THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
MASTER OF TECHNOLOGY IN INDUSTRIAL ENGINEERING – LEVEL 7
FINAL EXAMINATION – 2008/2009
MEX 7119 – MAINTENANCE MANAGEMENT
DATE : *22 March 2009*
TIME : *1400 hrs – 1700 hrs*
DURATION: *Three (03) hours*

041

Answer any five (05) questions. All questions carry equal marks.

1. (i) What is maintainability?

   (ii) Describe how the design process, manufacturing process and field use of plant and machinery affect the reliability, safety and maintainability.

   (iii) The reliability of any equipment is highly dependent on its surroundings or environment. Explain the environmental factors with suitable example that affect the reliability.

   (iv) Ten identical items with constant failure rates were put on test and their failure times in hours were 10, 17,25,33,34,41,48,59.72 and 79. Calculate the MTTF and the reliability at 20 hrs.

2. (i) Discuss the difference between the Preventive Maintenance and the Total Productive Maintenance with suitable examples.

   (ii) Discuss the importance of Business Centered Maintenance.

   (iii) Describe the important components of Conditioned Based Maintenance (CBM) with suitable examples.

   (iv) Give reasons with suitable examples to focus more on Conditioned Based Maintenance than Preventive Maintenance in order to minimize the cost of maintenance without sacrificing reliability.

3. (i) One of the major challengers of the Maintenance Manager is justifying his Maintenance Budget. Suggest a suitable process to overcome this problem.

   (ii) Describe the steps involve in preparing the preventive maintenance program.

   (iii) Availability of technical information to all maintenance personnel and documentation are a vital requirement to improve the effectiveness of the maintenance management process. What actions would you suggest to fulfill this requirement?

   (iv) Discuss two important components of best maintenance practices in facility management.

4. Liquid Crystal Display of a Distribution Board can be fail due to insufficient power to LCDs or multiple failures of LCDs. Reasons for insufficient power for LCDs are on/off switch failure position or internal wiring failure or power supply failure. Power supply failure can occur due to low/no power from charger and low/no power from battery. Charger can fail due to faulty transformer or faulty plug or no power at socket or wiring failure. Reasons for battery failure are uncharged battery or faulty battery or no battery in the system. Probabilities of occurrence of causes are given in the table.

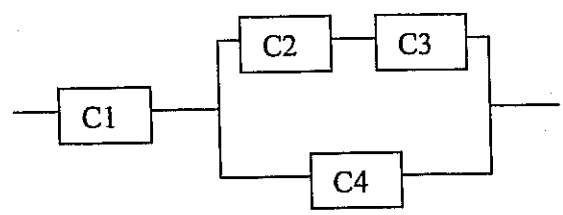
Cause	Probability
No battery	1×10^{-2}
Faulty battery	5×10^{-4}
Uncharged battery	2×10^{-3}
Faulty transformer	1×10^{-4}
Faulty plug	1×10^{-3}
No power at socket	2×10^{-4}
Wiring failure	5×10^{-4}
On/off switch failure at off position	2×10^{-4}
Internal wiring failure	2×10^{-4}
Multiple failures of LCDs	5×10^{-5}

(i) Draw the fault tree diagram.

(ii) Identify the failures which can contribute to the top event failure but can not be analyzed further due to lack of information or other reasons.

(iii) What is the probability of occurring the top event failure?

5. (i) Figure below shows a reliability block diagram of a complex system made up of four components. Details of the components are given below.



	C1	C2	C3	C4
Reliability %	95	85	90	98
Cost (Rs.00,000)	10	20	20	10

(i) Calculate the reliability of the system.

(ii) It is decided to improve the reliability of the system by keeping a second system as standby facility at a total cost of Rs. 10 million or adding identical backup components with similar reliabilities at component level. Find the new reliability of the system for both options.

(iii) If the system has to run 1,000 hrs and the loss due to system failure is Rs. 50,000.00 per hour, find the most suitable option.

6. (i) Valuable skills and experience in industry at large has been and is being lost due to retirement of trained and skilled staff or some other reasons. As the Maintenance Manager would you agree with this statement?

(ii) Success of the maintenance process is largely dependent on capable and committed workforce. As a maintenance manager what steps would you recommend to achieve this objective?

(iii) Why Contract Maintenance / Out Sourcing is necessary in maintenance management?

(iv) Discuss the features that you have to consider when selecting a suitable maintenance contractor.

(v) How does the duration of the out sourcing contractor influence the reliability of the maintenance activities?

7. (i) Safety is one important factor that the maintenance manager should consider seriously. Explain with suitable examples.

(ii) Name the basic components of a maintenance information system.

(iii) Failure information management system is an essential component to improve the reliability of the plant and machinery. Describe with suitable examples.

(iv) In a slandered fire fighting system a fire is detected and alarm activated before the sprinkler system is switched on to extinguish the fire. At each stage there is a human standby system to attend if alarm or sprinkler system fails.

(a) Draw the event tree diagram for all the possible outcomes.

(b) Name all possibilities that cause the fire spreading.

8. (i) As a member of a Technical Evaluation Committee to purchase a mobile crane, describe the factors that have to be considered in order to select the most suitable crane with clear examples to justify your answer.

(ii) It has been noted during a preventive maintenance program that a 15 year old 10 ton mobile, is due for a major overhaul. The total cost involvement in the overhauling process is Rs. 1.5 mn and the overhaul is expected to result in an additional 5 year life time with 250 hrs mean down time per annum.

Another option that the maintenance manager may consider is to sell this old crane for Rs. 1.5 mn and go for a brand new crane at a total cost of Rs. 20 mn. Estimated life time of the new crane is 20 years with 50 hrs mean down time per annum.

Select the best option if the cost of down time is Rs. 5000.00 per hour.

Capital Recovery Factor = $i\ (1 + i)^n / [(1+i)^n - 1]$

9. (i) Overall Equipment Effectiveness (OEE) is one of the key indicators of the maintenance management. Name three parameters which describe the OEE with suitable examples.

(ii) How may OEE can be used to justify the maintenance budget. Give suitable examples.

(iii) Waste is one factor that adds no value to the maintenance activities. Identify common sources of waste in maintenance management process.

(iv) Highly sophisticated machine produces only 20 units per day although it is expected to produce 30 units per day according to specifications. Average down time of the machine is 20 hrs per month in spite of the fact it is expected to function 160hrs per month. According to the quality control manager the average number of rejects per day is 2.

Calculate the OEE.

****END****