

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5260

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Unique Paper Code : 2374000024

Name of the Paper : Introduction to Reliability Theory

Name of the Course : B.A. (P) / B.Sc. (P) / B.Sc. (H)

Semester : VIII

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question 1 is compulsory.
3. Attempt six questions in all.
4. Use of a non-programmable scientific calculator is allowed.

1. Attempt the following:

- (a) Define Reliability of a system with a suitable example.
- (b) Define Mean time to failure (MTTF).
- (c) Differentiate between Cut and path sets.
- (d) If hazard rate of a component is $.5 \times 10^{-3}$, then find MTTF.
- (e) Check whether the following statement is true or false. Give reasons in support of your answer.
“A sample of n identical components numbered from 1 to n is put to test. The test is allowed to run until all n components fail. The data of records of the lifetimes of all n components thus obtained is an example of censored failure data.”
- (f) The maximum possible value of reliability for a given period of time is
i) 1 ii) 0 iii) 0.1 iv) 100

(3,3,3,3,2,1)

2. (a) Define the memoryless property of the exponential distribution.

(b) A device has a constant failure rate of $\lambda = 0.02$ failures/hour

- (i) Find the failure density function $f(t)$.
- (ii) Find the reliability function $R(t)$.

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- (iii) Find the probability that the device survives beyond 50 hours.
 (iv) Compute the Mean time to failure. (3.3 x 4)

3. a) Consider an exponential distribution with p.d.f as

$$f(t) = \frac{1}{\theta} e^{-\frac{t}{\theta}} \quad t > 0, \theta > 0.$$

Find out MLE and UMVUE of the parameter θ , in the case of complete samples.
 What would be the MLE of the reliability function?

- b) For a Weibull distribution with scale parameters ' α ' and shape parameter ' β ', write the expression for probability density function, cumulative distribution function, reliability function, hazard rate and Mean Time to Failure. (8, 7)

4. a) What are the different phases of Bath Tub failure curve? Explain with the help of Curve.

- b) For a two parameter Weibull distribution with p.d.f.

$$f(t) = \frac{p}{\theta} x^{p-1} e^{\left\{-\frac{t^p}{\theta}\right\}} \quad x > 0, p > 0, \theta > 0.$$

Estimate the unknown parameters p and θ in case of failure-censored sample. (5,10)

5. a) Explain the series and parallel systems with diagrams and write their reliability expressions. Explain why series systems are less reliable than parallel systems.

- b) What is redundancy? Explain different types of redundancy in systems. (7, 8)

6. a) For a Gamma distribution with shape parameter ' α ' and scale parameter ' θ ', Write down the expression for probability density function, cumulative distribution function, reliability function, hazard rate and Mean Time to Failure.

- b) A component has a lifetime following a Gamma distribution with parameters $\alpha = 1$ and $\theta = 1$. Find (i) MTTF, (ii) Reliability at $t = 2$ (iii) hazard function. (9, 6)

7. Write short notes on following :

- a) Time censored samples
 b) k out m systems
 c) Proportional reverse hazard rate model (5,5,5)