Total No. of Questions : 10]

SEAT No. :

P2981

[Total No. of Pages : 5

[5154]-536

B.E. (Mechanical Engineering)

RELIABILITY ENGINEERING

(2012 Pattern) (Semester - I) (Elective - I) (End Semester)

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) Compare the Weibull and Poisson distribution. (3 points) **[4]**

b) Fuel injectors of 900 numbers were tested for 240 hours and the failure data obtained for fuel injectors is tabulated as given below. Find the hazard rate and reliability and tabulate the results. **[6]**

Time interval (hrs.)	0-40	40-80	80-120	120-160	160-200	200-240
Number of failed fuel injectors	230	263	145	136	90	36

OR

Q2) a) Explain the term Probability Density Function and Cumulative Distribution Function. **[4]**

b) For the system shown in Fig.1, find the reliability of the system using cut set method. **[6]**

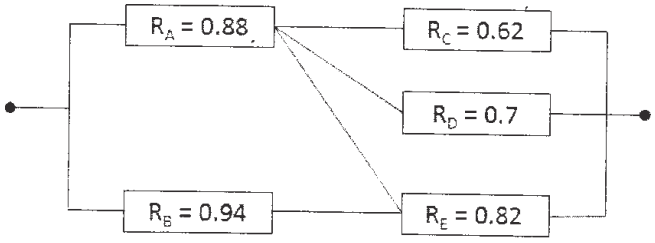

Fig. 1

Q3) a) It is desired to have reliability of the system as 0.945. How many numbers of identical and independent subsystems with reliability of 0.68 are required when connected in parallel? Also, find how many numbers of identical and independent subsystems with reliability of 0.98 are required when connected in series to have a system reliability of 0.945? **[4]**

P.T.O.

b) A system consists of three subsystems with elements as connected is shown in Fig. 2. Determine the reliability goal of each subsystem using minimum effort method if the system reliability is to be improved to a value of 0.88. **[6]**

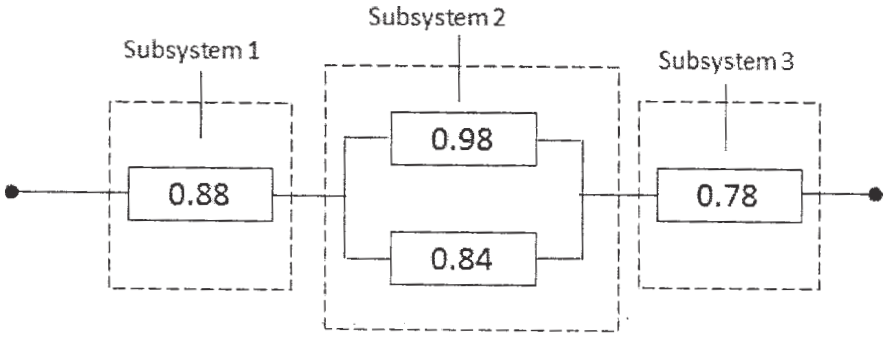

Fig. 2

OR

Q4) a) Explain conditional probability with an example. **[4]**

b) A system consists of 4 subsystems in series. Each subsystem consists of some number of modules. Determine the mean lives and reliabilities of various subsystems so as to have system reliability of 0.93 for 90 hours mission time using "AGREE" method of allocation. The necessary information for subsystem is given below: **[6]**

Subsystem	Number of modules (in each subsystem)	Importance factor	Operating time (hours)
1	35	0.88	69
2	63	0.97	81
3	33	1.00	90
4	57	0.83	57

Q5) a) Comment on the technology aspects in reliability management. Also, specify the functions to be performed by the reliability engineer to obtain the desired reliability. **[8]**

b) A refrigeration system has to be designed with a reliability value of 0.93 for 1050 hours. Operational availability is required to be 95% of the probability of survival over the same period of time. Consider the mean administrative and logistic time as 20% of mean time to repair. Assuming a constant hazard rate for failure and ignoring the preventive maintenance downtime find the mean time to repair (MTTR), mean down time (MDT) and inherent availability. **[8]**

OR

Q6) a) What is Maintainability function? Distinguish between Breakdown Maintenance and Preventive Maintenance. **[8]**

b) It has been observed that a failure pattern of an air conditioning system follows an exponential distribution with the probability of survival for 900 hours as 0.96. Obtain the inherent availability of system over the same period of time if maintainability of the whole system over the same period of time is 90% of the probability of survival an air conditioning system for 900 hours. Also, obtain the operational availability if administrative and logistic time is 15% of mean time to repair. Assume that the repair time follows an exponential distribution. **[8]**

Q7) a) Prepare FMEA in tabular form giving probable failure modes, causes and effects for "no water to the tap in house from overhead water tank."**[8]**

b) A system is represented by logic gate diagram for FTA as shown in fig. 3. The probability of failure for each component is also given in the figure. Represent the system by block diagram and find the reliability of the system. If component 'H' having reliability 0.9 is added in the system such that it is represented in series with component 'D' in the block diagram, find the reliability of new system. Is addition of component 'H' beneficial in reliability improvement? **[10]**

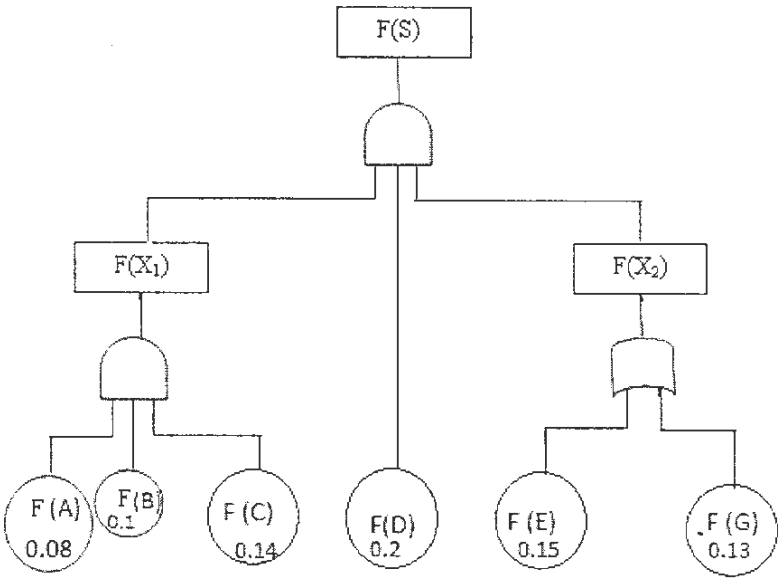

Fig.3

OR

Q8) a) Write a note on Monte Carlo simulation. Give details about its uses (three minimum), applications, the methodology adopted and how to find reliability of the system after conducting simulation. **[8]**

b) The block diagram of a system is as shown in figure. Draw FTA diagram and find the reliability of the system from the values of reliabilities of individual components as given in the fig.4. **[10]**

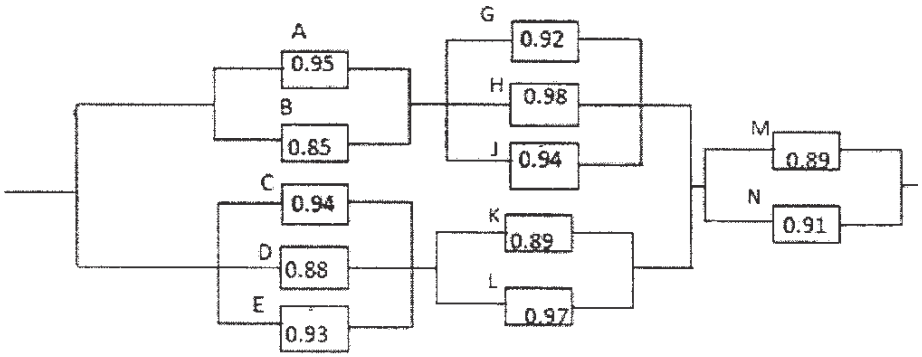

Fig. 4

Q9) a) Define HASS. What is the prerequisite for HASS? Write objective, methodology and benefits of HASS. **[8]**

b) The torsional mean stress of 350 MPa and standard deviation of 40 MPa is induced in a propeller shaft of 60 mm diameter. The medium carbon steel with a mean yield strength of 480 MPa and standard deviation of 58 MPa is used for the shaft. Find the **[8]**

i) Reliability of the shaft

ii) Minimum factor of safety

iii) Maximum factor fo safety

iv) Average factor of safety

With the help of data given below. Assume normal distribution. If the average factor of safety in design is required as 3, what is the strength and type of material required?

Z	1.80	1.81	1.82	1.83	1.84
(ØZ)	0.9641	0.9649	0.9656	0.9664	0.9671

Z	1.85	1.86	1.87	1.88	1.89
(ØZ)	0.9678	0.9686	0.9693	0.9699	0.9706

OR

Q10)a) What are the different types of stresses the components can be subjected to during the reliability testing? Name any six types and write in detail about any three types. **[8]**

b) Following table gives the failure data of 12 springs used in an engine. Find reliability of springs using

i) Mean method

ii) Median method

Plot the graph between failure time and reliability for both methods. Which method is more accurate? **[8]**

Spring No.	1	2	3	4	5	6	7	8	9	10	11	12
Failure time Hrs	235	340	176	67	489	524	695	257	392	798	456	617