SEVENTH SEMESTER B.TECH. DEGREE EXAMINATION

MODEL QUESTION PAPER

13.703 – RELIABILITY ENGINEERING (N)

TIME: 3 HOURS MAXIMUM MARKS: 100

PART A

(Answer all the questions, each question carries 2 marks)

1. Define the term reliability? Explain the reliability function
2. Explain the term MTTF. Also derive it with respect to reliability and CDF
3. State k-out-of-m system redundancy?
4. What is mixed redundancy?
5. Explain the static model for constant strength and load?
6. What is a tie and cut set?
7. What is ARINC method?
8. Define system effectiveness?
9. Explain inherent availability?
10. What is MTBF?

PART B

(Answer any one question from each module. Each question carry 20 marks)

Module-1

11.

a) State the difference between reliability and quality (5)

b) Draw and explain Bath tub Curve.(5)

c) The time to wear for a cutting tool is distributed normally with a mean of 2.8hour and standard deviation of 0.6 hour. Find

I. The probability that the tool will wear out in 1.5 hours

II. Find out the reliability for 1.5 hours

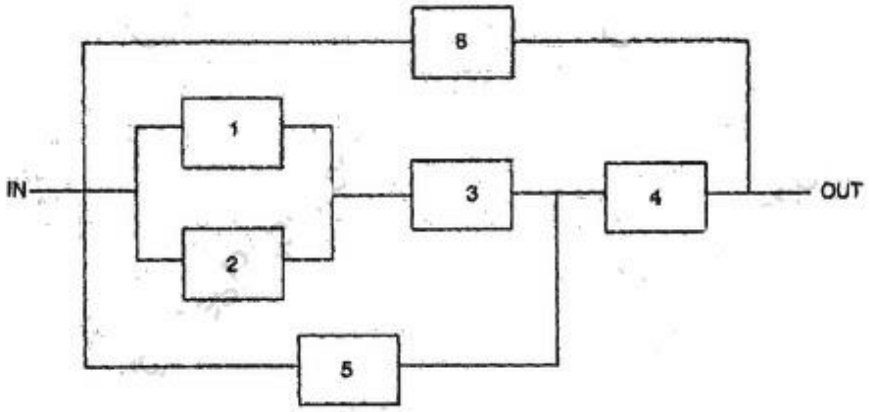
III. How often the cutting edge of the tool must be replaced in order to keep the failure less than 10 percentage? (10)

12.

a) Explain memorylessness with a example (4)

b) Find out the system reliability for a serial and parallel configuration with 2 components. (7)

c) Find out the reliability of the following system with 1,2,3,4,5 and 6 as 0.85,0.90, 0.95,0.90,0.80 and 0.85 respectively. Find out the tie sets and cut sets (9)



Module 2

13.

a) Compare unit vs Component Redundancy with sketches (8)

b) Given a budget of Rs 700 and the following data on three components that must operate in series .Determine, using marginal analysis, the optimum number of redundant units. Compute the achieved reliability.

Components	Reliability	Unit Cost
1	0.80	Rs 200
2	0.90	Rs 100
3	0.95	Rs 75

(12)

14.

a) Find out the reliability using markov analysis for load sharing units? (8)

b) A manufacturing company operates two production lines when both lines are operating, the production rate on each line is 500 units per hour. At this production rate the failure rate of line 1 is 3 failures per 8-hr day (CFR) and the failure rate of line 2 is 2 failures per 8-hr day. When one line fails, the production rate of the second line must be increased in order to make production quotas. At the increased rate of 800 units per hour, the failure rate of line 1 is 6 per 8 hr day and the failure rate of line is 3 per 8-hr day. Find the reliability and the MTTF and the reliability of the production system over a 1 hr and over an 8 hr production run. (12)

Module 3

15.

a) With a block diagram explain the reliability design process. (7)

b) A system consists of three components in series having the following parameters. The reliability goal is 0.90 for the system. Do the reliability allocation.

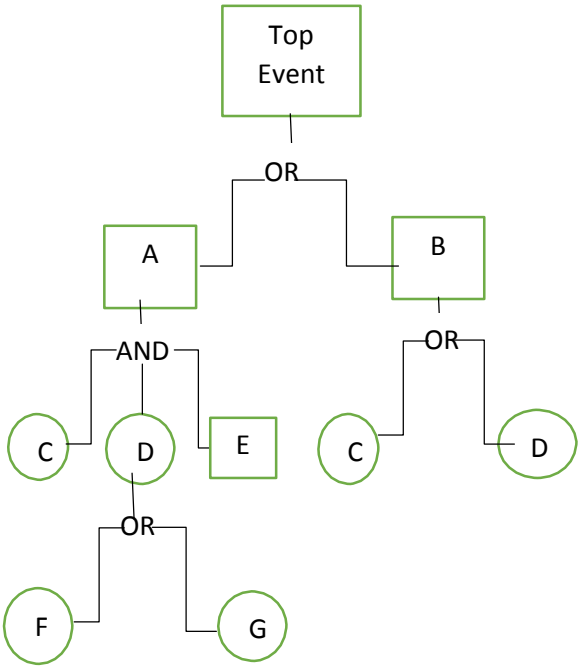
Components	Reliability	Unit Cost
1	0.85	Rs 25
2	0.80	Rs 20
3	0.90	Rs 40

(13)

16.

a) Explain the steps in FMECA. (10)

b) Perform a qualitative analysis on the following fault tree by expressing the top event in terms of non-reductant basic events using Boolean algebra. If the probability of each basic event is 0.005 and events are independent, what is the probability of the top event?



(10)

Module 4

17.

a) Compute markov analysis of availability model for two component stand by system. (8)

b) A generator system consist of primary and a standby unit. The primary fails at a constant rate of 2 per month, and the stand by system fails only when online at a constant rate of 4 per month. Repair can begin only when both units have failed. Both units are repaired at the same time with an MTTR of 20 days. Derive the steady state equations for the state probabilities and solve for the system availability. (12)

18.

a) Define Maintainability and availability and compare it with reliability. (5)
b) What is inspection and repair availability model? Explain a case for it. (7)
c) Determine the upper bound for each of the following aircraft subsystems MTTRs if a system availability goal of 0.95 is desired. Assume the repair restores the subsystem to as good as new and each system has the same availability. (7)

Subsystem	Time Between failures	Parameters
Propulsion	Weibull	θ =1000, β=1.7
Avionics	Exponential	λ=0.003
Structures	Weibull	θ =2000, β=2.1
Electrical	Weibull	θ =870, β=1.8
Environmental	Exponential	λ=0.001