MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING
III SEMESTER B.TECH. (I & P E) EXAMINATION NOV 2019
METROLOGY AND MEASUREMENTS [MME 2158]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1 A) Explain different static performance characteristics of instruments. (5)

B) A very high pressure gauge, using a manganin element is to measure a maximum pressure of 10^8 Pa. The wire diameter is 25µm, length is 3cm. Pressure sensitivity of wire material is 2.5×10^{-11} Ω/Ω-Pa , resistivity 45×10^{-6} Ω-cm . The wire forms one arm of a Wheatstone bridge, with resistances of all arms being equal. If the supply voltage is 12V, find the output voltage due to maximum pressure (3)

C) Explain the working of a McLeod gauge with a neat sketch (2)

2 A) Explain the following with neat sketch i) Proving Ring ii)Cradled Dynamometer (5)

B) Explain the shunting method used to calibrate the strain gauge and derive the expression for equivalent strain. (3)

C) A copper-constantan thermocouple was found to have linear calibration between 0°C and 400°C with emf at maximum temperature (reference junction temperature 0°C) equal to 20.68 mV. i)Determine the correction which must be made to the indicated emf if the junction temperature is 25°C. i) If the indicated emf is 8.92 mV in the thermocouple, determine the temperature of the hot junction. (2)

3 A) A tensile force link is to be made by mounting Four strain gauges (Gauge resistance 120 Ω & Gauge Factor 2.2) back to back on a thin aluminum strip (thickness 1 mm & width 1 cm) according to Poisson's arrangement (Poisson's ratio is 0.3). Young's modulus of strip material is 6.9×10^{10} N/m^2. Maximum force applied on the force link is 400N. i) Show the orientation of strain gauges on the force link. ii) If the output from the bridge is connected to an oscilloscope, which is set at 10 mV/cm of trace deflection, find the deflection of the trace at maximum force. The input impedance of the oscilloscope may be taken as infinity. Bridge excitation voltage is 6V. (5)

B) Derive an expression for effective diameter of a Whitworth screw thread by three-wire method, which depends on the diameter of the wires, dimension over the wires, the pitch and angle of the screw thread. (3)

C) Explain the working of disappearing filament optical pyrometer with neat sketch. (2)

4 A) Design the general type of GO and NO GO gauges for a 40 mm shaft and hole pair designated as 40 H8/d9, given that (5)

(a) $i = 0.453 (D)^{1/3} + 0.001D$

(b) 40 mm lies in the diameter range of 30–50 mm

(c) IT8 = 25i

(d) IT9 = 40i

(e) upper deviation of shaft = $-16D^{0.44}$

(f) wear allowance assumed to be 10% of gauge tolerance.

B) Explain the three different classes of fit with neat sketches. (3)

C) Differentiate between a hole basis system and shaft basis system. (2)

5 A) An autocollimator and reflecting block were used to measure the departure from straightness of a rectangular-section straight edge 1 m long, which was supported at the points for minimum deflection. The center distance of the feet of the block was 70 mm and the auto-collimator readings (in minutes) were: 0.2, 0.3, -0.4, -0.3, 0.2, -0.4, -0.2, 0, 0.3, 0.5. Determine the total straightness error. (5)

B) With the help of a sketch, discuss screw thread terminologies. (3)

C) With the help of a neat sketch, explain the Taylor-Hobson Talysurf to measure surface roughness. (2)