PROD/PC/B/T/225/2025

B.E. PRODUCTION ENGINEERING - SECOND YEAR - SECOND SEMESTER

INSPECTION AND PRODUCT CONTROL

Time : **Three hours** Full marks: **100**

Question No. 1 is compulsory. Answer any five from the rest.

1.(a) Once Prof. Ishikawa told "Application of these seven tools would reduce the amount of defective components by 80%". Justify his claim. (10)

(b) Being a production engineer, suggest some steps to reduce generation of the rough surface during machining a given component. Draw the corresponding surface profile having the PC value equal to zero. For regular and sinusoidal surface profile: (i) Rz = ___×Ra and (ii) Rq =___×Ra (Fill in the blanks) (4+3×2)

(c) The radius of curvature of a convex surface is expressed as $R = (L - d)^2/8d$. The errors in measurement in L and d are observed to be 1% and 2% respectively. What is the total error in the measured R value? (Given L = 22.5 mm and d = 6 mm) (5)

(d) During measurement of surface flatness, how would you distinguish between convex and concave surfaces? How would you reduce wear and tear in the plain gauges? Draw an ideal operating characteristic curve. Write down the significance of AOQL. (4+3×2)

(e) State the applications of computer vision system in contactless measurement. (5)

(f) During measurement of surface roughness, how you would interpret an SEM image. State the typical features of a measurement instrument for error-free data recording. Name and provide specification of the interments to measure (i) 1.01 mm diameter of a through hole and (ii) angle of a dovetail slot. (3+3+2×2)

2. Determine the GO and NOGO dimensions of standard gauges to control the production of 45 mm. shaft and hole pairs of H_8e_9 fit as per I.S. specifications given as below: (10)
(i) 45 mm. lies in the diameter step of 30 and 50 mm.
(ii) Fundamental deviation of 'e' type shaft is $-11D^{0.41}$
(iii) Wear tolerance = 10% of the gauge tolerance.

3. With a neat sketch, describe the working principle of a mechanical comparator. Also state its various merits and demerits. (6+2+2)

4. What is a CMM? State and draw its various configurations. With the help of a CMM, how internal taper angle can be measured? Why its probe is known as 'touch and trigger probe'? (2+4+2+2)

5. With a neat sketch, enumerate the working principle of NPL interferometer. Also describe its various merits and demerits. (6+2+2)

6. State Taylor's principle of gauge design. Providing dimensions and applications, distinguish between clearance fit, transition fit and interference fit. (4+6)

7. Between various acceptance sampling plans, which plan would you prefer? (Justify your answer) In a particular turning operation, there is an excessive setup and tool changing time. For this, develop the corresponding fishbone diagram. What is a recess gauge? (4+4+2)

8. A certain process produces pieces having thicknesses which are normally distributed with σ = 1.00 mm. Pieces less than 5 mm thick are undesirable as they cannot be used on the subsequent assembly process. What would need to be the setting of the average of the process in order to ensure that just 1.5% of undesirable pieces is produced?
An inspection plan is to be introduced where instructions read: 'From each lot presented randomly, select and measure 16 pieces. If the average thickness of 16 pieces is less than A reject the lot, otherwise, accept the lot'. What value of A should be specified to ensure that lots with exactly 1.5% undesirable pieces are almost always (i.e. 95% of the times they ate presented) accepted? (Given $\varphi(0.015) = -2.17$) (10)

[Turn over

9. Daily inspection records are maintained on production of a special-design electronic device. 100 items have been inspected each day for the past 21 days. A total of 546 items failed during a particularly severe heat stress test. The four highest and lowest values of p are: (10)

Highest	Lowest
0.46	0.18
0.33	0.18
0.32	0.20
0.31	0.21

a) Compute 3σ trial control limits for a p chart. Is the process operating in control?
b) Recommend an aimed-at value of p and 3σ control limits for continued use of the p chart.
c) The test results as described above are from a special severe heat stress chamber which is designed in such as a way that 25% of the products will fail when, in fact, it is satisfactory for its intended use. If the minimum stress specification is 750 units and the process standard deviation is known to be 12 units, what should be the lower limit of the test? Assume this stress characteristic to be normally distributed. (Given $\varphi(0.25) = -0.675$)