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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B. Tech Avionics
Subject (Course): Measurement and Instrument
Course Code :ELEG 316
No. of page/s

Semester – III
Max. Marks : 100
Duration : 3 Hrs

Note- ALL questions are compulsory.

Section A (4 x 5= 20)

- Q1- What do you understand by static characteristics of an instrument?
Q2- What do you understand by seeback effect. What are the types of thermocouple?
Q3- What do you understand by venture meter. Explain the working of venture meter with suitable diagram?
Q4- What are sensor available for pressure measurement. Explain the working of pirani gauge?

Section B (10x 4= 40)

- Q5) A parallel plate capacitive transducer uses plates of area 300 mm² which are separated by a distance 0.2mm.
(i) Determine the value of capacitance when the dielectric is air having a permittivity of 8.85×10^{-12} F/m.
(ii) Determine the change in capacitance if a linear displacement reduces the distance between the plates to 0.18 mm. Also determine the ratio of per unit change of capacitance to per unit change of displacement.
- Q6- What are the classifications of errors. Explain the different types of errors.
- Q7- Explain how Wien's bridge be used for experimental determination of frequency. Derive the expression for frequency in terms of bridge parameters.
- Q.8- 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

Section C (2 x 20 = 40)

Q9 (a) Figure 1 is a production line device for weighing masses of minimum and maximum values 0.9 Kg and 1.1 kg. Respectively. The mass of the platform is 0.2 kg.

- (a) What should be the spring stiffness if the scale deflection has to be within ± 10 mm over the range?
- (b) If we want to keep the damping ratio at 0.7, what should be the damping constant at the mean mass to be weighted?

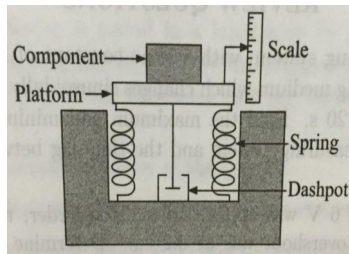


Fig1 The Production Line system

Q9 (b) A first order thermometer is used to measure the temperature of air cycling at a rate of 1 cycle every 5 min. The time constant of the thermometer is 20 s. Calculate the attenuation of the indicated temperature in percent. If the temperature undergoes a sinusoidal variation of $\pm 20^\circ\text{C}$, Calculate the indicated variation in temperature?

Q10. An RTD with resistance of $400\ \Omega$ at 30°C and temperature coefficient of resistance $\alpha = 0.004/^\circ\text{C}$ is used in a dc bridge circuit. R_1 and R_2 arms are of fixed resistance $400\ \Omega$ and R_3 is a variable resistance to balance bridge. The RTD has a heat dissipation rate of $20\ \text{mW}/^\circ\text{C}$, what is the value of R_3 to have null output?

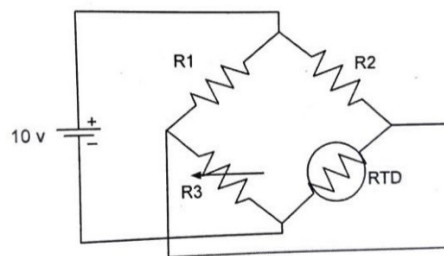


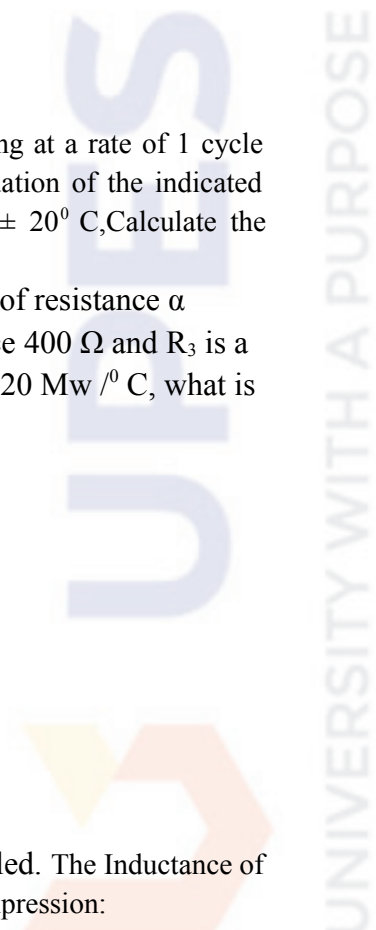
Fig 2

Q10 (b) Derive the equation for deflection if the instrument is spring controlled. The Inductance of a moving iron ammeter with a full scale deflection of 900 at 1.5A is given by the expression:

$$L = (180 + 40\theta - 4\theta^2 - \theta^3)\ \mu\text{H},$$

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 .



Set 2

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Section A (4 x 5= 20)

Q1- What do you understand by dynamic characteristics of an instrument?

Q2-What do you understand by peltier effect. What are the types of thermocouple?

Q3- What do you understand by venture meter. Explain the working of venturi meter with suitable diagram?

Q4- What are sensor available for pressure measurement. Explain the working of pirani gauge?

Section B (4 x 10= 40)

Q.5-Give the comparison of Current and potential transformers. Describe the testing methods of instruments transformers.

Q.6- Describe the working principle and classification of attraction and repulsion type moving iron instruments. Derive the expression for deflection of the instruments. Also, explain compensation for error due to change in frequency.

Q7- Derive the circuit for the Owen's bridge and obtain the expression for unknown parameter.

Q8- Describe the constructional details of an Electrodynamometer type wattmeter. Derive the expression for torque when the instruments is used on a.c. Explain why it is necessary to make the potential coil circuit purely resistive?

Section C (2 x 20 = 40)

Q.9- A first order thermometer is used to measure the temperature of air cycling at a rate of 1 cycle every 5 min. The time constant of the thermometer is 20 s. Calculate the attenuation of the indicated temperature in percent. If the temperature undergoes a sinusoidal variation of $\pm 20^{\circ}\text{C}$, Calculate the indicated variation in temperature.

(b) Find the deflection of a moving iron ammeter having the following data: Control spring constant = 8×10^{-6} Nm/rad; current = 6A, $L = 6 + 3\theta - 0.5\theta^2$ μ H

Q.10 (a) A linear second order, single degree of freedom system has a mass of 4 g and a stiffness of 1000 N/m. Calculate the natural frequency of the system. Determine the damping coefficient necessary to just prevent overshoot in response to a step input?

Q.10 (b) A pressure measuring instrument uses a capacitive transducer having a spacing of 4 mm between its diagram. A pressure of 600 kN / m² produce an average deflection of 0.3 mm of the diaphragm of the transducer. The transducer which has a capacitance of 300 Pf before application of pressure and is connected in an oscillator circuit having a frequency of 100 kHz. Determine the change in frequency of the oscillator after the pressure is applied to the transducer.