

M.E. DEGREE EXAMINATIONS: JUNE/JULY 2013

Second Semester

INDUSTRIAL ENGINEERING

IEE507: Quality Engineering

(Use of Statistical data book is permitted)

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

1. Differentiate between Quality Control and Quality Assurance concept.
2. Compute the C_{pk} measure of the process capability for the following machine and interpret the findings. What value would you have obtained with the C_p measure?
USL = 80, LSL = 50, Process mean = 60, Process standard deviation = 5
3. Define Acceptable Quality Level (AQL) and Lot Tolerance Percent Defective (LTPD).
4. With a flowchart, list the operations in a double-sampling plan.
5. What is meant by Blocking and Confounding in the 2^k design?
6. How will you choose an appropriate orthogonal array for an experiment?
7. What is quality circle? List out the advantages of having quality circle in an organization.
8. List out the procedure adopted for implementation of a six-sigma project in a company.
9. Provide the bathtub curve related to failure rate and list the classification.
10. An airborne electronic system has radar, a computer and an auxiliary unit with MTBF of 83, 167 and 500 hours respectively. Find the system MTBF and the reliability for a 5 hour operating time. Mission time is 1000 hours.

PART B (5 x 16 = 80 Marks)

11. a) A production manager at Ultra clean Dishwashing company is monitoring the quality of the company's production process. There has been concern relative to the quality of the operation to accurately fill the 16 ounces of dishwashing liquid. The product is designed for a fill level of 16.00 ± 0.30 . The company collected the following sample data on the production process:

Observations				
Sample	1	2	3	4
1	16.40	16.11	15.90	15.78
2	15.97	16.10	16.20	15.81

3	15.91	16.00	16.04	15.92
4	16.20	16.21	15.93	15.95
5	15.87	16.21	16.34	16.43
6	15.43	15.49	15.55	15.92
7	16.43	16.21	15.99	16.00
8	15.50	15.92	16.12	16.02
9	16.13	16.21	16.05	16.01
10	15.68	16.43	16.20	15.97

- (a) Are the process mean and range in statistical control?
 (b) Do you think this process is capable of meeting the design standard?

(OR)

- b) 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. Does the process seem to be in statistical control? If necessary, revise the trial control limits.

Data for Trial Control Limits, Sample Size $n = 50$

Sample Number	Number of non-conforming cans, D_i
1.	12
2.	15
3.	8
4.	10
5.	4
6.	7
7.	16
8.	9
9.	14
10.	10
11.	5
12.	6
13.	17
14.	12
15.	22
16.	8
17.	10

18.	5
19.	13
20.	11
21.	20
22.	18
23.	24
24.	15
25.	9
26.	12
27.	7
28.	13
29.	9
30.	6

12. a) Suppose that a product is shipped in lots of size $N = 5000$. The receiving inspection procedure used is single sampling with $n = 50$ and $c = 1$.
- (i) Draw the type-A OC curve for the plan.
 - (ii) Draw the type-B OC curve for this plan and compare it to the type-A OC curve found in the previous part.
 - (iii) Which curve is appropriate for this situation?

(OR)

- b) We wish to find a single-sampling plan for a situation where lots are shipped from a supplier. The supplier's process operates at a fallout level of 0.50% defective. We want the AOQL from the inspection activity to be 3%.
- (i) Find the appropriate Dodge–Romig plan.
 - (ii) Draw the OC curve and the ATI curve for this plan. How much inspection will be necessary, on the average, if the supplier's process operates close to the average fallout level?
 - (iii) What is the LTPD protection for this plan?

13. a) Consider an experiment with three factors, each at two levels. Determine the significance of each factor for a level $\alpha = 0.05$ and the factor effects. The results of the experiment are given in the following table.

Treatment condition	Factors							Response (Results)	
	A	B	C	AB	AC	BC	ABC		
1.	-	-	-	+	+	+	-	30	28
2.	+	-	-	-	-	+	+	28	31
3.	-	+	-	-	+	-	+	25	37
4.	+	+	-	+	-	-	-	36	33
5.	-	-	+	+	-	-	+	50	45
6.	+	-	+	-	+	-	-	45	48
7.	-	+	+	-	-	+	-	38	41
8.	+	+	+	+	+	+	+	44	37

(OR)

- b) Three two-level factors A, B and C were studied using L-4 orthogonal array and by assigning them to columns 1, 2 and 3, respectively. Each trial condition was tested once and the following results were obtained: 40, 65, 55 and 70 (for trials 1, 2, 3 and 4). Assume that a higher value is desired.
- Determine the optimum condition.
 - Determine the performance at optimum
 - Determine the main effect of factor B.

14. a) (i) What are the elements of ISO 9001:2008? (6)
Briefly explain the steps that are necessary to implement a quality management (10)
(ii) system in an organization.

(OR)

- b) Work individually, list six or more primary customer requirements for the production of product of your own choice. Then build the house of quality (HoQ) and deploy the design characteristics for the same product.

15. a) (i) Two fuel pumps, each having a Weibull failure distribution with $\beta = \frac{1}{2}$ and $\theta = 1000$ hour are configured to provide a redundant system. Find the system reliability for a 100-hour mission and the system MTTF. (8)
A series system has 3 independent parts A, B and C which have MTBF's of (8)
(ii) 100,400 and 800 respectively. Find MTBF of the system and reliability of the system for 30 hour mission.

(OR)

- b) (i) A device has a failure rate of 5×10^{-6} failures /hour. What is its reliability for an operating period of 100 hour? If there are 10,000 items in the test, how many failures are expected in 100 hours? What is the MTBF? (8)
(ii) 5 elements of a system are connected as shown in the figure below and their reliability of each element is also indicated. Calculate the system reliability. (8)


