B.E. PRODUCTION ENGINEERING 3rd Year 1st Semester - 2019 (OLD)

INSPECTION AND PRODUCT CONTROL

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

Answer Question No. 1 and any three from the rest

1. (a) Defining the term 'Metrology', highlight the requirements of metrology in manufacturing organizations. (5x8)

(b) Write short notes on the followings:
(i) Sensitivity and (ii) Repeatability

(c) State Taylor's principle of gauge design.

(d) Distinguish between universal interchangeability and selective assembly.

(e) With neat sketches, explain the use of the following gauges:
(i) Position/recess gauge, and (ii) adjustable snap gauge.

(f) Distinguish between p, np and 100p control charts.

(g) Write short notes on the followings:
(i) RMS value of roughness, (ii) R_t value, (iii) R_{max} value

(h) How are plain gauges classified? What are the identification marks for specifications as engraved on limit gauges?

2. Describe how the principle of light interference can be used for checking the surface flatness of a job. Show how the principle of interferometry can be applied to check the error in the slip gauges. State with a neat sketch the working principle of a NPL interferometer. (6+6+8)

3.(a) With a neat sketch, describe the working principle of a Taylor-Hobson type of surface roughness measuring instrument.

(b) Highlight the working principle of a mechanical-optical type of comparator.

(c) Enumerate various reasons for generation of rough surface. (8+8+4)

4. (a) The dimensions of a certain manufactured part is specified as 2.050±0.020 mm. If the dimensions fall below L, the part must be scrapped and if above U, rework is required. Control charts for $\bar{X}$ and R are maintained on this dimension. The subgroup size is 4. After 20 subgroups, $\sum \bar{X} = 41.340$ and $\sum R = 0.320$ were recorded. If the process is in statistical control and normally distributed, what can you conclude regarding its ability to meet the specifications. Also compute the control limits for $\bar{X}$ and R charts. (Given for n = 4, $A_2 = 0.73$, $D_3 = 0$, $D_4 = 2.28$, $d_2 = 2.059$ and $\phi(0.3846) = 0.6498$) (14)

(b) In the manufacture of certain products, approximately 200 units are produced and subjected to final inspection daily. At the end of 20 working days, 230 units have been rejected out of 4150 units produced and inspected. Determine the control limits for a p-chart based on the average daily production of 200 units. Only one point on the control chart is assumed to fall outside the limits. On that day, 30 non-conforming units were found in 200 units inspected. Now compute the new control limits for the chart based on 200 units daily production assumption. (6)

5.(a) For a given single sampling plan, N = 1000, n = 50, c = 1 have been given. Now, find the values of probability of acceptance, AOQ and AOQL for the lots containing 1%, 2%, 5%, 10% and 15% defective items. Also develop the corresponding operating characteristics curve. (10)

(b) Design a sequential sampling plan based on the following data: (10)
Producer's risk (α) = 5%, consumer's risk (β) = 10%, AQL = 10% and LTPD = 20%.

Also compute
(i) average outgoing quality when p = AQL.
(ii) Minimum number of items inspected for accepting the lot.
(iii) Average number of items inspected when the lot quality is equal to AQL.

6. (a) What is a CMM? Mention its various measuring capabilities. (2+4)

(b) What is quality circle? State the basic objectives of quality circle. (2+4)

(c) Describe the role of Pareto analysis and Ishikawa's Fishbone diagram in enhancing quality of manufactured products. (4x2)