BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

UG

Name: …… Roll No.: ……..

Branch: …… Signature of Invigilator: ……

Semester: VIth Date: 27/04/2022 (MORNING)

Subject with Code: **PE314 STATISTICAL QUALITY CONTROL**

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

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

CLASS: BE **SEMESTER : VI**
BRANCH: PRODUCTION **SESSION : MO/22**

SUBJECT: PE 314 STATISTICAL QUALITY CONTROL

TIME: 2 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1.The question paper is divided in two parts.
2. Part-A contains 30 MCQ's of one marks each. Candidates shall attempt all the questions of Part -A.
2. Candidates may attempt any combination of 20 marks questions from Part-B.
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.**

Part-A

1. Which of the following are offline quality control procedures?
   i. factorial design ii. control charts
   iii. designed experiment iv. Acceptance sampling

   a) (i) and (iii) are correct c) Only (iv) is correct
   b) (ii)and (iii) are incorrect d) (iii) & (iv) are correct

2. For the given range data calculate the median.

Weekly Expenditure :	0-1000	1000-2000	2000-3000	3000-4000	4000-5000
Number of families :	28	46	54	42	30

   a) 1481.5 b) 2481.5 c) 2565.2 d) 3000

3. The _____is excellent measure of dispersion for skewed distributions.
   a) Range c) Mean deviation
   b) Percentile range d) Interquartile deviation

4. The measure of central tendency which is affected by extreme values are_____.
   a) Mean c) Mode
   b) Median d) Mean deviation

   i) a, b, c ii) a, b, d iii) a, c, d iv) b, c, d

5. The standard deviation of the sample of 15 observations is 22.30. What is the degree of freedom of the observations?
   a) 15 c) 13
   b) 14 d) 16

6. A decrease in the sample size causes the control limits to expand which leads to
   a) Reduction in the probability of a type I error c) Reduction in the probability of a type II error
   b) Increase in the probability of a type I error d) Increase in the probability of a type II error

7. which of these is a situation when x bar and S charts should be utilized instead of x bar and R charts?
   a) When the sample size is variable
   b) When the sample standard deviation is less than 1
   c) When sample range is more than 1
   d) When sample size is constant

8. Which of the following conditions occurs when the process is centered at the midpoint of the Specifications?
   a) Cpk = 0
   b) Cpk = Cp
   c) Cpk < Cp
   d) Cpk < 0

9. If the estimate of the process standard deviation is 0.21, and the USL for the quality characteristic is 2.67, and the LSL=0.76, what will be the value of the estimate of PCR Cp?
   a) 1.21
   b) 1.19
   c) 1.52
   d) 1.64

10. The producer's risk means the probability that the consumer will:
   a) Reject a good lot
   b) Accept a good lot
   c) Reject a bad lot
   d) Accept a bad lot

11. In a double sampling plan,
   a) usually, more items need to be sampled compared to the single sampling plan
   b) usually, fewer items need to be sampled compared to the single sampling plan
   c) acceptance or rejection of the lot take place without the need for a second sample.
   d) acceptance or rejection of the lot take place based on two samples.

12. Which of the following are sampling plans?
   a) Single sampling plan
   b) Double sampling plan
   c) Triple sampling plan
   d) Sequential sampling plan

   i. a), b) & (c
   ii. b), c) & (d
   iii. a), c) & d
   iv. a), b), & (d

13. What is the effect of sample size on the probability of acceptance?
   a) as the number of items in a sample increases, the probability of acceptance increases
   b) as the number of items in a sample increase, the probability of acceptance decreases
   c) as the number of items in a sample decrease, the probability of acceptance decreases
   d) sample size does not affect the probability of acceptance

14. Select correct statements regarding single-sampling plans?
   i. The lot under test will be rejected if the total defective items in the sample exceed an acceptance number “c”
   ii. All items of a random sample of size “n” must be defined and tested
   iii. A rejected sample results in 100% sampling or return of the lot to the producer

   a) ii & iii
   b) i & ii
   c) i & iii
   d) All of the above

15. Select the correct statements regarding the operating characteristic curve?
    i. The OC curve plots the probability of accepting the lot for a range of proportions of defective items
    ii. The ideal OC curve would show 100% lot acceptance from zero to the AQL level of defective items and zero percent lot acceptance for higher defective rates
    iii. Increasing the acceptance number while holding the sample size constant increases the producer's risk and decreases the consumer's risk

    a) i&ii b) ii&iii c) i&iii d) All of the above

16. In constructing the type-B OC curve, it is assumed that the samples came from a large lot or that we were sampling from a stream of lots selected at random from a process. The probability of accepting the lot is calculated based on a :

    a. Hypergeometric distribution.
    b. Binomial distribution
    c. Normal distribution
    d. Poisson's approximation of the binomial distribution

17. The design of the experiment is:

    a) A map. b) A plan of experiment. c) An architect. d) All of these.

18. Suppose we have a set of five observations 32, 38, 36, 40, 37. The S/N ratio for nominal-the-best quality characteristics is nearly:

    a) -31.29 dB. b) 31.20 dB. c) 21.82 dB. d) -21.82 dB.

19. In the foundry industry, the level of rejection due to casting defects is very high. To reduce the casting rejection DOE is utilized to find the optimal parameter (density) level. For this S/N ratio is calculated for the designed experimental responses. The equation which is used for calculating the S/N ratio is:

    a) -10 〖log〗_10 (1/n ∑_(i=1)^n▒y_i^2)
    b) 10 log_10 (μ^2/σ^2)
    c) -10 log_10 (1/n ∑_(i=1)^n▒1/(y_i^2))
    d) All of these.

20. In a full factorial experiment with 3 factors at 3 levels each, how many trials are required:

    (a) 27 (b) 12 (c) 64 (d) 81

21. Compute the average loss for a process that produces steel shafts. The target value is 6.40 mm, and the coefficient is 9500. Eight samples give 6.36, 6.40, 6.38, 6.39, 6.43,6.39, 6.46, and 6.42. (Given s = 0.0315945, y-bar = 6.40375)

    a) 9.62 b) 5.66 c) 6.87 d) 7.89

22. Which of the below statement is not correct.
    a) Traditionally, the product characteristic's values that fall within the limits are considered acceptable and equal.
    b) In Taguchi Quality Loss while measuring the loss, the cost of poor quality was measured until the product was sold to the customer.

c) In traditional Loss Function, not all values falling within the specification limits are equal and create equal loss due to poor quality.
d) Taguchi quality loss is not only

i) a) & b) ii) b) & c) iii) c) & d) iv) a) & d)

23. Quality circle identifies, analyses, and solves quality, cost reduction, and any other problem in their work area.

a) True b) False

24. Which of the following is not an attribute of Quality Circle? resource development technique
a) It is a problem-solving technique
b) It is a human resource development technique
c) It is not a human resource development technique
d) It is a form of participation management

25. Which is the latest ISO 9001 version in the ISO 9000 family?

a) ISO 9001:2021 c) ISO 9001:2008
b) ISO 9001:2000 d) ISO 9001:2015

26. ISO 9000 determines
a) If the company practices its written procedures c) Process capability
b) If vendors are performing well d) Random causes of variation

27. Technically speaking, Six Sigma involves driving towards how many defective parts per million?
a) 230 b) 3.4 c) 1 d)0.002

28. What is the percentage accuracy in the six sigma process?

a) 99.8% b) 99.1% c) 99.9999998% d) 99.99966%

29. Six Sigma strategies seek to improve the quality of the output of a process by

(A) identifying the causes of defects (C) minimizing variability in manufacturing
(B) removing the causes of defects (D) all of the above

30. "DMAIC" is used for projects aimed at
(A) improving an existing business process
(B) creating a new product or process designs
(C) Both (A) and (B)
(D) None of the above

Part-B

1.	What is Quality? List the dimensions of quality in service industries?	[2]
2.	Why the formula of SD of a sample is different from formula of SD of a population?	[2]
3.	Why two separate control charts are maintained while dealing with a variable quality characteristic?	[2]
4.	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?	[2]
5.	What are the various Measures used to evaluate the goodness of a sampling plan? Briefly explain each of them.	[2]
6.	A factory produces 50 cylinders per hour. Samples of 10 cylinders are taken at random from the production at every hour and the diameters of cylinders are measured. Compute control limits for the X-bar and R control charts and decide whether the process is under control or not. **(For n=4 A2= 0.73 D3= 0, D4=2.28)**	[2]

Sample no.	1	2	3	4	5	6	7	8	9	10
x1	230	220	222	250	228	248	232	236	231	220
x2	238	230	232	240	242	222	232	234	248	222
x3	242	218	236	230	235	220	242	235	251	224
x4	250	242	240	225	225	230	242	237	271	231

7.	A company producing kitchen worktops, specified the length of one range at 120 cm $\pm$ 0.25 cm. 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 is 2.059.	[4]

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

8.	Frozen orange juice concentrate 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
No of non-conforming cans	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

	No of non-conforming cans	8	10	5	13	11	20	18	24	15	9	12	7	13	9	6	

9. 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]

Table 1: Value of np for Producer's risk of 0.05 and a consumer's risk of 0.10

C	Pa=0.95, np1	Pa=0.10, np2	np2/np1
0	0.051	2.303	44.84
1	0.355	3.89	10.96
2	0.818	5.322	6.51
3	1.366	6.681	4.89

10. Wirco Castings, Inc., designed an experiment to evaluate the percent of casting that required finish grinding, with the objective of reducing this labor-intensive operation. It was decided there were seven factors A, B, C, D, E, F, and G that influenced the grinding operation. An OA8 was used for the design, as shown in Table with the treatment condition results. Each treatment condition was run and produced 16 molds with 4 cavities per mold, for a total of 64 castings per TC. Using the column-effect method, rank the parameters in accordance with their effect over the response. Assume the quality characteristics for the response as smaller-the-better type. [4]

Experiment No.	Parameters						
	A	B	C	D	E	F	G
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2