

The Open University of Sri Lanka  
Faculty of Engineering Technology



Study Programme	: Master of Technology in Industrial Engineering – Level 7
Name of the Examination	: Final Examination
<b>Course Code and Title</b>	<b>: MEX7119 – Maintenance Management</b>
Academic Year	: 2016/17
Date	: 11 <sup>th</sup> November 2017
Time	: 09.30-12.30
Duration	: 3 hours

**General instructions**

1. Read the questions carefully before answering.
2. Please note that you should write your registration number and your index number in each pages of your answer book. Do not write your name.
3. In case of doubt, please consult the supervisor or an invigilator conducting the examination.
4. This paper consists of Eight (08) questions. Answer only five (05) Questions.

**Q1.**

- a) Define the term “MTTR” and suggest two ways of improving it. (04 marks)
- b) Tile Manufacturing Company scheduled to operate 345 days last year. It had 06 unscheduled breakdowns which resulted in 300 hrs of down time. The plant had 124 hrs of Preventive Maintenance during the operated period. Due to lack of raw materials the plant was shut down for 240 hrs and the manufacturing process was slow down for 120 hrs at 60% rate due to labour unrests. Further factory lost 96 hrs at 60% rate due to inferior quality of raw materials. The factory produced 200 tons per 24 hr shift at 100% capacity. During the period the 600 tons was rejected, and 500 tons were classified as second quality product and sold at 50%value. Find,
- |                                      |            |
|--------------------------------------|------------|
| (i) The plant availability           | (04 marks) |
| (ii) The process rate                | (04 marks) |
| (iii) The quality rate               | (04 marks) |
| (iv) Overall Equipment Effectiveness | (04 marks) |

**Q2.**

- a) Discuss the difference between Preventive Maintenance and Predictive Maintenance with suitable examples. (06 marks)
- b) What are the factors that you must consider when implementing a Preventive Maintenance Program for machinery and plant come under your supervision. (08 marks)
- c) One generator is placed in standby redundancy to the main generator. The failure rate of each generator is estimated to be 0.05 per hour. Compute the reliability of the system for 100 hrs assuming that the sensing and switching over device is 100% reliable. (06 marks)

**Q3.**

- a) Discuss four (04) reasons for equipment failures. (05 marks)
- b) Discuss the important steps that you can take to ensure the reliability of a product during the manufacturing stage. (05 marks)
- c) Discuss the difference between "Cold Standby" and "Warm Standby". (10 marks)

**Q4.**

- a) Discuss the difference between "Shared Active" and "Pure Active" in Active Parallel systems with suitable examples. (06 marks)
- b) Discuss the common failures that you can come across in Passive Parallel systems with examples. (06 marks)
- c) Redundancy allocation is one important method mostly used in enhancing the reliability of Engineering Systems. What are the principal factors that you must consider under redundancy allocation. (08 marks)

**Q5.**

- a) Discuss the important component which contribute to the unreliability of an equipment with suitable examples. (05 marks)
- b) What do you mean by "Design for Maintainability". (05 marks)
- c) Discuss the benefits of "Design for Maintainability" with suitable examples. (10 marks)

Q6.

- a) How would you obtain feedback in "Maintenance System". (05 marks)
- b) Discuss Maintenance Strategies available for Maintenance Manager. (05 marks)
- c) Discuss the importance of "Job Standards" in maintenance systems. (05 marks)
- d) How would you measure the quality of maintenance work. (05 marks)

Q7.

- a) Discuss the advantages of the Failure Tree Analysis (FTA) in estimating the failure probabilities of engineering systems. (04 marks)
- b) Electrically operated water pump is connected to the power supply through a switch and a fuse for the safety of the pump. Proper wiring system is vital for the function of the water pump.
  - (i) Draw the circuit diagram for the system. (04 marks)
  - (ii) Considering the top event failure as the failure to operate the motor, draw the Fault Tree for the circuit drawn in (i). (12 marks)

Q8.

- a) Discuss the important components that you have to consider in order to implement the Reliability Centered Maintenance program for the machinery and equipment come under your supervision. (08 marks)
- b) Reliability of a standby generator is given by  $R(t) = e^{(-0.02t - 0.00t^2)}$  where "t" is in hours.
  - (i) Determine the failure rate of the standby generator. (06 marks)
  - (ii) What should the design life be, to maintain a reliability of at least 0.95. (06 marks)