

MASTER OF ENGINEERING IN MECHANICAL ENGINEERING EXAMINATION, 2025

(1ST Semester)

RELIABILITY ENGINEERING

Time: Three hours

Full Marks: 100

Answer any FIVE questions

1. a) Define the term 'Reliability' mathematically. Show that, $\lambda(t) = \frac{f(t)}{R(t)}$

The notations bear the usual meanings

- b) Explain the significance of Weibull failure parameters. [(4+7)+9]

2. a) Express $f(t)$, $F(t)$ and $R(t)$ only in terms of $\lambda(t)$.

- b) The times to failure of 10 components are as follows (in days):

125, 83, 133, 99, 105, 118, 88, 121, 139, 109

Assume exponential distribution and estimate the values of failure. Also calculate the reliability and failure rate of the component for a specified time period of 105 days. [6+14]

3. The reliability of disk drives can be predicted by increasing the operational machine hours accumulated in the field or in the laboratory as part of the initial design process. The failures have been accumulated and given in Table.

(a) Plot graphs for $f(t)$, $R(t)$, $h(t)$, and $F(t)$.

(b) Comment on the above results.

(c) Derive an analytical expression for $h(t)$ and estimate the MTTF of a bar made of the same material and is subjected to the same loading conditions.

(d) Would you buy a disk produced by the above manufacturer? Why? [10+3+3+4]

[Turn over

TABLE . Failure Data

Hour of operation $\times 10^3$	Number of failed disks
0-10.0	0
10.1-14.0	10
14.1-18.0	15
18.1-22.0	18
22.1-26.0	20
26.1-30.0	16
30.1-34.0	22
34.1-38.0	20

(4) Develop the reliability expression for both series and parallel system containing 3 units.
Each of the units has 3 states. Also find failure probabilities. [20]

(5) (a) Why is reliability analysis play an important role in case of engineering design?
(b) Develop the reliability expression of a stress-strength modelling of an engineering design. The stress and strength follow Normal distribution. [5+15]

6. Develop the reliability expression of 3-unit standby system with imperfect decision switch. [20]

7. Write short notes on any four: [4X5]

- (a) FTA
- (b) Assumptions of system modelling
- (c) Accelerated Life Testing
- (d) Bath tub curve
- (e) Median rank
- (f) K-out-of-m systems