Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS / M.TECH (TT) / SEM-2 / MTT-206/ 2011

2011

STATISTICAL QUALITY CONTROL

Time Allotted : 3 Hours   *Full Marks* : 70

*The figures in the margin indicate full marks.*

Candidates are required to give their answers in their own words

as far as practicable.

Answer any *five* questions.   5 × 14 = 70

1. a) A coin is tossed repeatedly until a head appears. Find the expected no. of tosses required to obtain the first head.

   b) Give a distinction between discrete probability distribution and continuous probability distribution.

   c) Explain the condition under which Poisson distribution may be obtained as a limiting case of binomial distribution.   5 + 4 + 5

2. a) Distinguish between point estimation and interval estimation.

   b) Discuss the concept of 'standard error' of a statistic. What does the standard error of a statistic measure ?

30196 (M.TECH)   [Turn over
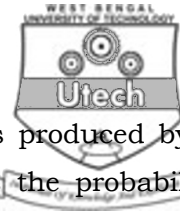
c) It has been found that 2% of the tools produced by a certain machine are defective. What is the probability that in a shipment of 400 such tools, 3% or more will be defective ? (Probability that the normal deviate lies between 0 and 1·43 is 0·4236). 4 + 5 + 5

3. a) How do you distinguish between 'standard error' and 'standard deviation' ?

b) Show that the mean and standard error of sample mean $(\bar{x})$ from sample of size n are

$$E(\bar{x}) = \mu \text{ and } SE(\bar{x}) = \frac{\sigma}{\sqrt{n}}$$

where μ and σ denote the mean and standard deviation of the population.

c) Define process capability and state the process capability ratios used.

d) What are chance and assignable causes of variability and what part do they play in operation and interpretation of a control chart ? 3 + 5 + 3 + 3

4. a) Give a difference between type I and type II errors.

b) A manufacturer claimed that at least 90% of the components which he supplied, conformed to specifications. A random sample of 200 components showed that only 164 where up to the standard. Test his claim at 1% level of significance. (Critical region at 1% level is $Z \le -2·33$).
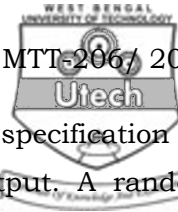
c) A normally distributed process has specification at LSL = 175 and USL = 85 on the output. A random sample of 25 parts indicate that the process is centered at the middle of the specification and standard deviation is $s = 1·5$.

    i) Find a point estimate of Cp.

    ii) Find a 95% confidence interval of Cp.   4 + 5 + 5

5. a) Explain the term 'rational subgroup' as used by S.Q.C.

    b) Explain the theoretical background of control chart.

    c) The standard deviations calculated from two random samples of sizes 9 and 13 are 2·1 and 1·8 respectively. May the sample be regarded as drawn from normal populations with the same standard deviation ? (The 5% value of F from tables with df 8 and 12 is $F_{0·05} = 2·85$)   4 + 5 + 5

6. a) Describe the important characteristics of t & F dist.

    b) If the random variable X has the probability density function

$$f(x) = \begin{cases} \dfrac{1}{4} & , -2 \le x \le 2 \\ 0 & , \text{elsewhere} \end{cases}$$

Obtain $P\{(2x + 3) > 5\}$. Here P denotes probability.

    c) A machine produced 20 defective articles in a batch of 400. After overhauling it produced 10 defectives in a batch of 300. Has the machine improved ?   5 + 4 + 5

=============