

UNIT IV - Laser and advances in Metrology

2 MARKS

81. What is interferometer?

Interferometer is optical instruments used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.

82. Name the different types of interferometer?

- 1) NPL flatness interferometer
- 2) Michelson interferometer
- 3) Laser interferometer
- 4) Zesis gauge block interferometer.

83. Name the common source of light used for interferometer

- a. Mercury 198
- b. Cad minus
- c. Krypton 86
- d. Helium
- e. Hydrogen

84. What is crest and trough?

The light is a form of energy being propagated by electromagnetic waves, which is a sine curve. The high point of the wave is called crust and the low Point is called is trough.

85. What is wavelength?

The distance between two crusts or two troughs is called the wavelength

86. What is meant by alignment test on machine tools?

The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool.

87. List the various geometrical checks made on machine tools.

- a. Straightness of guide ways and slide ways of machine tool.
- b. Flatness of machine tables and slide ways.
- c. Parallelism, equidistance and alignment of the slide ways.
- d. True running and alignment of shaft and spindle.
- e. The pitch error or lead of lead screw.
- f. Pitch errors of gears.

88. Distinguish between geometrical test and practical test on a machine tool.

The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool. Performance test consist of checking the accuracy of the finished component. Alignment test consist of checking the relationship between various machine elements when the machine tool is idle. Performance test consists of preparing the actual test jobs on the machine and checking the accuracy of the jobs produced.

89. What are the main spindle errors?

- a) Out of round.
- b) Eccentricity
- c) Radial throws of an axis.
- d) Run out
- e) Periodical axial slip

90. Write the various tests conducted on any machine tools

1. Test for level of installation of machine tool in horizontal and vertical planes.
2. Test for flatness of machine bed and for straightness and parallelism of bed ways on bearing surface.
3. Test for perpendicularity of guide ways to other guide ways.
4. Test for true running of the main spindle and its axial movements.

91. Why the laser is used in alignment testing?

The alignment tests can be carried out over greater distances and to a greater degree of accuracy using laser equipment. Laser equipment produces real straight line, whereas an alignment telescope provides a, imaginary line that cannot be seen in space.

92. Classify the machine tool test.

It can be classified into

1. Static tests
2. Dynamic tests.

93. What are the different types of geometrical tests conducted on machine tools?

1. Straightness
2. Flatness
3. Parallelism, equi-distance and coincidence.

94. What is the principle of laser?

The photon emitted during stimulated emission has the same energy, phase and frequency as the incident photon. This principle states that the photon comes in contact with another atom or molecule in the higher energy level E_2 then it will cause the atom to return to ground state energy level E_1 , by releasing another photon. The sequence of triggered identical photon from stimulated at in is known as stimulated emission. This multiplication of photon through stimulated emission leads to coherent, powerful, monochromatic, collimated beam of light emission. This light emission is called laser.

95. What is CMM?

It is a three dimensional measurements for various components. These machines have precise movement is x, y, z coordinates which can be easily controlled and measured. Each slide in three directions is equipped with a precision linear measurement transducer which gives digital display and senses positive and negative direction.

96. Define axial length measuring accuracy

It is defined as difference between the reference lengths of gauges aligned with a machine axis and the corresponding measurement results from the machine.

97. Write the types of coordinate measuring machines

1. Bridge type
2. Horizontal bore mill
3. Vertical bore mill
4. Spherical coordinate measuring machine

98. Explain CNC, CMM briefly.

A computer numerical control system can be used with CMM to do calculations while measuring complex parts. Error can be stored in memory while doing calculations. For automatic calibration of probe, determination of co-ordinate system, calculation, evaluation and recording etc., special software's are incorporated.

99. Write some features of CMM software.

Measurement of diameter, center distance can be measured as follows:

1. Measurement of plane and spatial curves
2. Minimize CNC program
3. Data communications.

4. Digital input and output command

5. Interface to CAD software

100. Define machine vision.

Machine vision can be defined as a means of simulating the image recognition and analysis capabilities of the human system with electronic and electromechanical techniques.

101. What are the four basic types of machine, vision system?

(i) Image formation.

(ii) Processing of image.

(iii) Analyzing the image

(iv) Interpretation of image.

102. Write the advantages of machine vision system.

(i) Reduction of tooling and fixture cash.

(ii) Elimination of need for precise part location.

(iii) Integrated automation of dimensions verification

(iv) Defect detection.

103. Define grayscale analysis.

In these techniques, discrete areas or windows are formed around only the portions of the image to be inspected. For determining if brackets are present, high intensity lighting is positioned. This type of discrete area analysis is a powerful tool and can be used for inspection of absence, correct part assembly, orientation, part, integrity, etc.

104. Mention the advantages of CMM.

(i) The inspection rate is increased.

(ii) Accuracy is reduced.

(iii) Operator's error can be minimized. Skill required for the operator is reduced.

(iv) Reduction in calculating, recording and set up time.

(v) No need of GO/NOGO gauges.

(vi) Reduction of scrap and good part rejection.

105. Mention the disadvantages of CMM.

(i) The table and probe may not be in perfect alignment.

(ii) The stylus may have run out.

(iii) The stylus moving in z-axis may have some perpendicularity errors.

- (iv) Stylus while moving in x and y direction may not be square to each other.
- (v) There may be errors in digital system.

106. Mention the application of CMM.

- (i) CMMs find its application in automobile, machine tool, electronics, space and many other large companies
- (ii) Inspections of test equipments, gauges and tools.
- (iii) For aircraft and space vehicles of hundred Percent inspections is carried out by using CMM.
- (iv) CMM can be used for determining dimensional accuracy of the component.
- (v) CMM can also be used for sorting tasks to achieve optimum pacing of components within tolerance limits.

107. Describe the features of a flexible inspection system.

- (i) A powerful computer serves as a real time processor to handle part dimensional data and as a multi 'programming system to perform such tasks as manufacturing process control.
- (ii) The terminal provides interactive communication with personnel Computer where the programs are stored.
- (iii) Input devices microprocessor based gauges and other inspection devices are used in CMM.

108. Write brief note about (i) Co-ordinate measuring machine equipped with a laser probe (ii) Virtual measuring system

(i) A CMM equipped with a laser probe can convert a part of physical model into a digitize file. Such a file can be compared with other file and can be manipulated by designers to improve quality. Manufactures can verify that each finished part measures exactly as designed.

(ii) Virtual measuring System uses a microscope system to examine an electronic replica of the Surface texture of part. Such a system is non-contact 3-1) Surface measurement system and provide image of the surface. The images are processed on a PC using vertical scanning interferometry and vision analysis software to produce 2D-profile, 3-D plots and counters plots. It generates statistics for average roughness, average profile height, reduced peak height, roughness depth, reduced valley depth and a number of other parameters. It also determines the

depth; spacing and angle of groove in a hard surface optical probe of a cylinder bore can be rotated 360 degrees and moved vertically along the cylinder wall.

109. Explain briefly the three important fields of machine vision system

Inspection: It is the ability of an automated vision system to recognize well-defined pattern and if these pattern match these stored in the system makes machine vision ideal for inspection of raw materials, parts, assemblies etc. Part identification: It is the ability of part recognition provides positive identifications of an object for decision-making purposes. Guidance and Control of machine vision systems are used to provide sensor feedback for real time guidance.

16 MARKS

- 1) With neat sketch explain the various types of CMM based on its construction. Write the advantages of computer aided inspection.
- 2) Explain the construction and working principle of laser interferometer with neat diagram? Explain the use of laser interferometer in angular measurement.
- 3) Explain the various geometrical tests that are to be done to get a better accuracy in the machine tool?
- 4) Describe the working principle of a dual frequency laser interferometer and state its application.
- 5) Explain the construction details of column type CMMs. What are the advantages of bridge type CMMs? State the possible sources of errors in CMM.
- 6) Explain with a neat sketch the working of talysurf instrument for surface finish measurement. What is the symbol for fully defining surface roughness and explain each term?
- 7) Describe in detail the method of checking roundness by using Roundness Measuring Machine. State its advantages.
- 8) Explain the working principle of AC LASER interferometer and how the straightness is measured?
- 9) Explain in detail the various methods of testing accuracy of horizontal milling machine and lathe using laser interferometer.
- 10) Sketch and describe the optical system of a laser interferometer.
- 11) write a brief note on laser as a means of alignment checking

- 12) Define explain the working principle of Tomlinson surface meter with a neat sketch.
- 13) Define straightness. Describe any one method of measuring straightness of a surface.
- 14) explain how the straightness error of a Lathe bed is checked using a Auto-collimator
- 15) With neat sketches, explain the significance of some important parameters used for measuring surface roughness. Why so many parameters are needed?
- 16) How surface finish is measured using LASER. How the angle is measured using a laser interferometer?
- 17) Explain with neat sketches how Roll, yaw and pitch of a lathe carriage is checked using laser interferometer.
- 18) Discuss the steps involved in computing flatness of surface plate.
- 19) How are the pitch and yan errors in X direction of table movement measured in a horizontal milling machine by LASER interferometer?
- 20) How are CMMs classified with respect to constructional features? Sketch and state the main applications, merits and demerits.