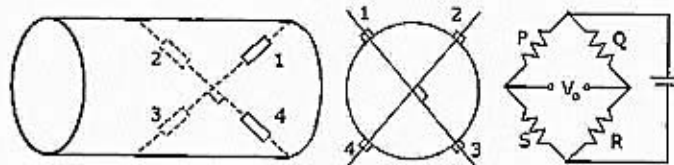


Q1. Answer any four with proper explanation (4x2=8)

- I. For measurement the torque of rotating shaft, is Use of a slip rings necessary?
- II. Can pressure reading be negative if measurements are taken in 'Gauge Pressure' scale?
- III. In well type manometer, is the ratio of cross sectional diameter of the well and the tube the factor that determine the scale of the manometer?
- IV. Can calibration of the Mc-loed gauge be directly related to the physical dimension of the gauge, independent of nature of the gas being used?
- V. Are dynamic characteristics of a strain gauge torque transducer poor at very low frequency?

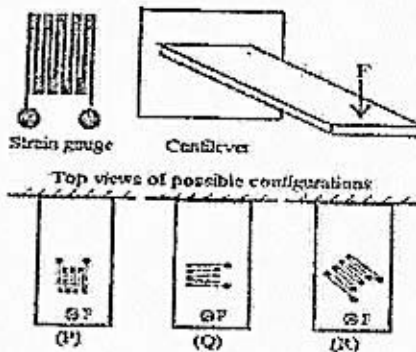
Q2. Support your answer (3x 4=12)

1. Four strain gauges are fixed on a cylindrical shaft to measure torque, as shown in the figure.



A correct way to place these gauges in the bridge is
 (A) P-1, Q-2, R-3, S-4 (B) P-1, Q-3, R-2, S-4
 (C) P-3, Q-1, R-2, S-4 (D) P-2, Q-1, R-3, S-4

2. The figure below shows various configurations of bonding a strain gauge to a cantilever subjected to a bending force F. Which configuration gives the maximum change in resistance for this force ?



- A).P B). Q C).R D).All have equal change in resistance

3. In a flapper-nozzle displacement transducer, the values of the following parameters are given:

Diameter of the orifice = 0.2mm, Diameter of the nozzle = 0.8mm,

Supply pressure = 1.4×10^2 kPa (gauge) , Ambient pressure = 0 (gauge). The maximum value of the sensitivity is

- (A) 4.0 MPa/mm (B) 5.6 MPa/mm (C) 6.4 MPa/mm (D) 7.3 MPa/mm

4. A barium titanate piezoelectric crystal with $d_{33}=150$ pC/N, $C_{\text{crystal}} = 25$.pF and $R_{\text{crystal}} = 10^{10} \Omega$ is used to measure the amplitude of a step force. The voltage output is measured using a digital voltmeter with input impedance $10^{13} \Omega$ connected across the crystal. All other capacitances and resistances may be neglected. A step force of 2 N is applied from direction "3" on the crystal. The time in milliseconds within which the voltmeter should sample the crystal output voltage so that the drop from the peak value is no more than 0.12V is

- a. 3.0 m sec b. 2.1 m sec c. 2.8 m sec d. 2.48 m sec

Any five from CO1,CO2,CO3 & CO4 (16X5=80)

CO1

1. What are the advantages of 4-20mA signal transmission? What are the direct acting and reverse-acting relay? Explain the operation of pneumatic pressure-amplifying relay with diagram? Draw the diagram of a force-balance pneumatic pressure transmitter and explain its working principle? What are the major drawback of this instrument?

3+2+4+5+2

CO2

2. Differentiate between relative and absolute acceleration measurements? What are the different methods used commonly for calibration of vibration pick-up? Explain the constant acceleration method of calibration

An accelerometer has a suspended mass of 0.01 kg with a damped natural frequency of vibration of 150 Hz. When mounted on an engine undergoing an acceleration of 1g at an operating speed of 6000 rpm, the acceleration is recorded as 9.5 m/s^2 by the instrument. Find the damping constant and the spring stiffness of the accelerometer.

3+2+4+7

3. Draw the diagram of mechanical magnetic switch? How does it work? Differentiate between rotating torque sensors and stationary sensors?

A disc mounted on the shaft of a machine has 12 marked points. The number of flashes projected on to the disc by a stroboscope is 6000 in one minute. Find the speed of the machine if the disc appears stationary and has single image of 12 points. If the disc appears to move forward in the direction of rotation at 10 rpm, find the speed of the disc.

6+4+6

CO3

4. Describe installation process of pressure measuring instruments in process plant? what are problem encountered with strain gage pressure transmitter? Explain them.

5+3+8

A pressure tapping is taken from a measuring point by means of a tubing 50 cm long, 5 mm bore to a U-tube manometer using water as the working liquid. The tubes are of 10 mm bore. To start with, the water level is 30 cm below the top of the tube. Taking viscosity of air as $1.78 \times 10^{-5} \text{ kg/m-s}$, find the time constant of the system if a small change occurs in the pressure which is around atmospheric.

5. Draw a simple diagram of capacitive pressure transmitter and label it properly. How does it transmit pressure signal? What is HART transmitter?

6+2+4+4

A mercury manometer has one arm in the shape of a well and the other as a tube inclined at 30° to the horizontal. The well is 4 cm in diameter and the tube 5 mm in diameter. Find the percentage error if no area correction factor is used.

For a McLeod gauge, with a capillary of 1 mm diameter and effective bulb volume of 80 cm^3 , find the reading as indicated by mercury column due to a pressure of 10 Pa.

6. How do you perform testing and calibration of pressure measurement system with dead weight tester? How do you measure vacuum using Knudson gage? Explain that the vacuum pressure in McLeod Gage is proportional to the square of pressure head difference (h). How nonlinear motion of the resulting tip of the bourdon gage is converted into linear motion? explain with diagram

5+4+4+3

CO4

7. What are the two type of Mechanical Load Cells? How do they differ from electronic load Cell? Explain one method of non-contact weight measurement? explain the proximity type torque measurement system with diagram. Why Dc cradle dynamometer is preferred to measure torque inside combustion engine?

2+4+4+4+2