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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



V SEMESTER B.TECH (MECHANICAL ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2015

SUBJECT: METROLOGY AND INSTRUMENTATION [MME 309]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- ✤ Missing data may be suitably assumed.
- 1A. Explain the following with neat sketch
 - (i) Progressive form of plug gauge
 - (ii) Double ended Snap gauge
 - (iii) Tee-Bo type combined limit gauge
- 1B. List the slip gauges to be wrung together to produce an overall dimension of 73.562 mm [2] using two protection slips of 2.5mm size.(Use M112 Slip gauge set). Also show schematically the sequence of wrung slip gauges
- **1C.** With the help of a neat sketch explain the working of McLeod Gauge and derive the **[5]** expression for pressure measurement.
- **2A.** State the Taylor's principle for the design of gauges.
- **2B.** Explain with neat sketch the squareness measurement of a try-square using Engineer's **[4]** square tester
- **2C.** Explain the working principle a metallic resistance thermometer with a neat sketch in **[4]** temperature measurement.
- **3A.** Explain with a neat sketch the determination of force using a Tensile- Compressive load **[4]** cell.
- **3B.** With neat sketch derive the relation for distance over wires in terms of effective diameter, **[4]** diameter of wires, pitch and thread angle using two wire method experiment
- **3C.** Explain the shunting method used to calibrate the strain gauge. [2]

[3]

[2]

4A. Determine the straightness error of the data recorded in a test using autocollimator and **[5]** reflector. The distance between the legs of the reflector was 120mm. Represent the line graphically (Error Vs position graph).



- **4B.** With neat sketch of Bourdon Tube Pressure Gauge draw the generalized block diagram to **[5]** show its functional elements in different stages. Also explain the function of these functional elements.
- **5A.** Determine the limits on a shaft and a bearing of 20mm nominal diameter, which fit [4] together with a clearance fit. The tolerance on the shaft is g6 and on the bearing H7. Calculate (i) The tolerance on the shaft and the bearing. (ii) The maximum and minimum clearance. The fundamental deviation for g shaft = $-2.5D^{0.34}$. Tolerance on Shaft IT6 = 13μ m and on bearing IT7 = 21μ m.
- **5B.** Explain with neat sketch and necessary equations, the power measurement of Torque of **[4]** rotating shaft using strain gauges
- **5C.** Explain with neat sketch the process of wringing of slip gauges
- 6A. Calculate the CLA (Ra) value of a surface for which the sampling length was 0.8 mm. The [2] graph was drawn to a vertical magnification of 8000 and a horizontal magnification of 150 and the areas above and below the datum line were :

| Above (in mm ²) | 150 | 170 | 150 | 120 |
|-----------------------------|-----|-----|-----|-----|
| Below (in mm ²) | 80 | 60 | 80 | 40 |

- **6B.** With the help of neat sketch explain the working of Bench micrometer.
- 6C. A solid shaft is to be designed to measure the torque of an engine by measuring angular [5] deflection. The torque is 400Nm. Spring steel with E = 200GPa and Poisson's ratio υ =0.3 is used for the construction. An angular deflection of 10° is required to get sufficient resolution. Determine (a) suitable length & cylinder diameter combination for this measurement. (b) If length L=100mm, what will be the diameter of the shaft. (c) What will be the strain obtained from strain gauge connected at 45° to the axis.

[2]

[3]