



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2018

Module Number: ME7301

Module Name: Maintenance Management

[Three Hours]

[Answer all questions, each question carries 10 marks]

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- Q1. a) State and briefly explain at least **three** key objectives of maintenance management in the context of a manufacturing organization. [3.0 Marks]
- b) Briefly explain the importance of Key Performance Indicators (KPIs) for the effective execution of maintenance management in industrial context. [3.0 Marks]
- c) Discuss the expected roles and responsibilities of a maintenance engineer in a manufacturing organization. [4.0 Marks]
- Q2. a) State **four** of the most common causes for a sudden breakdown of a given production machine, and propose at least one suitable precaution for each cause. [4.0 Marks]
- b) Briefly describe how to ensure the efficiency and the effectiveness of a preventive maintenance activity of a given machine in a production organization. [3.0 Marks]
- c) Compare the advantages and disadvantages offered by time-based, usage-based and condition-based preventive maintenance activities. [3.0 Marks]
- Q3. a) Table Q3(a) presents a summary of breakdown data of a critical machine of a production organization observed for the year 2017, where the machine had been planned for production for the whole year (365 days). Answer the following questions.
- i. Calculate the MTBF of this machine and state **four** key measures that can be taken to improve this KPI.
- ii. Calculate the MTTR of this machine and state **four** key measures that can be taken to improve this KPI. [4.0 Marks]

b) A machine in a production line operates in 12-hour shifts. Table Q3 (b) shows the average time consumed for different purposes within the 12-hour shift, where the machine had been stopped from normal operation. At an average, the machine produces 50 identical products per a shift and out of that, at an average 12 products are having quality defects. Average cycle time per one product is ~~12~~<sup>9</sup> min. Answer the following questions.

- i. Calculate the Overall Equipment Efficiency parameters: OEE 1 and OEE 2 of the machine.
- ii. Draw the Overall Equipment Efficiency Chart (based on OEE 1).
- iii. Discuss the insights which can be drawn from the OEE chart developed in Q3(b)ii, which can be used to improve the maintenance management process as well as the overall productivity of the production process.

[6 Marks]

Q4. a) Briefly explain the importance of implementing a Total Productive Maintenance (TPM) programme in any goal oriented manufacturing organization.

[3.0 Marks]

b) Explain why "The success of TPM will heavily depend on the commitment from each and every employee including the top management".

[3.0 Marks]

c) Why the formation of cross-functional teams is important in implementation and progress evaluation of TPM?

[4.0 Marks]

Q5. Non-destructive Testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage.

a) Briefly explain the applicability of NDT in maintenance management.

[2.0 Marks]

b) Provide *three* common applications of NDT with suitable examples.

[3.0 Marks]

c) Give the most appropriate NDT method for each of the following applications.

- i. Heat exchanger tubes of power plants for corrosion damage.
- ii. Damages of wire ropes used in chairlifts and cranes.
- iii. Thinning of fuel storage tanks.
- iv. Corrosion damage of aircraft bodies.
- v. Cracks in jet engines.

[5.0 Marks]

- Q6. a) Why an effective communication system is required in maintenance management?  
[1.0 Marks]
- b) What are the commonly used communication methods in maintenance/ service industry?  
[1.0 Marks]
- c) What are the purposes of using 'display boards' in maintenance communications?  
[1.0 Marks]
- d) Briefly explain the effectiveness of using 'kanban' systems in maintenance activities.  
[2.0 Marks]
- e) Prepare sample documents for  
i. Breakdown recording.  
ii. Job ordering (to machine shop).  
[5.0 Marks]

Table Q3(a)

Breakdown description	Day of the year the breakdown occurred	Repair time (min)
Belt failure	20	130
Relay failure	102	74
Bearing failure	122	240
Overheating	201	30
Pneumatic cylinder failure	275	87
Hydraulic motor failure	341	700

Table Q3(b)

Description	Time (min)
Tea and Meals	60
Preventive Maintenance	45
Breakdown	70
Change over	40