

The Open University of Sri Lanka

Faculty of Engineering Technology



Study Programme	: MASTER OF TECHNOLOGY IN INDUSTRIAL ENGINEERING
Name of the Examination	: Final Examination
Course Code and Title	: MEX 7119 – MAINTENANCE MANAGEMENT
Academic Year	: 2013/14
Date	: 24th AUGUST 2014
Time	: 0930 hours -1230 hours
Duration	: 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 8 questions. All questions carry equal marks.
3. Answer any 5 questions only.

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1. (a) Discuss the vital components of Maintenance Planning Activities with suitable examples. (10 marks)
 - (b) Inventory control is one important function which influences the effectiveness of the entire maintenance work. Discuss with suitable examples. (05 marks)
 - (c) Prepare a program to achieve maintenance quality. (05 marks)
 2. (a) How would you obtain feedback in a maintenance system? (05 marks)
 - (b) Discuss why feedback in maintenance is important? (05 marks)
 - (c) Discuss the components involved in maintenance with suitable examples. (10 marks)
 3. (a) Discuss the importance of major steps involved in planned maintenance. (05 marks)
 - (b) Why is preventive maintenance in general more effective than the other types of maintenance strategies? (05 marks)
 - (c) Discuss the cost components involved in the Equipment Life Cycle. How do you estimate each component? (10 marks)

4. (a) Discuss the difference between Inherent Availability and Operational Availability with suitable examples. (04 marks)
- (b) Discuss the components of Cost of Reliability from the manufacturer's point of view. (06 marks)
- (c) List and discuss the four points the designer has to take into consideration in "Design for maintenance" when designing material handling equipment such as Fork Lift Trucks. (10 marks)
5. (a) Discuss the factors contributing to downtime. (03 marks)
- (b) Suggest suitable methods to minimize the downtime. (03 marks)
- (c) Discuss some important constraints in maintenance scheduling. (04 marks)
- (d) A tyre changing machine was tested for 06 months and was found to have a reliability of 0.95. Assuming constant failure rate determine,
- i. failure rate
 - ii. mean time to fail
 - iii. Design life reliability for a design life of 4 years.
 - iv. Design life to achieve a reliability of 0.99. (10 marks)
6. (a) Discuss the difference between Primary Failures and Secondary Failures. (08 marks)
- (b) Power supply system of a hospital consists of a standby generator, in addition to the national power supply, to have an uninterrupted power throughout. A voltage monitoring device has been installed to generate necessary signal to the standby generator in the event of national power failure. An operator has been detailed to switch on the generator in case of failure of voltage monitoring device as a precautionary measure. Combination of events that might cause a standby generator failure is given below.
- Basic failure of the power generation part (Alternator) of the generator set
 - Engine failure
 - Engine failure can be due to defective ignition system or fuel system
 - Fuel system can be failed due to contaminated fuel
 - Contaminated fuel can enter the system as a result of
 - ✓ Contaminated fuel in the fuel tanks
 - ✓ Failure of fuel cleaning system deployed to clean the contaminated fuel, if any, to suit the smooth running of the engine.
 - ✓ Ignition system can be failed due to defective nozzles or faulty fuel pump.

Draw the fault tree diagram for the top event, total blackout, of the system.

(12 marks)

7. (a) The reliability of a machine is given by

$$R(t) = e^{(-0.02t - 0.004t^2)}, \text{ where 't' is time.}$$

- i. Find the failure rate
- ii. What should the design life be, to maintain a reliability of 0.95

(10 marks)

(b) If the Cumulative Distribution Function (CDF) for time to failure of a hand grinder is

$$F(t) = 1 - \left\{ \frac{100}{(t + 10)^2} \right\}, \text{ where 't' is time,}$$

- i. find the failure rate as a function of time.
- ii. determine the region of the bath tub curve; the hand grinder would fall into.

(10 marks)

8. (a) Discuss the factors influencing the system effectiveness.

(04 marks)

(b) Discuss the major component of Reliability Centered Maintenance.

(04 marks)

(c) It is desired that a power plant be in operating condition for 95 percent of the time. The average time required for repairing a failure is about 24 hours. What must be the mean time between failures in order to meet 95 percent availability of the power plant?

(06 marks)

(d) Past data of the above power plant show a reliability of 50 percent with 100 hours time between failures. Actions have been taken to reduce the average time to repair from 24 to 6 hours. Find the availability of the system with this reduction.

(06 marks)

END