

**OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY.**

SEMESTER 1 December 1999

**Diploma in Quality Assurance
Master of Applied Science(Operations & Quality Management)
VISITING STUDENTS**

RELIABILITY AND MAINTENANCE

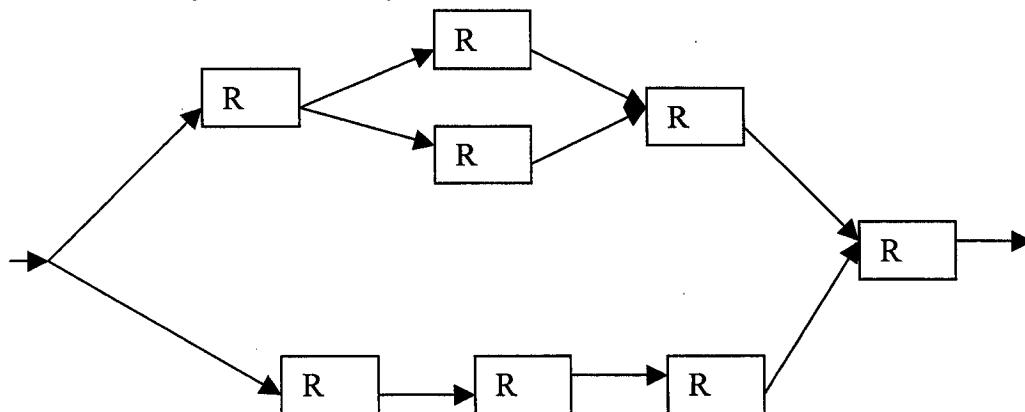
**Dr. E. J. Wright
Dr. J. Sheil
Mr S. Dunlop
Mr. P. Donnellan**

Time allowed: Two hours

Candidates should attempt to answer three questions; all questions carry equal marks.

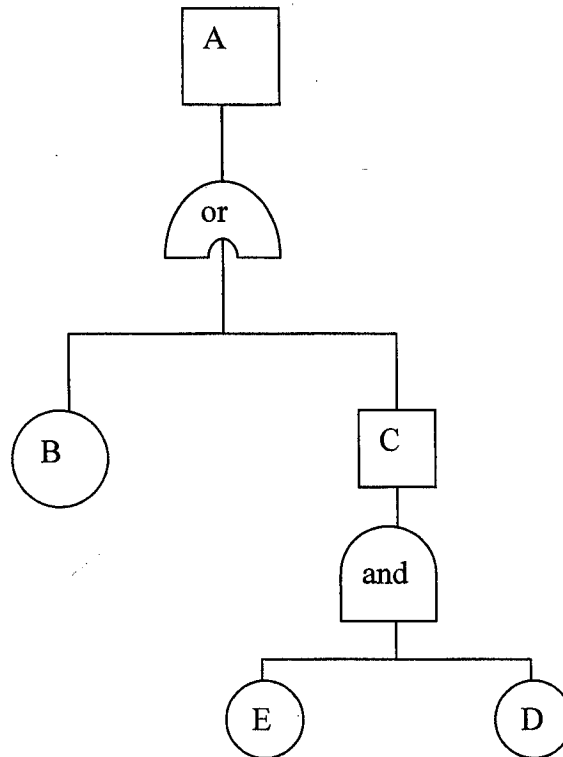
[Paper marked out of 60]

- Q1.(a) In the network shown below all the components have a reliability R . Derive an expression for the system reliability. (8)



- (b) Compute the reliability if $R = 0.9$ (4)
- (c) A radio set consists of three major components; a power supply, a receiver and an amplifier having reliabilities of 0.8, 0.9 and 0.85 respectively. Compare the reliability of two options:
 - one where each element is duplicated in low level redundancy and
 - the other where the first two items are duplicated in high level redundancy. (8)
- Q2(a) Describe in detail the typical variation in instantaneous failure during the lifetime of a product highlighting the characteristics of each stage of the life of the item. (6)
- (b) Explain why the MTTF is the reciprocal of the failure rate when the failure rate is constant. (5)
- (c) A hospital operating theatre has an emergency generator on standby in the event of a power failure. If power failures occur at the rate of once every 5000 hours and the failure rate for the generator is 2000 failure per million hours, what is the reliability for the theatre's power system for a 10 hour mission? Assume perfect sensing and switching and a negligible standby failure rate for the emergency generator. (9)

- Q3 (a) What does Total Productive Maintenance require of management? (4)
- (b) Explain with the use of a graph the effect on the cost per unit for different aspects associated with the cost of maintenance (5)
- (c) Describe three different approaches to equipment maintenance and compare the merits and demerits of each approach (9)
- 4.(a) Design an FMEA worksheet and define with examples five classes of criticality which can be used in an FMECA analysis (8)
- (b) Explain the fundamental difference between FMEA and FTA? (4)
- (c) Determine the probability of Event A in the FTA below given that the basic events B, D and E are statistically independent and mutually exclusive to one another.
 $P(B)=20\%$ $P(D)=50\%$ $P(E) = 30\%$



- Q5.(a) What is the purpose of the Ishikawa diagram when it is used in fault analysis?

What are the traditional breakdowns in the major branches of the diagram? Demonstrate these by considering fire risk in an apartment block. What are the limitations of this diagram when compared with other possible methods of fault analysis? (10)

- (b) Explain how the results of a Weibull plot may be utilised in the analysis of maintenance costs. (10)