Total No. of Questions : 12] SEAT No. :

P1947

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B.E. (Mechanical Engineering) (Semester - II)

RELIABILITY ENGINEERING

(2008 Pattern)

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

Instructions to the candidates:

1) ***All questions are compulsory i.e. Solve Q.1 or Q. 2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12.***
2) ***Figures to the right indicate full marks.***
3) ***Assume suitable data, if necessary.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

SECTION - I

Q1) a) Define and explain the following terms in brief : **[8]**

i) Reliability.

ii) Hazard rate.

iii) Mean time to failure

iv) Probability density function of failure.

b) Following table shows the result of life tests carried out on 100 components simultaneously. **[8]**

Operating Time interval (Hours)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Numbers of failed Components	10	9	8	7	6	5	5	5	4	4

Evaluate hazard rate and failure density and represent it on graph against time interval.

OR

Q2) a) State and explain quality and reliability assurance rules in detail. **[8]**

P.T.O.

b) Why is the reliability important? Give any four reasons and also state the areas of application of reliability. **[8]**

Q3) a) Find the reliability of a system shown in the figure 1 by using conditional probability method. Assume that the components 1, 2, 3, 4 are identical and independent with the reliability value of 0.89 and component 5 has reliability of 0.8. **[8]**

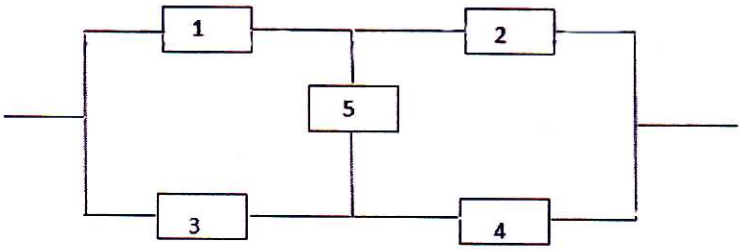


Fig. 1

b) What is the concept of K out of n structure? Explain with the help of example and derive equation for reliability and MTTF for this structure. **[8]**

OR

Q4) a) Find the reliability of the following structure shown in fig.2. **[8]**

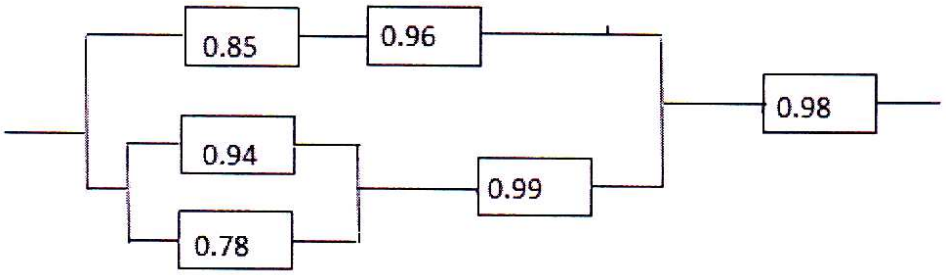


fig.2

b) Explain in detail with the example and application : **[8]**

i) Active redundancy

ii) Standby redundancy

Q5) a) What is the importance of reliability allocation? Explain the dynamic programming apportionment in detail for reliability allocation. **[8]**

b) A system consists of 6 sub-systems connected in series. The system reliability goal is 0.998 for a period of 20 hours operation. The necessary information for the sub-system is given below : **[10]**

Sub-system	Number of Modules (Ni)	Importance factor (Wi)	Operating time 't' Hours
1	30	1.00	20
2	75	0.98	18
3	40	1.00	20
4	50	0.95	16
5	60	0.93	14
6	70	1.00	20

Find the values of allocated reliabilities of subassemblies and their minimum acceptable failure rates using AGREE method. State any assumptions made.

OR

Q6) a) Write assumptions made and explain the procedure in ARINC method of reliability Allocation. **[8]**

b) A system having reliability goal of 0.645 consists of 4 subsystems having reliabilities of 0.795, 0.895, 0.845,0.945. How should this be apportioned in four units? Use minimum effort method. **[10]**

SECTION - II

Q7) a) What are the objectives of maintenance process? Classify the maintenance techniques and explain each type in detail. **[8]**

b) For the system from the following data collected at a plant : **[8]**

Mean time before failure : 65 hrs

Mean time to repair : 20 hrs

Administrative logistics time : 125% of MTTR

Calculate operational availability & inherent availability of the plant.

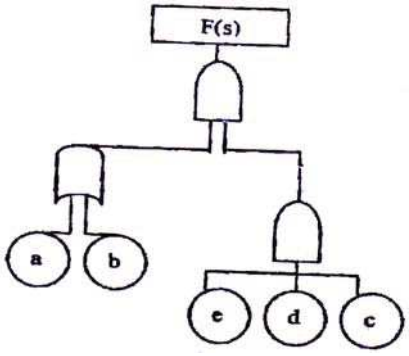
OR

Q8) a) Write a note on reliability centered maintenance. **[8]**

b) For a pharmaceutical lab a suitable HVAC system has to be designed. It should have reliability value of 0.95 for an operation of 800 hrs. The availability value over the same period of time is required to be 0.98. Assume constant hazard rate for failure & repair. Estimate MTBF & MTTR. **[8]**

Q9) a) Write a note on FMECA. **[8]**

b) The failure probabilities of a, b, c, d and e are 0.01, 0.003, 0.005, 0.007 and 0.09 respectively. Find the reliability of the system. **[8]**



OR

Q10)a) Write a note on minimal tie set & cut set method. **[8]**

b) Explain Ishikawa Diagram with an example. **[8]**

Q11)a) Write a note on Markov model. Write assumptions and give its applications. **[8]**

b) The following data refers to a short sample reliability test of engineering instruments : **[10]**

Failure No.	1	2	3	4	5	6	7	8
MTTF (Hrs.)	12	20	18	10	16	29	28	32

Calculate the reliability using mean and median ranking method. Also plot Reliability vs. Time curve.

OR

Q12)a) What is HALT? Explain the procedure to conduct it. **[8]**

b) The mean strength and the standard deviation of a bolted joint are 300 N /mm^2 and 30 N/mm^2 respectively. The joint is loaded such that stress induced has a mean value 250 N/mm^2 with standard deviation 5 N/mm^2. Assuming that the strength & induced stresses are normally distributed, find out the probability of survival of the bolted joint. **[10]**

Z	1.2	1.3	1.4	1.5	1.6	1.7	1.8
φ(Z)	0.8849	0.9032	0.9192	0.9331	0.9452	0.9550	0.9640