Total No. of Questions : 10]

SEAT No. :

P4882

[Total No. of Pages : 4

[5155] - 8
M.E. (Mechanical) (Design Engineering)
RELIABILITY ENGINEERING
(2008 Pattern) (Elective - II)

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

Instructions to the candidates:

1) *Answer any THREE questions from each section.*
2) *Answers to the two sections should be written in separate books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Assume suitable data, if necessary*
5) *Figures to the right indicate full marks.*
6) *Use of non-programmable electronic calculators is allowed.*

SECTION - I

Q1) a) In a survival test conducted on 100 cardboard boxes for their strength under impact loading, the following results were obtained: **[10]**

No. of impacts	20	22	24	26	29	32	35	37	40
No. of boxes failed	7	10	15	14	15	14	13	8	6

For this case, how will you define failure density ,failure rate and reliability? Tabulate theses quantities and represent them graphically.

b) Explain life characteristic phases with one common practical application. **[6]**

Q2) a) Explain laws of Probability with examples. **[4]**

b) The failure time of mechanical element follows Weibull distribution with $\beta = 3$, $\eta = 2500$ and $1 = 1000$. Find the reliability of the element and the failure rate for an operating time of 3000 Hours. Derive the formula used. **[12]**

Q3) a) A generator in the laboratory goes out of order on the average once per 1000 hours of operation. What are the probabilities of the generator failing in 200 hours,500 hours and 800 hours of operation? **[8]**

b) Explain Markov analysis with one practical example. **[8]**

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Q4) a) Define: availability and maintainability. How "Operational availability" is different from "inherent availability"? **[8]**

b) Explain reliability and maintainability trade - off with graphs. **[8]**

Q5) Write the short note on following (Any Three) **[18]**

a) Reliability Engineering Tools

b) Cut set and tie set method

c) Chebyshev inequality

d) MTBF and MTTF

e) Redundancy

SECTION - II

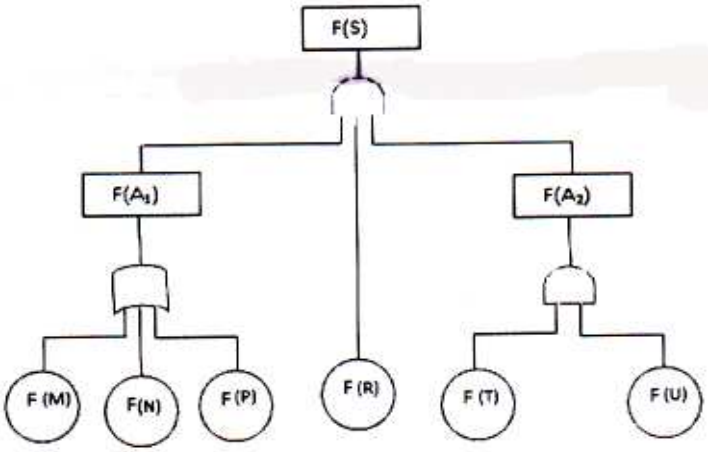
Q6) a) An assembly consists of five subassemblies whose details are given in the table below. The system reliability required is 0.95 for 30 hrs of continuous operating time. Find the values of allocated reliabilities of subassemblies and their failure rates using AGREE method. **[8]**

Subsystem	No.of modules	Importance factor	Operating time
1	11	1	22
2	15	0.93	16
3	69	0.97	17
4	52	1	21
5	16	0.94	18

b) Write a note on Delphi method stating its advantages, limitations and applications. **[8]**

Q7) a) What is the necessity of reliability testing? Define HALT and write methodology, advantages and disadvantages of HALT. **[8]**

b) The logic gate diagram for failure of a system is as 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 M,N,P,R,T,U is 0.07, 0.05, 0.1, 0.14, 0.09 and 0.02 respectively. **[8]**



Q8) a) What is the use of an Ishikawa diagram? Explain how it can be built and used, with an example. **[8]**

b) The steel tubes produced by extrusion process in the factory are found to have average outer diameter of 20.435 mm and standard deviation of 0.5435 mm, normally distributed. Find the following data required by the top management of the factory.

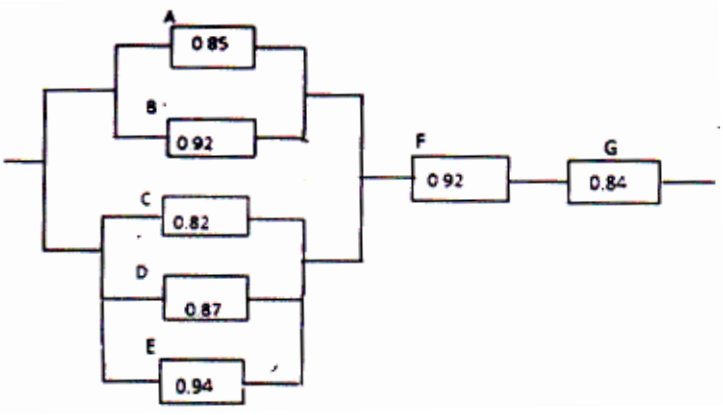
i) The percentage of components below 20.400 mm diameter.

ii) The percentage of components between 20.6 mm and 20.435 mm diameter. **[8]**

Z	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
Area	0.004	0.008	0.012	0.106	0.0199	0.0239	0.0279	0.0319	0.0359

Q9) a) Write a note on Dynamic programming apportionment. **[8]**

b) A system is represented by the block diagram given below and the reliabilities of its elements A to G are as given in the figure. Construct Fault Tree Diagram & find out the reliability of the system. if reliabilities of B and D are changed to 0.94. What will be the new reliability of the system? Write the minimal cut sets. **[8]**



Q10)a) A 60 mm diameter shaft made up of Alloy steel material is having mean yield strength of 380 MPa and standard deviation of 72 MPa. it is subjected to torsional mean stress of 285 MPa and standard deviation of 38 MPa. Find the reliability and the average value of factor of safety for the shaft with the help of part of the standard normal table given below assuming normal distribution. **[10]**

Z	1.1	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19
Ó(Z)	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830

b) Explain FMECA with the help of an example and write the procedure of finding RPN **[8]**