**Roll No: -------------------------**

# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

**End Semester Examination, December 2017**

**Program: B.Tech PSE** **Semester – V**
**Subject (Course): Electrical Measurement & Instrument** **Max. Marks: 100**
**Course Code : ELEG313** **Duration : 3 Hrs**
**No. of page/s: 2**

## Section A (4*5=20)

Q.1 [CO3] Draw the wiring diagrams of current and potential transformers. (5)

Q.2 [CO1, 3] Draw the circuit diagram of wien bridge for the measurement of frequency. Derive the expression of measured frequency. (5)

Q.3 [CO1, 2, 5] Briefly describe the working of RVDT. List the applications. (5)

Q.4 [CO2, 5] Differentiate between LCD and LED. Explain how LED is effective in power saving (5)

## Section B (4*10=40)

Q.5 [CO2] The Inductance of a moving iron ammeter with a full scale deflection of 900 at 1.5A is given by the expression: $L = (180 + 40\theta - 4\theta^2 - \theta^3)\mu H$
Where, $\theta$ is the deflection in radians from the zero position, calculate: (10)

I. Spring Constant.
II. The angular deflection of the pointer for a current of 1.0A

Q.6 [CO1, 4] A bakelite sheet of 4.5 mm thickness is tested at 50 hz between the electrodes 110 mm diameter. The schering bridge shown has an air capacitor $C_2$ of 104 pF, a non reactive resistance $R_4$ of (1000/π) Ω in parallel with a variable capacitor $C_4$ and non-reactive variable resistance $R_3$. Balance is obtained with $C_4$= 0.52 μF and $R_3$= 250 Ω. Determine the following: (10)

I. Draw the circuit with given specifications.
II. Derive the expression for unknown parameter.
III. Find Unknown Capacitance
IV. Power factor of sheet capacitance
V. Relative permittivity of sheet

Q.7(a) [CO2,5] Describe the working principle semiconductor strain gauges. (5)

Q.7 (b) [CO2,5] A resistance strain gauge has gauge factor of 2 and is fastened to a steel member subjected to a stress of 1050 $kg/cm^2$. Modulus of elasticity of steel is $2.1x10^6$ $kg/cm^2$. Calculate the % change of resistance of strain gauge. (5)

Q.8 [CO1, 2, 5] A parallel plate capacitor transducer uses plates of area 300 $mm^2$ which are separated by a distance of 0.2 mm. (10)

I. Determine the value of capacitance when the di-electric is air having a permittivity of $8.85x10^{-12}$ F/m.
II. Determine the change in capacitance if a linear displacement reduces the distance between plates to 0.18 mm. Also determine the ratio of per unit change of capacitance to per unit change of displacement.
III. If a mica sheet 0.01 mm thick is inserted in the gap, calculate the value of original capacitance and change in capacitance for the same displacement. Also calculate the ratio of per unit change in capacitance to per unit change of displacement. The dielectric constant of mica is 8.

## Section C (2*20=40)

Q.9 (A) [CO1, 2, 5] Discuss Energy Harvesting using piezo electricity. How it is beneficial for meeting the power requirements of the society? List the latest industrial applications. (10)

Q.9 (B) [CO1, 2, 5] A Barium titanate pickup has the dimensions of 5 mm x 5 mm x 1.25 mm. The force acting on it is 5 N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is 12.5x 10-9 F/m. If the modulus of elasticity of barium titanate is 12x106 N/m2, calculate thestrain. Also calculate the charge and the capacitance. (10)

**OR**

Q.9[CO1,2] Describe how single phase power is measured with the help of suitable circuit and phasor diagrams. Mention their relative merits and limitations. (20)

I. Three Voltmeter Method
II. Three Ammeter Method

Q.10 [CO3] Describe the instrument transforms with reference to the following viewpoints. (20)

I. What are the instrument transformers?
II. Applications of instrument transformers.
III. Terms related to instrument transformers.
IV. Brief working principle of CT and PT.
V. Uses in power system protection

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## Section A (4*5=20)

Q.1 [CO1,3]Define the following instrument transformer related terms: (5)
a) Burden b) Transformation Ratio (Actual) c) Nominal transformation Ratio

d) Turns Ratio e) Ratio Correction Factor

Q.2 [CO1,2,3,5] Differentiate between the following by citing suitable examples. (5)

1. Active and passive transducers 2. Primary and secondary transducers
3. Analog and digital transducers 4. Transducers and inverse transducers

Q.3 [CO4] Draw the circuit for the Owen's bridge. Derive the expression for unknown parameter. (5)

Q.4 [CO1,2] Describe the following terms with the suitable diagrams and examples. (5)

1. Grounding
2. Shielding.

## Section B (4*10=40)

Q.5(A) [CO1,2]A moving coil galvanometer employed in a plant deflects 240 mm on a scale at a distance of 1.2 m from the mirror when a current of 1.2 μA passes through it. The free time period of the galvanometer is 3.8 seconds. The galvanometer is dead beat when the total resistance in the galvanometer is 16500 Ω. Determine the moment of inertia of the galvanometer moving system. (5)

Q.5(B) ) [CO1,2] Describe the dynamic response of galvanometer. List various constants in dynamic response. (5)

Q.6 [CO1,2] Suggest the devices for power measurement in an industrial application and discuss the various types of errors introduced in the dynamometer type wattmeter. Also describe how the error due to inductance of pressure coil is compensated also derive the expression for correction factor. (10)

Q.7 [CO1,2] The Inductance of a moving iron ammeter is given by the expression: (10)

$$L = (12 + 5\theta - 2\theta^2)\mu H$$

Where, $\theta$ is the deflection in radians from the zero position, calculate:

I. Spring Constant.

II. The angular deflection of the pointer for a current of 10A if the deflection for a current of 5A is $30^0$.

Q.8 [CO3 ]A 100/5A current transformer, at its rated load of 20 VA, has an iron loss of 0.18 W and a magnetizing current of 1.4 A. It is supplying rated output to a meter having a ration of resistance to reactance of 4. Calculate: (10)

I. Ratio error

II. Phase angle.

## Section C (2*20=40)

Q.9 [CO2,3] A bakelite sheet of 2.5 mm thickness is tested at 50 hz between the electrodes 220 mm diameter. The schering bridge shown has an air capacitor $C_2$ of 208 pF, a non reactive resistance $R_4$ of (1000/π) Ω in parallel with a variable capacitor $C_4$ and non-reactive variable resistance $R_3$. Balance is obtained with $C_4$= 0.52 μF and $R_3$= 500 Ω. Determine the following: (20)

I. Draw the circuit with given specifications.

II. Derive the expression for unknown parameter.

III. Unknown Capacitance

IV. Power factor of sheet capacitance

V. Relative permittivity of sheet

Q.10 [CO 1,3] Describe the instrument transformers. Give the comparison of Current and potential transformers. Describe the testing methods of instruments transformers. (20)

**OR**

Q.10 (A) [CO1,2,4,5] Enlist the objectives of instrumentation and emphasize the parameters to be measured in view of a thermal power plant. (10)

Q.10 (B) [CO1,2,4,5] Discuss the instruments available for measuring the parameters discussed above with their relative advantages and disadvantages. (10)