

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: B.Tech
BRANCH: PIE

SEMESTER : V
SESSION : MO/2025

SUBJECT: PE326 METROLOGY & STATISTICAL QUALITY CONTROL

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
-

- | | | CO | BL |
|--|-----|----|----|
| Q.1(a) A 20 mm diameter shaft and bearing are to be assembled with clearance fit. The tolerance and allowance are:
Allowance = 0.002 mm, Tolerance on Hole = 0.005 mm, Tolerance on Shaft = 0.003 mm. Find the limits of size for the hole and shaft using Hole basis system. The tolerances are disposed of unilaterally. | [5] | 1 | 4 |
| Q.1(b) Calculate the distance between two supports of an end bar of 100mm length, considering (i) minimum central deflection, (ii) Airy points. Also, calculate the position of the supports from the end of the end bar in both cases. | [5] | 1 | 3 |
| Q.2(a) Explain how the degree of freedom affects the calculation of standard deviation. | [2] | 2 | 2 |
| Q.2(b) Briefly discuss the eight dimensions of quality. Select a specific product or service and discuss how the eight dimensions of quality impact its overall acceptance by consumers. | [3] | 2 | 3 |
| Q.2(c) Explain various measures of central tendency and their advantages and limitations. In a class of 30 students, the marks obtained by students in MSQC out of 50 are tabulated as below. Calculate the mode of data given.
Marks obtained: 10-20 20-30 30-40 40-50
No. of students: 5 12 8 5 | [5] | 2 | 4 |
| Q.3(a) Explain the difference between specification limits and control limits. Is there a desired relationship between the two? | [2] | 3 | 2 |
| Q.3(b) A company producing kitchen worktops, specified the length of one range at 120 cm \pm 0.25 cm. As a normal part of production monitoring, Control Charts were kept for such specified measures and all output was inspected against specification limits. | [3] | 3 | 5 |

X1	X2	X3	X4
120.03	120.02	120.01	120.01
120.01	120	120.03	119.98
120.02	120.01	120	120
120	120.03	120.04	120.01
120.01	120.02	120.02	119.99
120.01	119.98	120.01	120
120	120.01	120.02	119.99
120	120	120.02	120
120.03	120.02	119.99	120.02
120.01	120.01	120.01	119.99

A request from the sales team for tighter limits prompted the question of whether the limits could be reduced to \pm 0.1cm, as this could result in significant orders from a new customer who preferred not to shave worktops to fit. Analyse the feasibility of same. [For $n=4$ $d_2= 2.059$]

Q.3(c) The data in Table give the number of nonconforming bearing and seal assemblies in samples of size 100. [3] 3 5

Sample Number	Number of Nonconforming Assemblies	Sample Number	Number of Nonconforming Assemblies
1	7	11	6
2	4	12	15
3	1	13	0
4	3	14	9
5	6	15	5
6	8	16	1
7	10	17	4
8	5	18	5
9	2	19	7
10	7	20	12

Construct a fraction nonconforming control chart for these data. If any points plot out of control, assume that assignable causes can be found and determine the revised control limits.

Q.4(a) Construct the AOQ curve for the sampling plan $N = 4000$, $n = 50$, $c = 3$. What is the AOQL? Interpret it. [5] 4 5

Q.4(b) Consider a double sampling plan given by the following parameters: $N=2200$, $n_1 = 60$, $c_1 = 0$, $r_1 = 5$, $n_2 = 100$, $c_2 = 6$, $r_2 = 7$. Find the probability of accepting lots that are 3% nonconforming. What is the probability of accepting a lot on the first sample? What is the probability of making a decision on the first sample? [5] 4 5

Q.5(a) Explain (i) Quality Circle (ii) Quality Systems [5] 5 1

Q.5(b) A company producing plastic bottles finds that 6% of its products are rejected due to thickness variation. The management decides to use Six Sigma methodology to reduce defects. Question: Using the DMAIC approach, outline the steps the company should follow to identify causes, implement improvements, and control the process. [5] 5 3

:::::19/11/2025:::::M