Total No. of Pages: 4

Register Number: **7189**

Name of the Candidate:

DIPLOMA EXAMINATION - 2010

(PRODUCTION MANAGEMENT)

(PAPER – III)

130. MANAGEMENT OF QUALITY AND RELIABILITY

December) (*Time: 3 Hours*

Maximum: 100 Marks

Answer any FIVE questions. **(5 × 20 = 100)**
Use of statistical tables is permitted.

1. (a) Indicate the differences between inspection and 'quality control'. (4)
   (b) Enumerate the objectives of statistical quality control. (6)
   (c) In a production process, the number of defectives found in an inspection of 10 lots of 20 items each are given below:

Lot number	I	II	III	IV	V	VI	VII	VIII	IX	X
Number of defectives	1	3	1	2	2	8	1	0	2	1

   Construct the 'np' chart and plot the values. State whether the process is in statistical control or not. (10)

2. (a) With the aid of an example, describe the importance of carrying out inspection in a bank. (4)
   (b) Differentiate 'p', 'c' and 'u' charts. (6)
   (c) The following table shows the number of welding defects noted during the final inspection of railway coaches.

Coach number	Number of welding defects	Coach number	Number of welding defects
I	2	XI	4
II	4	XII	5
III	5	XIII	2
IV	3	XIV	2
V	11	XV	3
VI	15	XVI	4
VII	5	XVII	5
VIII	2	XVIII	4
IX	3	XIX	4
X	5	XX	3

Using the above data, compute the trial control limits of c chart and plot this control chart for c. What values of control limits of c chart would you suggest for subsequent periods. (10)

3. (a) What are chance causes? What are their implications in the application of control charts for variables? (4)

(b) The following data were obtained over a 10 days period to indicate the means and ranges of a quality characteristic of a certain manufactured product that require a substantial amount of rework The sub-group size was 5, Two sub-groups were taken per day.

Sample number	$\bar{X}$	R	Sample number	$\bar{X}$	R
I	77.6	3	XI	79.8	4
II	76.6	3	XII	76.4	5
III	78.4	22	XIII	78.4	6
IV	76.6	4	XIV	78.2	4
V	77.0	6	XV	180.6	6
VI	79.4	4	XVI	79.6	6
VII	78.6	5	XVII	77.8	5
VIII	79.6	6	XVIII	78.4	4
IX	78.8	7	XIX	81.6	6
X	78.2	5	XX	77.6	3

(i) Determine the trial control limits for the X and R charts.

(ii) What preliminary conclusions can you draw about the statistical control from your observation and analysis of the data and of the control charts?

(iii) The specified requirements for the quality characteristics are given as 71± II. If a product falls below lower specification limit of 60, it must be scraped, whereas if it falls above the upper specification limit of 82, it may be reworked. Because scraping an article is much more costly than rework, it is desired to hold scrap to a low figure without causing excessive rework. The process averages can be shifted easily through simple machine adjustment.

What would you suggest as the aimed at value for process centring in the immediate future? Why?

(iv) The X and R charts are to be continued. What would you recommend as the new limits on these charts? Show your calculations and explain your reasoning. (16)

4. (a) Describe the actions to be taken to maintain control charts. (4)

(b) The diameters of castings of 10 samples each containing four units are tabulated below:

Sample number	Sub-groups				Sample number	Sub-groups			
	a	b	c	d		a	b	c	d
I	52	37	49	40	VI	24	41	36	31
II	38	38	39	39	VII	28	49	31	41
III	39	39	36	39	VIII	38	17	34	48
IV	17	26	29	52	IX	30	27	42	38
V	40	28	43	45	X	34	37	45	18

Construct the mid-range chart for the above data on the diameters of castings. (16)

5. A certain product has been statically controlled at a process average of 66.0 and a standard deviation of 1.00. The product is presently being sold to two users who have different specification requirements. User A has established a specification of 68.0 ±4.0 for the product and user B has specification of 66.0 ± 4.0.

(i) Based on the present process setup, what percent of the product produced will not meet the specifications setup by the user A?

(ii) What percent of the product will not meet the specification of user B?

(iii) Assuming that the two users' needs are equal, a suggestion is made to shift the process target to 67.0. At this suggested value, what percent of the products will not meet the specifications of user A?

(iv) At the suggested process target, what percent of the product will not meet the specifications of user B?

(v) Do you think that the shift to a process target of 67.0 would be desirable? Explain your answer. (20)

6. (a) Compare the applications of control charts and Analysis of Variance. (4)

(b) Following are the number of seats produced by a plastic moulding machine under four conditions in one hour.

Level (condition)	Data				
I	16	15	22	19	20
II	24	21	16		
III	5	6	15	8	3
IV	2	5	3	1	

Construct the ANOVA table using the above production data. Use $\alpha = 0.05$ to determine if there is any significant difference in the number of seats produced. Table value of F is 3.41. (16)

7. (a) A single sampling plan uses a sample size of 5 and an acceptance number 1, Using

binomial probabilities, compute the probability of acceptance of lots of 50 articles with 5% defective. (4)

(b) The procedure followed in a double sampling plan is as follows.

(i) Select a sample of 2 from a lot of 20. If both articles inspected are good, accept the lot. If both are defective, reject the lot. If one is good and one is defective, take a second sample of one article.

(ii) If the article in the second sample is good, accept the lot, If it is defective, reject the lot.

If a lot with 20% defective is submitted, what is the probability of acceptance? Apply Poisson approximation. (16)

8. (a) Discuss the terms 'Acceptable Quality Level' and 'Lot Tolerance Percent Defective'. (4)

(b) Construct the operating characteristic curve for the single sampling plan with the parameters, n= 100, c=4. (16)

9. (a) Describe the working of sequential sampling plan. (4)

(b) Design a sequential sampling plan for the following specifications.

$\alpha = 0.05, p_1 = 0.10$

$\beta = 0.20, p_2 = 0.30$

Also compute (i) Average outgoing quality when $p^1 = p_1$

(ii) Minimum number of inspected for accepting the lot

(iii) Minimum number of defectives for rejection of the lot

(iv) Average number of items inspected when the quality of lot is p_i. (16)

10. (a) Define the term reliability and indicate its importance in the operation of a machine. (4)

(b) Distinguish between reliability and quality control. (4)

(c) An electrical subsystem of a car consists of two sub-systems in parallel, each having the following components and characteristics:

Component	Failure rate per hour	Number of components
Printed circuit board	20×10^{-6}	1
Bulb	10×10^{-6}	4
Capacitor	5×10^{-6}	2
Battery	2×10^{-6}	1
Sensor	15×10^{-6}	3

The components within each subsystem are all necessary for the failure free functioning of the sub-system. Two parallel sub-systems function simultaneously and either can perform the mission What is the mission reliability if the mission time is 250 hours? (Assume that the mission of this electronic subsystem mimics the exponential distribution). (12)

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