Total No. of Questions : 12]

SEAT No. :

P3684

[Total No. of Pages :5

[4759] - 49
B.E. (Mechanical)
RELIABILITY ENGINEERING
(2008 Course) (Elective - IV(C)) (Semester -II)

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

Instructions to the candidates:

1) *Answers to the two sections must be written on separate answer sheets.*
2) *Figures 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) State and explain the quality and reliability assurance rules. (Any 4). **[8]**

b) Define MTTF and MTBF. In the life-testing of 100 specimens of a particular device, the number of failures during each time interval of 25 hours is shown in following table. Estimate the MTTF for these specimens. **[8]**

Time Interval Hours	Number of failures during interval
$T \leq 1000$	0
$1000 < T \leq 1025$	15
$1025 < T \leq 1050$	50
$1050 < T \leq 1075$	20
$1075 < T \leq 1100$	15

OR

P.T.O.

Q2) a) Gear pumps of 500 numbers were tested and the failure data obtained is tabulated as given below. Find the failure density and hazard rate. **[10]**

Time Interval	0-10	10-20	20-30	30-40	40-50
No. of components failed	123	67	85	25	20

b) Explain safety, Failure rate and product liability with example. **[6]**

Q3) a) Calculate the reliability of the system shown in Fig.1 using conditional probability method. **[8]**

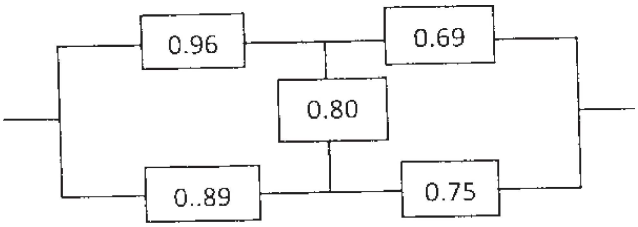


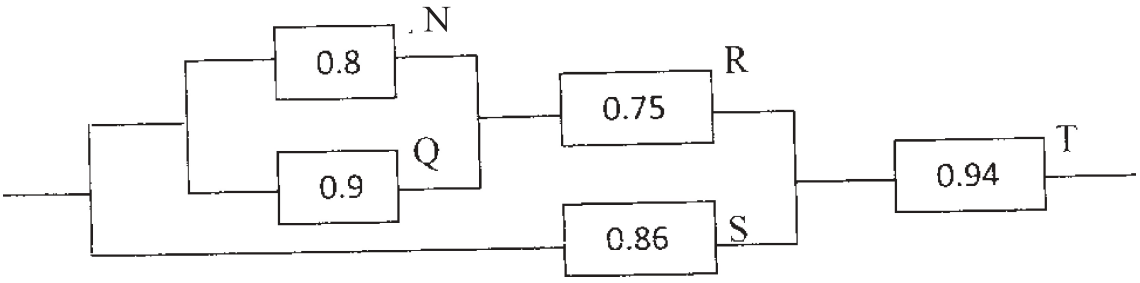
Fig.1

b) What is redundancy? Explain how the element redundancy is superior to unit redundancy with an example. **[8]**

OR

Q4) a) Name the different distributions and explain their selection criteria. **[8]**

b) Find the system reliability for the configuration of the system given below. **[8]**



Q5) a) A system consisting of 6 sub-systems has a reliability goal of 0.98 for period of 20 hours operation.Compute the minimum acceptable failure rate, allocated reliability goal for each sub-system using AGREE method of allocation and system reliability. **[10]**

Sub-system	Number of modules	Operating Time	Importance Factor
1	35	20	1.0
2	70	18	0.98
3	45	20	1.0
4	55	16	0.95
5	40	14	0.93
6	80	20	1.0

b) Explain Minimum Effort method with the help of an example. **[8]**

OR

Q6) a) A system reliability requirement is 0.96 and has mission time of 40 hrs. It has four subsystems with failure rates of 0.004, 0.002, 0.003 and 0.006 respectively. Find the reliability of each subsystem to achieve the required system reliability. Use ARINC apportionment technique. **[10]**

b) Explain the need of reliability allocation. Discuss the equal apportionment technique with its advantages and limitations. **[8]**

SECTION - II

Q7) a) A machine is to be designed for an operating time of 500 hours and reliability of 0.95. The inherent availability value for the operating period has to be 0.98. Estimate mean time between failure & mean time to repair. If the reliability requirement increases to 0.98 and MTTR remains same, what will be the changes in estimated values of MTBF and Inherent availability? **[8]**

b) Define and explain reliability, availability and maintainability. **[8]**

OR

Q8) a) Discuss about preventive & breakdown maintenance. State advantages and limitations of each type. **[6]**

b) For the particular system the following data is collected at a plant: **[6]**

Mean time between failure: 86 hrs

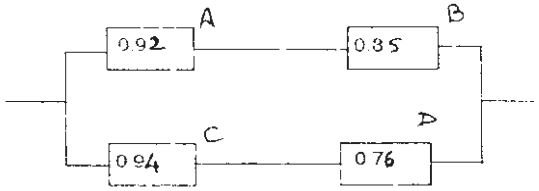
Mean time to repair: 32 hrs

Administrative logistics time: 118% of MTTR

Calculate operational & inherent availability of the plant.

c) Define and explain MTBF and MTTR. **[4]**

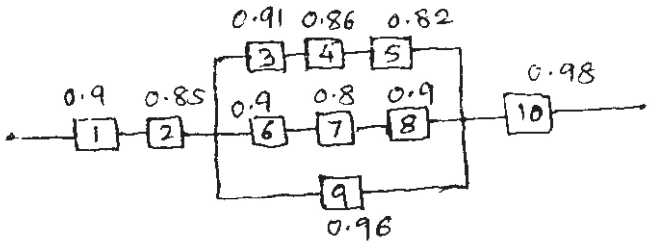
Q9) a) For the given block diagram construct Fault Tree Diagram & using that find out the reliability of the system. If reliabilities of B and D are changed to 0.9, what will be the new reliability of the system? Write the minimal cut sets. **[9]**



b) Explain the steps involved in carrying out FMECA with an example. Explain the significance of RPN. **[9]**

OR

Q10)a) A special purpose machine is represented by the block diagram as shown below. Construct a fault tree diagram for the system and calculate the reliability of the system. **[10]**



b) Explain minimal tie set & minimal cut set method for finding reliability with an example and compare results. **[8]**

Q11)a) State and explain in brief the different methods for reliability testing. **[6]**

b) A welded component has the mean strength & standard deviation of 460N/mm^2 & 35 N/mm^2 respectively. The stress induced in the component because of applied load has a mean value of 400N/mm^2 with standard deviation 12N/mm^2. Assuming that shear strength & the induced stresses are independent & normally distributed, find out the probability of survival of the component. If the applied load increases to 415N/mm^2 with increase in standard deviation to 13N/mm^2, discuss its effect on probability of survival of the component. Refer the statistical data given below. **[10]**

Z	1.2	1.3	1.4	1.5	1.6	1.7	1.8
$\phi(z)$	0.8849	0.9032	0.9192	0.9331	0.9452	0.9550	0.9640

OR

Q12)a) Write a note on HASS. **[6]**

b) The following data refers to a certain test of equipment **[10]**

Failure No.	1	2	3	4	5	6	7	8
Mean time to failure (hrs.)	34	21	16	43	29	38	25	65

Find out the reliability of the equipment by

i) Mean Method &

ii) Median Method & compare the two by plotting.

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