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Question Paper Code : 82351

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth Semester

Mechanical Engineering

ME 3592 — METROLOGY AND MEASUREMENTS

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. List the general calibration requirements of the measuring systems.
2. State the reason for random errors in the measurement system.
3. What is a comparator?
4. What are the basic elements of a spur gear that require inspection?
5. Define tolerance.
6. State the principle of selective assembly.
7. What is the advantage of stylus based in surface measurement techniques?
8. List two parameters used in surface finish measurement.
9. Mention two advantages of using lasers in metrology.
10. What is the purpose of on-line monitoring in production?

PART B — ($5 \times 13 = 65$ marks)

11. (a) What are errors in measurement? Explain the different types of errors with example.

Or

- (b) Elaborate on the process of calibrating measuring instruments. What are the key steps involved, and why is calibration important in maintaining measurement accuracy?

12. (a) Explain the working of the following instruments with specific applications:

(i) Alignment telescope. (6)

(ii) Autocollimator. (7)

Or

- (b) Explain the process of measuring screw threads. Discuss the methods used to measure pitch diameter, lead, and pitch in screw threads. How do these measurements contribute to the quality of a screw thread?

13. (a) (i) Explain the types of fits. (5)

- (ii) The tolerances for a hole and shaft assembly having a nominal size of 50 mm are as follows:

+0.021 -0.040

Hole = 40 +0.000 mm and shaft = 40 - 0.075 mm

Determine

(1) maximum and minimum clearances (2)

(2) tolerances on shaft and hole (2)

(3) allowance (2)

(4) MML of hole and shaft (2)

Or

- (b) Discuss the methods of tolerance stack-up analysis and their impact on manufacturing.

14. (a) Explain the different types of geometric tolerances and represent them.

Or

- (b) With suitable diagrams, explain the concepts of straightness, flatness and roundness deviations. How are these deviations measured during inspection?

15. (a) Discuss the concept and constructional features of a Coordinate Measuring Machine (CMM). Include types, probes, accessories, software integration, and the benefits of multi-sensor CMMs in modern metrology.

Or

- (b) Describe the components of a machine vision system and explain its working principle, along with applications in online and in-process monitoring during production. How are computed tomography and white light scanning integrated into such systems?

PART C — (1 × 15 = 15 marks)

16. (a) (i) What are the primary reasons for surface irregularities? With the help of an illustration, explain the terms: roughness, waviness, lay, and flaws. (7)
- (ii) Explain the following methods of quantifying surface roughness:
- (1) Rz value,
 - (2) RMS value, and
 - (3) Ra value. (8)

Or

- (b) White light scanners are a type of 3D scanning technology used for capturing precise measurements of objects and environments. Unlike traditional methods that use laser beams or contact sensors, white light scanners utilize a combination of structured light and cameras to create detailed 3D models.
- (i) Explain the principle of operation of a white light scanner. Discuss how it uses structured light patterns and multiple cameras to achieve 3D data acquisition.
 - (ii) Discuss two applications of white light scanning in industries like manufacturing, healthcare, or heritage preservation. Provide specific examples.
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