

**University of Ruhuna- Faculty of Technology**  
**Bachelor of Engineering Technology Honours Degree**  
**Level 3 (Semester I) Examination, June 2023**  
**Academic year 2021/2022**

Course Unit: ENT 3122 - Electrical/Electronic and Mechanical Equipment Maintenance (Written)

**Duration: 2 hours**

- All symbols have their usual meanings.
- This paper contains **four (4)** questions on **two (2)** pages.
- Answer all the questions.
- This is a **closed-book** examination.

Q1.

- a) Briefly explain what is meant by **“Run to Failure Maintenance Management Method”** and list down three (03) major expenses associated with the run to failure maintenance management method. (05 marks)
- b) Illustrate the statistical life of a machine/equipment using the **“Bathtub Curve”** and briefly explain the three parts of the bathtub curve. (10 marks)
- c) Table: 01 presents a summary of breakdown data of a critical machine of a production organization observed for the year 2020, where the machine had been planned for production for the whole year (365 days). Answer the following questions.

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: 01

- i. Calculate the **MTTR** of the machine. (03 marks)
  - ii. Calculate the **MTBF** of the machine. (03 marks)
- d) Imagine that a production on the line has three devices of the same kind. Device one completely failed at 5200 hours, device two at 4200 hours and the third at 5600 hours. Calculate the **MTTF**. (04 marks)

Q2.

- a) List down two (02) benefits of **predictive maintenance**. (04 marks)
- b) List down five (05) **predictive maintenance techniques**. (05 marks)
- c) What is **Tribology**? Define its role in maintenance. (04 marks)

- d) Consider the following data recorded in Table: 02 for a particular production line in ABC factory.

Item	Data
Shift length	8 hours
Tea time	½ hours
Break time	½ hours
Downtime	47 min.
Ideal run rate	60 parts per min.
Total output	19, 271 parts
Rejected parts	423 parts

Table: 02

- i. Briefly explain **OEE** with equations. (07 marks)
- ii. Calculate the OEE for the given data. (04 marks)
- iii. What is the meaning of **OEE becoming 100%**? (01 marks)

Q3.

- a) Write short notes for the following **maintenance improvement methods**.
  - i. Total Productive Maintenance (TPM) (04 marks)
  - ii. Reliability-Centered Maintenance (RCM) (04 marks)
- b) Briefly explain the **economics of maintenance** using decision-making methods. (07 marks)
- c) The management of ABC company wants to reduce its labour cost by installing a new machine in its production process. For this purpose, two types of machines are available in the market, namely, the Machine X and the Machine Y.  
Machine X would cost \$18,000 whereas, Machine Y would cost \$15,000, and Machine Y would require an additional labourer who would cost \$1,500 per year.  
The expected annual cash inflow is \$3,000 from each machine.
  - i. Calculate the **payback period** for each machine. (04 marks)
  - ii. Which is the best machine to purchase according to **payback method of project analysis**? (02 marks)
- d) Assume a shoe-producing company bought a property for \$100,000 in cash. After repairs and improvements, which cost an additional \$50,000, the property is valued at \$200,000. Calculate the **ROI**. (04 marks)

Q4.

- a) List down five (05) requirements for an **effective maintenance program**. (05 marks)
- b) Write three (03) indices to evaluate the **effectiveness** of a maintenance organization. (03 marks)
- c) Explain what information is given by the first digit and second digit of the **IP code**. (04 marks)
- d) Explain the following **testing methods** with their applications. (08 marks)
  - i. Continuity testing
  - ii. Insulation resistance testing
- e) Draw the diagram for the **insulation resistance testing** of a cable. (05 marks)

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