LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SECOND SEMESTER – **APRIL 2023**

PST2ME02 – RELIABILITY THEORY

Date: 10-05-2023 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)	System reliability for components arranged in parallel, _____ as the number of components increases.	
b)	In series configuration of five components, the entire system will fail if _____	
c)	A bathtub curve has _____ distinct phases.	
d)	In a bathtub curve, the wear out period is characterized by _____ failure rate.	
e)	_____ is the probability that a failed component will be restored or repaired within a period of time.	

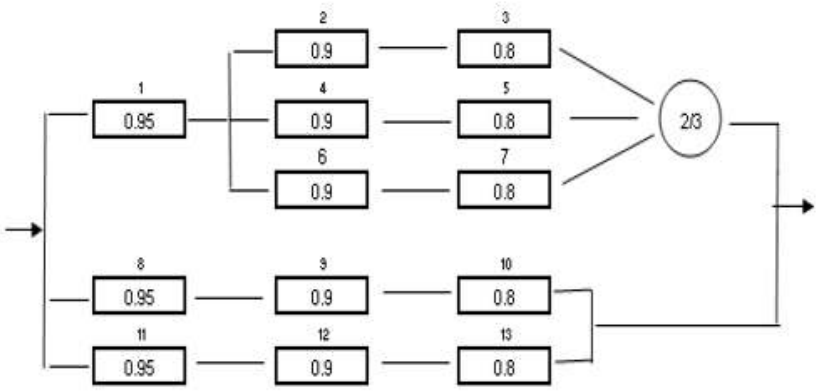
SECTION A – K2 (CO1)

	Answer ALL the questions	**(5 x 1 = 5)**
2.	**Answer the following**	
a)	Let a parallel system be composed of n = 2 identical components, each with failure rate $\lambda = 0.01$ and mission time T = 10 hours, find the total system reliability.	
b)	System has two identical components in parallel with CFR of λ. We want R(1000) = 0.95. What should component MTBF be?	
c)	What is low-level redundancy?	
d)	What is a hot standby?	
e)	Define MRLF.	

SECTION B – K3 (CO2)

	Answer any THREE of the following	**(3 x 10 = 30)**
3.	List any four probability distributions used in reliability modelling and state two important characteristics of that model.	
4.	Define F(t), f(t), R(t), h(t) and derive the relationship between them.	
5.	Explain IFR and DFR distributions and its characteristics.	
6.	The stress developed in an engine component is known to be normally distributed with a mean of 350 Mpa and a standard deviation of 40 Mpa. The material strength distribution, based on the expected temperature range and various other factors, is known to be normal with a mean of 820 Mpa and a standard deviation of 80 Mpa.	

7. Calculate the reliability of the following system clearly explaining the steps using the following reliability block diagram.



SECTION C – K4 (CO3)

Answer any TWO of the following **(2 x 12.5 = 25)**

8. Ten hypothetical electronic components are placed on life test. Failure times for the components are {5, 10, 17.5, 30, 40, 55, 67.5, 82.5, 100, 117.5}. Find the reliability and hazard rate.

9. Explain the concept of Bathtub and Upside-down Bathtub Shaped Failure Rate in relation to ageing.

10. 10 failure times are given below. Estimate the reliability, cumulative failure distribution, failure density and failure rate functions.

Failure no:	1	2	3	4	5	6	7	8	9	10
Operating time : (hrs)	2	6	31	51	76	116	140	182	250	302

11. Explain the types of accelerated life testing models.

SECTION D – K5 (CO4)

Answer any ONE of the following **(1 x 15 = 15)**

12. 100 components were put on life-test. The test was terminated as soon as the 11th component failed. The life-length of those components which failed were as follows: 8, 16.1, 24.3, 32.55, 40.9, 49.3, 57.8, 66.4, 75.1, 83.9, 92.85. Guess which distribution fits the data using Hazard rate. Estimate the parameter.

13. Explain stress-strength models and derive the general expression to derive the reliability function for the model,
    (i) Based on stress-strength
    (ii) Interference between stress-strength (10 +5)

SECTION E – K6 (CO5)

Answer any ONE of the following **(1 x 20 = 20)**

14. Discuss why exponential distribution is called constant failure rate model by deriving it's reliability function and hazard rate and, also show that the spacings follow exponential and derive its mean and variance.

15. Compute the stress-strength reliability function for normally distributed stress and strength.

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