



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: November 2022

Module Number: ME 6304

Module Name: Maintenance Management

[Three Hours]

[Answer all questions, each question carries 12 marks]

- Q1. a) Due to financial restrictions imposed by the prevailing economic crisis, the CEO of a particular company is seeking justifications not to close the maintenance department in his company in the usual manner, without ceasing the maintenance operations in the company. Assuming that you are a maintenance management consultant to the CEO, provide a brief justification in this regard. [5.0 Marks]
- b) State at least **six** key difficulties in practicing maintenance management in a private sector small or medium-scale Sri Lankan manufacturing organisation. [3.0 Marks]
- c) If you were newly appointed as the chief maintenance engineer of the organisation mentioned in Q1 (b), discuss how you will overcome the difficulties. [4.0 Marks]
- Q2. a) State at least **six** ways of reducing the frequency and the severity of machine breakdowns of a given manufacturing plant. [3.0 Marks]
- b) Describe the procedure of developing a preventive maintenance schedule for the machines of a given manufacturing plant, assuming that there have not been any previous preventive maintenance schedules in use. [4.0 Marks]
- c) Briefly describe the procedure of identifying and rectifying the recurrent breakdowns of critical machines in a manufacturing plant using different maintenance analysis techniques such as: Bad Actor Analysis, Failure Mode and Effect Analysis (FMEA) and Root Cause Analysis (RCA). [5.0 Marks]
- Q3. a) How do you justify Kaizen as a Key performance indicator (KPI) in a production organization [3.0 Marks]
- b) State **four** key negative outcomes of improper use of Kaizens in a manufacturing organisation and briefly suggest ways to minimise those negative outcomes. [4.0 Marks]
- c) Briefly explain **five** possible ways of promoting a Kaizen scheme in a government or semi-government organization where performance-based employee evaluations rarely persist. [5.0 Marks]

- Q4. a) Name **four** key documents used in maintenance communication systems and discuss their practical applications. [2.0 Marks]
- b) Briefly describe the benefits of adhering to the ISO quality standards by a manufacturing organisation. [4.0 Marks]
- c) Suggest a suitable procedure to introduce 5S concept to a maintenance department of a manufacturing organisation, assuming that you are the Head of the respective department. However, assume that your staff are very busy with work and they have no prior knowledge about the 5S concept or its benefits. [6.0 Marks]
- Q5. a) **Table Q5(a)** presents a summary of breakdown data of a critical machine in a production organisation observed for the year 2021, where the machine had been planned for production for the whole year (365 days).
- Calculate the MTBF of this machine and state **four** key measures that can be taken to improve this KPI.
 - Calculate the MTTR of this machine and state **four** key measures that can be taken to improve this KPI. [4.0 Marks]
- b) A semi-automated tyre production machine in a particular manufacturing organization operates in 8-hour shifts. **Table Q5(b)** presents the average time consumed for special reasons within a typical 8-hour production shift. It is known that the average quality loss is 12 tyres per shift out of its nominal production of 70 tyres per shift. Average cycle time to produce a tyre is 4 min.
- Calculate the Overall Equipment Efficiency (OEE 1) of the machine.
 - Draw the OEE Chart.
 - Find the OEE loss due to breakdowns.
 - Suggest measures to improve the OEE 1 of this machine. [8.0 Marks]

Table Q5(a). Summary of breakdown data of a critical machine

Breakdown description	Day of the year the breakdown occurred	Repair time (min)
Belt failure	26	134
Motor coupling failure	113	152
Sensor failure	169	48
Bearing failure	247	181
Hydraulic valve failure	304	305
Cooling fan failure	335	710
Electronic control unit failure	360	104

Q5 continues to page 3...

Q5 continues from page 2

Table Q5(b). Average time consumed for special reasons within a typical 8-hour production shift of a semi-automated tyre production machine

Description	Time (min)
Tea and Meals	45
Preventive Maintenance	40
Breakdown	45
Change over	32