

III B.Tech I Semester Regular Examinations, November 2006
METROLOGY AND QUALITY CONTROL
(Production Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) With the help of neat sketches, explain the working of a differential screw type micrometer ?
(b) Describe the method of checking flatness and squareness with the axis of spindle end of an external micrometer. [8+8]
2. (a) Discuss briefly the Spirit level. What are the factors that determine the sensitivity and accuracy of Engineer's Spirit level ?
(b) Sketch a Bevel protractor and explain its uses
(c) With the help of Slips, rollers how do you determine taper angles of a taper plug gauge ? Sketch the experimental set up and explain pushright [6+5+5]
3. (a) Discuss M-system and E-system of assessing surface Roughness. Explain their relative merits and demerits.
(b) Name the various methods of inspecting the surface finish by comparison. State their advantages and limitations.
(c) Explain the terms :
 - i. R_z value of surface finish
 - ii. Micro irregularities in Macro irregularities. [6+6+4]
4. (a) Sketch a progressive type of GO and NOGO plug gauge suitable for 25H7 hole wear and manufacturing allowances need to be considered. For 25H hole fundamental deviation is zero and IT7 is 21 microns.
 - i. State one advantage and one disadvantage to this type of gauge when compared to double ended plug gauge.
 - ii. How can you identify the GO and NO GO ends of double ended plug gauges ?
(b) Explain the following in connection with the "Gauge Design"
 - i. Gauge maker's Tolerance
 - ii. Different types of wear allowance on limit gauges
Give examples of each [8+8]
5. (a) What do you mean by 'pressure sensitive air gauging'. How it can be applied to a pneumatic comparator ? Discuss with a neat sketch ?
(b) Discuss the following with reference to pneumatic comparator
 - i. Pneumatic sensitivity

- ii. Overall magnification of pneumatic system [8+8]
6. (a) Explain the different “screw thread” errors commonly encountered during manufacturing. How can they be identified ? Give remedies for their elimination.
- (b) Explain the method of measurement of thread angle (or) flank angle by optical projection. [8+8]
7. (a) Define the concept of Quality and Total Quality Management.
- (b) Define the term “Process Capability”. How it can be evaluated? [8+8]
8. (a) What do you mean by “acceptance sampling”. Define “acceptance number”. How the “operating characteristic” is affected by sample size and acceptance number.
- (b) In a double sampling 2% AOQL acceptance rectification plan:
 $n_1 = 32$ $c_1 = 0$
 $n_2 = 38$ $c_2 = 2$
 $n = 1000$
Determine
- i. the probability of acceptance of a 2% defective lot.
- ii. the average total inspection. [8+8]

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1. (a) What are the basic requirements to be fulfilled for calibration of slip gauges by Interferometry ?
(b) Explain with a neat sketch about the working of NPL-Hilger Gauge Interferometer
(c) Discuss a brief note on slip gauge accessories ? What is the cross-section of a slip gauge ? [4+8+4]
2. (a) Show, for a Sine Bar, that the error of angular setting θ arising from errors of the dimensions l and h is given by : $\Delta\theta(\text{radians}) = \frac{\sec\theta}{1} \Delta h - \frac{\tan\theta}{1} \Delta l$
(b) Show that the sensitivity of the precision block level depends upon the radius of curvature of the vial only. How do you express its sensitivity. [8+8]
3. (a) Discuss the working of a profilograph with a neat sketch. What are its applications and limitations
(b) In the measurement of surface roughness, heights of 20 successive peaks and troughs were measured from a datum and were 35, 25, 40, 22, 35, 18, 42, 25, 35, 22, 36, 18, 42, 22, 32, 21, 37, 18, 35, 20 microns. If these measurements were obtained over a length of 20 mm, determine C.L.A. (R_a) and R.M.S value of the rough surface. [8+8]
4. (a) Sketch and describe the following:
 - i. Gap Gauge
 - ii. Snap Gauge, and
 - iii. Position Gauge(b)
 - i. Explain the Taylor's principle of limit gauging. Can this principle be strictly followed in practice.
 - ii. Determine the limit dimensions of the gauge for checking holes of 30 ± 0.02 mm diameter and sketch the limit gauge. [8+4+4]
5. (a) What are the advantages and limitations of electrical and electronic comparator ?
(b) Discuss the principle and applications of a Sigma comparator. Show with a neat sketch how it works. [8+8]
6. (a) Describe in detail an experimental set up to determine the pitch error of a spur gear

- (b) Explain how the pitch error of lead screws of an engine lathe is determined. Show by a neat sketch about a Drunken thread. [8+8]
7. (a) Differentiate between Quality and Inspection. Describe different method of Inspection
(b) Discuss the role of statistical quality control in modern production technology. [8+8]
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8. (a) In a doubling sampling plan,
N = 10,000
 $n_1 = 100$
 $n_2 = 150$
 $c_1 = 0, c_2 = 2$
Determine the probability of acceptance of 1% defective lot.
(b) Distinguish between sequential sampling and multiple sampling. [8+8]

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1. (a) Sketch an Inside Micrometer calipers and show various parts.
 - i. A bench micrometer was used for measuring the diameter of a plug gauge, using the setting cylinder, the following data were obtained :
 Nominal diameter of setting cylinder = 30.000 mm
 Reading on setting cylinder = 13.128 mm
 Reading on plug gauge = 15.134 mm
 What is the dia of gauge ? Also.
 Calculate the least count of a micrometer ?
- (b) Explain the spindle locking arrangement in micrometer with a neat sketch.
 What are the precautions to be taken in using Micrometer. [8+8]
2. (a) Derive the expressions used and explain the procedure to determine
 - i. The angle of a taper plug gauge
 - ii. The small end diameter, using Sine bar, Slip gauges, a roller and a dial gauge.
- (b) A 100 mm Sine bar is to be set up to an angle of 33° , Determine the slip gauges needed from 87 pieces set. Briefly state the features of Sine Bar which have tolerances for accuracy. [8+8]
3. (a) Define the elements of surface Texture with a neat sketch. Differentiate between roughness, waviness and sampling length.
- (b) Calculate the CLA (R_a) value of a surface for which the sampling length was 0.8mm.
 The graph was drawn to a vertical magnification of 10,000 and a horizontal magnification of 100 and the areas above and below the datum line were:-

Above	150	80	170	$40mm^2$
Below	80	60	150	$120mm^2$

[8+8]

4. (a) Using gauge maker's tolerance of 10% of the component tolerance calculate the limits of size for the limit gauges to check the fit 25H8 f7

the tolerance for hole is $25^{+0.03(+003)}_{-0.000}$

the tolerance for shaft is $25^{+0.20}_{-0.060}mm$

- (b) Explain the principle of GO and NOGO gauges. Describe the necessity of Gauge maker's tolerance in gauge design. [8+8]
5. (a) With the help of neat sketches describe how a dial gauge may be used as ?
- i. Comparator
 - ii. Part of limit gauge
 - iii. A fiducial indicator
 - iv. A test indicator
- (b) What is meant by pneumatic comparator ? State some uses of air gauging? State the mathematical relationship between measured length or thickness and other related parameters. [8+8]
6. (a) Describe a method for inspecting the involute profile of a spur gear tooth. Explain the principle of operation of rolling gear tester. State the errors in a spur gear that can be detected by tester. Show different graphical recordings tested by it ?
- (b) Explain with the help of sketches, the working principles of the instruments used in checking of profile and base pitch of the gear ? [8+8]
7. (a) Differentiate between the following.
- i. \bar{X} chart and P chart
 - ii. Variables and Attributes
 - iii. Sampling inspection and 100% inspection.
- (b) i. Discuss the different types of Quality characteristics and explain with sketches.
- ii. Define Quality control and explain its objectives. [8+8]
8. (a) Explain a single sampling plan. Draw an O.C. Curve for a single sampling plan :
 $n = 150$
 $c = 2$
Mark the values of AQL and LTPD.
- (b) A lot of 1000 units contain 50 defectives. A random sample of 4 units is taken. Calculate the poisson probabilities that the sample will contain exactly 0, 1, 2 and 3 defectives.
What is the meaning of acceptance sampling by attributes ? [8+8]

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1. (a) Using slip gauges, rollers and micrometers, explain the procedure for determination of :
 - i. Small end and big end diameters of a taper plug gauge
 - ii. The taper angle
- (b) With the help of sketches. Describe a vernier type micrometer. How do you calculate its least count ? [8+8]
2. (a) Name the various factors affecting the accuracy of a Sine Bar? How will you specify Sine Bar ? why holes are provided in body of Sine Bar ?
- (b) Explain the use of a Sine plate by means of a sketch. What are its application, advantages and limitations.
- (c) What are angle gauges ? Explain the use of Angle gauges by means of a neat sketch. How do you set $32^{\circ} 51' 24''$ [6+5+5]
3. (a) How Tomlinson surface recorder and Talysurf machine works? Describe with a neat sketch ?
- (b) Calculate the R_a value of a surface for which the sampling length was 10mm, the graph was drawn to a vertical magnification of 1000 and areas above and below datum line were:

Above	180	90	155	$50mm^2$
Below	70	90	175	$145mm^2$

[8+8]
4. (a) Discuss in detail about various types of plug, ring and snap gauges. Show with necessary sketches. Give examples of each for checking various parameters ?
- (b) Find the dimensions of GO and NOGO gauges to check the dimensions of a shaft $\phi 25_{-0.04}^{+0.08}$ considering gauge tolerance and wear tolerance. [8+8]
5. (a) Explain the principle of pneumatic gauging by the 'back pressure' system and state the range of pressures over which it is normally used.
- (b) For the back pressure system above, draw typical curves to show the relationship between the ratios "back-pressure / applied pressure" and the ratios of cross-sectional areas "measuring jet / control jet". From these curves show what is the particular value for the range of pressure ratios between 0.6 and 0.8. [8+8]

6. (a) What do you understand by 'Constant Chord' caliper settings? Calculate the chord length and its distance below the teeth tip for a gear of module 2.5 mm and 14.50 pressure angle ?
- (b) Discuss the effects that are associated with type of errors in Screw threads. How do you eliminate them. [8+8]
7. (a) How do you calculate control limits for attributes ? Is there any way to represent graphically ? Explain the procedure involved.
- (b) Distinguish between "Inspection by variables" and "nspection by attributes" show why the distinction is important ? [8+8]
8. (a) How the Zero-Defect programmes are useful for a well organised production process ? Discuss briefly. What are the merits and demerits of a Zero-defect programme?
- (b) Briefly discuss the following sampling techniques :
- i. AQL
 - ii. LTPD
 - iii. AOQL

[8+8]
