has a coil of dimension 15mm x 12mm. The flux density in the air gap is 1.8×10^{-6} Nm/rad. Determine the number of turns required to produce an angular deflection of 90° when a current of 5mA is flowing through the coil.

5 + 3 + 4 = 12

3. (a) Derive the equation for deflection of an electrodynamic instrument.
- (b) In an electrodynamic instrument the total resistance of the voltage coil circuit are 8Ω and the mutual inductance changes uniformly from $-173\mu\text{H}$ at zero deflection to $+175\mu\text{H}$ at full scale, the angle of full scale being 95° . If a potential difference of 100V is applied across the voltage circuit and a current of 3A at a power factor of 0.75 is passed through the current coil, what will be the deflection? The spring control constant is 4.63×10^{-6} N-m/rad.
- (c) Define accuracy and precision.

5 + 5 + 2 = 12

Group – C

4. (a) A wattmeter has a current coil of 0.03Ω resistance and a pressure coil of 6000Ω resistance. Calculate the percentage error if the wattmeter is so connected that:
(i) the current coil is on the load side, (ii) the pressure coil is on the load side, if the load takes 20A at a voltage of 220V and 0.6 power factor in each case.
- (b) What is creeping? How is it avoided?

- (c) How friction compensation is done in an induction type energy meter?

5 + (2 + 2) + 3 = 12

5. (a) Draw the equivalent circuit and phasor diagram of a potential transformer (PT).
(b) Define ratio error and phase angle error in current transformer (CT).
(c) A current transformer with a bar primary has 300 turns in its secondary winding. The resistance and reactance of the secondary circuit are 1.5Ω and 1Ω respectively including the transformer winding. With 5 A flowing in the secondary winding, the magnetizing m.m.f is 100 AT and the iron loss is 1.2 watt. Determine the ratio error.

4 + 4 + 4 = 12

Group – D

6. (a) Draw and derive the balance equations for Schering bridge. Draw the phasor diagram under balance conditions.
(b) A Maxwell's capacitance bridge is used to measure an unknown inductance in comparison with capacitance. The various values at balance: $R_2 = 400\Omega$, $R_3 = 600\Omega$, $R_4 = 1000\Omega$, $C_4 = 0.5\mu\text{F}$. Calculate the values of R_1 and L_1 . Calculate also the value of storage (Q) factor of coil if frequency is 1000 Hz.

(2 + 3 + 3) + 4 = 12

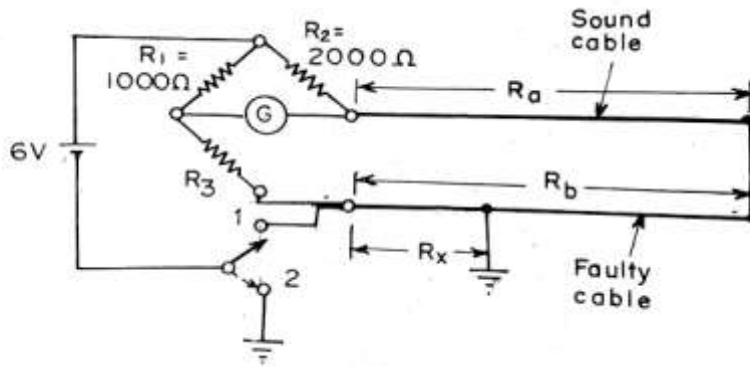
7. (a) Write the functions of the following when the test terminals are open in a megger:
(i) Current coil (ii) Pressure coil
(b) Explain various application of DC potentiometer.
(c) A basic potentiometer has 200 cm slide wire with a resistance of 100 ohm. A 4 V battery in series with a variable resistance R_1 provides current through the slide wire. The standard cell potential is 1.018 V and the potentiometer is calibrated when the sliding contact is set to 101.8 cm from the zero voltage end of the slide wire.
(i) Calculate R_1 and the current through R_1
(ii) Determine the measured voltage when zero galvanometer deflection is obtained with the slide rule at 94.3 cm from the zero voltage end.

2 + 4 + 6 = 12

Group – E

8. (a) Draw and describe the block diagram of dual slope integrating type digital voltmeter.
(b) A Wheastone bridge is connected for a Varley Loop test. When the switch is in position 1 the bridge is balanced with $R_1 = 1000\Omega$, $R_2 = 2000\Omega$, $R_3 = 100\Omega$. When

switch is in position 2 the bridge is balanced with $R_1=1000\Omega$, $R_2= 2000\Omega$, $R_3= 99\Omega$. If the resistance of the earthed wire is $0.15\Omega/\text{Km}$, how many metres from the bridge have the ground fault occurred.



6 + 6 = 12

9. (a) The reference voltage of a dual slope ADC is 5 V. The integrator has a capacitor of $1\mu\text{f}$ and resistance of $100\text{ k}\Omega$. The time taken to read an unknown voltage V_x is 0.2 seconds. Find V_x .
- (b) Explain with the help of a block diagram, the various parts of an electronic multimeter.

6 + 6 = 12

Department & Section	Submission Link
EE regular students	https://classroom.google.com/c/MTIxOTkwOTkyOTkz/a/MjcxNTgzODE1NDY2/details
EE backlog students	https://classroom.google.com/c/MjQ4ODk2ODE4NzMw/a/MjcxNTg4MzQxMjc5/details