(c) A company manufactures a critical electronic component with a specified MTTF of 10,000 hours and an MTTR of 2 hours. Calculate the availability of the component and discuss how this information can influence production and maintenance strategies. (6)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1224 **I**

Unique Paper Code : 2513040010

Name of the Paper : Reliability and Quality Control (DSE)

Name of the Course : **B.Sc. (H) Instrumentation**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **7** questions. Attempt any **five** questions in all.
3. Question **1** is compulsory.
4. **All** questions carry equal marks.
5. Use of non-programmable Scientific Calculator is allowed.

1. (a) Explain the concept of hazard rate and how it relates to system reliability. (3)

   (b) Explain the importance of sample size and sampling frequency in the construction of control charts. (3)

   (c) Explain the terms Acceptable Quality Level and Lot Tolerance Percent Defective. (3)

   (d) Discuss how reliability can be improved in electronic systems through design choices. (3)

   (e) What is a Pareto Diagram, and how is it used in quality improvement? (3)

   (f) Briefly explain Juran's approach to quality and its significance in management. (3)

2. (a) A grinding machine has a specification of 40 mm $\pm$ 0.1 mm. Over 5 days, a sample of 6 parts was measured daily, yielding the following diameters : (12)

   (b) Compare and contrast the control charts for attributes: p-chart and np-chart. Describe the scenarios where each type would be appropriate and explain the difference in their construction and interpretation. (6)

   (c) Explain the purpose and methods of evaluating quality control in an organization.

   Describe key performance indicators and metrics that can be used to assess the effectiveness of quality control practices. (6)

7. (a) For a single sampling plan with N=20,000, n=200, and c=3, if the probability of acceptance for lots with 2% defective items is 0.870, determine the AOQ value for these lots. (6)

   (b) Define Kaizen and explain its role in continuous improvement. Describe how Kaizen principles are applied in a workplace and give examples of small, incremental changes that can lead to significant improvements in quality. (6)

(b) Define the failure density function in the context of reliability engineering. Explain how it is used to determine the probability of failure over time, and illustrate its relation to the reliability function with a diagram. (6)

(c) Consider a scenario in a manufacturing industry where quality issues are affecting customer satisfaction. Choose one quality management approach and describe how you would apply it to address and resolve the quality issues. (6)

6. (a) In a hydraulic control system, the connecting linkage has a reliability factor of 0.98.

The pressure sensor actuates the linkage has a reliability factor of 0.92. The pressure sensor which actuates the valve has a reliability factor of 0.90. Assume that all the three elements namely; the actuator, the linkage and the hydraulic valve are connected in series with independent reliability factors. What is the reliability of the control system. (6)

1	2	3	4	5	6	7	8	9	10
59.92	60.58	59.61	59.57	60.57	60.58	62.6	61.65	62.6	59.96
60.08	59.57	59.6	60.61	60.62	59.99	59.62	60.57	60.59	60.61
60.04	60.62	60.64	60.56	61.62	62.59	62.61	59.57	61.6	61.68
60.01	62.61	60.58	60.59	60.61	60.56	61.67	61.56	60.63	62.62
59.98	62.68	60.64	59.89	59.88	61.57	62.6	59.61	61.56	60.62

Construct the X bar and R chart and find out the process capability for the machine. State whether the process is in control or not. (Assume: d_2=2.326, D_3=0, D_4=2.110, A_2=0.58).

(b) A company implementing Six Sigma noticed a gradual improvement in quality but an initial increase in costs. Explain how the Value of Quality can justify these costs in the long term. Provide a scenario where this approach is beneficial. (6)

3. (a) Suppose a consumer receives lots of 500 candles from a new supplier. To check the quality of the lot, the consumer draws one sample of size 20 and accepts the lot if the inspected sample contains

at most one defective candle. Otherwise, he/she rejects the lot. Construct the OC curve for this plan and compute the probabilities of acceptance of lots 0.5%, 1%, 1.5%, 2%, 2.5%,3%, 4% and 5% defective. (12)

(b) A smartphone manufacturer is facing issues with high defect rates in the assembly line, leading to increased customer complaints. Using a Cause and Effect Diagram, identify the potential root causes of these defects and suggest solutions for each identified cause. (6)

4. (a) Mobile charger suppliers draw a randomly constant sample size of 500 chargers every day for quality control tests. Defects in each charger are recorded during testing.

Based on the given data, draw the appropriate control chart and comment on the state of control.

Lot	1	2	3	4	5	6	7	8	9	10
No of defects in the sample	12	14	16	18	16	14	12	12	32	16
Lot	11	12	13	14	15	16	17	18	19	20
No of defects in the sample	18	16	14	12	16	18	12	19	18	21

Compute trial control limits, plot c chart and establish the value of c bar and control limits of the future production. State whether the process is in control or not. (12)

(b) Explain K-type systems in reliability engineering. Illustrate with an example how K-type systems can provide improved reliability compared to simpler series or parallel structures. (6)

5. (a) Describe a practical scenario in a manufacturing or service industry where control charts could be used to monitor quality. Explain which type of control chart(s) you would choose, how you would set it up, and what you would look for to ensure process stability. (6)