

M.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2018**Sub: RELIABILITY ENGG.****Time: Three hours****Full Marks: 100****Answer any FIVE questions****(Tables of z , t , F and Chi -square distributions can be used if required)**

1(a) Define the term 'Reliability' mathematically. (4)

(b) The service life of a bearing follows normal distribution with mean life 1500 hours and standard deviation 50 hours. Estimate the reliability and failure rate of the bearing for a specified time period of 1300 hours. (10)

(c) Prove that $MTTF = \int_0^{\infty} R(t)dt$. (6)

2(a) Explain the significance of Weibull failure parameters. (6)

(b) The failure pattern of a component is given by the following frequency distribution:

Time Interval(hrs)	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	500 - 600
Frequency	48	36	22	12	8	4

Fit the data into a suitable failure distribution using χ^2 (chi-square) test.

Take level of significance = 5% (14)

3(a) The times to failure of 10 components are as follows (in days): (14)

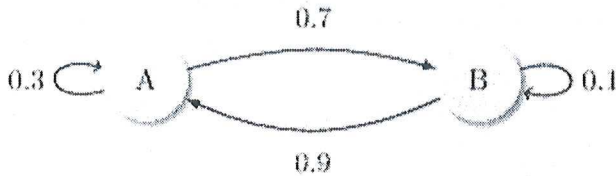
1250, 835, 1330, 990, 1055, 1185, 880, 1210, 1395, 1090

Assume two parameter Weibull distribution and estimate the values of failure parameters using analytical method. Calculate the reliability and failure rate of the component for a specified time period of 1025 days.

(b) Make a rough sketch of Weibull graph paper and explain how to determine the failure parameters. (6)

4(a) What do you mean by a Markov process? Explain with an example.

(b) For the time-independent Markov chain described by the picture below, what is its 2-step transition probabilities?



(c) What do you mean by recurrent, transient, and periodic states of a Markov Process?

(d) What is steady state of a Markov process? Why is it called steady? (5+5+5+5)

(5) Develop the reliability expression of a system containing 3 units. Each of the units has 3 states. Also find failure probabilities. (20)

6(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)

(7) Write short notes (Any Four) : (4x5)

- (a) Types of failure test data
- (b) Bath tub curve
- (c) Advantages of Weibull failure analysis
- (d) Types of hazard models
- (e) FTA
- (f) Risk assessment
- (g) Assumptions of system modelling