

**9210-138**

**Level 6 Graduate Diploma in Engineering**

Quality and reliability engineering

**Sample Paper**

**You should have the following for this examination**

- one answer book
- non-programmable calculator
- pen, pencil, drawing instruments

**A reference booklet is attached**

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**General instructions**

- This question paper is of **three** hours duration.
- This paper consists of **nine** questions.
- Answer any **five** questions.
- All questions carry equal marks. The maximum marks for each section within a question are given against that section.
- An electronic non-programmable calculator may be used but candidates **must** show clearly the steps prior to obtaining final numerical values.
- Drawings should be clear, in good proportion and in pencil. Do **not** use red ink.

- 1 a) 'Quality is a term that has been defined by organizations, such as the International Organization for Standardization (ISO), and also by experts in the field of quality.' Explain **two** recognized definitions one by an expert and another by an organization. (8 marks)
- b) Three basic steps to achieve quality are identified as Quality Planning, Quality Control and Quality Improvement. Explain the activities carried out under each of these steps. (12 marks)
- 2 a) Safety is an important subject in product design. Explain the importance of safety with respect to products. What are the safety aspects to be considered in the design of a product? (10 marks)
- b) Maintainability is also an important subject in product design. What are the maintainability aspects to be considered in the design of a product? (10 marks)
- 3 a) Explain the important features of Total Quality Management (TQM). (6 marks)
- b) What are the basic steps to be taken by an organization in order to start a program to achieve TQM status? (14 marks)
- 4 A Company packing plastic materials in bags has marked 10 kg as the net weight for each bag. The company wishes to keep 10 kg as the minimum net weight during the packing process. A study of the packing process was performed and the results showed that the mean net weight was 10.1 kg with a standard deviation of 70 g. If the weight is normally distributed, answer the following questions.
- a) Does the process produce bags less than 10 kg? (5 marks)
- b) The company has set up an upper specification limit of 10.2 kg. Is the process capable of meeting the upper specification limit? (5 marks)
- c) If the company wishes to produce at least 97% of bags within specification limit (10 kg – 10.2 kg), what should be the process-standard deviation? (5 marks)
- d) If the company wishes to produce at least 97% of bags below upper specification limit, what should be the mean of the packing process if the standard deviation remains the same? (5 marks)
- 5 a) The International Organization for Standardization (ISO) published a series of standards on quality management systems. They are known as ISO 9000 series. These standards were revised many times in the past. Write an account on the revisions done to those standards since 1987 when they were first published. (10 marks)
- b) What are the major steps to be taken by an organization in obtaining certification for ISO 9001 quality management system standard? (10 marks)
- 6 a) Explain Failure Mode and Effect Analysis (FMEA). (5 marks)
- b) Write an account on how a Failure Mode and Effect Analysis are carried out. (5 marks)
- c) A vacuum cleaner requires 30 minutes to clean a floor area. The mean time between failures of the machine is 50 hours. Assuming constant failure rate, what is the reliability of the machine completing the work without failure? (10 marks)
- 7 a) Variation is a fact of industrial life. Variation in product quality and processes is the biggest issue faced by organizations. Write an account on the effect of this variation on the survival of the organization. (8 marks)
- b) Control charts for mean-range are maintained for a metal piece production process. Five pieces at a time were taken during the installation of the control charts. Sample mean and sample range values were computed for 20 subgroups. Sum of sample means was 101 cm and sum of sample ranges was 2 cm. The company specification for the metal pieces is  $(5 \pm 0.1)$  cm. According to the control charts, the process is in statistical control. What is your opinion and recommendations regarding the use of this control chart for future production? (12 marks)

- 8 a) Define the terms, Reliability, Maintainability and Availability. (6 marks)
- b) Setting reliability goals is an important activity in a reliability programme. Explain the common reliability indices used for setting reliability goals. (4 marks)
- c) An electronic component has a uniform failure rate of 0.00002 per hour. Find the reliability of the component for an operating period of 20,000 hours. If two of these components are used in series such that the failure of either one causes the system to fail, find the reliability of the system for 20,000 hours. (10 marks)
- 9 a) What are the conditions required for a manufacturing process to be stable. (10 marks)
- b) Explain the basic quality tools used to determine whether a process is statistically controlled. (10 marks)