

Master of Science (Instrumentation) Examination, 2018-2019
2nd year, 1st Semester
SUBJECT: Sensor, Transducer and Actuators for Instrumentation
PAPER: XII (T-302)

Time : Four hours

Full Marks : 100

Use separate answer script for each group
GROUP-A

Answer any five questions: 5 × 10

1. What is the displacement measurement? Briefly describe the operation of inductive sensors for displacement measurement. Briefly describe variable Reluctance Transducer. **2+4+4**

2. Describe the operation of LVDT in details with suitable diagram. **10**

3. Describe the operation of a Hall Effect sensor suitably narrating Hall Effect. **10**

4. Describe the operation of Orifice Plate and flow nozzle for flow measurement **5+5**

5. What is Rota meter? How does it function? Deduce the connected equation
$$p_1 - p_2 = \frac{V_g}{\alpha} (p - p_f)$$

Where the symbols have their usual meaning. **3+3+4**

6. What is transducer? What are the classifications of transducer? What is a Thermistor? How does it work? **2+2+2+4**

7. Write down the expression of Gauge Factor (K), A resistance strain gauge with K=2 is fastened to a steel rod, which is subject to a strain of 1×10^{-6} . If the original resistance value of the gauge is 130Ω , Calculate the change in resistance. **3+7**

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GROUP B

Answer any five questions: 5x10=50

1. What is RTD? Explain the relationship between resistance and temperature for the RTD from resistance temperature curve. Why offer 2,3 or 4 wire RTD probes ? Compare thermistor with RTD.
2+2+3+3
2. Why and when we use thermocouple for measurement of temperature? Write names of four types of thermocouple sensor and their range of temperature measurement? What are errors may be there in the temperature measurement by thermocouple ? Explain working principle of a thermistor with associated circuits for measurement of temperature
2+2+2+4
3. (i) What are control valves? What are the basic factors that affect the valve performance?
(ii) Explain briefly Flow Control Valve. Explain any two types of Flow control valve.
4+6
4. (i) Explain briefly the function of Directional Control Valve (DCV). How are DCVs classified?
(ii) What do you mean by 3/2 DCV?
(iii) Explain Piston Hydraulic pump.
3+1+6
5. (i) What is Pressure control valve?
(ii) What are the different types of pressure control valves and how is pressure control valve identified?
(iii) A pressure relief valve has a pressure setting of 140 bar. Compute the KW loss across the valve if it returns all the flow back to the tank from a $0.0016m^3/sec$ pump.
Also, the primary part of a circuit is operating at 180 bar. A secondary circuit supplied from the primary circuit via a pressure valve requires a constant flow of 30 L/min at 100 bar. Find the power loss over pressure relief valve (in KW).
Given 1 bar = $10^5 N/m^2$
1+2+7
6. (i) Explain basic principle of DC motor and obtain the mathematical model of DC motor. What is the need of commutator for DC motor?
(ii) A 240V DC motor takes 40A when giving its rated output at 1500 rpm.
Its resistance is 0.3 ohms. Calculate the value of resistance that must be added to obtain the rated torque-
(a) Starting condition
(b) At 1000 rpm
7+3
7. (i) What are optical flats? Explain its working principle.
(ii) Two job blocks hold an optical flat at an angle Θ and the distance between the left ends of the block is 130mm. Laser beam is used (He-Ne laser) for the measurement which shows the number of fringes as 13 for 130mm. Obtain the dimensional differences of the two blocks and the angle which they make with flat. Given wavelength of laser is 632.8 nm.
(iii) Explain total radiation pyrometer.
3+4+3
8. (i) What is actuator?
(ii) Explain hydraulic Gear Pumps and Vane Pumps. Why do Gear pumps usually operate at comparatively low pressure?
(iii) Explain Separately excited, Self excited and Compound excited DC motor with circuit diagram.
9. (i) Explain Synchronous AC motor and its working. Along with it explain Synchronous AC motor power factors with phasor diagram.
(ii) Explain Optical Pyrometer.
The surface emissivity of a metal target whose temperature is measured as $1250^\circ C$ is assumed as 0.8. If the actual emissivity is 0.85, what would be the error in temperature measurement?