2022

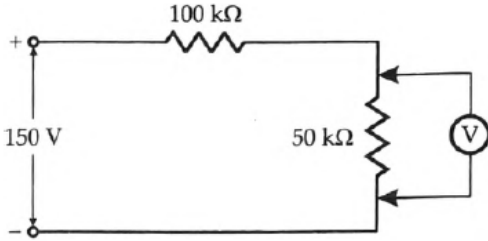### ELECTRICAL AND ELECTRONIC MEASUREMENTS

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	Explain the working principle of a permanent magnet moving coil instrument.	6
	b)	What are the operating forces that act on a measuring instrument? Briefly explain each of them.	6
	c)	What is electromagnetic damping? The coil of a moving coil galvanometer has 300 turns and is suspended in a uniform magnetic field of 0.1 Wb/m^2 . The control constant is 0.2 x 10^6 N-m/rad. The coil is 20 mm wide and 25 mm high, with a moment of inertia of 0.15 x 10^{-6} kg-m^2. If the galvanometer resistance is 200 Ω, calculate the value of the resistance which, when connected in the galvanometer terminals, will give critical damping. Assume the damping as purely electromagnetic.	2+6=8
2.	a)	With the help of diagram show how does a galvanometer work as an ammeter? Derive the expression of multiplying power of ammeter.	2+3=5
	b)	What are the essential requirements of a multiplier resistor in voltmeter circuit? It is desired to measure the voltage across a 50 Ω resistor in the circuit below. Two voltmeters are available for this purpose: Voltmeter A with a sensitivity of 1000 Ω /V and Voltmeter B with a sensitivity of 20,000 Ω /V. Calculate (a) the reading of each voltmeter and (b) the error in each reading expressed as a percentage of true value, if both the voltmeter has a range of 0-50 V. 	2+6 = 8

	c)	Explain the working principle of electrostatic type instrument. Derive the equation of force in electrostatic instrument.	3+4=7
3	a)	Electrodynamometer type instrument is widely used for the measurement of which parameter? Whether it works for DC as well as AC inputs? How torque is developed in electrodynamometer type instrument? Write the advantages and disadvantages of such instruments.	1+1+5+2=9
	b)	With the help of circuit diagram write the constructional details of single phase induction type energy meter. Briefly describe the operating principle of single phase induction type energy meter.	6+5=11
4	a)	What are the ranges of resistance values for low and medium resistors? How ammeter-voltmeter method can be used for measurement of unknown resistance? With the help of circuit diagram show how a Kelvin's bridge can be used for low resistance measurement.	2+4+5=11
	b)	What are the issues faced in the measurement of high resistance measurement? How loss-charge method can be used for high resistance measurement? How many coils are used in Megger? To which coil, deflecting pointer is connected?	3+4+2 = 9
5	a)	Derive the expression of unknown inductance of Maxwell's inductance bridge. Also draw the phasor diagram of the currents and voltages.	5+2=7
	b)	Which bridges can be used for measurement of capacitance? Derive the expression of unknown capacitance in any one of the bridge and draw the necessary phasor diagram.	1+5+2=8
	c)	A Maxwell's capacitance bridge as shown below is used to measure an unknown inductance in comparison with capacitance. The various values at balance, $R_2 = 400\ \Omega$; $R_3 = 600\ \Omega$; $R_4 = 1000\ \Omega$; $C_4 = 0.5\ \mu F$. Calculate the values of R_1 and L_1. Calculate also the value of storage (Q) factor of coil if frequency is 1000 Hz. 	5
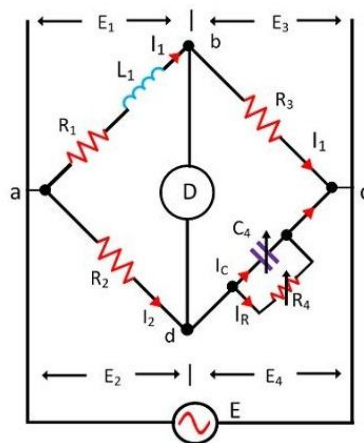
6	a)	What do you mean by storage and dissipation factors? What is the total inductance between two coils connected in series opposite? Draw the circuit diagram of a Heaviside mutual inductance bridge and derive the expression of mutual inductance?	2+2+5=9
	b)	What are the sources of errors in bridge circuits? How stray conductance effect in bridge circuits can be eliminated? Show how Wien's bridge can be used for the measurement of frequency of a power supply?	2+2+7=11
7	a)	What are the advantages of digital meters over the analog meters? Describe the working of a ramp type digital voltmeter.	2+7=9
	b)	What is basic difference between CRO and DSO? With the help of block diagram, explain the function of the components of a CRO.	1+10 =11