

THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
MASTER OF TECHNOLOGY IN INDUSTRIAL ENGINEERING – LEVEL 07
FINAL EXAMINATION – 2005/2006
MEX7119 – MAINTENANCE MANAGEMENT
DATE : 25TH MARCH 2006
TIME : 0930 HRS. – 1230 HRS.
DURATION : THREE HOURS



ANSWER ANY FIVE (05) QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS

QUESTION 01

- (a) Briefly explain the concept of Strategic Asset Management. (4 marks)
- (b) How does Strategic Asset Management differ from traditional maintenance improvement efforts? Explain. (8 marks)
- (c) Compare and contrast the Functional Excellence Model and Asset Management Excellence Model. (8 marks)

QUESTION 02

- (a) Briefly describe the major parts of a maintainability program? (2 marks)
- (b) Explain the common features of merit of maintainability. (4 marks)
- (c) What are the different methods of improving the maintainability of a design? (4 marks)
- (d) Explain the difference between Predictive maintenance and Reliability Centered maintenance. (3 marks)
- (e) What are the seven major waste categories in lean maintenance? (7 marks)

QUESTION 03

- (a) How do you design an effective maintenance strategy for a manufacturing organization? (6 marks)
- (b) "Planning and scheduling is a disciplined approach for utilizing existing maintenance resources to reduce downtime and minimize the overall production costs". How do you accomplish this? Explain. (6 marks)
- (c) "A better approach in analyzing an outsourcing decision is to look at the decision in terms of a two-by-two matrix". Critically comment on this statement. (8 marks)

QUESTION 04

- (a) What are the engineering and economical factors that influence the decision of equipment replacement? (6 marks)
- (b) A transport department of a company operates a fleet of vehicles for delivering company products. A new vehicle costs Rs. 4.5 million and it is estimated that in future too a vehicle will continue to cost Rs. 4.5 million. The operating & maintenance (O & M) cost and resale value with respect to the age of the vehicle are given below.

Age (Years)	O & M Cost (Rs. in '000s)	Resale Value (Rs. in '000s)
1	750	3000
2	920	2500
3	1100	2125
4	1250	1825
5	1685	1000
6	2050	225

All money values are given in present values and are assumed to remain constant in the future. Assume that the company makes replacement decisions once a year and that the company purchases only new vehicles.

What is the replacement policy that should be adopted by the company in order to minimize the total cost? (14 marks)

QUESTION 05

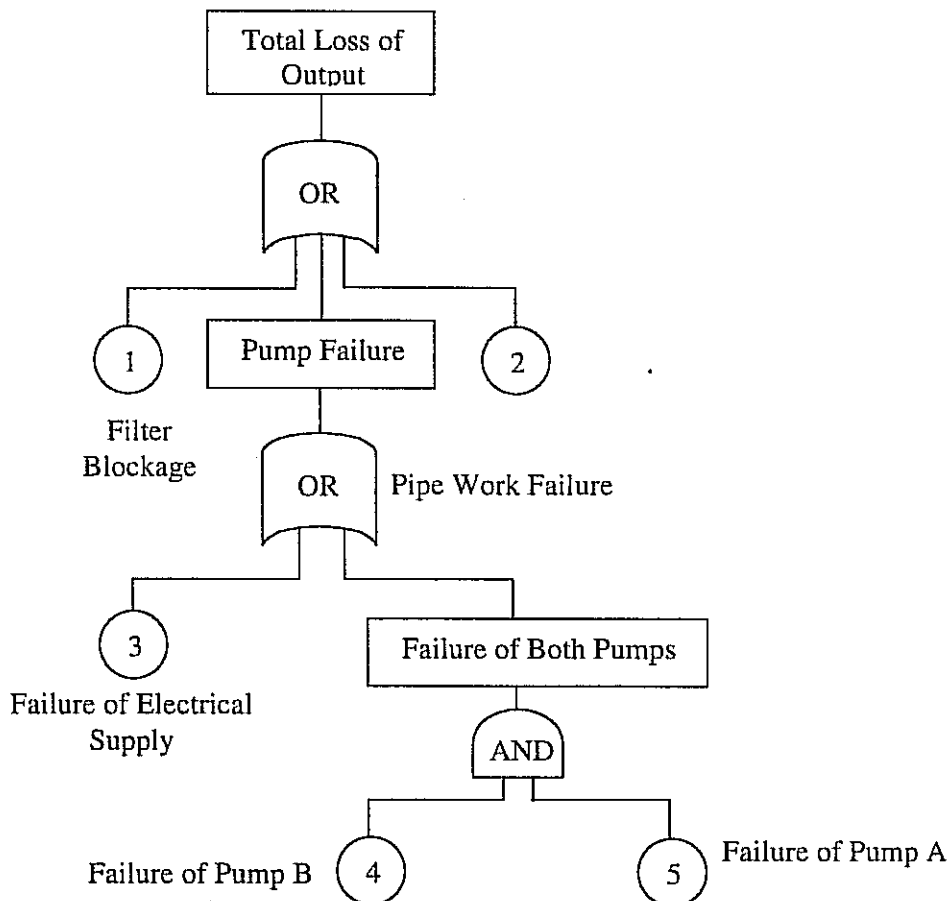
- (a) Briefly explain the typical causes for unreliability in manufacturing. (6 marks)
- (b) Briefly explain the reliability design techniques that are employed to meet the specified reliability. (7 marks)
- (c) Explain the procedural steps in the Failure Mode, Effect and Criticality Analysis (FMECA). (7 marks)

QUESTION 06

- (a) Failures can be classified according to the time of occurrence in the system life time. Explain the different regions in the bathtub curve giving possible failure types and failure causes in each region. (7 marks)
- (b) Explain the difference between active parallel systems and passive parallel systems. (5 marks)
- (c) Completed fault tree of a pumping system is shown in Fig. Q6. The following probabilities were found from historical data.

Probability of filter blockage (1)	= 0.06
Probability of pipe work failure (2)	= 0.03
Probability of electrical supply failure (3)	= 0.20
Probability of single pump failure (4/5)	= 0.30

Calculate the probability of total loss of output. You may assume that the pumps A and B are acting as an active parallel system. (8 marks)



QUESTION 07

- (a) "The basic measure associated with Total Productive Maintenance (TPM) has been the Overall Equipment Effectiveness or OEE". Discuss. (10 marks)
- (b) Three repairable systems behave according to a homogeneous Poisson process. System 1 starts its operation at time 0 and system 2 starts its life when system 1 has been operating for 150 hours and system 3 starts life when system 1 has been operating for 250 hours. Up to now the systems 1, 2 and 3 have been operating for 400, 250, and 150 hours respectively with only eight failures.

Calculate:

- (i) The estimated failure rate (λ).
- (ii) Estimated Mean Time Between Failures (MTBF).
- (iii) If the particular system has a MTBF of 125 hours, what is the probability of having one failure in a total of 150 hours of operation?

Probability of failures, $P(x) = \frac{e^{-m} m^x}{X}$ (10 marks)

QUESTION 08

- (a) Briefly discuss the main steps in the process of reliability design. (6 marks)
- (b) Briefly discuss the major cost components in analyzing the cost of reliability. (8 marks)
- (c) What are the four basic elements of a company's production reliability assurance program, which can be different from, but complementary to those of the design and development departments? Explain. (6 marks)

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