B.E. MECHANICAL ENGINEERING (PART TIME) 3RD YEAR 2ND SEM. EXAMINATION, 2017

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)

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) Same mean but different SD (b) Different mean but same SD c) Different mean and different SD   (2+6)

b) A manufacturing process has the following data regarding the process:

Process mean = 60 unit; Process standard deviation = 6 unit; Production specification = 55±16 unit

Calculate rejection percentage of products.   (12)

2a) Explain the followings with reference to testing of hypothesis:

Type-I error,   Type-II error,   Left Tailed Test,   Right Tailed Test   (12)

b) What is test statistics ? Mention the expressions of test statistics for testing a hypothesis with z-test and t-test with meanings of notations used.   (2+6)

3) The following data shows the cutting speed of a grade of HSS cutting tool (in m/min)

250,   245,   262,   236,   240,   252,   266,   270,   238,   252

Can it be concluded that tensile strength of the material is 250 m/min with α = 5% ? Determine the 95% confidence interval of true cutting speed of HSS cutting tool. Clearly write the expressions for 'null hypothesis' and 'alternate hypothesis' ?   (16+4)

4a) Define the term 'Reliability' and mention its mathematical expression.

Show that, $\lambda(t) = \frac{f(t)}{R(t)}$,   the notations bear the usual meanings ,   (4+8)

b) Prove that $\int_0^\alpha R(t)dt$, the notations bear the usual meanings,   (8)

[Turn over

5a) Explain the exponential failure law. Show that the failure rate remains constant for components following exponential failure law. (4+6)

b) A component follows exponential failure law and has constant failure rate 3.5×10^{-4} failures per hour. Calculate reliability and failure probability for a specified time period of 2500 hour. Derive the expressions used. (6+4)

6a) What do you mean by 'shape parameter' and 'characteristic life' of a component ? (6)

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

   1050, 805, 1350, 980, 1075, 1285, 870, 1220, 1390, 1090

   Assume two parameter Weibull distribution and estimate the values of failure parameters using analytical method. Calculate the reliability of the component for a specified time period of 850 days. (10+4)

7a) 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) By drawing a rough sketch of Weibull graph paper, explain how to determine the failure parameters using this graph paper. (8)

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

   a) Testing of hypothesis

   b) Median rank

   c) Confidence level

   d) k-out of-m system configuration

   e) Confidence interval

   g) parallel system configuration

   h) Degrees of freedom