Name: Enrolment No:	UPES

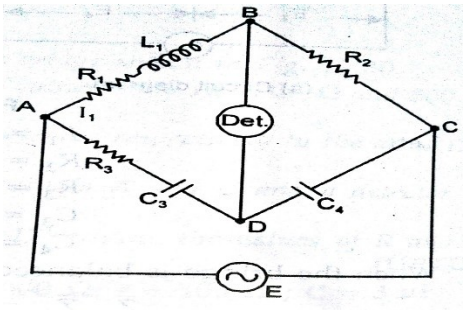
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: B.Tech PSE **Semester : V**
Course Name : Electrical Measurement & Instrumentation **Time : 03 hrs**
Course Code : ELEG-313 **Max. Marks : 100**
Nos. of page(s) : 3
Instructions: Attempt all the questions.

SECTION A

S. No.		Marks	CO
Q 1	1. LVDT can be used for the measurement of…….. 2. Self-generating transducers are……. 3. Piezoelectric crystals produced emf when…… 4. The gauge factor of a strain gauge is given as…….	**4**	**CO2**
Q 2	Data acquisition system is very important process in measurement. Enumerate the objectives of DAS and draw its block diagram.	**4**	**CO1**
Q 3	Describe the working principle of any two of the following transducers: 1. Strain Gauge 2. Thermocouple 3. Obstruction type flow meters	**4**	**CO2**
Q 4	Define the following parameters: . 1. Arithmetic mean 2. Average deviation 3. Standard deviation, 4. Variance Calculate the above mentioned parameters using the data given below. Eight different students tuned in the circuit for resonance and the values of the resonant frequency in kHz were recorded as : 412, 428, 423, 415, 426, 411, 423, 416.	**4**	**CO1**
Q 5	Power consumed by a balanced 3 phase, 3 wire load is measured by 2 wattmeter method. The first wattmeter reads twice the second one. Find the load impedance angle in radians and power factor.	**4**	**CO2**

	SECTION B		
Q 6	(A) List the Galvanometer Intrinsic constants, define them and write the equation for each constant, analyze the dynamic response by using these galvanometer constants. (B) In an industrial application for the measurement of electrical quantities a galvanometer is found with following data: Number of turns = 320 Flux Density = 0.12 Wb/m^2 Control constant = 0.12 x 10^{-6} *Nm/rad* Coil size = 21 mm x 22 mm Moment of inertia = 0.2 x 10^{-6} kg-m^2 Galvanometer resistance (including external resistance) = 2100 Ω. Determine: 1. Total resistance for critical damping 2. Damping ratio 3. Frequency of undamped oscillations 4. Frequency of damped oscillations 5. Deflection for the measurement of current 1 A.	**5+5**	**CO2,CO5**
Q 7	(A) 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 (B) Prove that the deflection of a moving iron instruments is proportional to square of the r.m.s value of the operating current.	**5+5**	**CO2,CO5**
Q 8	The bridge shown in Figure: 1 is used to measure the properties of a sample of a sheet at 2 kHz. At balance, arm AB is the test specimen; arm BC is R_2 =100Ω; arm CD is C_4 = 0.1 μF and arm DA is R_3 =834Ω in series with C_3 = 0.124 μF. 1. Name the bridge and list the parameters that can be used by this bridge. 2. Derive the expression for the measurement of unknown variables. 3. Calculate the effective impedance of specimen under test conditions. 4. Calculate the Q factor of the specimen under test.  Figure:1	**10**	**CO4**

Q 9	Present the comparative study of LEDs with LCDs with respect to the following points: 1. Working Principle 2. Applications 3. Advantages and disadvantages 4. Power saving model of LEDs	**10**	**CO1**
	SECTION-C		
Q 10	(A) A current transformer with a bar primary has 250 turns in its secondary winding. The resistance and reactance of the secondary circuit are 1.4 Ω and 1.1 Ω respectively including the transformer winding. When 5A current flows in the secondary winding, the magnetizing mmf is 80AT and the iron loss is 1.1 W. Determine the following: 1. Ratio Error. 2. Phase Angle Error. (B) Present the comparison of Current and Potential transformers. (C) Describe the testing method of instrument transformers.	**10+5+5**	**CO3**
Q 11	(A) Power measurement is the essential process in any industrial applications. Suggest and discuss the measurement schemes for power. Describe these methods with the help of examples. (B) In order to measure the power input and the power factor of an over-excited synchronous motor two wattmeters are used. If the meters indicate (-3.5kW) and (+8.0kW) respectively. Calculate: 1. Power factor of the motor 2. Power input to the motor **OR** (A) An electrodynamometer wattmeter is employed to measure power in a single-phase circuit. The load voltage is 200V and the load current is 5A at a lagging power factor of 0.1 the wattmeter potential coil has a resistance of 12000 Ω and inductance of 120 mH. Determine the percentage error in the wattmeter reading. (B) Analyse the error due to inductance of pressure coil. Discuss how it is compensated and derive the expression for correction factor.	**10+10**	**CO2,CO5**

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SECTION A

S. No.		Marks	CO
Q 1	Describe the working principle of Resistance thermometer and thermistors.	4	CO2
Q 2	Draw the circuit diagrams and phasor diagrams for the measurement of single phase power using following methods: 1. 3 Voltmeter Method 2. 3 Ammeter Method	4	CO2
Q 3	Differentiate between the following citing suitable examples. 1. Active and passive transducers 2. Primary and secondary transducers 3. Analog and digital transducers 4. Transducers and inverse transducers	4	C05
Q 4	Define the following and mention the examples. 1. Resolution 2. Loading Effect 3. Threshold 4. Accuracy and Precision	4	CO1
Q 5	Two wattmeters are connected to measure the total power on a three-phase system supplying a balance load. The readings of the wattmeters are 10.5KW and -2.5 KW respectively. Find the total power, load impedance angle and power factor.	4	CO2

SECTION B

Q 6	(A) Discuss the criteria for section of a galvanometer and derive the expression for the deflection of a galvanometer. (B) The following data relate to a moving coil galvanometer which has a former of a non-conducting material: The current sensitivity of the instrument = 0.012 μA/mm at 1 m. The period of undamped oscillation = 5.5 seconds The displacement constant of the instrument = 4.8×10^{-3} Nm/A	5+5	CO2,CO5

	Calculate: 1. Control constant 2. Inertia constant 3. Total circuit resistance for instrument to be dead beat.		
Q 7	(A) The Inductance of a moving iron ammeter with a full scale deflection of 90 degrees at 1.5A is given by the expression: $L=(120+80\theta-8\theta^2-\theta^3)\mu H$ 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 1.0A (B) Describe the construction and working principle of following: 1. Attraction type moving iron instruments. 2. Repulsion type moving iron instruments.	**(5+5)**	**CO3,CO5**
Q 8	(A) Draw the labeled circuit diagram of Wien Bridge. What are the parameters that can be measured by using this bridge? Derive the expression for the measurement of unknown variables. (B) Determine the equivalent parallel resistance and capacitance that causes a wien bridge to null with the following component values: R_1=2.8k Ω; C_1=4.8 μF; R_2=20k Ω; R_4=80k Ω; f=2kHz;	**5+5**	**CO4**
Q 9	Describe the effect of electromagnetic and electrostatic interference on the measurement of electrical quantity with the help of practical examples. Mention the specific types of these interferences.	**6+4**	**CO2,CO1**
	SECTION-C		
Q10	(A) Describe the following terms with reference to the Instrument transformer. 1. Burden of an instrument transformer 2. Transformation ratio (actual) 3. Nominal transformation ratio 4. Turns ratio 5. Ratio Correction factor (B) Describe the characteristics of current and potential transformers. (C) How the errors can be reduced in Instrument transformer.	**10+5_5**	**CO3**
Q11	(A) The primary winding of a 1000/5A, 50 Hz current transformer has a single turn. Its secondary burden consists of a non-inductive impedance of 1.4 Ω. If the iron loss in the core is 1.4 W at full load and magnetizing mmf is 80 AT, calculate: 1. Flux in the core 2. Ratio Error at full load Neglect leakage reactance. (B) Identify five industrial variables that require utmost attention in view of any	**10+10**	**CO2,CO3**

	plant, then present the comparative study for their measurement. **OR** (A) A wattmeter has a current coil of 0.03 Ω resistance and a pressure coil of 6000 Ω resistance. Calculate the percentage error if the wattmeter is o connected that: I. The current coil is on the load side; II. The pressure coil is on the load side; a. If the load takes 20 A at a voltage of 220 V and 0.6 power factor in each case; b. What load current would give equal errors with the two connections? (B) Describe the concepts of energy harvesting. What are the essential components of this system? Discus the working principle of the associated transducers and derive the supporting expressions.		