Roll No. | | | | | | | | |

**B.E / B.Tech (Full Time ) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014**

MECHANICAL ENGINEERING

Semester 5

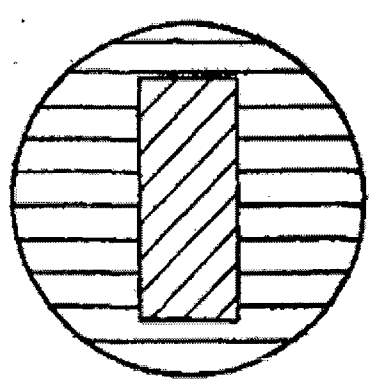
**ME 375 / 9311 & Metrology and Measurements**

(Regulation 2008)

Time : 3 Hours | Answer ALL Questions | Max. Marks 100

**PART-A (10 x 2 = 20 Marks)**

1. Why measuring instruments should be calibrated?
2. What is uncertainty of measurement?
3. Calculate the radius of curvature of the inside surface of the glass tube of a spirit level which has a sensitivity of 1 second per division. Each division is 2 mm apart.
4. What are the applications of slip gauges?
5. What is meant by "qualifying the tip" in CMMs?
6. What is machine vision?
7. A surface tested under an optical flat using an NPL flatness interferometer shows the following interference fringe pattern. Interpret the nature of the surface.



8. What is meant by $RS_m$?
9. What is meant by reliability of a measuring instrument?
10. What is the principle behind pitot tube?

**Part – B ( 5 x 16 = 80 marks)**

11. A digital micrometer is calibrated at 25 mm using Grade 0 steel gauge blocks. The readings obtained are 25.000, 25.001, 24.998, 24.999, 25.000, 25.005, 25.003, 25.002, 25.001, 25.000. All dimensions are in mm. The coefficient of thermal expansion of the gauge block is 10.8±0.5 ($10^{-6}$/K). The limit deviation of grade 0 gauge

blocks upto 25 mm lengths is given to be ±0.2μm as per ISO specification for grade 0 gauge blocks. The resolution of the micrometer is 1 μm. The laboratory temperature is maintained $20^0$ C ± $0.5^0$C. **The standard uncertainty due to repeatability of the instrument is 0.5 μm**. Considering the laboratory's procedure for thermal soaking, the lab estimates a maximum temperature deviation of ± $0.5^0$C between the parts. What is the uncertainty of the calibration process?

This micrometer is used to measure a particular dimension in a component. Five readings are taken and the mean of the five readings is 20.01 mm with a standard deviation of 0.007071 mm. Estimate the expanded uncertainty of the measured value at a coverage factor of 2 providing coverage probability of approximately 95%.

12. a) Explain the construction and working principle of an alignment telescope with a neat diagram.

**OR**

b) (i) Determine the dimensions and tolerances of shaft and hole having the fit 30 H7/h8. Standard tolerance for IT 7 is 16i and IT 8 is 25i, where "i" is the standard tolerance unit. Also determine the allowance and maximum clearance. Show graphically the hole and shaft tolerance zones with dimensions. The diameter lies in the range 18 to 30 mm. **(10)**
(ii) Explain the concept of interchangebility and selective assembly. **(6)**

13. a) What are the different types of CMM probes available? Write briefly about the working principle, merits and applications of each type.

**OR**

b) With a neat diagram explain the working principle of a DC Laser interferometer. Show graphically the laser source and interferometer arrangement for measuring straightness of a machine tool guideway.

14. a) (i) Write briefly about the following surface roughness parameters - $R_t$, $R_z$, $R_a$ and $R_q$. **(8)**
(ii) With neat diagrams explain how pitch error of a screw thread is measured using the pitch measuring machine. **(8)**

**OR**

b) Derive the expression for tooth thickness of a gear in the base tangent method.

15. a) Explain the construction and working principle of **any two** instruments used for measuring temperature.

**OR**

b) What are the various errors which occur in measurements? What are the precautions to be taken to eliminate or minimise them?