Reg. No.										

MANIPAL UNIVERSITY

THIRD SEMESTER B.S. (ENGG.) DEGREE EXAMINATION – DECEMBER 2015

SUBJECT: STATISTICAL QUALITY CONTROL (IE 231)

(BRANCH: MECHANICAL/IP)
(NEW SCHEME)

Friday, December 11, 2015

Time: 10:00 – 13:00 Hrs. Max. Marks: 100

- **Answer any FIVE full questions.**
- **Use of SQC tables permitted.**
- **Missing data if any, may be suitably assumed.**

1A. What is paterns of variation? Explain the methods used in describing the patterns of variation.

1B. The resistances in ohms for certain components have been arranged in the following frequency distribution:

Cell boundaries, ohms	Frequency
88.5-86.5	2
86.5-84.5	5
84.5-82.5	16
82.5-80.5	24
80.5-78.5	40
78.5-76.5	44
76.5-74.5	25
74.5-72.5	22
72.5-70.5	13
70.5-68.5	7
68.5-66.5	2

Compute the average and standard deviation for this distribution. What percentage of a normal distribution having your computed estimates of μ and σ would fall outside the specification limits 75 $\pm$ 10 ohms?

(8+12 = 20 marks)

2A. Explain the chance causes and assignable causes of quality variation.

2B. Explain the importance of acceptance sampling.

2C. $\overline{X}$ and R charts have been run on a process for sufficient time to obtain good statistical control at an aimed at mean $\overline{X}_0$ of 1015 units and a σ of 5 units. Upper and lower specifications on the product are 1030 and 1000 units respectively. Samples of 4 units are drawn every half hour and tested.

i) Find the 3 sigma control limits for $\overline{X}$ and R charts.

ii) After a period of shutdown the process is restarted and sampled as before. When the data from 25 subgroups have been collected $\sum \overline{X} = 25250$ and $\sum R = 257.4$ units. Estimate μ and σ from these new data assuming the process is in control.

iii) Assuming that the $\overline{\overline{X}}$ found in part (ii) is the true mean what proportion of product does not meet specifications?

(4+4+12 = 20 marks)

3A. Explain the inequality throrems.

3B. A p chart is used to control brake pad assemblies used in automotive production. The average number of units inspected each shift is 800 and the chart uses a target value p_o of 0.010.

i) What are the control limits on the p chart based on the average number of units inspected on a shift?

ii) Assume that the process is actually operating at a μ_p of 0.018. Use Poissons distribution table to estimate the probability that any one point plot would fall within the control limits when 800 units are inspected (Type II error).

(8+12 = 20 marks)

4A. Write a note on OC Curve.

4B. A producer of electronic components for the automobile industry uses the following double sampling plan to inspect batches of incoming integrated circuits:

$n_1 = 20, c_1 = 0, n_2 = 40, c_2 = 3$.

Use Poisson distribution table to compute the probability of acceptance of incoming batches containing 5% rejectable units. Assume the lot size is large in relation to the sample size.

(8+12 = 20 marks)

5A. Explain AOQ and AOQL.

5B. An item is made in lots of 200 each. The lots are given 100% inspection. The record sheet for the first 25 lots inspected showed that a total of 75 items did not confirm to specifications.

i) Determine the trial control limits for an *np* chart.

ii) Assume that all points fall within the control limits. What is your estimate of the process average fraction non-conforming μ_p?

iii) If this μ_p remains unchanged, what is the probability that the twenty-sixth lot will contain exactly 7 non-conforming units?

(8+12 = 20 marks)

6A. Distinguish between p and np charts.

6B. Control charts for $\overline{X}$ and s are to be run on the contained weight of a cereal product. After 25 subgroups of 5 weights each have been taken

$\sum \overline{X} = 11600$ gm and $\sum s = 31.53$ gm

i) Calculate control limits for $\overline{X}$ and s control charts.

ii) Estimate the value of σ. Assuming that this process is operating in statistical control and that the distribution of weights is approximately normal, what proportion of product does meet a minimum weight specification of 460 gm?

(8+12 = 20 marks)

7A. Explain the Type II error with regard to control charts for variables. How it is minimised?

7B. A control chart for nonconformities per unit u uses probability limits corresponding to probabilities of 0.975 and 0.025. The central line on the control chart is at $\mu_u = 2.0$. The limits vary with the value of n. Determine the correct position of these upper and lower control limits when $n = 5$.

(10+10 = 20 marks)

8A. Briefly discuss the System reliability.

8B. A certain type of electronic component has a uniform failure rate of 0.00001 per hour. What is the reliability for a specified period of service of 10000 hours? Of 2000 hours?

8C. Write a note on Quality costs.

(6+6+8 =20 marks)