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B.E (Full Time) DEGREE EXAMINATIONS, Nov-Dec 2011
INDUSTRIAL ENGINEERING
FIFTH SEMESTER (Regulation 2008)

IE 9303 STATISTICAL QUALITY CONTROL

Time: 3 Hours

Max.Marks: 100

Answer all questions
Use of statistical tables permitted

PART – A (10 x 2 = 20 marks)

1. What is Quality Assurance?
2. Classify the various types of quality costs and give example for each cost.
3. What preliminary decisions are made before initiating control charts?
4. Differentiate between control limits and specification limits.
5. How machine capability is evaluated?
6. Differentiate between p and c charts.
7. What is Acceptable Quality Level?
8. How do you select a sampling from MIL-STD-105 E standards?
9. What is a clinometer? What are its uses?
10. What are the advantages of CMM?

PART – B (5 x 16 = 80 marks)

11. The following data are collected from a process of manufacturing power supplies. The variable of interest is output voltage and $n = 5$.

Sample No.	\bar{X}	R	Sample No.	\bar{X}	R
1	103	4	11	105	4
2	102	5	12	103	2
3	104	2	13	102	3
4	105	11	14	105	4
5	104	4	15	104	5
6	106	3	16	105	3
7	102	7	17	106	5
8	105	2	18	102	2
9	106	4	19	105	4
10	104	3	20	103	2

- i) Develop control charts for \bar{X} and R and comment on the process.
- ii) Determine control limits for controlling future production.
- iii) If the specification is 103 ± 4 , what is the fraction non-conforming?
- iv) Suggest how to reduce the fraction non-conforming.

12 a) Control charts for \bar{X} and R are in use with the following parameters.

\bar{X} chart	R chart
UCL= 363.0	16.18
CL = 360.0	8.91
LCL = 357.0	1.64

The sample size is 9. Both charts exhibit control. The quality characteristic is normally distributed.

- i) What is the α - risk associated with the \bar{X} chart?
- ii) The specifications on this quality characteristic are 358 ± 6 . Evaluate the capability of the process.
- iii) Suppose the mean shifts to 357. What is the probability that the shift will not be detected on the first sample?
- iv) What would be the appropriate control limits for the \bar{X} chart if the type 1-error probability were to be 0.01?

(OR)

b) The following data has been collected while testing the primary cut-off (displacement) of auto brake cylinders. The upper and lower specification for this quality characteristic is 1.4 and 0.6 respectively.

Part No.	Operator 1 Measurements		Operator 2 Measurements		Operator 3 Measurements	
	1	2	1	2	1	2
	1	1.11	1.10	1.09	1.10	1.15
2	1.07	1.10	1.06	1.10	1.10	1.10
3	1.17	1.20	1.18	1.20	1.19	1.30
4	1.11	1.10	1.14	1.10	1.18	1.20
5	1.20	1.20	1.15	1.10	1.15	1.20
6	1.26	1.20	1.15	1.20	1.19	1.20
7	1.18	1.20	1.18	1.20	1.21	1.30
8	1.24	1.30	1.21	1.30	1.28	1.30
9	1.17	1.20	1.24	1.20	1.28	1.20
10	1.20	1.10	1.18	1.10	1.22	1.20

- i) Estimate gage repeatability and reproducibility.
- ii) What can you say about the gage capability?

13 a) The daily inspection results of electronic controllers for 14 days are as follows.

Day	Number inspected	Number rejected	Day	Number Inspected	Number rejected
1	165	16	8	195	38
2	170	35	9	165	33
3	175	12	10	140	21
4	167	6	11	162	18
5	141	50	12	191	22
6	159	26	13	139	16
7	181	16	14	181	27

Construct an appropriate control chart with constant control limits and comment on the process.

(OR)

b i) A c- chart is used to monitor surface defects on steel plates of constant size.

Past history indicates a mean of 2.5. Answer the following.

Compute type I error and average run length (ARL).

What is type II error and ARL if the Process mean shifts to 6.8? (8)

ii) The following tensile strength data has been obtained from a line processing steel.

Hour	Strength	Hour	Strength
1	93.0	7	94.0
2	87.5	8	96.5
3	96.5	9	98.0
4	98.0	10	92.0
5	96.0	11	93.8
6	98.5	12	96.0

i) Develop a control chart for individual measurements and comment on the process.

ii) Develop a moving average chart and comment on the process.

14 a) Suppose that a single sampling plan with $n = 150$ and $c = 2$ is being used for receiving inspection where the vendor ships the product in lots of size $N = 3000$. Draw the AOQ curve and find the AOQL.

(OR)

b) Derive an item-by-item sequential sampling plan for which $p_1 = 0.01$, $\alpha = 0.05$, $p_2 = 0.10$ and $\beta = 0.10$.

15 a) Discuss the following angular measuring instruments.

i) Bevel protractor ii) Sine bar iii) Autocollimator

OR

15 b) Explain any two non destructive testing methods in detail with neat diagram.