Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B. TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: METROLOGY AND MEASUREMENTS [MME 3104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. With neat sketch of Pressure Thermometer draw the block diagram for its generalized measurement system with various functional elements. **3**

1B. A very high pressure gauge, using a manganin element is to measure a maximum pressure of 0.1GPa. The wire diameter is 30µm, length is 0.04m. Pressure sensitivity of wire material is 2.4×10^{-11} Ω/Ω-Pa, resistivity 45×10^{-8} Ω-m. 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. Take atmospheric pressure as 0.1MPa. **3**

1C. With the help of neat sketch explain the working of Mcleod gauge and derive the expression for unknown pressure. **4**

2A. With the help of schematics state the laws of thermocouples. A copper constantan thermocouple was found to have linear calibration between 0°C and 300°C with emf at maximum temperature (reference junction temperature 0°C) equal to 60 mV. Find the sensitivity and the correction which must be made to the indicated emf if the junction temperature is 25°C. **3**

2B. A strain gauge is bonded to a steel beam 0.1m long and having a cross-sectional area of $4cm^2$. Young's Modulus for steel is $207GN/m^2$. The strain gauge has an unstrained resistance of 220Ω and a gauge factor of 2.4. When a load is applied axially to the beam, the resistance of gauge changes by 0.018Ω. Calculate the change in length of the steel beam and the amount of force applied to the beam. Also show the setup schematically. **3**

2C. With the help of neat sketch explain the construction and working of optical pyrometer. **4**

3A. With the help of a neat sketch explain the working of a Pneumatic Load Cell. **3**

3B. 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. **3**

3C. Determine the limits on a shaft and a pulley of 40mm nominal diameter. The tolerance on the shaft is g6 and on the pulley is H8. Calculate. (a)The tolerance on the shaft and pulley. (b) The upper and lower limits of shaft and pulley. (c)The maximum and minimum clearance. (d)Show the limits schematically. Refer table 1 for tolerance data. **4**

4A. Draw neat sketches of a) Progressive plug gauge b) Double ended Snap gauge and indicate its limits. **3**

4B. Explain with neat sketch the procedure for measuring the squareness with Engineer's square tester. **3**

4C. Design a plug and ring gauge for the fit $\phi 17F_6f_7$. Refer table 1 for tolerance data. **4**

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

5B. In the measurement of surface roughness, heights of 5 successive peaks and troughs were measured from a datum and were found to be 35, 22, 36, 18, 42, 22, 32, 21, 30, 15 micrometers. Determine the Ra, Rz and R.M.S. value of the rough surface. **3**

5C. Determine the straightness error of the data recorded in minutes in a test using autocollimator and reflector. The distance between the legs of the reflector was 120mm. The readings obtained were 0.5, -0.4, 0.6, -0.2, -0.1, 0.4, -0.5, -0.2, 0.3, 0.1. **4**

Table 1 for Question No. 3C and 4C (Tolerance Data)

Basic Size (mm)	
Above	**Up to and including**
6	10
10	18
18	30
30	50
50	80
80	120

Tolerance Grades	**IT5**	**IT6**	**IT7**	**IT8**	**IOT9**	**IT10**
Xi **(µm)**	**7i**	**10i**	**16i**	**25i**	**40i**	**64i**

Type	**Fundamental Deviation (µm)**
D	$\mathbf{16D^{0.44}}$
E	$\mathbf{11D^{0.41}}$
F	$\mathbf{5.5D^{0.41}}$
G	$\mathbf{2.5D^{0.34}}$