Total No. of Questions : 10]

SEAT No. :

P2141

[Total No. of Pages : 4

[5254]-536

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

RELIABILITY ENGINEERING

(2012 Pattern)

Time : 2½ Hours] *[Max. Marks : 70*

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.***
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.***

Q1) a) List and compare discrete and continuous probability distributions. **[4]**

b) Following table shows test results for 600 fuel pumps tested for 660 hours under severe conditions. The following data was obtained for number of fuel pumps failed out of 600 nos. Calculate the failure density and hazard rate and tabulate the results. **[6]**

Time interval (hrs.)	0-110	110-220	220-330	330-440	440-550	550-660
Number of fuel pumps failed	123	180	144	63	54	36

OR

Q2) a) State the importance and role of the reliability function in an organization.**[4]**

b) Obtain the reliability of the system for the block diagram shown in figure 1. The number in each block shows the reliability of each component. All the elements are independent. Find the reliability of the system if all the elements have a reliability value of 0.88. **[6]**

P.T.O.

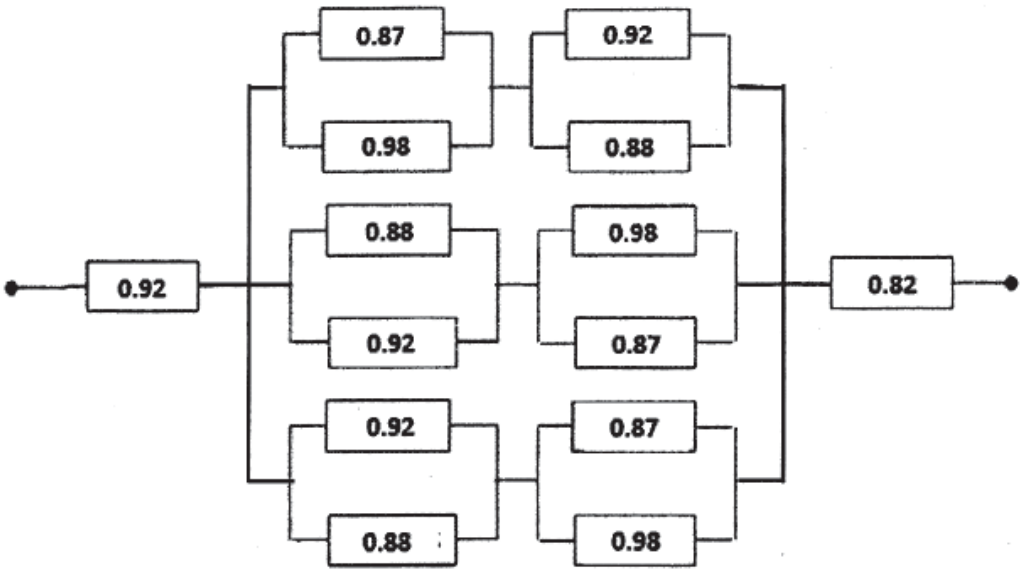

Fig. 1

Q3) a) Explain delta-star method for conditional probability analysis. **[4]**

b) A steering gear assembly consists of three components having reliabilities of 0.78, 0.93 and 0.84 connected in series. The reliability of a steering gear assembly is desired as 0.72. Find for which components the reliability values are to be improved and also find the values of individual reliabilities of the critical components by using minimum effort method. **[6]**

OR

Q4) a) compare the approach used for reliability analysis of a system when using tie-set and cut-set methods. **[4]**

b) A system with three elements 1, 2 and 3are having failure rates $\lambda 1=0.008$, $\lambda 2=0.003$ and $\lambda 3=0.002$ per hour respectively. Find failure rates as well as reliability of each sub system for the entire mission period using ARINC apportionment technique assuming mission time of 120 hours and desired system reliability of 0.86. **[6]**

Q5) a) Operational availability of a cold storage assembly over 1600 hours is 0.84. Failure of the cold storage assembly follows an exponential distribution with the probability of failure within 1600 hours is 0.24. Find mean down time (MDT), mean time to repair (MTTR) and inherent availability of the cold storage assembly ignoring the preventive maintenance downtime. Consider mean administrative and logistic time as 25% of MTTR. **[8]**

b) Define maintainability and state the factors which affect maintainability. Also, compare the inherent, achieved and operational availability. **[8]**

OR

Q6) a) A carburetor assembly has to be designed with a reliability value of 0.96 for 900 hours. Obtain the operational availability if maintainability of the carburetor assembly over the same period of time is 0.88 and administrative and logistic time is 30% of MTTR. Assume that the repair time follows an exponential distribution and a constant hazard rate for failure of carburetor assembly. Also, obtain the inherent availability of the system over the same period of time. **[8]**

b) Define preventive, predictive and corrective types of maintenance. State the benefits of each type of maintenance with suitable examples. **[8]**

Q7) a) Abrasive feeder system supplies abrasive particles to mixing chamber of abrasive jet machine using two supply lines. Flow of abrasive particles is controlled by flow control valves. Supply line 1 has fitted with flow control valve A and a supply line 2 has fitted with flow control valve B. Compressed air is supplied to mixing chamber using compressor (C) which is run by a prime mover (PM). To have a proper mixing of the abrasive particles with the compressed air, it is necessary to have a continuous supply of the abrasive particles from at least one of the supply lines and prime mover and compressor should function satisfactorily. Draw the block diagram for the complete feeder system and construct the fault tree for the condition no mixing of abrasive particles. Also, calculate the reliability of the feeder system. The probability of failure of the valves, compressor and prime mover is as given below. **[10]**

Name of the Component	Valve		Compressor	Prime mover
	A	B	C	PM
Failure Probability	0.004	0.005	0.003	0.006

b) What is fault tree analysis (FTA)? Give four basic symbols used in FTA. Explain four points of differences between FTA and failure mode and effects analysis (FMEA) approach. **[8]**

OR

Q8) a) A coolant supplying system consists of two supply lines fitted with valves, motors and pumps. A supply line 1 is fitted with coolant pump P1 run by a coolant motor Ml and flow control valve V1 to control the flow of coolant. A supply line 2 is fitted with coolant pump P2 run by a coolant motor M2 and a flow control valve V2. To have a continuous coolant supply, it is necessary to have a coolant supply at least from one of the supply line. Draw a block diagram for the system and construct the fault

tree for the condition 'no supply of coolant from the system'. Also, calculate the reliability of the system if the reliabilities of pumps, valves and coolant motors are as follows. **[10]**

Name of the Component	Coolant pumps		Valves		Coolant motors	
	P1	P2	V1	V2	M1	M2
Failure Probability	0.953	0.872	0.932	0.888	0.915	0.865

b) What is Design of Experiments (DOE)? Comment on the statement that a well-designed experiment assist in determining the key factors in a process and in selecting the process parameters at which the process would give better performance. **[8]**

Q9) a) The following data refers to a certain test of equipment : **[8]**

Failure number	1	2	3	4	5	6	7	8
MTTF (hrs.)	277	144	444	377	311	244	188	366

Find out the reliability of the equipment and plot the variation of reliability against time using:

i) Mean ranking method and

ii) Median ranking method

b) Write a note on **[8]**

i) Markov model

ii) Reliability in Manufacturing

OR

Q10)a) The stress developed in journal housing is known to be normally distributed with a mean a value of stress is 281 N/mm^2 and standard deviation of 24 N/mm^2. The mean material strength of journal housing is 384 N/mm^2 and standard deviation is 33 N/mm^2. Assuming that the material strength of journal housing and induced stresses are independent, determine the probability of survival of journal housing, average, minimum and maximum values of factor of safety.

Extract the data from following table which shows the normal variant (Z) and ∅(Z). **[8]**

Z	2.1	2.2	2.3	2.4	2.5	2.6
∅(Z)	0.9642	0.9722	0.9786	0.9836	0.9876	0.9906

b) Reliability test and durability test appear very similar from the testing mechanics' viewpoint; it is often difficult to discern any differences. Comment on the statement. **[8]**