Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

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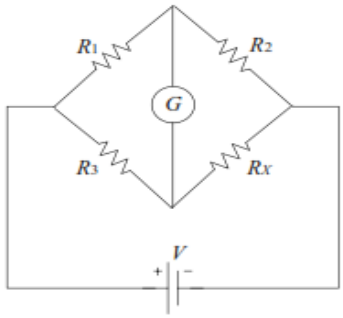
Programme Name: B.Tech/ Electrical **Semester : V**
Course Name : Measurement & Instrumentation **Time : 03 hrs.**
Course Code : EPEG3009 **Max. Marks : 100**
Nos. of page(s) : 4

SECTION A

1. Each Question will carry 5 Marks
2. Instruction: Complete the statement / Select the correct answer(s)

S. No.	Question	CO
Q.1	**A. Which of the following transducers is used to measure displacement with excellent sensitivity, linearity and resolution:** a) Thermocouple b) Strain gauge c) LVDT d) Tachometer **B. In a 3-phase power measurement by two-wattmeter method, both the wattmeters have identical readings. The power factor of the load is** a) 0.8 lagging (b) 0.8 leading (c)Unity (d) Zero **C.** Two wattmeter method is used for measurement of power in a balanced three-phase load supplied from a balanced three-phase system. If one of the wattmeters reads half of the other (both positive), then the power factor of the load is: (a) 0.532 (b) 0.632 (c) 0.707 (d) 0.866 **D. An ammeter has a current range of 0 - 5 A, and its internal resistance is 0.2Ω. In order to change the range to 0 - 25 A, we need to add a resistance of** a) 0.8Ω in series with the meter b) 1.0Ω in series with the meter c) 0.04Ω in parallel with the meter d) 0.05 Ω in parallel with the meter **E. Which of the following are desirable static characteristics of a measuring system.** a) Accuracy and Precision b) Accuracy, Sensitivity and Reproducibility c) Static error d) Drift and dead zone	**CO1**

Q 2	I. Match the following: **Instrument Type** — **Used for** P. Permanent magnet moving coil — 1. DC only Q. Moving iron connected through current transformer — 2. AC only R. Rectifier — 3.AC and DC S. Electrodynamometer (A) P-1 Q-2 R-1 S-3 (B) P-1 Q-3 R-1 S-2 (C) P-1 Q-2 R-3 S-3 (D) P-3 Q-1 R-2 S-1 II. Consider the following statement: (i) The compensating coil of a low power factor wattmeter compensates the effect of the impedance of the current coil. (ii) The compensating coil of a low power factor wattmeter compensates the effect of the impedance of the voltage coil circuit. (A) (i) is true but (ii) is false (B) (i) is false but (ii) is true (C) both (i) and (ii) are true (D) both (i) and (ii) are false	**CO2**
Q 3	**A. If an inductance is connected in one arm of bridge and resistances in the remaining three arms** a) the bridge can always be balanced b) the bridge can not be balanced c) Reduce the the bridge can be balanced if the resistances have some specific values d) All of the above **B. The bridge suitable for the measurement of capacitance is / are** a) Anderson's Bridge b) Owen's Bridge c) Hay's Bridge d) None of these **C.** When the Wheatstone bridge shown is used to find value of resistance R_X , the galvanometer G indicates zero current when $R_1=50\Omega$, $R_2=65\Omega$ and $R_3=100\Omega$.	**CO4**

	If R_3 is known with $\pm 5\%$ tolerance on its nominal value of 100Ω, what is the range of R_X in Ohms?  Fig:1 (A)[123.50, 136.50] (B) [125.89, 134.12] (C) [117.00, 143.00] (D) [120.25, 139.75] **D.** Write the name of any two bridges that are used to measure inductance. **E.** Writhe the name of any two bridges that are used to measure capacitance.	
Q 4	**State true or false for the followings:** a) In an electrodynamometer type instruments the current coil is fixed and the pressure coil is moving. **T/F** **b)** The defection of PMMC instrument is determined by the combined effect of the deflecting torque/force, control torque/force and damping torque/force. **T/F** c) Deflection in a moving iron instruments is directly proportional to cube of the rms value of the operating current. **T/F** d) In an electrodynamometer type wattmeter the current coil carries the load current and the pressure coil carries the proportional to the applied voltage. **T/F** e) Multiplier and shunt resistors connected in series and parallel can extend the range of the Voltmeters and ammeters. **T/F**	CO2
Q 5	**By Considering, following points in view of the transducers, fill in the blanks.** 1. RVDT can be used for the measurement of…….. 2. Self-generating transducers are known as ……. 3. Piezoelectric crystals produced emf when…….. 4. The gauge factor of a strain gauge is given as……. 5. Thermocouple works on the principle of…….	**CO5**
Q 6	**Define the following by citing proper examples.** 1. Dynamic Response 2. Limiting Errors 3. Gross Errors 4. Random Errors	CO3

	5. Systematic Errors	
SECTION B **1. Each question will carry 10 marks** **2. Instruction: Write short / brief notes**		
Q 7	(A). The coil of a moving coil galvanometer is wound on a non magnetic former whose height and width both are 25mm. It moves in a constant field of 0.1wb/m^2. the moment of inertia of its moving part is 0.3x10^-6 kg-m^2 and the spring constant is 32x10^-6 Nm/rad. Calculate: I. The number of turns that must be wound on the former to produce a deflection of 140 degrees with a current of 12mA. II. The resistance of coil to produce critical damping, assume all damping are electrical. (B). The Inductance of a moving iron ammeter with a full scale deflection of 90 degrees at 1.5A is given by the expression: $L = (58 + 40\theta - 4\theta^2 - \theta^3)\mu H$ Where, θ is the deflection in radians from the zero position, calculate: 1. Spring Constant. 2. The angular deflection of the pointer for a current of 2.0A	CO1
Q 8	Illustrate the energy harvesting using Piezo electric crystals. Derive the expression for the voltage generated.	CO2
Q 9	I. Describe the following terms with reference to the Instrument transformer. 1. Instrument Transformers 2. Burden of an instrument transformer 3. Transformation ratio (actual) 4. Nominal transformation ratio 5. Turns ratio and Ratio Correction factor II. Present the comparison of Current and Potential transformers.	CO3
Q 10	1. Drive the expression of unknown inductance using an Owen's bridge. Draw the labeled circuit diagram and write all the expressions required. 2. A Schering Bridge consists of the following: Arm ab-unknown capacitance with internal resistance, which has to be measured. Arm ad- known capacitor value is 1.5uF. Arm bc-non inductive resistance value is 130 Ω. Arm dc-a known capacitor value is 3uF with known reactive resistance 260 Ω. Calculate the values of C_1 and it's internal resistance R_1.	CO4
Q 11	Describe the construction and working principle of strain gauges. Derive the expression of gauge factor. **OR** Describe the construction and working principle of flow measuring transducers. Write the required expressions.	CO1

Section C **1. Each Question carries 20 Marks.** **2. Instruction: Write long answer.**		
Q 12	Describe the criteria for choosing a transducer for a particular industrial application. Assume an industrial application, identify few variables in that industry, design the detailed report mentioning the transducers available, and suggest the best instrument for that particular application. You are required to add a comparative analysis of the sensors available including their working principles and relative advantages disadvantages. Use block diagrams and figures in support of your answer.	CO5