Unit 01- Linear Measurements, Tolerances and Gauging

1. Explain Taylor's principle of gauge design. What do you mean by gauge makers tolerance and wear allowance?
2. Calculate tolerances and limits for hole-shaft pair designated as ϕ45H7 g6 and also determine the minimum and maximum clearance. The dimension ϕ45 lies between the range 30-50mm. Fundamental deviation of g-shaft is $-2.5\ D^{0.34}$. The standard tolerance is given by $i = 0.45D^{1/3} + 0.001D$ microns.
3. What do you understand by "error" What are the various types of errors? Explain the difference between systematic and random errors.
4. What are slip gauges? Why maintenance.
5. Explain the principle of Vernier Caliper. What are the various types of Vernier Calipers used in Metrology? In are they used? How are they classified? Explain their care and a Vernier Caliper if 10 divisions on main scale coincide with l0 mm and 50 divisions on Vernier scale coincide with 49 mm, what is its least count?
6. An M 45 slip gauge set consists of the following:

Range (mm)	Steps (mm)	No of pieces
1.001 to 1.009	0.001	9
1.01 to 1.09	0.01	9
1.1 to 1.9	0.1	9
1 to 9	1	9
10 to 90	10	9

Choose the minimum number of slip gauges to build up the following dimensions:

1. 43.716 2. 29.865 3. 24.095 4. 101.105

7. Design the general type (According to present British System) Go and No Go plug and ring gauges for a hole shaft system designated by 70H7g8. Assume the following.
   i. The diameter 70 lies between steps of 50-80 mm.
   ii. Fundamental Tolerance Factor $i = 0.45\sqrt[3]{D} + 0.001\,D$ Where D is in mm and i is in microns.
   iii. Fundamental deviation for shaft g is $-2.5\ D^{0.34}$.
   iv. For grade IT 7 tolerance = 16 i and for grade IT 8 tolerance = 25 i.
   v. Gauge tolerance =10% of work tolerance.
   vi. Wear allowance 1Micron (0.001 mm).

Unit 02- Comparators and Angle Measurement

1) Write short note on sigma comparator.
2) A set of angle gauges consists of following gauges
   i. First series 1^o, 3^o, 9^o, 27^o, 41^o, 90^o.

ii. Second series 1', 3', 9', 27'.
iii. Third series 3", 6", 18", 30".

Select suitable angle gauges required to built the following angles:

1) 11°22' 2) 31°49'24" 3) 32°50'54" 4) 110°30'

3) What do you understand by comparators? How do they differ from measuring instruments? Enumerate various types of comparators and state their relative merits and demerits.
4) Write short note on clinometer / angle gauges / sine bar.
5) Explain the working of pneumatic comparator with a neat sketch. State its advantages and disadvantages.
6) What are the various angle measuring methods? Explain any one with the help of neat sketch.

Unit 03-Measurement of Straightness, Flatness and Surface Roughness

1. Explain the principle of interference of light and state the necessary conditions for interference of light.
2. Write short note on Flatness testing of surface plate.
3. What is optical flat? What is its role in interferometry? Explain the mechanism of production of interference fringe pattern on a surface using an optical flat.
4. Write short note on Tomlinson surface finish meter.
5. Define straightness and flatness. Briefly explain how straightness and flatness is measured and specified.
6. State the principle of interferometry and explain its use in checking flatness of a surface.
7. Define surface roughness and explain CLA method for measurement of surface roughness.
8. Explain the working principle of any one instrument used in surface finish measurement.

Unit 4 - Measurement of Screw Threads and Gears

1. State the various elements of a screw thread. Explain 3 - wire method to measure the effective diameter of screw thread.
2. Explain the use of gear tooth vernier caliper for the measurement of gear tooth thickness.
3. Discuss the various types of errors which may occur on a threaded component stating the possible causes of occurrence of each.
4. What are the different methods for measurement of effective diameter of a screw thread? Explain the two wire method with neat sketch.
5. Suggest the methods to measure the following parameters
   a. Tooth profile b. Run out c. Backlash d. Pitch

6. Write short note on following
    a. Tomlinson surface meter
    b. Pitch measuring machine
    c. Parkinson gear tester
    d. Measurement of tooth thickness
    e. Taylor Hobson Talysurf.
    f. Different errors in screw thread.
    g. Different errors in gear tooth profiles.

Unit 5 – Quality Control

1. Define quality control and state the objectives of the quality control.
2. What is cost of quality and explain cost of failure, cost of appraisal and cost of prevention
3. Explain the terms quality and quality control. Explain the objectives and advantages of quality control.
4. Explain clearly the meaning of the term "Quality Characteristic". Discuss the variable quality characteristic and attribute quality characteristic with suitable examples. What control charts are plotted for each of them?
5. What are the factors that control the quality of design?
6. Differentiate between quality control and quality assurance.
7. Write short note on the following.
    a. Quality of design and quality of conformance.
    b. Quality planning.

Unit 6 – Statistical Quality Control and Acceptance Sampling

1. What do you understand by the terms assignable and random causes of variation? Differentiate between assignable causes and random causes of variation.
2. Differentiate between 100% inspection and sampling inspection. Explain their merits and demerits.
3. What do you understand by the terms single sampling plan and double sampling plan? Explain their relative merits and demerits.
4. Write short note on the following.
    a. Chance causes and assignable causes
    b. Operating characteristic curve.
    c. Methods of plotting X and R chart.
    d. Accepting sampling
    e. The C chart and its method of plotting.
    f. Variable inspection and attribute inspection.
    g. AWQL and LTPD.

h. Basic concept of sampling inspection.

5. Following data was obtained for diameter of a component from shop floor. Construct X and R charts and state whether the process is in control or not.

Sample no.	X̿	R
1	50.04	0.07
2	50.24	0.08
3	50.14	0.03
4	50.08	0.05
5	50.28	0.04
6	50.16	0.09
7	50.30	0.04
8	50.10	0.04
9	50.16	0.05
10	50.10	0.07

For a sample of size "5" take A_2=0.577, D_4= 2.114, D_3=0

6. 10 lots of varying sizes of bicycle axles were drawn randomly at regular interval and checked for conformance. The following table shows sample sizes and no. of non-conforming parts in each sample. Plot P chart and comment on the process.

Number	1	2	3	4	5	6	7	8	9	10
Lot size	400	380	425	375	430	390	410	420	400	410
Defects	45	40	55	35	60	45	50	65	50	55