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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM:IV - THEORY EXAMINATION (2025-2026)

Subject : Measurement and Metrology

Time: 3 Hours

Max. Marks:100

General Instructions:**IMP:** Verify that you have received question paper with correct course, code, branch etc.

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION – A

20

1. Attempt all parts:-

- | | | |
|-------|---|---|
| (1.1) | Metrology is defined as the science of: (CO1) K1 | 1 |
| | (a) Manufacturing | |
| | (b) Inspection | |
| | (c) Measurement | |
| | (d) Quality control | |
| (1.2) | Interchangeability in manufacturing ensures: (CO1) K1 | 1 |
| | (a) High cost production | |
| | (b) Parts can be replaced without modification | |
| | (c) Only manual fitting | |
| | (d) Reduced production rate | |
| (1.3) | Flatness is a type of: (CO2) K1 | 1 |
| | (a) Dimensional tolerance | |
| | (b) Form tolerance | |
| | (c) Orientation tolerance | |
| | (d) Runout tolerance | |

- (1.4) Parallelism is classified under: (CO2) K1 1
- (a) Form tolerance
 - (b) Runout tolerance
 - (c) Profile tolerance
 - (d) Orientation tolerance
- (1.5) In CMM, probing is used to: (CO3) K1 1
- (a) Heat the surface
 - (b) Polish the surface
 - (c) Detect coordinates of points
 - (d) Cut material
- (1.6) Touch trigger probe works on the principle of: (CO3) K1 1
- (a) Optical sensing
 - (b) Electrical contact signal
 - (c) Thermal expansion
 - (d) Magnetic effect
- (1.7) Laser vision systems are used for: (CO4) K1 1
- (a) Precision measurement
 - (b) Cutting
 - (c) Welding
 - (d) Casting
- (1.8) Nanotechnology instrumentation deals with: (CO4) K1 1
- (a) Nano scale measurement
 - (b) Macro scale measurement
 - (c) Large structures
 - (d) Thermal systems
- (1.9) Computer Aided Metrology mainly involves: (CO5) K1 1
- (a) Manual measurement
 - (b) Software-based measurement systems
 - (c) Visual inspection
 - (d) Mechanical fitting
- (1.10) Image processing in metrology is used for: (CO5) K1 1
- (a) Data storage
 - (b) Welding
 - (c) Machining
 - (d) Feature detection and analysis

2. Attempt all parts:-

- | | | |
|-------|---|---|
| (2.1) | Explain Interchangeability. (CO1) K2 | 2 |
| (2.2) | What is Surface Roughness Measurement? (CO2) K2 | 2 |
| (2.3) | Write two applications of CMM. (CO3) K2 | 2 |
| (2.4) | Define Laser Vision System. (CO4) K2 | 2 |
| (2.5) | Explain use of Computer Aided Metrology? (CO5) K2 | 2 |

SECTION – B

30

Answer any one of the following-

- | | | |
|-------|--|---|
| (3.1) | Explain standardization and tolerances with examples. (CO1) K2 | 6 |
| (3.2) | Explain limit gauging and types of gauges. (CO1) K2 | 6 |

Answer any one of the following-

- | | | |
|-------|--|---|
| (3.3) | Explain GD&T symbols with the help of diagrams. (CO2) K3 | 6 |
| (3.4) | Explain feature inspection methods (straightness, flatness, parallelism). (CO2) K3 | 6 |

Answer any one of the following-

- | | | |
|-------|--|---|
| (3.5) | Explain working principle of CMM. (CO3) K3 | 6 |
| (3.6) | Describe Touch Trigger Probe with neat diagram. (CO3) K3 | 6 |

Answer any one of the following-

- | | | |
|-------|--|---|
| (3.7) | Explain laser vision and its applications in metrology. (CO4) K3 | 6 |
| (3.8) | Explain In-process gauging and CNC metrology systems. (CO4) K3 | 6 |

Answer any one of the following-

- | | | |
|--------|---|---|
| (3.9) | Explain laser interferometer and its working. (CO5) K3 | 6 |
| (3.10) | Explain non-contact measurement techniques and image processing. (CO5) K3 | 6 |

SECTION – C

50

4. Answer any one of the following-

- | | | |
|-------|--|----|
| (4.1) | Explain limit system, tolerances and fits with neat diagrams. (CO1) K3 | 10 |
| (4.2) | A shaft is manufactured with limits 50.00 mm to 50.04 mm and the hole with limits 50.05 mm to 50.10 mm.

i. Find type of fit
ii. Calculate maximum and minimum clearance
iii. Comment on interchangeability (CO1) K3 | 10 |

5. Answer any one of the following-

- | | | |
|-------|--|----|
| (5.1) | Explain GD&T industrial applications. (CO2) K3 | 10 |
| (5.2) | A component has tolerance of ± 0.02 mm on length of 100 mm. Measured value is 100.03 mm.

i. Determine deviation | 10 |

- ii. Check acceptance as per tolerance
- iii. Comment on quality (CO2) K3

6. Answer any one of the following-

- (6.1) Explain CMM construction, types and error sources. (CO3) K2 10
- (6.2) A force sensor measures a force of 500 N with an error of $\pm 2\%$. 10
- i. Calculate absolute error
 - ii. Find corrected value range
 - iii. Comment on measurement accuracy (CO3) K2

7. Answer any one of the following-

- (7.1) Explain advanced metrology systems including laser vision and 3D metrology. 10
(CO4) K2
- (7.2) Discuss implementation challenges A manufacturing industry is shifting to in-process gauging using CNC systems. (CO4) K3 10

8. Answer any one of the following-

- (8.1) Explain Computer Aided Metrology and software integration. (CO5) K3 10
- (8.2) Discuss significance in precision measurement a laser interferometer measures displacement of 0.002 mm per fringe shift. If 250 fringes are observed. (CO5) K3 10