THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
POSTGRADUATE DIPLOMA IN TECHNOLOGY IN INDUSTRIAL ENGINEERING LEVEL 7
FINAL EXAMINATION – 2007/2008
MEX7214 – QUALITY AND RELIABILITY ENGINEERING

DATE: 07 MAY 2008 022
TIME: 0930-1230 HRS
DURATION: THREE (03) HOURS.

Answer any five (05) questions. All questions carry equal marks. Normal Distribution Table and Coefficients of $\overline{X}$-R Control Charts are provided.

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1. (a) Quality is a term which has been defined in many ways. Over the years experts and organizations have attempted to define quality. Discuss at least two of those definitions. Support your answer with appropriate examples.

   (b) One method to achieve quality is through "Quality Parameters". What are these "Quality Parameters"? Explain how quality is achieved by paying attention to "Quality Parameters".

2. (a) "Process Approach" is a concept widely used in modern quality management systems. Explain the concept briefly and write an account of the important elements of this approach.

   (b) "Statistical Approach" is another concept important to maintain and improve quality. Explain the concept using an example.

3. (a) Define the term "Reliability" and explain the key terms in the definition giving suitable examples.

   (b) 15 (identical or branded) Transformers were tested for 500 hours each under prescribed operating conditions. Four transformers failed after 100, 150, 250, 450 hours respectively. What is the failure rate for this type of transformer?

   (c) Following Table summarizes basic failure rate data on components in an electronic sub-system.

Component	Quantity	Failure rate per hours
Silicon transistor	40	74.0×10^{-6}
Film resistor	100	3.0×10^{-6}
Paper capacitor	50	10.0×10^{-6}

Estimate the Mean Time Between Failures (MTBF). Assume an exponential distribution. All components are critical for subsystem success.

4. Write an account on each of the following statements.

(a) "Control" and "Improvement" are like two sides of a coin and they are linked together but they need two different approaches.

(b) Variation in product quality leads to customer dissatisfaction and also affects profitability of manufacturers.

(c) In order to achieve customer satisfaction it is important to practice internal customer concept.

5. (a) Histogram analysis has been done on a bottle filling process in order to understand the state of the process. Analysis shows that the process follows a normal distribution with mean 103.8g and standard deviation 0.8g. Filling specification has been decided as 100g minimum and 105g maximum. Comment on the state of the process. What action would you suggest for the continuation of the process?

(b) Analysis done on a second filling line shows that the process is normally distributed with mean 103g and standard deviation 1.4g. If the filling specification is 100g minimum and 105g maximum, what are your comments on the state of, the process? What action would you suggest for the continuation of the process?

6. (a) Mean-Range Control Chart has to be setup in order to control the packing process. The characteristic to be controlled is the weight of a packet. Explain in a step-wise manner how you would proceed with task.

(b) The specification for washing powder packets manufactured by a company is 403 ± 3g. $\overline{X}$-R control charts are maintained to control the weight of packets. 5 packets are taken as the sub-group size. To install the control charts 25 Sub-groups were taken and the results are as follows.

Sum of sample means = 10025
Sum of sample ranges = 45
All 25 points in the $\overline{X}$ and R charts are within control limits and randomly distributed.

(i) What can you conclude about the state of the process?

(ii) Does the process meet specification?

(iii) What further action would you suggest to improve the situation?

7. (a) In the problem solving methodology it is important to narrow down a problem and then find root causes. Describe a quality tool for each of the two purposes.

(b) A company producing garments for exports received a special order from a regular buyer. He gave description of the requirements pertaining to the product, packing and delivery. The order was made and shipped on time. Few weeks after receiving the order the buyer informed of some serious defects found in the products. Even packing was not up to expectation. However, buyer indicated that he is still prepared to offer a small order for this type of garment provided quality is maintained as required. If you are given the assignment to deal with this situation, what course of action would you recommend to maintain quality as required and satisfy the buyer?

8. (a) In a process there are two aspects that are important. The process has to be statistically controlled and also it should conform to specification. Briefly explain the two aspects.

(b) A fraction defective control chart has been set up at a particular stage of a manufacturing process. In setting up the control chart 50 items were inspected each time. The central line of the control chart is 0.02. An inspector took 50 items and found 4 items defective.

In terms of statistical control, what is your opinion about the process at this time?