Exam Date & Time: 01-Feb-2023 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH END SEMESTER MAKE UP EXAMINATIONS, FEB2023 METROLOGY AND MEASUREMENTS [MME 2158]

A

Marks: 50

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed Explain with sketch, the generalized measurement system for a pressure measuring instrument 1) based on tertiary measurement. (4)A) B) With the help of neat sketch explain the following terms i) Linearity ii) Repeatability and iii) Sensitivity (3) C) A McLeod Gauge has a volume of bulb and measuring capillary $V=80 \times 10^{-6} \text{ m}^3$ and a measuring capillary diameter of 1.5 mm. Calculate the pressure in terms of height of mercury indicated when the reading of the measuring capillary is 28mm in case approximate formula is used. What is the (3) error if the exact formula is used for measurement of pressure? 2) With the help of neat diagram explain the working of bimetallic thermometer and also write the equation related to it. (3)A) B) With the help of schematics state the laws of thermocouples. A copper constantan thermocouple was found to have linear calibration between $0 \square C$ and $300^{\circ}C$ with emf at maximum temperature (reference junction temperature 0° C) equal to 60 mV. Find the sensitivity and the correction which (3) must be made to the indicated emf if the junction temperature is 25°C. C) For a metallic resistance strain gauge prove that gauge factor is the function of poisons ratio alone. (4)3) A mild steel shaft is used to connect a motor drive to a constant load torque. To measure this torque, a resistance strain gauge with a resistance of 120 ohms and a gauge factor of 2, is mounted on a shaft with its at 45° to the shaft axis. Shear modulus of mild steel is $8 \times 10^{10} \text{ N/m}^2$. Shft (3) A) diameter is 3cm and the change in gauge resistance due to load is 0.2 ohms. Find the load torque. B) Explain Proving Ring Load cell with neat sketches and write deflection equation. (3) Calculate limits of tolerance and allowance for a 40mm shaft nominal diameter and hole pair C) (4)designated by H8g9 to get precision fit. The fundamental tolerance is calculated by $i = 0.45D^{1/3}$ +0.001D microns. The following data are given i. Upper deviation of the shaft = $-2.5D^{0.34}$ microns.

- ii. 40 mm lies in the diameter step of 30 to 50mm
- iii. IT8=25i & IT9=40i.

Duration: 180 mins.

State the type of fit and sketch the same graphically.

- 4) Define the following terms with sketch as per IS919.
 A)

 i. Tolerance (Bilateral)
 A)
 ii. Fit.
 iii. Basic Size.
 iv. Zero line
 - B) Explain Taylors principle and third British system for the design of gauges (Sketches necessary). (3)
 - C) Design a plug and ring gauge for the fit \Box 17F6f7. Refer table (given below) for tolerance data.

Table 1 for Question No. 3C and 4C (Tolerance Data)								
Basic Size (mm)		Tolerance Grades	IT5	IT6	IT7	IT8	ЮТ9	IT10
Above	Up to and including	Xi (μm)	7i	10i	16i	25i	40i	64i
6	10			•	-		•	
10	18	Туре	Fundamental Deviation (µm)					
18	30	D	16D ^{0.44}					
30	50	E	11D ^{0.41}					
50	80	F	5.5D ^{0.41}					
80	120	G	2.5D ^{0.34}					

Draw graphical representation.

5) With the help of neat sketch derive the expression for effective diameter using 3-wire method.

A)

- B) Sketch and explain the working of an Auto collimator.
- C) Using M112 slip gauge set, list the slip gauges to be wrung together to produce the following dimensions. One protection slip of 2mm size is available and to be used at the top in each case. a) 52.7895 b)79.247. Also show the setup schematically.

-----End-----

(2)

(5)

(4)

(4)