Ex/PROD/PC/B/T/225/2022

B.E. PRODUCTION ENGINEERING - SECOND YEAR - SECOND SEMESTER EXAMINATION 2022
INSPECTION AND PRODUCT CONTROL

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

Question Number 1 is compulsory. Answer another four questions from the rest.

1.(a) State why the concept of 'Inspection and Product Control' is crucial in present day manufacturing systems. (4×5)

(b) Citing suitable numerical examples, differentiate between precision and accuracy.

(c) Develop a cause and effect diagram for a turning process producing components with excessively high surface roughness values.

(d) How the Coordinate Measuring Machine can be applied to measure internal taper angle and out of roundness error of manufactured jobs?

(e) Describe the Indian Standard for tolerance design for shaft and hole assembly (IS 919 –1963).

2. With neat sketches, describe the working principles of the following measuring instruments: (5×4)

a) Solex pneumatic comparator, b) Taylor Hobson Talysurf, c) NPL interferometer and d) Ring gauge.

3. Describe in details the roles of 'magnificent seven' in controlling the quality of manufactured products. (20)

4.(a) Stating the principle of light interference, show how this principle can be effectively used to measure the flatness of workpiece surfaces. (4×5)

(b) State the applications of machine vision system in inspection and product control.

(c) Describe the working principles of two indirect methods of surface roughness measurement techniques.

(d) With examples, distinguish between off-line and on-line inspection systems.

(e) Differentiate between C_p and C_{pk}. Between them, which one is preferred and why?

5.(a) State the purpose of developing a p-chart. (4)

(b) Write a short note of sequential acceptance sampling plan. (4)

(c) An item is made in lots of 200 each. The lots are given 100% inspection. The record sheet for the last 25 lots inspected showed that a total of 75 items were defective.

(i) Determine the trial control limits for np chart showing numbers of defectives in each lot. (ii) Assume that all points fall within the control limits. What is your estimate of the process average fricative defective? (iii) If this p value remains unchanged, what is the probability that the 26^{th} lot will contain exactly 2 defectives? (12)

6.(a) Define the term 'Statistical Quality Control'. (5)

(b) A certain product has been statistically controlled at a process average of 36.0 and a standard deviation of 1.00. The product is presently being sold to two users who have different specification requirements. User A has established a specification of 38.0±4.0 for the product, and user B has specification of 36.0±4.0. (15)

[Turn over

(i) Based on the present process setup, what percent of the product produced will not meet the specification set by user A?

(ii) What percent of the product will not meet the specification of user B?

(iii) Assuming that the two users' needs are equal, a suggestion is made to shift the process target to 37.0. At this suggested value, what percent of the product will not meet the specifications of user A?

(iv) At the suggested process target, what percent of the product will not meet the specification of user B?

(v) Do you think that this shift to a process target of 37.0 would be desirable? Explain your answer.

(Given that $\Phi(-2) = 0.0228$, $\Phi(-3) = 0.00135$, $\Phi(3) = 0.99865$)

7.(a) For a pneumatic comparator, the relationship between various parameters can be depicted as follows: (12)

$p/P = 1.10 - b\ M/c$ for $0.6 > p/P > 0.8$

where, P = supply pressure,

p = pressure between measuring and control orifices,

b = constant = 0.4 for P of 1.25 kg/cm^2,

$M = \pi DL$

L = separation between nozzle surface and the surface to be gauged,

D = orifice diameter,

d = control orifice diameter,

c = control orifice area.

For a pneumatic comparator, the control orifice and measuring orifice diameters are 0.55 and 1.05 mm respectively and the supply of air is at 1.25 kg/cm^2 pressure.

Now, evaluate the range of linear measurement.

(b) State the advantages and disadvantages of having a rough surface. (4)

(c) With numerical examples, describe how interpolation and extrapolation methods can be used for measurement of product features. (4)