Total No. of Questions : 12]

SEAT No. :

P3327

[Total No. of Pages : 5

[4959]-50
B.E. (Mechanical)
c-RELIABILITY ENGINEERING
(2008 Pattern) (Semester - II) (Elective - IV) (402050)

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

Instructions to the candidates:

1) ***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 and Q. 11 or Q. 12.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right indicate full marks.***
4) ***Neat diagrams musst be drawn wherever necessary.***

Q1) a) Explain the term Product Liability in detail. Also state the impact of reliability engineering on Product life cycle. **[6]**

b) Following table shows the test result of 1000 spark plugs tested simultaneously. Evaluate: Hazard rate, failure density function, reliability and also plot these functions against time interval. **[10]**

Operating Time (hrs.)	0	100	200	300	400	500	600	700	800	900	1000
no. of surviving components	1000	895	810	730	660	600	545	495	450	410	373

OR

Q2) a) Explicate the main objectives of reliability engineering. Also discuss the role of reliability engineering in an engineering development project and state the correlation between quality and reliability. **[8]**

b) Explain availability and maintainability. Explain the types of availability in detail. **[5]**

c) What do you mean by instantaneous failure rate? Discuss with suitable example. **[3]**

P.T.O.

Q3) a) Arman Malik has put $ 2 in each of the 3 horses running three different races in Dubai Horse Racing center. He feels that each of the bets he has made has a 0.2 probability of winning. A winning ticket on any of the three horses will earn Arman Malik $40. Assuming a Bernoulli process, answer the following questions: **[9]**

i) What is the probability of at least 2 horses (on which Arman Malik has bet) winning?

ii) What is the Expected Earnings from all the three horses?

iii) What is the probability of at most 1 out of the three horses (on which Arman Malik has bet) winning?

What is the probability distribution of his possible earnings from all the three races?

b) Elaborate system reliability model in parallel configuration with the help of suitable example. **[9]**

OR

Q4) a) Determine the reliability of bridge network using Delta star method. **[6]**

b) What do you mean by redundance allocation? Explain in detail. **[6]**

c) P. Chidambaram believes that the annual profit of State Bank of India is a normal random variable with a mean of $600, 000 and a standard deviation of $ 100,000. P.Chidambaram is currently analyzing those banks whose annual profit volume lies between $500,000 and $650,000. **[6]**

i) If total number of banks is 270, what is the approximate number of bank that Chidambaram will analyze?

ii) Chidambaram randomly selects a bank to analyze, what is the probability that this bank will have an annual profit volume of more than $400,000?

Q5) a) Explain the minimum effort method to determine reliability of system. **[6]**

b) A system requires a reliability of 0.9 for 10 hours of operation. There are four units connected in series with failure rates $\lambda_1 = 0.003$, $\lambda_2 = 0.006$, $\lambda_3 = 0.008$, $\lambda_4 = 0.010$ allocate reliabilities to four units. **[6]**

c) Describe ARINC apportionment technique. **[4]**

OR

Q6) a) What do you mean by redundancy? Explain different techniques of incorporating redundancy in a system. **[6]**

b) State the assumptions to be made while using AGREE method. Find out the failure rates of the component so that the system reliability becomes 0.99 provided with following observations: **[8]**

Subsystem	No. of component modules	Operating Time	Importance factor
1	25	10	1.0
2	80	09	0.97
3	45	10	1.0
4	60	07	0.95
5	70	10	1.0
6	20	10	0.95

c) Enlist the objectives of Apportion Method. **[2]**

Q7) a) The following data collected at FMCG plant: **[10]**

- Mean time before failure: 35 Hrs.
- mean time to repair: 10 Hrs
- Administrative and logistic time: 50% of MTTR

Calculate operational availability and inherent availability of the plant. Also on the basic of the system define availability and maintainability concept.

b) Describe Specific Maintainability Design considerations and explain the design factors involved in maintainability design. **[6]**

OR

Q8) a) For a Pharmaceutical Lab a suitable HVAC system has to be designed. Its 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 for failure and repair. Estimate MTBF and MTTR. **[8]**

b) What do you understand by Operational Availability and Inherent availability? Derive expression for these two. **[8]**

Q9) a) What is FMECA? Explain the steps involved to perform design with FMECA. **[6]**

b) For an emergency operation theatre in a hospital, the power is obtained from the main city supply through a transformer connected in series. To ensure an uninterrupted power supply, an auxiliary generator is used for switching over. The probability of failure of the main city supply is 0.01 and transformer reliability is 0.996. The auxiliary power generator has a reliability factor of 0.99. Draw a block diagram for the system. Construct the fault tree and calculate reliability of the system. **[6]**

c) Explain the minimal cut-sets method. **[4]**

OR

Q10)a) Discuss the method of obtaining criticality of a component or a subsystem using Risk Priority Number. **[6]**

b) Write short note on Monte Carlo Evaluation. **[4]**

c) A heavy current special machine demands continous DC power supply during a particular period. The required power can be made available through a converter. In order to ensure uninterrupted power supply, two converters are used, so that even if one fails, the other converter provides necessary current. The two converters receive their power supplies from a substation which is connected to the main grid. Construct the fault tree for the system. **[6]**

Q11)a) Explain Accelerated life testing and HALT in detail. **[8]**

b) The mean strength and standard deviation of a bolted joint are 3000kgf/cm^2 and 300kgf/cm^2 respectively. The joint is loaded such that stress induced has a mean value of 2500kgf/cm^2 with standard deviation of 50kgf/cm^2. Assuming that shear strength and the induced stresses are independent and normally distributed, find out the probability of survival of bolted joint. The data from statistics is: **[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) Explain Reliability Testing with suitable example. **[6]**

b) Derive Reliability function using Markov Model. **[6]**

c) Discuss Stress-Strength Interacting using Probabilistic Approach. **[6]**