

B.E. MECHANICAL ENGINEERING THIRD YEAR FISRT SEMESTER EXAMINATION 2025
MECHANICAL MEASUREMENT AND INDUSTRIAL STATISTICS

Time: Three hours

Full Marks: 100

Answer any FIVE questions

(Tables of z , t , F and Chi -square distributions can be used if required)

- 1a) Write the expression of probability density function of normal distribution. Draw normal distributions for the following cases (draw at least two distribution in each case): (a) Different mean but same SD
(b) Different mean and different SD (2+4)
- b) What are different process capability indices ? (4)
A manufacturing process has the following data regarding the process:
Process mean = 65 unit; Process standard deviation = 5 unit; Production specification = 62 ± 8 unit
Determine process capability indices and the number of rejected items out of a total output of 8000 items. (8)
- 2a) What do you mean by 'Null Hypothesis' and 'Alternate Hypothesis' ? Explain the errors involved in testing of hypothesis ? (8)
- b) The following experimental data shows the tensile strength (in kg/mm^2) of 12 specimens of certain material:
26.8, 25.5, 25.2, 24.1, 26.4, 25.6, 24.4, 26.8, 25.4, 23.8, 25.4, 23.6
Can it be concluded that tensile strength of the material is $25 kg/mm^2$? Determine the 95% confidence interval of true tensile strength of the material. (12)
- 3a) Explain the steps involved in testing of hypothesis. Explain the term 'test statistic' with examples. (3+3)
- b) How will you perform testing of hypothesis for a single specified variance ? Write the expressions for test statistic and confidence intervals for testing a single specified variance. (3+4)
- c) How will you estimate Weibull failure parameters using method of least squared error. (7)
- 4a) Define the term 'Reliability' mathematically. (3+8)
Show that $\lambda(t) = \frac{f(t)}{R(t)}$. The notations bear the usual meanings.
- b) Explain the significance of Weibull failure parameters. (9)
- 5a) Explain the exponential failure law. Show that the failure rate remains constant for components following exponential failure law. (3+5)

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- b) The times to failure of 10 components are as follows (in days): (12)

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

Assume two parameter Weibull distribution and estimate the values of failure parameters. Also calculate the reliability and failure rate of the component for a specified time period of 1025 days.

- 6a) Perform analysis of variance and estimate percent contribution of main effects and interaction for the data given in the following table: (14)

	B1	B2	B3
A1	200, 215	246, 254	275, 270
A2	240, 242	262, 260	280, 284

- b) Explain the basic principles of Design of Experiment. (6)

- 6a) Two components having same and constant failure rate ' λ ' are connected to form a standby system with 1-operating unit and 1-standby unit. Derive the expression for system reliability and MTTF for the system. (12)

- (b) Prove that $MTTF = \int_0^{\infty} R(t)dt$. The notations bear usual meanings. (8)

7. Write short notes on the followings (any four): (4 x 5)

- a) Testing of hypothesis
- c) Factorial experiments
- d) Two tailed test
- e) k-out-of-m system
- f) Power of test in testing of hypothesis
- g) ANOVA
- h) Median rank
- e) Weibull plot of failure data