UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: January 2022

Module Number: ME 6304 **Module Name: Maintenance Management**

[Three Hours]

[Answer **all questions**, each question carries **12** marks]

Q1. a) State the main objectives of maintenance management in an industrial setting.

[2.0 Marks]

b) Write short notes on following maintenance techniques applicable to a manufacturing organisation.

i. Opportunistic maintenance
ii. Corrective maintenance

[2.0 Marks]

c) The Sapugaskanda oil refinery, which is the only oil refinery within Sri Lanka has been closed in recent times mainly due to the lack of crude oil supply. As the Chief Maintenance Engineer of the refinery, you have been given permission by the authority to continue essential maintenance activities of the refinery during this shutdown period. Briefly explain **five** maintenance management related activities that you will arrange during the closure. Also, in each case, mention how you will manage the progress of the implementation of the activities and how you will maintain the motivation of your employers during the conduct, although the oil refinery is a state-owned organisation.

[8.0 Marks]

Q2. a) Briefly discuss the importance of key performance indicators (KPIs) in maintenance management.

[3.0 Marks]

b) List **four** KPIs applicable to a maintenance system of a manufacturing organisation and briefly explain each.

[4.0 Marks]

c) Provide templates of any **two** documents which can be used in a maintenance system for communication or record keeping purposes.

[5.0 Marks]

Q3. a) You have been recently recruited as the Maintenance Manager of a production organisation, where the machine operators are being identified as under-utilised and less engaged with machine maintenance activities. Briefly discuss how you may introduce the Autonomous Maintenance concept in this organisation in order to rectify this problem.

[4.0 Marks]

b) As the next step to the Autonomous Maintenance implementation in Q3 (a), you have decided to introduce a Kaizen programme targeting the machine operators and

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the maintenance crew of the organisation. Briefly discuss three advantages and three disadvantages of a Kaizen program when introduced to a manufacturing organisation of this nature.

[4.0 Marks]

c) In the same organisation mentioned in Q3 (a) and (b), prior to your appointment as the Maintenance Manager, it has been reported that there had been a 5S programme introduced in the maintenance office and tool stores. However, it had not progressed well. Briefly explain four possible reasons for this outcome. Also, suggest four possible solutions to overcome each of the reasons mentioned by you in order to ensure a sustainable 5S implementation.

[4.0 Marks]

Q4. a) "Total Productive Maintenance (TPM) is a well-structured and sustainable maintenance management approach, which can be commonly applied to a broad spectrum of industries". Justify this statement by referring to the fundamentals of TPM.

[4.0 Marks]

b) A semi-automated steel bar cutting machine in a particular steel fabrication plant is used to cut long steel bars in to fixed length pieces. **Table Q4 (b)** presents different time values reported in an OEE analysis of this machine. It is found that out of 350 pieces produced in each shift, around 5 steel pieces are rejected due to major deviations in their lengths. Also, around 25 steel pieces per each shift are re-worked to fix minor deviations in lengths. The cutting blade of the machine must be changed frequently as the lifetime of a blade is limited to cutting of 50 steel pieces. Considering this case, answer the following questions.

i. Calculate the Overall Equipment Efficiency (OEE 1) of the machine.
ii. Draw the OEE Chart.
iii. Find the OEE loss due to breakdowns.
iv. Suggest measures to improve the OEE 1 of this machine.

[8.0 Marks]

Table Q4(b). Time values reported in an OEE analysis of this machine

Description	Time (min)
Shift time	480
Time taken by the machine to cut a steel piece	1
Time for tea and meals	30
Time for pre-planned machine cleaning at the end of each shift	10
Time for pre-planned lubrication of the gear wheels of the machine at the beginning of each shift	10
Time taken by machine stoppages due minor faults	45
Time to replace a worn-out cutting blade	2

Q5. 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 had not been any previous preventive maintenance schedules in the plant.

[4.0 Marks]

c) State the procedure to identify and rectify the recurrent breakdowns of critical machines in a manufacturing plant using Failure Mode and Effect Analysis (FMEA), Rood Cause Analysis (RCA) and other relevant maintenance analysis techniques.

[5.0 Marks]