B. Tech.

(SEM. IV) EXAMINATION, 2006-07

MEASUREMENT & METROLOGY

Time : 2 Hours] [Total Marks : 50

Note : (1) Attempt all questions.
(2) They carry marks shown against each. Assume suitably any missing data / information, if any.

1. Attempt any four parts of the following : \(3.5 \times 4 = 14\)
   a. What do you understand by SIGNAL CONDITIONING? Describe an optical method of amplifying an angular displacement.
   b. A mercury thermometer has a capillary tube of 0.3 mm diameter. Calculate the volume of the bulb if the thermometer has a sensitivity of 3 mm/°C. Assume ambient temperature of 20°C and coefficient of volume expansion of mercury in glass to be 0.181 x 10^-3 per °C.
   c. Describe a piezoelectric force transducer and draw a sketch to illustrate its output characteristics.
   d. A solid rectangular block measures 100 x 10 x 1 mm. If the uncertainty of length, width and thickness of the block is ±0.1mm, what is the uncertainty in the determination of its volume?
   e. Describe the essential features of a cathode ray
oscilloscope. What is the purpose of exciting the horizontal deflection plates with a voltage of saw tooth profile waveform?

f. Distinguish: (any two of the following)
   i) Systematic and random errors.
   ii) Passive and active transducers
   iii) X-Y and y-t recorders, and
   iv) Accuracy and precision of an instrument.

2. Attempt any four parts of the following: 3x4=12
   a. A stroboscopic light is directed on to a rotating shaft containing a single keyway. The keyway seems stationary under a flashing frequency of 500 flashes per minute. The flashing frequency is then increased slowly and the keyway next appears stationary at a frequency of 750 flashes / minute. Estimate the r.p.m of the shaft and describe a checking procedure to verify the r.p.m of the shaft.
   b. How is temperature compensation achieved while using a resistance strain gauge?
   c. Sketch a BOURDON TUBE pressure gauge and explain its principle of operation.
   d. Describe a total radiation pyrometer, for measuring the temperature inside a furnace.
   e. What is a PIRANI GAUGE and how is it used?
   f. A strain gauge with a gauge factor of 2 measures the strain on the surface of a shaft subjected to a tensile stress. Numerical resistance of the gauge is 120 $\Omega$ and change in resistance is 0.012 $\Omega$. Calculate the stress induced in the shaft, if modulus of elasticity for the shaft material is 206 GN/m$^2$.

V-4043] 2 [Contd..
3 Attempt any two of the following:  

a. Why are comparators used in metrology? 
Describe, with the help of a sketch, the essential features of a JOHANSSON MIKROKATOR.

b. Explain (any two of the following)
   i) Use of snap, plug and ring gauges for limit gauging.
   ii) Taylor's principle of gauge design.
   iii) Difference between hole basis and shaft basis system of limits and fits.
   iv) A method used for checking a large radius is shown in the figure below. Show that the equator to the radius may be stated as 

   \[ R = \frac{c^2}{8(d-h)} - \frac{h}{2} \]

   ![Diagram](image)

   **Fig.**

   In the measurement of which parameter (c, h or d) will you exercise greatest care so that value of R is estimated accurately?
Attempt any **two** of the following:

6x2 = 12

a. How are gears usually checked in a gear production shop? Describe a routine functional test. Sketch a gear tooth vernier and explain its use.

b. Draw a sketch showing the internal mechanism of a dial indicator. How can roundness of a cylindrical object be checked with it? What other accessories would be required for this check?

c. What is a profile projector? Can it be used to check the profile of the lion emblem usually embossed on a rupee coin? If so, how?