Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

V SEMESTER B.TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: METROLOGY & 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.
- Draw neat sketches wherever is required.

1A. A dial indicator has a scale from zero to 1 mm and 100 divisions on scale. During a calibration tests the following results were obtained:

Calibration Length (mm)	0.00	0.10	0.20	0.30	0.40	0.50	0.60
Scale Value (mm)	0.00	0.09	0.20	0.29	0.41	0.51	0.61
Calibration Length (mm)	0.70	0.80	0.90	1.00			
Scale Value (mm)	0.69	0.79	0.91	1.00			

Determine (i) The sensitivity (ii) Maximum error as a percentage of scale value (iii) Maximum error as a percentage of full scale value (iv) Whether the dial indicator conforms to the maker's specification of accuracy within ±1.0% of full scale deflection. **03**

1B. Draw the generalized block diagram to show the functional elements of the pressure thermometer in different stages with input and output parameter for each element. **02**

1C. With neat sketch show how elastic pressure elements are used to measure pressure. **03**

1D. Explain the method of measuring force using a pneumatic load cell. **02**

2A. With a neat sketch show the McLeod gauge which has a bulb volume of 20 ml and the capillary diameter of 0.2 mm. What is the gauge reading when the pressure to be measured is 2 Pa.? **02**

2B. Explain the shunting method used to calibrate the strain gauge and derive the expression for equivalent strain. **02**

2C. A load cell is formed of a hollow steel cylinder loaded axially. The four strain gauges with gauge resistance = 1000Ω and gauge factor = 2 are so bonded as to enhance the signal and compensate for temperature variation. The load cell has a cross-sectional area of 2 cm^2. Young's modulus of steel is 2.07 x 10^{11} N/m^2 and Poisson's ratio 0.3. The current in strain gauge is limited to 20 mA. Calculate (i) the bridge supply voltage and (ii) current in the detector arm if this consists of a micro ammeter of resistance 500Ω, when the load cell is subjected to a force of 10^5 N. **03**

2D Explain with neat sketch how the torque & power can be measured using strain gauge Torque meter. **03**

3A. A K type thermocouple is used as shown in Figure Q No. 3(A) (i) without a reference junction. The terminals of the voltmeter are at room temperature of 30^{o}C while the measuring junction is at 100^{o}C. What is the voltmeter reading? What would have been the reading had it been connected as shown in Figure Q No. 3(A) (ii) with the reference junction at the ice point?
The calibration chart of the thermocouple is:

Temperature ^{o}C	20	30	40	50	60	70	80	90	100
Voltage, mV	0.798	1.203	1.612	2.023	2.436	2.851	3.267	3.682	4.096

03

3B. Explain the working of disappearing filament optical pyrometer with neat sketch. **03**

3C. A machine operator needs a gauge for checking the diameter of holes to be machined to a diameter of 20 + 0.06 mm. What should be the dimensions of the gauge if, unilateral system of tolerances are incorporated? Assume gauge tolerance and wear allowance each as 10% of work tolerance. **02**

3D With the help of neat sketches, discuss the fundamental deviation for hole and shaft system. **02**

4A. What are the primary reasons for surface irregularities? Differentiate between first, second, third, and fourth order irregularities. **04**

4B. A 100 mm diameter journal and bearing assembly has a clearance fit, with the following specifications:
Tolerance on bearing = 0.005 mm
Tolerance on journal = 0.004 mm
Allowance = 0.002 mm
Determine the sizes of the bearing and the journal on (i) Hole Basis System (ii) Shaft Basis System. Take Unilateral System of tolerances. **04**

4C A series of waves takes the form of equilateral triangle of length of the side 40 mm. Taking five waves as representing a sampling length, determine the Centre Line Average Value when the vertical magnification is X 500 and the horizontal magnification is X 20. **02**

5A. (i) Explain with neat sketch the use of an optical square to test the squareness of machine slide ways.
(ii) Explain with neat sketch the use of standard square to test the squareness of cross-slide of a lathe with the spindle axis **03**

5B. A metric screw thread is being inspected using the two-wire method in order to measure its effective diameter. The distance across 10 threads measured using a scale is 12.5 mm. The distance over the wires is 25.08 mm. Determine the effective diameter of the screw thread. **03**

5C 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 centre distance of the feet of the block was 70 mm and the autocollimator readings (in minute) were: +0.5, +0.8, -0.3, 0, +0.1, +0.5, -0.2, 0, -0.5, 1.2. Make a diagrammatic sketch of the set-up, plot the graph in micrometer and deduce the graph to show errors from a straight line through the point of support. **04**

Figure Q No. 3(A) (i)

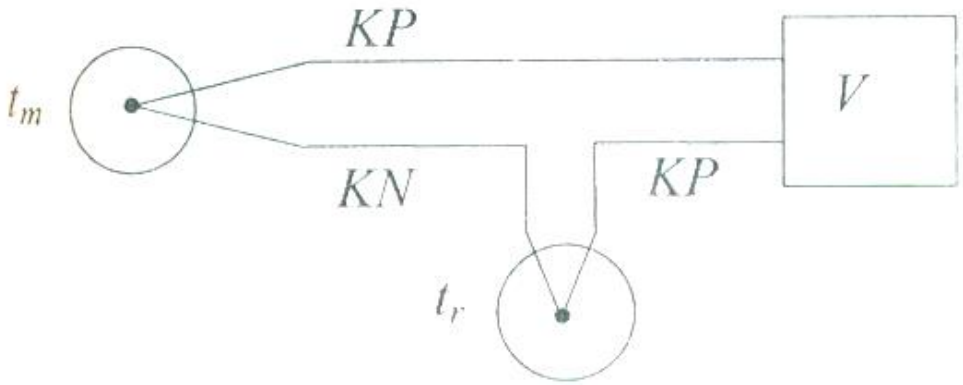

Figure Q No. 3(A) (ii)