LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

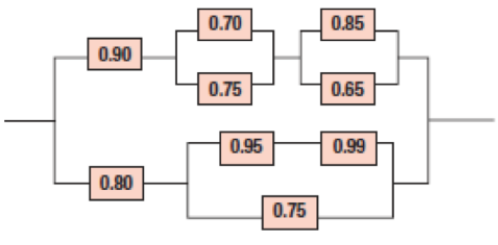
M.Sc. DEGREE EXAMINATION – **STATISTICS**

SECOND SEMESTER – **APRIL 2025**

PST2ME02 – RELIABILITY THEORY

Date: 07-05-2025 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

	SECTION A – K1 (CO1)
	Answer ALL the questions **(5 x 1 = 5)**
1	**Fill in the blanks**
a)	_____ is a system whose components are arranged in such a way that the system fails only if all its components fail.
b)	Redundancy is a common approach to _____ the reliability and availability of a system.
c)	A bathtub curve has _____ distinct phases
d)	Stress-Strength Models determines the probability that a component, a subsystem, or a system fails when the stress, _____ the strength.
e)	Component level redundancy is termed as _____
	SECTION A – K2 (CO1)
	Answer ALL the questions **(5 x 1 = 5)**
2	**Answer the following**
a)	Define mean residual life function.
b)	A simple computer consists of a processor, a bus and a memory. The computer will work only if all three are functioning correctly. The probability that the processor is functioning is 0.99, that the bus is functioning 0.95, and that the memory is functioning is 0.99 . Find the overall reliability of the computer.
c)	What is high-level redundancy?
d)	Define reliability of a component in a stress-strength model.
e)	What is Accelerated life testing?
	SECTION B – K3 (CO2)
	Answer any THREE of the following **(3 x 10 = 30)**
3	Explain the characteristics of IFR and DFR models.
4	Derive the relationship between reliability function, failure distribution, hazard rate.
5	In a series system consisting of n independent components, show that the hazard rate function of the system is the sum of the hazard functions of its components.
6	Explain the types of stress in accelerated life testing models.
7	The reliability block diagram of a system is given below. The number in each box is the reliability of the component. Find the reliability of the system. 

	SECTION C – K4 (CO3)
	Answer any TWO of the following **(2 x 12.5 = 25)**
8	A system has three components connected in parallel having reliabilities 0.20, 0.40, 0.50, respectively, for a mission of 400 hours. What is the percentage increase in the reliability of the system in each of the following cases? (i) Reliability of the first component is increased by 0.1 and that of the second and third components remains the same. (ii) Reliability of the second component is increased by 0.1 and that of the first and third components remains the same. (iii) Reliability of the third component is increased by 0.1 and that of the first and second components remains the same.
9	Explain Censoring and differentiate between Censored Type I and Type II data.
10	Probability that a device can survive after 0,1,2,3,4 or more shocks are 1,0.8,0.4,0.2, 0 respectively. If the arrival of shocks follow Poisson distribution with λ=0.15, find R(10).
11	A new component is to be designed. A stress analysis revealed that the component is subjected to a tensile stress. But there are variations in the load and the tensile stress is found to be normally distributed with a mean of 35,000 psi and a standard deviation of 4000 psi. The manufacturing operations create a residual compressive stress that is normally distributed with a mean of 10,000 psi and a standard deviation of 1500 psi. A strength analysis of the component showed that the mean value of the significant strength is 50,000 psi. The variations introduced by various by various strength factors are not clear at the present time. What is the the maximum value of the standard deviation for the strength that will ensure that the component reliability does not drop below 0.999?
	SECTION D – K5 (CO4)
	Answer any ONE of the following **(1 x 15 = 15)**
12	A machine has a useful life described by N(500, 100), i)What is the probability that a new machine of this type will last atleast 600 hours ii)What is the probability that a machine of this type that had already functioned for 500 hours will function for atleast 600 hours more.
13	Explain stress-strength models and derive the general expression to derive the reliability function for the model, based on stress-strength and the Interference between stress-strength
	SECTION E – K6 (CO5)
	Answer any ONE of the following **(1 x 20 = 20)**
14	Explain why exponential distribution is called constant failure rate model also show that the spacings follow exponential and derive its mean and variance.
15	Derive the reliability function when the stress and strength of the components follow normal distribution.

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