

ME8501 METROLOGY AND MEASUREMENTS

UNIT I BASICS OF METROLOGY

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III ADVANCES IN METROLOGY

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV FORM MEASUREMENT

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE

Force, torque, power - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer– Reliability and Calibration – Readability and Reliability.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.
2. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.

REFERENCES:

1. Alan S. Morris, “The essence of Measurement”, Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2014.
3. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, “Industrial Instrumentation”, Wiley Eastern, 2004.
5. Raghavendra ,Krishnamurthy “Engineering Metrology & Measurements”, Oxford Univ. Press, 2013.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Name : METROLOGY AND MEASUREMENTS **Code** : ME8501
Year : III **Semester** : V
Degree & Branch : B.E. – MECHANICAL

SANJCEET

B.E. / B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017
Fifth Semester
ME6504 –ENGINEERING METROLOGY AND MEASUREMENT
(Regulation 2013)

Time: 3 Hours

Maximum marks: 100

Answer ALL questions

PART - A (10x2=20 marks)

1. Define traceability(Ref P.NO 2)
2. What is difference between gauging and measurement. (Ref P.NO 3)
3. Why is rocking procedure followed when measuring with a dial bore gauge.
(Ref P.NO18)
4. Name any four instrument used measuring internal diameter in components(Ref P.NO18)
5. What is meant by “Qualifying the tip” in CMM(Ref P.NO45)
6. Write any four application of artificial vision system in manufacturing industries(Ref P.NO45)
7. Calculate the “ best size wire” for checking the effective diameter of a M10 X 2.5 thread.
8. Is assessment length greater /lesser than traverse length in surface finishmeasurement?
why? (Ref P.NO 62)
9. What is meant by reliability of a measuring instruments(Ref P.NO 79)
10. Write the working principle of pyrometer. (Ref P.NO 79)

PART - B (10x2=20 marks)

11. (a) Explain the various error in measurement(Ref P.NO 5)
Or
(b) What is the need of calibration? Explain the classification of various standards(Ref P.NO 4)
12. (a) Explain the construction and working principle of autocollimator with a neat diagram (Ref P.NO37)
Or
(b) Explain the construction, working principle and application of sine bar(Ref P.NO40)
13. (a) Explain the working principle of AC laser laser interferometer and how the straightness

is measured(Ref P.NO47)

Or

(b) With neat diagram explain the working principle of touch trigger probes(Ref P.NO58)

14. (a) With neat diagram explain how gear tooth thickness is measured using a gear tooth Vernier caliper (Ref P.NO67)

Or

(b) Derive the expression for tooth thickness of the gear in the constant chord method (Ref P.NO 67)

15. (a) With neat sketch explain construction and working principle of following (i) Rotameter (Ref P.NO 81) (ii) Resistance thermometer (Ref P.NO 86)

Or

(b) With neat sketch explain construction and working principle of following (i) Pitot tube (Ref P.NO 95) (ii) Bimetallic strip (Ref P.NO 80)

PART - C (10x2=20 marks)

16. (a) Calculate the tolerance, fundamental deviation and limits of sizes for the shaft designated as 40 H8/f7. Standard tolerance for IT 7 is 16i and IT 8 is 25i. Where 'i' is the standard tolerance unit. Upper deviation for 'f' shaft is $-5.5D^{0.41}$, 40mm lies in the diameter range 30 – 50 mm. (Ref P.NO42)

Or

(b) Design general type GO and NOGO gauge for a 40H7/d8 fit. 40mm lies in the diameter range 30 – 50 mm. Show graphically the disposition of gauge tolerance zones relative to the work tolerance zones. Standard tolerance for IT 7 is 16i and IT 8 is 25i. Where 'I' is the standard tolerance unit. The upper deviation for 'd' shaft is $-16D^{0.44}$. (Ref P.NO42)

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016

Fifth Semester

ME6504 –ENGINEERING METROLOGY AND MEASUREMENT

(Regulation 2013)

Time: 3 Hours

Maximum marks: 100

Answer ALL questions

PART - A (10x2=20 marks)

1. Brief on sensitivity in measurement. (Ref P.NO 2)
2. Differentiate between accuracy and precision. (Ref P.NO 2)
3. Write short notes on Bevel protractor. (Ref P.NO18)
4. Write short notes on interchangeability. (Ref P.NO 18)
5. Why laser is used as light source in interferometers? (Ref P.NO45)

6. Name the different stages involved in the machine vision based measurement. (Ref P.NO45)
7. Define drunken thread. (Ref P.NO62)
8. What are the various factors affecting surface roughness of a machined component? (Ref P.NO62)
9. Give the principle of hot wire anemometer. (Ref P.NO 79)
10. Name the materials used for thermocouples. (Ref P.NO 79)

PART - A (10x2=20 marks)

11. (a) With a suitable example explain the various elements of generalized measurement systems. (Ref P.NO 11)

Or

- (b) Describe the different types of error and its causes. (Ref P.NO 5)

12. (a) Discuss in detail about the various types of limit gauges with neat sketch (Ref P.NO 11)

Or

- (b) (i) Explain the working principle of Angle Dekkor with neat sketch.
(ii) Write its advantages (Ref P.NO 34)

13. (a) (i) With neat diagram explain the working of AC laser interferometer
(ii) List the advantages of AC laser interferometer (Ref P.NO 47)

Or

- (b) (i) With neat sketch briefly explain the different types of CMM based on its contraction
(ii) List out the advantages of CMM (Ref P.NO 51)

14. (a) Describe the construction of gear tooth Vernier caliper. Explain how it can be used for measuring tooth thickness (Ref P.NO 67)

Or

- (b) Enlist and explain the different methods used for measuring the roundness (Ref P.NO 74)

15. (a) (i) Explain the working of rotameter in flow measurement (Ref P.NO 81)

- (ii) Discuss the working principle of Bourdon tube pressure gauge (Ref P.NO 92)

Or

(b) (i) Draw the construction of electrical resistance thermometer. Explain how it can be used for temperature measurement (**Ref P.NO 86**)

(ii) With the neat diagram discuss the working of liquid in glass thermometer (**Ref P.NO 93**)

**B.E. / B.Tech. DEGREE EXAMINATION, APRIL/MAY 2016 Fifth Semester
ME6504 –ENGINEERING METROLOGY AND MEASUREMENT**

(Regulation 2013)

Time: 3 Hours

Maximum marks: 100

Answer ALL questions

PART - A (10x2=20 marks)

1. What are the factors affecting the inherent characteristics of measuring instruments?
2. Explain line and end standards.
3. List out any four angular measuring instruments used in metrology (**Ref P.NO 14**)
4. What are the advantages of pneumatic comparator? (**Ref P.NO 14**)
5. What are the different types of geometrical tests conducted on machine tools (**Ref P.NO 37**)
6. Write the advantages of machine vision system.
7. What is best size of wire? (**Ref P.NO 51**)
8. What are factors affecting surface roughness? (**Ref P.NO 51**)
9. What are load cells? (**Ref P.NO 67**)
10. Mention the principle involved in bimetallic strip (**Ref P.NO 68**)

PART - B (16x5=80 marks)

- 11(a)** Explain various causes of errors (**Ref P.NO 4**) **(16)**
- (OR)**
- (b)** Elaborate on different methods of measurements (**Ref P.NO 7**)
- 12a)** Explain Johansson microkator and sigma comparator with neat sketches **(16)**
- (OR)**
- (b)** Discuss about various types of limit gauges (**Ref P.NO 15**) **(16)13a)**
- Explain working of laser interferometer (**Ref P.NO 40**) **(16)**
- (OR)**
- (b)** Explain different types of CMM and their constructional features **(16)(Ref P.NO 43)**

14(a) Define various terminologies of screw thread with suitable diagrams (16)

(OR)

(b) Derive the expression for finding the effective diameter by two and three wire method (Ref P.NO 63) (16)

15(a) Discuss about any two types of measurement of temperature (Ref P.NO 70) (16)

(OR)

(b) Explain the working of rotometer and orificemeter with neat sketches (16)(Ref P.NO 71)

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B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015 Fifth

Semester

ME6504 –ENGINEERING METROLOGY AND MEASUREMENT

(Regulation 2013)

Time: 3 Hours

Maximum marks: 100

Answer ALL questions

PART - A (10x2=20 marks)

1. What is the difference between repeatability and reproducibility? (Refp.no11)
2. What is the difference between allowance and tolerance?
3. Write any two precautions to be followed when using gauge blocks. (Ref P.NO 15)
4. Why are lasers used in metrology? (Ref P.NO 14)
5. What are touch trigger probes?
6. What are diffraction gratings? (Ref P.NO 38)
7. Define “material ratio” with reference to surface finish measurement.
8. How is roundness measured in the Least squares circle method?
9. Why are measuring instruments calibrated? (Ref P.NO 67)
10. What is the working principle behind strain gauges? (Ref P.NO 67)

PART - B (16x5=80 marks)

11(a) What are the various elements of metrology? With examples, explain how these elements influence the accuracy of measurements? (16)

(OR)

(b) Explain with neat diagrams the method for measurement of straightness of a machine tool guide way using an Autocollimator. Show the tabulation to determine the error in straightness by choosing a reference line passing through the first and last points of the guide way. (16)

12a) (i) with a neat diagram explain the working of angle dekkor (12)

(Ref P.NO 30) (4)

(ii) why are sine bars not used for measuring large angles

(Ref P.NO 13)

(OR)

- (b)** Calculate the limits for a hole shaft pair designated 25 H8/d9. **(16)**
Show graphically the disposition of tolerance zones with reference to the zero line. The lower deviation for a H type hole is zero. 25 mm lies in the diameter range 18 mm to 30 mm. standard tolerance for IT 8 is 25 i and IT 9 is 40 i, where “i” is the standard tolerance unit in microns and is given as $i(\mu\text{m})=0.45 + 0.001D$, (D is in mm). the upper deviation for ‘d’ shaft – $16D^{0.44}$
- 13a)** (i) What is a co ordinate Measuring Machine? What are its basic elements? **(Ref P.NO 43)** **(6)**
(ii) Explain the working principle of a DC laser interferometer with a neat diagram? **(Ref P.NO 50)** **(10)**
- (OR)**
- (b)** Write briefly about the various stages involved in machine vision? **(16)**
(Ref P.NO 45)
- 14(a)** (i)What is meant by functional inspection of gears? How it is done? **(2)**
(ii) How is the tooth thickness of a gear measured in the base tangent method? Derive the expression for tooth thickness of a gear in this method? **(10)**
- (OR)**
- (b)** (i)With a neat diagram explain the working principle of any one stylus type surface finish measuring instrument? **(Ref P.NO 56)** **(10)**
(ii) How is surface finish indicated in an engineering drawing? **(6)**
What are the various elements indicated in the symbol?
(Ref P.NO 57)
- 15(a)** With a neat diagram explain the working principle of rotameter and pitot tube? **(Ref P.NO 71)** **(16)**
- (OR)**
- (b)** With a neat diagram explain the working of bimetallic strip and thermocouple? **(Ref P.NO 70 & 78)** **(16)**