



# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS  
ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

..... YEAR **SECOND** SEMESTER EXAMINATION FOR, BACHELOR OF  
SCIENCE IN .....

**EM7 411**– TQM AND RELIABILITY MAINTENANCE

DURATION: 2 HOURS

**Instructions to candidates:**

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

## **SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION**

### **QUESTION ONE (30 MARKS)**

Preventive maintenance ranks first in planned maintenance of plant and equipment and is designed to improve the life of equipment and machinery and avoid any unplanned maintenance activities hence minimizing breakdowns and excessive depreciation.

- i) Discuss in detail why preventive maintenance increasingly became important for equipment and machinery in the 1980s and as a consequence manufacturing companies started to allocate appropriate resources for maintenance activities. What is the expected trajectory of maintenance with the current trend of growing adoption of Artificial Intelligence (AI) ? ( 8marks)
- ii) Traditional preventive maintenance was based on the concept of the bathtub curve which stipulates that new equipment and machinery go through three stages of life while in operation. Outline the three stages of the bath-tub curve and explain the implications of these stages for the design of maintenance programs ( 7marks).

## **SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION**

Maintainability is probability that a component or system that has failed will be repaired to normal service within a given time. Component or system maintainability and reliability are considered complimentary from inherent availability perspective.

- i) Discuss how maintainability relates to reliability, inherent availability and operational availability. Explain why inherent availability will be expected to be higher than operational availability ( 8marks)
- ii) Design for maintainability is similar to design for manufacture and assembly which focuses on simplification of products and processes to achieve equivalent or better performance at a lower cost for the benefit of customers. Discuss the concept of design for maintainability and its value for the maintenance function. What should be the attitude for an engineer forward on creating value maintenance activities. ( 7marks)

### **QUESTION TWO (20 MARKS)**

Condition monitoring is mostly used a predictive or condition-based maintenance technique. This approach to maintenance uses various technologies in order to determine equipment condition and potentially predict and take steps to avoid failure.

- a) Vibration analysis is the most widely used technique in present day condition monitoring of plant and equipment. Describe the vibration analysis technique and explain why it is used for condition monitoring of plant equipment. ( 10marks)
- b) Oil and lubricant analysis is another technology that is commonly used in condition monitoring of plant and equipment. Explain why oil and lubricant analysis would be an effective approach in determining the condition of plant and equipment ( 10marks)

### **QUESTION THREE (20 MARKS)**

Total production maintenance ( TPM) views maintenance as a necessary and critically important part of the business and no longer regards it as a cost center activity. TPM is team based, proactive maintenance and involves entry level and function in the organization and its objectives includes the elimination of breakdowns, defects, rework, rejects and accident.

- a) Total production maintenance begins with measuring and analyzing overall equipment effectiveness ( OEE) and introduces the concept of autonomous maintenance and show how it eliminates waste in a factory ( 10marks)
- b) Overall equipment effectiveness ( OEE) of plant and equipment
- c) is defined as the ability to extract maximum profits from the minimum investment and may be achieved through autonomous maintenance. Explain in detail how autonomous maintenance may be used to achieve effectiveness of plant and equipment ( 10marks)

### **QUESTION FOUR (20 MARKS)**

Lean maintenance is a proactive maintenance operation which promotes continuous improvement and is founded on total production maintenance. Total production maintenance (TPM) views maintenance as a necessary and vitally important part of business and no longer regards it as a non-profit activity.

- a) Describe lean maintenance process showing how it utilizes total production maintenance to achieve its goals, including eliminating waste. ( 10marks)
- b) The Shingo system developed by the Japanese, advocates for improving the overall equipment effectiveness (OEE) through identifying and eliminating major wastes, reducing set up times, quality maintenance and Poka-Yoke ( avoid mistakes). Discuss whether you agree or disagree, giving reasons for the following widely held belief about involvement of production employees on maintenance activities and the impact on productivity. If line employees are required to work on maintenance activities, their productivity will suffer. ( 10marks)