Total No. of printed pages = 7

EE 1317 E 011

Roll No. of candidate | | | | | | | | | | |

2018

B. Tech. 7th Semester End-Term Examination

RELIABILITY ENGINEERING (Elective – I)

Full Marks – 100 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *six* from the rest.

1. Choose the correct answer for the following questions: $(10 \times 1 = 10)$

   (i) Which type of failures occurs due to some major reason by terminating the functioning level for a long duration of time?

   (a) Initial failures

   (b) Early failures

   (c) Wear out failures

   (d) Catastrophic failures

(ii) If all the subsystems in series have constant failure rate then

(a) The failure rate of system is constant

(b) The failure rate of system will increase as more subsystems are added.

(c) The failure rate of system is sum of subsystems.

(d) All of the above

(iii) How many channels are to be connected in parallel to achieve a reliability of 0.95 when reliability of each channel is 0.6?

(a) 1.25

(b) 6.9

(c) 3.2

(d) 3.75

(iv) Calculate the reliability of a parallel series system with m=3 and n=4 and reliability of each component is 0.80?

(a) 0.9952

(b) 0.456

(c) 0.978

(d) 0.9045

(v) Find the design life reliability of 90% of a weibull distributed system with wave and shape parameter 1 80 and 0.5 respectively.

(a) 5 years

(b) 2 years

(c) 4.5 years

(d) 1 year

(vi) What is MTTF?

(a) Maximum time to failure

(b) Mean time to failure

(c) Minimum time to failure

(d) None of the mentioned

(vii) Which of the following is not a phase of "bathtub curve" of hardware reliability?

(a) Useful Life

(b) Burn – in

(c) Wear – out

(d) Time

(viii) Which of the following approaches are used to achieve reliable systems?

(a) Fault prevention

(b) Fault removal

(c) Fault tolerance

(d) All of the mentioned

(ix) If a fair coin is tossed four times. What is the probability that two heads and two tails will result

(a) 3/8

(b) 1/2

(c) 5/8

(d) 3/4

(x) Two dice are thrown at random, what is the most probable sum to obtain

(a) 6

(b) 12

(c) 7

(d) None of these

2. (a) A certain item is manufactured at two plants. Plant 1 makes 80% of requirement and Plant 2 makes 20%. From Plant 1, 90% meet a particular standard and from Plant 2 only 80% Evaluate:

(i) Out of every 100 items purchased, by a customer how many will be upto standard (6)

(ii) Given that an item is standard, what is the probability that it was made by Plant 2.

(b) What is the percentage of area covered by the following:

(i) $\mu \pm \sigma$

(ii) $\mu \pm 2\sigma$

(iii) $\mu \pm 3\sigma$ (6)

(c) In a sample of 60 nails, 10 of them contains only defective heads, fine contains only defective tail-ends and fine contains both the defect. What is the probability that a nail is selected randomly contains either a defective head or defective tail. (4)

3. (a) Discuss the difference between Mean time to failure and mean time in between failure. Derive the expression for mean time to failure (MTTF) for an exponential distribution having a constant hazard model. (2+4=6)

(b) A system with constant failure rate $\lambda = 0.001$ has a guaranteed life time of 200 hours. Find the reliability at 1000 hrs. Calculate MTTF, t_{med} and design life for 45% reliability. (4)

(c) The time to failure density function of a component is represented by

$f(t) = 0.0025e^{-0.0025t}$; $t \geq 0$ where t is in hrs. Determine

(i) Hazard rate function.

(ii) Reliability at t= 10 hrs.

(iii) MTTF.

(iv) Set the design life for a reliability of 90%. (5)

4. (a) What is Markov Model? Derive the expression for probabilities of operating and failed state as a function of time. (2+8=10)

(b) Discuss the Markov model for a non-Repairable system. (5)

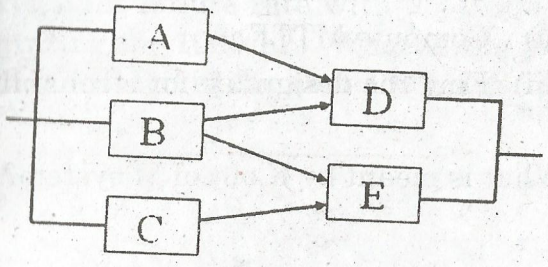
5. (a) Define Stochastic transitional probability Matrix (STPM). A system with single identical repairable component with failure rate λ and repair rate μ

(i) Develop state space diagram. (3+7=10)

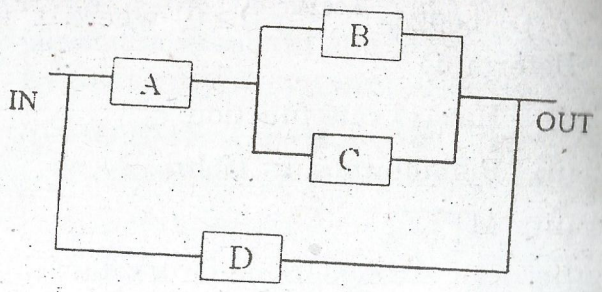
(ii) Find STPM .

(iii) Solve and find steady state probability.

(b) Determine reliability of the following system if all the components have a reliability of 0.9. (5)



6. (a) Draw the fault tree diagram of given system and find the probability. (5)



(b) A plant has following units:

25 MW× 2 units

50 MW× 1 unit

FOR=0.02

Derive the Capacity Outage Probability table using Recursive Algorithm. (10)

7. (a) A system having 3 identical units of 50 MW. The unavailability of the units can be calculated using the following data:

Failure Rate/year = 5

Repair Duration = 10 hrs

Develop the capacity outage probability table using Binomial Distribution. (6)

(b) The failure distribution is defined by:

$F(t) = 3t^2/10^9$; $0 \le t \le 1000$ hr.

(i) What is the probability of failure within a 100 hr warranty period?

(ii) Compute MTTF.

(iii) Find the design life for a reliability of 0.99. (6)

(c) What is meant by K out of M system? (3)

8. (a) Two non-identical units A and B operating in standby mode. Assuming 100% reliability of sensing and switching system, determine the reliability of the system for an operating time 't'. Simplify the function for the cases $\lambda_A = \lambda_B$. Determine the MTTF of both the systems. (6)

(b) The mean life of a component is 100 hours. If you want to build a parallel system having a mean life of 200 Hours, how many components would be repaired? (5)

(c) A power plant consists of 5 generators of capacity 20 MW. The probability of failure of each generator is 0.03. What is the probability that:

(i) Exactly 4 units are in operation.

(ii) At least 3 units are in operation. (4)

9. (a) Two units A and B are independent P(A) = 0.75; P(B) = 0.28. Find

(i) $P(A \cup B)$

(ii) $P(A \cap \overline{B})$. (4)

(b) An engine is designed to have minimum reliability of 0.8 and minimum availability of 0.98 over a period of 103 hrs. Determine mean repair time and frequency of failure of engine. (4)

(c) A constant failure rate with $\lambda = 0.004$ has been operating for 1000 hrs. What is the probability that it will fail in the next 100 hours. (7)
