Total No. of Questions :12]

SEAT No. :

P1709

[Total No. of Pages :5

[4859]-50
B.E. (Mechanical)
c:RELIABILITY ENGINEERING
(2008 Pattern) (Elective - IV) (Semester - II)

Time : 3 Hours] *[Max. Marks :100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Figures in bracket to the right indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data, if necessary and mention it.***

SECTION - I

Q1) a) Define the terms: **[6]**

i) Failure density

ii) Probability density function

iii) Hazard rate

iv) Cumulative distribution function

b) The following failure data is collected for a group of 650 components. Find the failure density, hazard rate & reliability & plot functions against time. **[10]**

Operating time (Hrs)	1	2	3	4	5	6	7	8	9	10
No. of failures	130	83	75	68	62	56	51	46	41	38

OR

P.T.O.

Q2) a) Why is the reliability important? Give any six reasons and explain. **[8]**

b) Explain with neat sketch different modes of failure and its causes. **[8]**

Q3) a) A Q.C. engineer is checking the dimensions of mass produced iron bars. Following are the probabilities of getting a bar with various types of defects: **[8]**

i) With bend = 0.003

ii) With oversize = 0.019

iii) With under size = 0.002

iv) With bend & oversize = 0.00045

v) With bend & undersize = 0.0005

What is the probability of getting a bar with no defects?

b) State and explain the theorem of Total Probability. **[8]**

OR

Q4) a) In a parallel system consisting of four identical independent units, the successful working of the system depends on any one unit operating satisfactorily. Determine the expression for the reliability in terms of failure rate λ & mission time t. If λ is considered as 0.005 & mission time 100 hrs, find reliability. **[8]**

b) Discuss briefly various probability distributions. Explain Weibull distribution. **[8]**

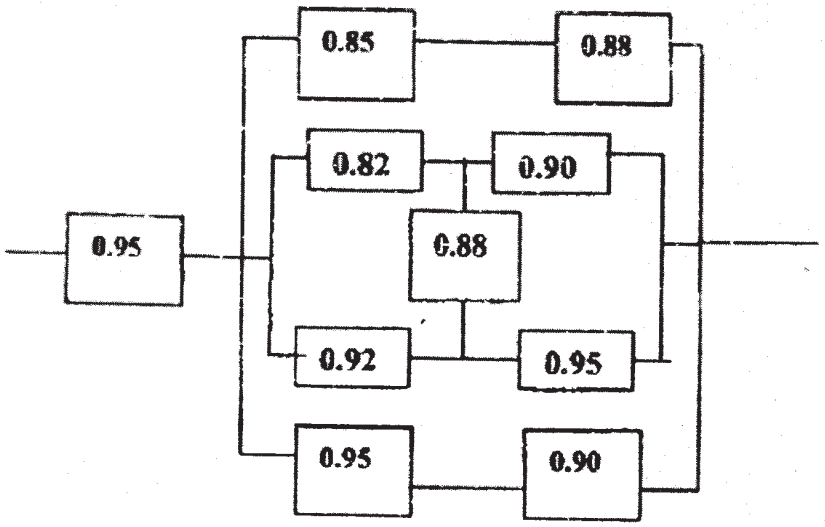
Q5) a) Write a note on AGREE Allocation method. **[6]**

b) A system consists of four subsystems A, B, C & D having failure rates 0.006, 0.0035, 0.004 & 0.002 respectively per hour. If the mission time is 100 hours & the system reliability required is 0.90, find the failure rate as well as reliability of each subsystem for the entire mission using ARINC method. **[6]**

c) A system consists of four components connected in series with reliabilities 0.9, 0.8, 0.958, 0.95. It is desired that reliability of system should be 0.85. How this should be apportioned in three units using minimum effort method? **[6]**

OR

Q6) a) Find the reliability of the structure given below. **[10]**



b) Write a note on dynamic programming apportionment technique. **[8]**

SECTION - II

Q7) a) Explain maintainability. Name the different maintainability tools used. Elaborate on specific maintainability design considerations. **[8]**

b) Define inherent, achieved and operational availability. **[3]**

c) Following data is recorded for a system under consideration. Mean time between failures = 1250 hrs, mean active maintenance downtime = 130 hrs, Mean time to repair = 128 hrs, mean time between maintenances = 1380 hrs, MDT = 224 hrs. Find inherent, achieved and operational availability of the system. If MTTR to MTBF ratio changes to 0.32, what will be the inherent availability? **[5]**

OR

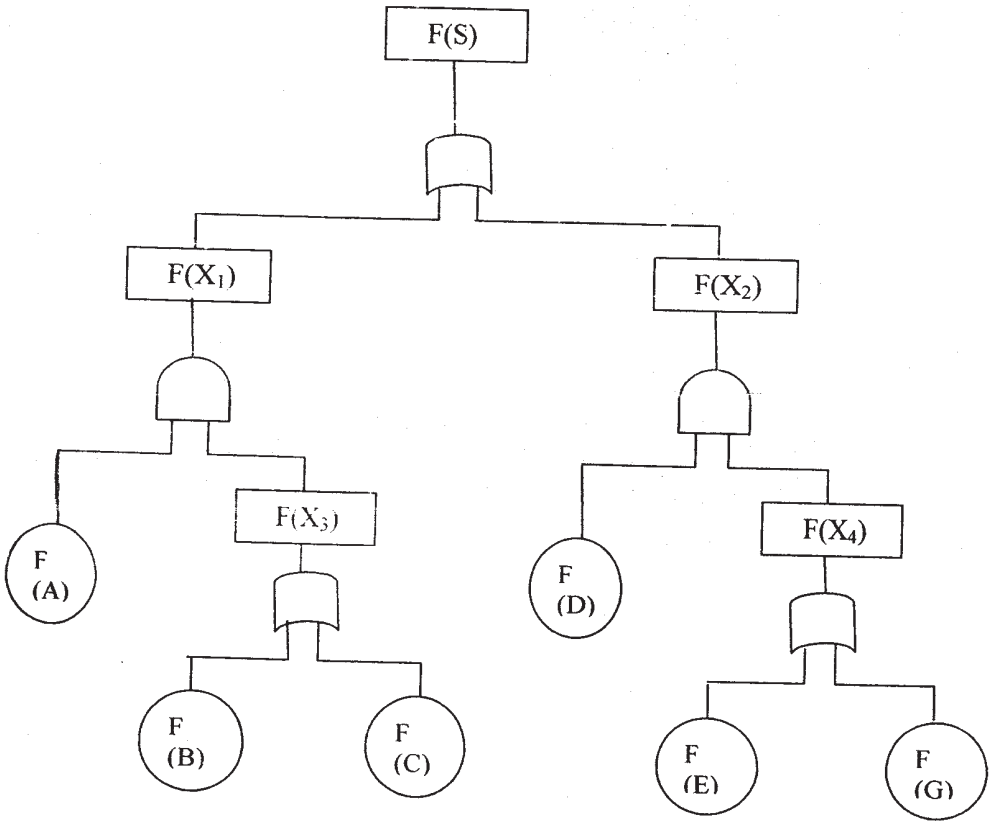
Q8) a) State and differentiate between MTBM and MTBF with a sketch. Explain the condition for them to be equal. **[6]**

b) A Drilling machine has achieved availability value of 0.92. The preventive and corrective maintenance requires down time of 345 hrs. The administrative and supply downtime of 96 hrs is added to maintenance downtime to get mean downtime. Find the operational availability. **[6]**

c) Explain the objectives of maintenance. **[4]**

Q9) a) What is the significance of rectangle, circle, AND and OR gate in a fault tree? **[6]**

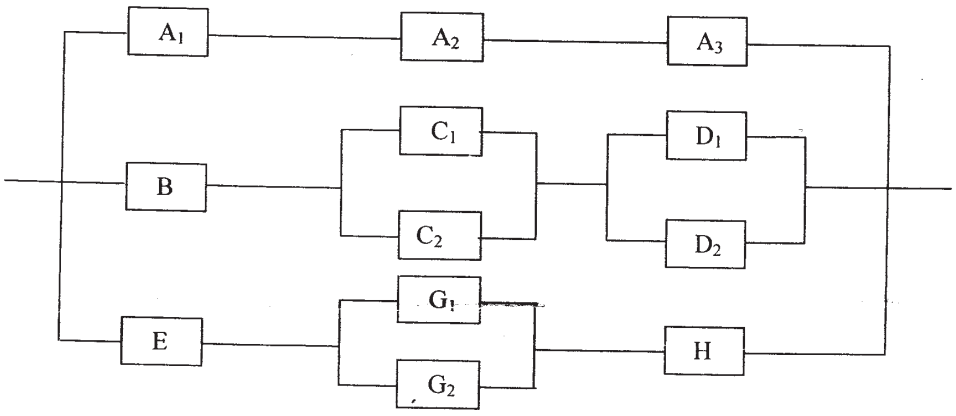
b) The fault tree for failure of a system is given below. Draw a block diagram and find the minimal cut sets. Find the reliability of the system if the probability of failure for different elements of system are as given below. Probability of failure of A is 0.01, Probability of failure of B is 0.02, Reliability of C is 0.97, Probability of failure of D is 0.02, Reliability of E = 0.97, Probability of failure of G = 0.01. **[12]**



OR

Q10)a) Explain the procedure for building Ishikawa diagram with a suitable example. **[6]**

b) Find minimal tie sets for the following configuration of the system and draw the fault tree for system failure. **[12]**



Q11)a) Write a note on Markov modelling. **[6]**

b) An engine shaft of 50 mm diameter is subjected to torsional mean stress of 220 MPa and standard deviation of 30 MPa. The shaft is made up of high alloy steel with a mean yield strength of 400 MPa and standard deviation of 65 MPa. Assuming normal distribution, find the reliability of the shaft with the help of a part of the standard normal table given below. How much is the central (average) factor of safety for the shaft? **[10]**

Z	2.47	2.48	2.49	2.50	2.51	2.52	2.53	2.54	2.55
ϕ(Z)	0.9932	0.9934	0.9936	0.9938	0.9940	0.9941	0.9943	0.9944	0.9946

OR

Q12)a) Differentiate between Accelerated Life Testing and Highly Accelerated Life Testing. **[6]**

b) Failure data of 11 bulbs is given below. Use mean and median method to find reliability of bulbs and plot the graph between failure time and reliability for both methods. **[10]**

Bulb No	1	2	3	4	5	6	7	8	9	10	11
Failure Time Hrs	340	294	567	431	142	265	389	530	456	78	684

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