Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(AUE)/SEM-6/AUE-605/2010

2010

QUALITY CONTROL AND RELIABILITY ENGINEERING

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.

Any missing data may be assumed properly.

Graph sheets(s) will be provided by the Institution.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

   i)   A.Q.L. stands for

   a)   Acceptable Quality Level

   b)   Average Quality Level

   c)   Average Quality Limit

   d)   Acceptable Quality Limit.

   ii) If by inspection number of defects in a product is found out, the readings should be plotted in

   a)   *p*-chart   b) $\bar{x}$ and *R*-chart

   c)   *c*-chart   d)   any of these charts.

6429   [Turn over
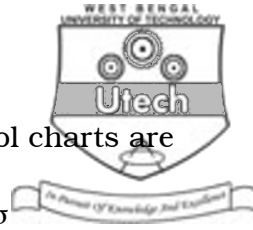
iii)   The most common limits on the control charts are

    a) $\pm\ 3\ \sigma$ b) $\pm\ 2\ \sigma$

    c) $\pm\ 4\ \sigma$ d) $\pm\ \sigma.$

iv) $\bar{p}$ stands for

    a)   process average defectives

    b)   percentage defectives

    c)   average defectives

    d)   maximum defectives.

v)   Inspection of a product means

    a)   finding the defects in a product

    b)   improving the quantity of the product

    c)   verifying the quality of the product with the standard

    d)   increasing value of the product.

vi)   Acceptance sampling by variable is done by

    a)   'Go' and 'No Go' gauges

    b)   Actual measurement of the items

    c)   Destructive testing

    d)   none of these.

vii) MTBF stands for

    a)   Mean Time Between Failure

    b)   Maximum Time Between Failure

    c)   Minimum Time Between Failure

    d)   Minimum Time Before Failure.

viii) If two systems with failure rates λ_1 and λ_2 are in series, then their overall system reliability is

    a) $e^{-\lambda_1 \lambda_2 t}$ b) $e^{-(\lambda_1 + \lambda_2)t}$

    c) $e^{-\lambda_1 / \lambda_2 . t}$ d)   none of these.

ix) The probability of device performing its purpose adequately for the period of time intend under operating conditions encountered is called

    a)   Reliability   b)   Quality

    c)   Maintainability   d)   Performance.

x) Availability is equal to

    a) $\dfrac{MTBF}{MTBF + MTTR}$ b) $\dfrac{MTTR}{MTBF + MTTR}$

    c) $\dfrac{MTBF + MTTR}{MTTR}$ d) $\dfrac{MTBF + MTTR}{MTBF}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is the difference between quality control and quality assurance ?

3. What is Kaizen concept ? What do you mean by continuous improvement and continual improvement ?

4. What is availability and outage rate ?

5. Prove that $R \ (\ T \ ) = e^{-\int_0^T \lambda \, (t) \, \mathrm{d}t}$ and relate $R \ (\ T \ )$ with T by drawing a graph.

6. What is instantaneous failure rate ? Write the expression of reliability in terms of instantaneous failure rate.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. A machine fills boxes with dry cereals. 15 samples of 4 boxes are drawn randomly. The weight of the sample boxes are shown as follows :

Sample No.	1	2	3	4	5	6	7	8
Wt. of boxes	10.0	10.3	11.5	11.0	11.3	10.7	11.3	12.3
	10.2	10.9	10.7	11.1	11.6	11.4	11.4	12.1
	11.3	10.7	11.4	10.7	11.9	10.7	11.1	12.7
	12.4	11.7	12.4	11.4	12.1	11.0	10.3	10.7
Sample No.	9	10	11	12	13	14	15	
Wt. of boxes	11.0	11.3	12.5	11.9	12.1	11.9	10.6	
	13.1	12.1	11.9	12.1	11.1	12.1	11.9	
	13.1	10.7	11.8	11.6	12.1	13.1	11.7	
	12.4	11.5	11.3	11.4	11.7	12.0	12.1	

Draw the control charts for the sample mean and sample range and determine whether the process is in a state of control. (Take A_2 = 0.729, D_3 = 0, D_4 = 2.282, for n = 4)

8. a) What is Ishikawa diagram ? Discuss its applications and general method of construction. 2 + 5

   b) Discuss the importance of Pareto diagrams in process improvement. An analysis of defects of the output from a job shop produced the following results :

 | Type of defect | Frequency |
   |---|---|
   | Non-conforming diameter | 40 |
   | Rough surface | 80 |
   | Warped flange | 50 |
   | Non-conforming length | 20 |
   | Non-conforming ream | 60 |

   Construct a Pareto diagram and discuss the results.

   3 + 5

9. a) Explain the difference between natural tolerance limit and specification limit. How does a process capability index incorporate both of them ? 2 + 4

 b) What are the advantages of having a process spread that is less than the specification spread ? What should the value of C_p be in this situation ? 5

 c) Find the probability of a lot being accepted if it has a coming quality of 5% defective, a sample size of 40 and an acceptance number 1. 4

10. a) What is system reliability ? If the failures of components of a parallel system follow exponential distribution, find out an expression for the system reliability. 5

 b) Consider the seven component system shown in *fig.* Assume that the time to failure for each component has an exponential distribution. The failure rates are as follows :

 $\lambda_A = 0.0005/h$, $\lambda_B = 0.0005/h$, $\lambda_C = 0.0003/h$,

 $\lambda_D = 0.0008/h$, $\lambda_E = 0.0004/h$, $\lambda_F = 0.006/h$,

 $\lambda_G = 0.0064/h$,

 Find the reliability of the system after 1000 h. What is the mean time to failure of the system ? 10

Fig.
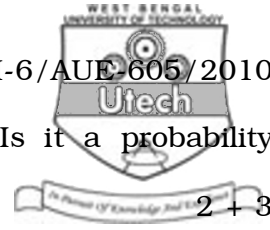
11. a) What is failure density function ? Is it a probability density function ? Explain. 2 + 3

b) What is Mean Time to Failure (MTTF) ? If failure rate (λ) is constant then prove that MTTF = $\frac{1}{\lambda}$. 1 + 3

c) What are the two main types of maintenance action ? Give their difference. Define maintainability. 2 + 2 + 2

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