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

CLASS: BE **SEMESTER : V**
BRANCH: PRODUCTION **SESSION : MO/18**

SUBJECT: PE5005 STATISTICAL QUALITY CONTROL

TIME: 3.00 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
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.

Q.1(a) List the dimensions of quality? [2]

Q.1(b) What is quality control? What are the objectives of quality control? [4]

Q.1(c) These data represent the record high temperatures for each of the 50 states. Construct a grouped frequency distribution for the data using 7 classes. Draw frequency polygon and ogive diagram. [6]

112	100	127	120	134	118	105	110	109	112
110	118	117	116	118	122	114	114	105	109
107	112	114	115	118	117	118	122	106	110
116	108	110	121	113	120	119	111	104	111
120	113	120	117	105	110	118	112	114	114

Q.2(a) Why two separate control charts are maintained while dealing with a variable quality characteristic? [2]

Q.2(b) Frozen orange juice is packed in 6-oz cardboard cans. These cans are formed on a machine by spinning them from cardboard stock and attaching a metal bottom panel. By inspection of a can, we may determine whether, when filled, it could possibly leak either on the side seam or around the bottom joint. Such a nonconforming can has an improper seal on either the side seam or the bottom panel. Set up a control chart to improve the fraction of nonconforming cans produced by this machine. [4]

Sample No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of Non conforming	12	15	8	10	4	7	16	9	14	10	5	6	17	12	22
Sample No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Number of Non conforming	8	10	5	13	11	20	18	24	15	9	12	7	13	9	6

Q.2(c) Parts manufactured by an injection moulding process are subjected to a compressive strength test. 15 samples of five parts each are collected, and the compressive strengths in psi are shown in Table. [6]

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
x1	83	88.6	85.7	80.8	83.4	75.3	74.5	79.2	80.5	75.7	80	80.6	82.7	79.2	85.5
x2	81.2	78.3	75.8	74.4	78.4	79.9	78	84.4	86.2	75.2	81.5	81.8	81.3	74.9	82.1
x3	78.7	78.8	84.3	82.5	82.6	87.3	80.8	81.5	76.2	71.1	78.4	79.3	79.1	78.6	82.8
x4	75.7	71	75.2	74.1	78.2	89.7	73.4	86	64.1	82.1	73.8	73.8	82	77.7	73.4
x5	77	84.2	81	75.7	78.9	81.8	79.7	74.5	80.2	74.3	78.1	81.7	79.5	75.3	71.7

i) Compute control limits for the X-bar and R control charts.
ii) Establish X -bar and R control charts for compressive strength using these data.
ii) Is the process in statistical control?

For n=5: A2=0.58, A3=1.427, B3=0, B4=2.11, B5=0, B6=1.964 , D1=0, D2=4.918, D3=0, D4=2.004

Q.3(a) What is acceptance sampling? List the advantages and limitations of acceptance sampling. [4]

Q.3(b) Consider a single sampling plan N = 1500, n = 200, c = 3. Construct the OC curve. If the acceptable quality level is 0.05% nonconforming and the limiting quality level is 6% nonconforming, describe the protection offered by the plan at these quality levels. [8]

PTO

Q.4(a) Explain the meaning and importance of the average outgoing quality limit. [2]

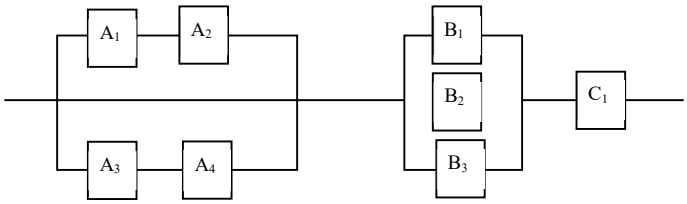
Q.4(b) A sampling plan is desired to have a producer's risk of 0.05 at AQL = 0.9% and a consumer's risk of 0.10 at LQL = 6.5% nonconforming. Find the single sampling plan that meets the consumer's stipulation and comes as close as possible to meeting the producer's stipulation. [4]

Q.4(c) With the help of an example discuss the multiple sampling plans? How will you calculate the probability of making decisions at level 1, 2 and 3? [6]

Q.5(a) An amplifier has an exponential time-to-failure distribution with a failure rate of 8% per 1000 hours. What is the reliability of the amplifier at 5000 hours? Find the mean time to failure. [2]

Q.5(b) From reliability point of view describe the life cycle of a product. What probability distributions would you use to model each phase? [4]

Q.5(c) Find the reliability of the eight-component system shown in Figure. The reliabilities of the components are as follows: R_{A1} = 0.92, R_{A2} = 0.90, R_{A3}= 0.88, R_{A4}= 0.96, R_{B1} = 0.95, R_{B2} = 0.90, R_{B3} = 0.92, and R_{Cl} = 0.93. [6]



Q.6(a) Define Quality circle. Explain its concept. [2]

Q.6(b) What is ISO 9000 series of standards. What are its advantages and limitations? [4]

Q.6(c) Describe briefly [6]

i. Pareto Analysis ii. Scatter Diagrams iii. Cause-and-Effect Diagrams

Q.7(a) Explain the concept of 'total Quality Control'. [2]

Q.7(b) What is a six sigma process? Why it is assumed that Six Sigma process would produce about 3.4 ppm defective instead of 0.002 ppm defectives? [4]

Q.7(c) List the important points of Deming philosophy for implementing quality and productivity improvement? [6]

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Table 1: Cumulative Poisson Probabilities

	λ=np									
x	**0.01**	**0.07**	**0.08**	**0.50**	**0.60**	**0.90**	**1.50**	**1.80**	**2.10**	**2.40**
1	1.0000	0.9977	0.9970	0.9098	0.8781	0.7725	0.5578	0.4628	0.3796	0.3084
2	1.0000	0.9999	0.9999	0.9856	0.9769	0.9371	0.8088	0.7306	0.6496	0.5697
3	1.0000	1.0000	1.0000	0.9982	0.9966	0.9865	0.9344	0.8913	0.8386	0.7787
	λ=np									
x	**2.70**	**3.00**	**3.60**	**4.20**	**4.50**	**5.10**	**6.00**	**6.60**	**7.20**	**7.50**
1	0.2487	0.1991	0.1257	0.0780	0.0611	0.0372	0.0174	0.0103	0.0061	0.0047
2	0.4936	0.4232	0.3027	0.2102	0.1736	0.1165	0.0620	0.0400	0.0255	0.0203
3	0.7141	0.6472	0.5152	0.3954	0.3423	0.2513	0.1512	0.1052	0.0719	0.0591
	λ=np									
x	**8.10**	**8.20**	**8.30**	**8.40**	**8.50**	**8.60**	**8.70**	**8.80**	**8.90**	**9.00**
1	0.0028	0.0025	0.0023	0.0021	0.0019	0.0018	0.0016	0.0015	0.0014	0.0012
2	0.0127	0.0118	0.0109	0.0100	0.0093	0.0086	0.0079	0.0073	0.0068	0.0062
3	0.0396	0.0370	0.0346	0.0323	0.0301	0.0281	0.0262	0.0244	0.0228	0.0212

Table2: Value of np for a producers Risk of 0.05 and a consumers Risk of 0.10 (Grubbs table)

Acceptance number, c	Pa= 0.95, np1	Pa= 0.1, np2	Np2/np1
0	0.051	2.303	44.84
1	0.355	3.890	10.96
2	0.818	5.322	6.51
3	1.366	6.681	4.89
4	1.970	7.994	4.06