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

CLASS: BTECH **SEMESTER : V/ADD**
BRANCH: PIE **SESSION : MO/2025**

SUBJECT: PE326 METROLOGY STATISTICAL QUALITY CONTROL

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	Define the term 'Airy Point', state the condition to achieve it.	[2]	1	1
Q.1(b)	Four end bars A, B, C & D are to be calibrated using a calibrated length bar of 600mm whose actual length is 599.9999mm. The bar B is longer than bar A by 0.0005mm, bar C is longer than bar A by 0.0002mm, while bar D is shorter than bar A by 0.0001mm. The four gauges together have a combination length of 600.0002mm. Determine the corrected (actual) length of each bar.	[3]	1	4
Q.2(a)	Interpret the meaning of fit H7r6 and differentiate between allowance and tolerance.	[2]	1	2
Q.2(b)	A Hole and a mating Shaft are to have a nominal assembly size of 45mm.The assembly is to have a maximum clearance of 0.25mm and minimum clearance of 0.10 mm. The hole tolerance is 1.75 times the shaft tolerance. Determine the limits for both hole and shaft by using Hole basis system.	[3]	1	5
Q.3(a)	What is Quality? Why is it difficult to define quality?	[2]	2	1
Q.3(b)	Discuss various measures of dispersion. Explain the conditions for their usage.	[3]	2	2
Q.4(a)	Define and explain type I and type II errors in the context of control charts. How does the choice of control limits influence these two errors?	[2]	3	2
Q.4(b)	The time to deliver packaged containers by a logistics company is found from samples of size 4. The mean and standard deviation of delivery times is estimated to be 140 hours and 6 hours, respectively. i. Find the 2σ and 3σ control limits for the average delivery time. ii. Suppose that Rules 1 and 3 are used simultaneously to detect out-of-control conditions. Assuming independence of the rules, what is the overall probability of a type I error for 3ó control limits? iii. If the mean delivery time shifts to 145 hours, what is the probability of not detecting this by the second sample after the shift?	[3]	3	4
Q.5(a)	A soft drink bottling company is interested in controlling its filling operation. Random samples of size 4 are selected, and the fill weight is recorded. The table shows the data for 12 samples. Daily production rate is 20,000 bottles. (For n=4 A2= 0.73 D3= 0, D4=2.28)	[5]	3	5

Sample	Observations (g)			
1	352	350	348	351
2	351	351	352	350
3	351	342	346	350
4	349	352	353	352
5	351	351	350	351
6	353	346	351	346
7	348	350	344	347
8	350	351	349	346
9	344	346	345	349
10	349	352	350	352
11	353	354	352	356
12	348	346	353	351

PTO

(a) Find the control limits for the *X*- and R-charts.
(b) Draw X-bar and R chart.
(c) Assuming the distribution of fill weights to be normal, how many bottles are nonconforming daily?

Normal Distribution Table:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441

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