

QP CODE: 26801759



Reg No :

Name :

INTEGRATED M.Sc. DEGREE EXAMINATION, APRIL 2026

Eight Semester

INTEGRATED M.Sc. BASIC SCIENCES-STATISTICS

ELECTIVE - IST8EL05 - RELIABILITY THEORY

2020 Admission Onwards

A7744978

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. What is a minimal path set?
2. Obtain reliability of a series system in terms of component reliability.
3. Define association of random variables.
4. When we say that failure rate is modified bathtub shaped?
5. Define discrete failure rate.
6. Define IFR in continuous set up.
7. Let F be a continuous lifetime distribution and $\psi(p)$ be the scaled TTT transform, then show that F is IFR (DFR) if and only if $\psi(p)$ is concave (convex) in $p \in [0, 1]$
8. Define DFRA 1.
9. What is type II censoring ?
10. Write down the maximum likelihood estimator of the parameters of a two parameter Weibull distribution.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

11. Explain equipment performance of a system.
12. Explain failure rate function.





13. Let X be an absolutely continuous random variable with distribution function in the support of $R^+ = \{x|x \geq 0\}$, then show that X has an exponential distribution with parameter λ iff $r(t) = \lambda$, where $\lambda > 0$ is a constant.
14. Write down the reliability of a k out of n system in which life time components are independent and identically distributed. Obtain the reliability of series and parallel system as special cases.
15. Let $\mu(t)$ be a mean residual life and $r(t)$ be the corresponding failure rate function then show that i) if $\mu(t)$ is decreasing and convex for $t \geq 0$ then $r(t)$ is strictly increasing for $t \geq 0$ ii) if $\mu(t)$ is increasing and concave for $t > 0$ then $r(t)$ is strictly decreasing.
16. Show that a) If F is IFR then F is IFRA 1 b) If F is IFRA 1 then F is IFRA 2, in discrete setup.
17. Suppose a manufacturer wants to promote a new brand of light bulb in the market. A random sample of 10 bulbs is put to test and their failure times recorded. Suppose the bulbs failed after 125, 189, 210, 351, 465, 580, 630, 760, 810 and 870 hours.
 - a) If new bulb of this brand is bought, what is the probability that it will survive at least 600 hours?
 - b) if the failure rates are exponentially distributed, find the maximum likelihood estimator of reliability function.
18. Obtain the maximum likelihood estimator of reliability function of a two parameter Gamma distribution based on non-censored sample.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. a) Find the failure rates for i) Pareto ii) Rayleigh iii) Makeham distributions b) Find the Glaser's eta function for Gamma distribution.
20. Let X be a non negative random variable admitting an absolutely continuous distribution function. Let $r(x)$ and $\mu(x)$ denote the failure rate and mean residual life respectively then show that 1) X follows an exponential iff $r(x)\mu(x) = 1$, 2) X follows a Pareto iff $r(x)\mu(x) > 1$, 3) X follows a finite range iff $r(x)\mu(x) < 1$
21. Explain the different notions of ageing - NBU, NBUE, HNBUE classes and their duals in discrete setup.
22. Explain the non-parametric estimation of reliability function using Kaplan-Meier method.

(2×5=10 weightage)

