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	:	**MEX7119 Maintenance Management**
Academic Year	:	2012/13
Date	:	11th August 2013
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.
3. Answer only five (05) questions.

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1)

a) Discuss the relationship between performance, cost and reliability.

(08 marks)

b) Discus the difference between inherent reliability and the achievable reliability.

(04 marks)

c) A fuel distributing system has three components A, B and C in series and their reliabilities are 0.6, 0.75 and 0.8 respectively.

i) Find the reliability of the fuel distributing system.

(02 marks)

ii) If the component "A" has a redundant part in parallel having same reliability, determine the net reliability of the system.

(02 marks)

iii) Determine the reliability of the system if component "A" has two redundant parts, each having reliability of 0.6, in parallel.

(02 marks)

iv) The cost of failure of the system is Rs. 30,000.00. Component "A" has backup units and cost of each backup unit per production cycle is Rs. 3,000.00. How many backup units will be required to minimize the cost?

(02 marks)

2)

a) Discuss the different stages of equipment life cycle.

(06 marks)

b) How would you determine the exact time of replacement of a machine? Explain.

(04 marks)

c) An existing machine is worth Rs. 2.5 million today and it will loose Rs. 1 million in first year and thereafter Rs. 0.5 million in each year. Its operating cost for this year is

Rs. 0.2 million and thereafter it increases by Rs. 0.1 million annually owing to deterioration. It will be disposed in 4 years once it reaches zero salvage value.

A new improved machine that satisfactorily performs the same function as the existing machine can be purchased for Rs. 16 million and is expected to have relatively constant annual operating cost of Rs. 0.75 million to the end of its 07 years economic life at which time the salvage value would be Rs. 1.5 million. No major improvements are expected in designs for machines of this nature for next 07 years. If the minimum alternative rate of return is 12%, should the existing machine be replaced? If so when?

Capital Recovery Factor is given as, $i\,(1+i)^n / \{(1+i)^n - 1\}$

(10 marks)

3)

a) Compare and contrast the benefits and shortcomings of Reactive, Preventive, Predictive and Proactive Maintenance.

(08 marks)

b) Selecting the most suitable type of maintenance is vital in order to improve the effectiveness of your maintenance program. Discuss the steps that you would follow to select the best system out of preventive and reactive maintenance.

(04 marks)

c) What is meant by "design for maintainability"?

(03 marks)

d) Discuss the benefits of "design for maintainability".

(05 marks)

4)

a) "A technically competent maintenance manager will fail to achieve his objectives if he neglects the selection, training and motivation of those responsible to him."Do you agree with the statement? Justify your answer.

(08 marks)

b) The problem of communication between management and workers becomes more acute as the size of maintenance units increase. Discuss the ways of minimizing this issue.

(04 marks)

c) It is observed that the majority of personnel involved in maintenance work perform much below the required levels. Discuss the ways of overcoming this situation with suitable examples.

(04 marks)

d) Discuss the requirements that you have to consider for implementing sound quality control system to improve the effectiveness of you maintenance process.

(04 marks)

5)

a) Discuss the various elements of cost involved in ownership of an equipment.

(05 marks)

b) Discuss how cost reduction in maintenance is achieved through better maintenance practices.

(05 marks)

c) The general view of the management is that the reduction of maintenance workforce is one way of improving the overall profitability. Suggest the ways of keeping the maintenance workforce as small as possible while meeting the maintenance load.

(05 marks)

d) Discuss the factors that you have to consider when outsourcing your maintenance activities.

(05 marks)

6)

a) Discuss the importance of Fault Tree analysis in Maintenance.

(04 Marks)

b) What is meant by Fault Classification in Fault Tree Analysis?

(03 Marks)

c) Discuss the difference between Passive Faults and Active Faults with suitable examples.

(03 Marks)

d) Figure 6 shows a pumping system used to avoid basement flooding complete with a backup pump powered by a battery to use in case of failure of utility power. Draw the fault tree diagram for basement flooding.

(10 Marks)

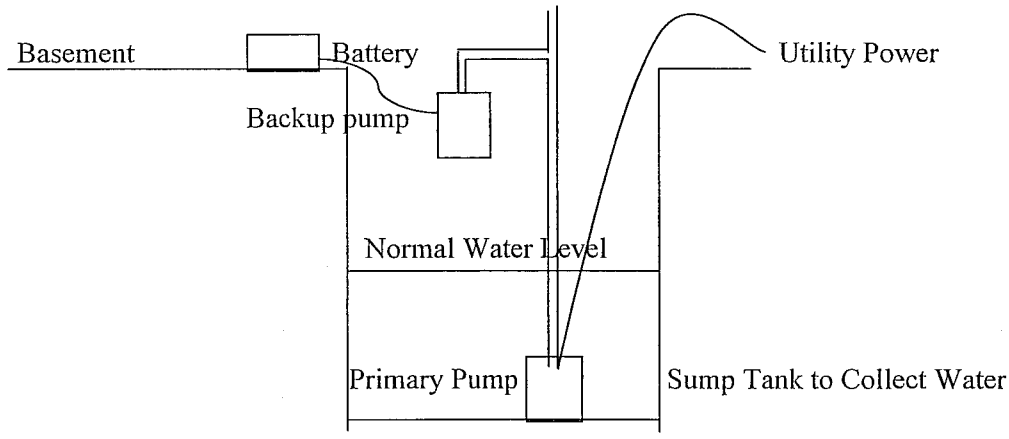


Figure 6

7)

a) Discuss the objectives of Man Power Planning in Maintenance Management.

(05 Marks)

b) Discuss the steps to be followed in Man Power Planning.

(05 Marks)

d) Suggest the steps that you are going to follow as a Maintenance Manager, in improving Man Power Utilization.

(05 Marks)

e) Discuss the benefits of Occupational Safety.

(05 Marks)

8)

a) Discuss the difference between Inherent Availability and Operational Availability with suitable examples.

(02 Marks)

b) Maintainability is an important parameter which has to be seriously considered when selecting suitable machinery and plants from among the available options. Discuss the procedure adopted in evaluating maintainability.

(02 Marks)

c) What are the factors which determine the overall equipment effectiveness? Explain with suitable examples.

(02 Marks)

d) Water pump powered by utility power, shown in figure 6, has a failure rate of 6 $x10^{-6}$ failures per hour. What is its reliability for an operating period of 5000 hours?.

(02 Marks)

If a pump manufacturer tests 500 such pumps in a test,

i) How many failures are expected in 5000 hours?

(03 Marks)

ii) If the Mean Time between Failures (MTBF) is 100000 hours, what is the reliability if the operating time is equal to 500000 hours?

(03 Marks)

iii) If the length of constant failure rate period is 50000 hours what is the reliability for operating for that length of time.

(03 Marks)

iv) If the pump has just entered useful life period what is the probability it will survive for 500 hours.

(03 Marks)

END