RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Third Year - Semester II Examination – October/November 2017

MAT 3312 -STATISTICAL QUALITY CONTROL

Time: Three (03) hours

Answer **all** questions.

Calculators and **Statistical Tables** will be provided

1. Write detailed explanations to the following terminologies in statistical quality control by providing examples if necessary:

   a) Quality characteristics.

   b) Natural and assignable causes.

   c) Quality costs.

2. Derive control limits of the *p*-chart.
   A tire manufacturer has been concerned about the number of defective tires found recently. In order to evaluate the true magnitude of the problem, a production manager selected ten random samples of 20 units each for this inspection. The number defective tires found in each sample as follows:

Sample	Number Defective
1	1
2	3
3	2
4	1
5	4
6	1
7	2
8	0
9	3
10	1

a) Develop a p – chart with 3-sigma limits. Is the process in control? If not revise the control limits.

b) If the mean process fraction nonconforming has shifted to 0.15, what is the probability of detecting it in the second sample after the shift? What is the Average Run Length (ARL)?

c) Suppose that the next 4 samples selected had 6, 3, 3, and 4 defects, what conclusion you can make?

3. Derive the control limits of the c –chart.

Explain briefly the difference between p – chart and c – chart.

Discuss an application in the use of c – chart.

Kinder Land Child Care uses a c – chart to monitor the number of customer complaints per week. Complaints have been recorded over the past 20 weeks. Develop a control chart with $\alpha = 0.05$ for the following data:

Week	Number of Com[plaints	Week	Number of Complaints
1	0	11	4
2	3	12	3
3	4	13	1
4	1	14	1
5	0	15	1
6	0	16	0
7	3	17	2
8	1	18	1
9	1	19	2
10	0	20	2

a) If the average number of defects shifts to 2.0, what is the probability of detecting in the first sample after the shift?

b) If the number of complaints in the 11^{th} week was 6, does the process is in statistical control? If not, what are the revised control limits.

4. Select the correct answer for each of the following questions:

a) Kaoru Ishikawa is famous for:
(a) Statistical quality control (b) Fish bone diagram (c) Loss function concept
(d) all of the above.

b) Poor quality adversely affects:
(a) Costs (b)Productivity (c)Profitability (d) All of the given above.

c) A product performing consistently refers to which of the following dimensions of quality:
(a) Safety (b) Conformance (c) Durability (d) Reliability.

d) If you go to dine out at McDonalds and you observe a very cool and pleasant atmosphere over there. It depicts which of the following dimensions of quality?
(a) Performance (b) Aesthetics (c) Reliability (d) Conformance.

e) Sunil purchased a TV set. After a period of a year, the picture quality started deteriorating. He went to the company and complained. The company responded subsequently. Which of the following dimensions of quality would come into play?
(a) Reliability (b) Conformance (c) Serviceability (d) Aesthetics.

f) Warranty cost is an example of which of the following?
(a) Internal failure cost (b) External failure cost (c) Prevention cost
(d) Appraisal cost.

g) Which of the following is the focus of statistical process control?
(a) Determining the efficiency of an operations system
(b) Measuring the amount of re-work required to rectify faulty goods
(c) Identifying the security needs of an operations system
(d) Measuring and controlling process Variations.

h) Which of the following is a measure of how closely a product or service meets the specifications?
(a) Quality of Conformance (b) Continuous improvement
(c) Competitive benchmarking (d) Statistical process control.

5. Derive the 3-sigma control limits of $\bar{x}$ and R charts.

Samples of size n=5 are taken from a process every half hour. After m=25 samples have been collected, we calculate

$\sum_{i=1}^{m} \bar{x}_i = 662.5$ and $\sum_{i=1}^{m} R_i = 9.00$.

$\bar{x}$ and R control charts are used. Assume that both charts indicate that the process is in control and that the quality characteristics is independent and normally distributed.

a) Estimate the process standard deviation and estimate the natural tolerance limits.

b) Find the 3-sigma control limits of the $\bar{x}$ and R charts.

c) Assume that both charts exhibit control. If the specification limits are 26.40 ± 0.50, estimate the fraction non-conforming and process capability ratio (PCR).

d) If the process mean is shifted to 27.00, what will be the probability of detecting the shift in the second sample after the shift?

e) Suppose the sample size has been reduced to 3, what are the new control limits of $\bar{x}$ and R Charts?

END