Ref No: Ex/EE/PC/B/T/214/2024

B.E.E. 2ND YEAR 1ST SEMESTER EXAMINATION, 2024

SUBJECT: - ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Time: Three hours **Full Marks 100**

(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART-I	Marks
	Answer any 3, 2 marks for well-organized answers (16 X 3 + 2 = 50)	
1.	**Justify and/or correct the following statements with proper explanations (any four):**	(4X4=16)
a)	***Gauge factor*** and ***Transverse sensitivity*** of strain gauges should be as high as possible.	
b)	Series and Shunt type ohmmeters can be identified form their scales.	
c)	A metal link is used between the current and potential coils of the wattmeter during calibration using the "Phantom Loading" arrangement.	
d)	Low resistances are made with four terminals.	
e)	Guard wires/rings are not usually required for high resistance measurement.	
2. a)	Explain Price's Guard wire method of measurement of cable insulation resistance with proper circuit connections. What precautions are to be taken at the moment of energization (supply ON) for the measurement circuit?	6 2
b)	A series type ohmmeter has a moving system with 60 Ω internal resistance (R_m). If the full-scale deflection current is 1.2 mA, internal supply battery voltage is 3 V and the desired scale marking for half-scale deflection is 1500 Ω, determine (i) Series resistance (R_{se}) and shunt resistance (R_{sh}) (ii) maximum value of R_{sh} to compensate for 10% drop in battery voltage (iii) error at the half scale mark when R_{sh} is set at a value obtained in (ii).	2+3+3
3. a)	Describe separation of iron loss components of a specimen of magnetic material using Lloyd Fisher Square. How the corrections for various sources of copper losses in the primary and in the secondary sides of the measurement setup are applied?	6 4
b)	In magnetic loss test of a specimen of magnetic material of total weight 10 kg, the measured values of iron loss at a given peak flux density were 36 watt at 40 Hz and 78 watt at 60 Hz. Estimate hysteresis and eddy current losses in Watt/kg at 50 Hz for the same peak flux.	6
4. a)	How does the ambient temperature variation affect the measurement accuracy in strain gauges? What is the use a dummy gauge in this context?	2+2

[Turn over

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b)	Derive bridge sensitivity in such a condition for Wheatstone bridge method based strain measuring system using one active and one dummy gauges.	6
c)	The four arms of a Wheatstone bridge at balance under alternating current (A.C.) excitation are: arm AB an unknown inductance L_1 having an equivalent resistance R_1; arm BC a non-inductive resistance of 100Ω; arm CD a capacitance of 0.5μF in parallel with a resistance 100Ω; arm DA a resistance of 1000Ω. The source is connected to A and C and the detector is connected between B and D. Derive the equations for balance and find the values of R_1 and L_1.	6
5.	Write short notes on ***any two***	2X8=16
a)	Cold junction compensation for thermocouple circuits	
b)	Megger insulation tester	
c)	Loss of Charge method for high resistance measurement	

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B.E. ELECTRICAL ENGINEERING 2ND YEAR 1ST SEMESTER EXAMINATION

SUBJECT: - ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Full Marks 100
(50 marks for each part)

Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions	PART- II	Marks
1.	*Answer questions as per the directives associated.* [CO1-K1] Fill up the following table with crisp statement(s) and justify in favour of your comments:	10

Type of Instrument	Number and type of coils present	Nature of signals (AC / DC) to which instrument responds	Nature of scale
PMMC			
Electrodynamometer			
Moving Iron			

OR

Describe the constructional features of various types of frequency measuring instruments with proper diagram.	10
2. [CO2-K2] How do you decide the type of connections required for the coils of an electrodynamometer type instrument to measure the power consumed by a load when the load operates at different voltages and currents and power factors?	10
OR	
What do you mean by logarithmic damping? What does it signify? Derive expressions of logarithmic damping for indicating instruments.	10

3.	Answer any FOUR: [CO3-K3]	4x5=20

(a) A 1000/5A Current Transformer (CT) has primary turns of 2 and secondary turns of 396. The secondary impedance of the CT is 0.1 + j0.4 ohm. The burden connected to secondary consists of a resistance of 0.12 ohm and an inductive reactance of 0.18 ohm. The ampere-turns to supply excitation and to iron losses are 10AT and 4AT, respectively. When secondary current of the CT is 6A, determine its:

(i) The ratio error

(ii) The phase angle

(b) In reference to circuit shown in Fig-A,

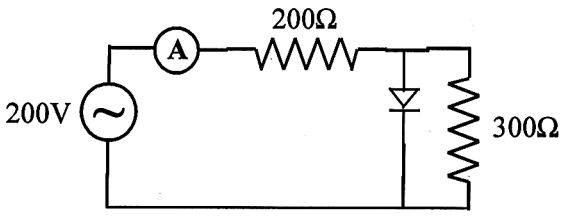

Fig-A.

Find the reading of the PMMC ammeter. The diode connected in the circuit is an ideal one.

c) A current of 4 mA is passed through a moving coil galvanometer. Find the steady state deflection in degree and also the deflection on a scale placed 1 m away from the mirror. Also find the external critical damping resistance (CDRX) of the galvanometer when the open circuit relative damping is 0.1. The following design data of the galvanometer are given:

Height of the coil = 4.0 cm

Width of the coil = 1.5 cm

No. of turns of the coil = 120

Resistance of meter coil = 10 ohm

	Flux density in the airgap = 0.15 wb-m^{-2} Moment of inertia of moving system = $30x10^{-8}$ Kg-m^2 Stiffness constant of suspension = $25x10^{-6}$ N-m-rad^{-1}. d) An electrodynamometer type wattmeter is used to measure power in a single phase circuit. The load voltage and load current are 220V and 10A and the load is supposed to operate at 0.8 power factor. The pressure coil circuit has a resistance of 2KΩ and an inductance of 100mH. Estimate the percentage error in the reading of wattmeter. The operating frequency is 50Hz. e) A non-sinusoidal periodic voltage is applied to a load whose power consumption P is measured by an electrodynamometer type wattmeter through its usual connection. Find the expression of P in terms of appropriate quantities. State your assumptions clearly.	
4.	Answer any TWO. [CO4-K4] a) How is the error of wattmeter affected due to the presence of solid metal parts in its construction? b) What happens if an AC signal is applied to the coil of a PMMC instrument? c) How do you make the performance of a ammeter free from the effect of temperature variation?	2x5=10