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

CLASS: BTECH **SEMESTER : V**
BRANCH: PIE **SESSION : MO/2024**

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. Graph paper to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Calculate the distance between two supports of an end bar 1000mm length considering Airy Points. Also calculate the position of supports from the end of the end bar. What are the different types of measurement errors?	[5]	1	3
Q.1(b)	Interpret the meaning of fit H7f6. A 20 mm diameter shaft and bearing are to be assembled with clearance fit. The tolerance and allowance are as follows: Allowance = 0.002mm, Tolerance on Hole = 0.005mm, Tolerance on Shaft = 0.003mm. Find the limits of size for Hole and Shaft using Hole basis system and Shaft basis system. The tolerances are disposed of unilaterally.	[5]	1	3
Q.2(a)	List the advantages and limitations of Mean and Median.	[2]	2	2
Q.2(b)	Define quality control. Briefly explain statistical quality control and its components.	[3]	2	1
Q.2(c)	What are the various measures of dispersion? How does the degree of freedom influence the calculation of standard deviation? Find the Standard Deviation of Group Data given below:	[5]	2	4

x_i	3	5	7	8	9
f_i	2	3	2	2	1

Q.3(a) The net weight (in oz) of a dry bleach product is to be monitored by and *R* control charts using a sample size of *n* = 5. Data for 20 preliminary samples are shown in Table. [5] 3 5

For n= 5 A2=0.577, A3=1.427, d2=2.326, D3=00 , D4= 2.114, B3= 0, B4= 2.049

Sl. No	*x*1	*x*2	*x*3	*x*4	*x*5	Sl. No	*x*1	*x*2	*x*3	*x*4	*x*5
1	15.8	16.3	16.2	16.1	16.6	11	16.2	16.4	15.9	16.3	16.4
2	16.3	15.9	15.9	16.2	16.4	12	15.9	16.6	16.7	16.2	16.5
3	16.1	16.2	16.5	16.4	16.3	13	16.4	16.1	16.6	16.4	16.1
4	16.3	16.2	15.9	16.4	16.2	14	16.5	16.3	16.2	16.3	16.4
5	16.1	16.1	16.4	16.5	16	15	16.4	16.1	16.3	16.2	16.2
6	16.1	15.8	16.7	16.6	16.4	16	16	16.2	16.3	16.3	16.2
7	16.1	16.3	16.5	16.1	16.5	17	16.4	16.2	16.4	16.3	16.2
8	16.2	16.1	16.2	16.1	16.3	18	16	16.2	16.4	16.5	16.1
9	16.3	16.2	16.4	16.3	16.5	19	16.4	16	16.3	16.4	16.4
10	16.6	16.3	16.4	16.1	16.5	20	16.4	16.4	16.5	16	15.8

(a) Set up X-bar and *R-control* charts using these data. Does the process exhibit statistical control?
(b) Estimate the process mean and standard deviation.
(c) If the specifications are at 16.2 ± 0.5, what conclusions would you draw about process capability?

PTO

Q.3(b) Explain the conditions under which a p-chart would be used instead of a np-chart. [5] 3 5
The number of nonconforming switches in samples of size 150 are shown in Table. Construct a fraction nonconforming control chart for these data. Does the process appear to be in control? If not, assume that assignable causes can be found for all points outside the control limits and calculate the revised control limits.

No.	Switches	No.	Switches
1	8	11	6
2	1	12	0
3	3	13	4
4	0	14	0
5	2	15	3
6	4	16	1
7	0	17	15
8	1	18	2
9	10	19	3
10	6	20	0

Q.4(a) What is the importance of the OC curve in the selection of sampling plans? Describe the impact of the sample size and the acceptance number on the OC curve. [2] 4 2

Q.4(b) Consider a double sampling plan given by the following parameters: N = 1200, n1 =50, c1 = 1, r1 = 4, n2 = 110, c2 = 5, r2 = 6. Find the probability of accepting lots that are 4% nonconforming. [3] 4 6

Q.4(c) Construct the AOQ curve for the sampling plan N = 2000, n = 50, c = 2. What is the AOQL? Interpret it. [5] 4 5

Q.5(a) Define the Quality circle and explain its objectives. With the help of a neat diagram, explain its implementation process. [5] 5 2

Q.5(b) Why is 3.4 ppm defective when used in place of 0.02 ppm defective in the six-sigma concept? [2] 5 1

Q.5(c) What is ISO 9000? Describe briefly the ISO 9000 series of standards in general. [3] 5 1

Cumulative Poisson Probability Distribution Table

	np										
x	0.5	1	1.5	2	2.5	3	3.5	4	4.4	5	
0	0.6065	0.3679	0.2231	0.1353	0.0821	0.0498	0.0302	0.0183	0.0123	0.0067	
1	0.9098	0.7358	0.5578	0.4060	0.2873	0.1991	0.1359	0.0916	0.0663	0.0404	
2	0.9856	0.9197	0.8088	0.6767	0.5438	0.4232	0.3208	0.2381	0.1851	0.1247	
3	0.9982	0.9810	0.9344	0.8571	0.7576	0.6472	0.5366	0.4335	0.3594	0.2650	
4	0.9998	0.9963	0.9814	0.9473	0.8912	0.8153	0.7254	0.6288	0.5512	0.4405	
5	1.0000	0.9994	0.9955	0.9834	0.9580	0.9161	0.8576	0.7851	0. 7199	0.6160	
x	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	
0	0.0041	0.0025	0.0015	0.0009	0.0006	0.0003	0.0002	0.0001	0.0001	0.0000	
1	0.0266	0.0174	0.0113	0.0073	0.0047	0.0030	0.0019	0.0012	0.0008	0.0005	
2	0.0884	0.0620	0.0430	0.0296	0.0203	0.0138	0.0093	0.0062	0.0042	0.0028	
3	0.2017	0.1512	0.1118	0.0818	0.0591	0.0424	0.0301	0.0212	0.0149	0.0103	
4	0.3575	0.2851	0.2237	0.1730	0.1321	0.0996	0.0744	0.0550	0.0403	0.0293	
5	0.5289	0.4457	0.3690	0.3007	0.2414	0.1912	0.1496	0.1157	0.0885	0.0671	
x	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
1	0.0003	0.0002	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	
2	0.0018	0.0012	0.0008	0.0005	0.0003	0.0002	0.0001	0.0001	0.0001	0.0000	
3	0.0071	0.0049	0.0034	0.0023	0.0016	0.0011	0.0007	0.0005	0.0003	0.0002	
4	0.0211	0.0151	0.0107	0.0076	0.0053	0.0037	0.0026	0.0018	0.0012	0.0009	
5	0.0504	0.0375	0.0277	0.0203	0.0148	0.0107	0.0077	0.0055	0.0039	0.0028	