

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

CLASS: MTECH/PRE-PHD
BRANCH: P&IE

SEMESTER : II
SESSION : SP/2024

SUBJECT: PE521 QUALITY ENGINEERING AND ROBUST DESIGN

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
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.

- | | | CO | BL |
|---|-----|----|----|
| Q.1(a) What is process capability index? | [2] | 1 | 2 |
| Q.1(b) Identify if there exist any out of control set by using R-chart. Develop X bar chart of the remaining measurements and indicate if any measurement is out of control | [8] | 1 | 3 |

Sample	Measured Values			
	1	2	3	4
1	44	26	24	34
2	50	48	51	43
3	32	28	26	22
4	52	55	56	44
5	16	16	21	26
6	36	36	35	31
7	21	15	18	26
8	29	21	23	22
9	26	46	24	12
10	24	20	26	23
11	56	52	56	50
12	8	12	11	17
13	19	21	27	28
14	18	24	24	49
15	32	22	18	25

- Q.2 A manufacturer receives large batches of components daily and decides to institute an acceptance-sampling scheme. Three possible plans are considered, each of which requires a sample of 30 components to be tested: [5+5] 2 4

Plan A: Accept the batch if no non-conforming components are found, otherwise reject.

Plan B: Accept the batch if not more than one non-conforming component is found, otherwise reject.

Plan C: Accept the batch if two or fewer non-conforming components are found, otherwise reject.

For each plan, calculate the probability of accepting a batch containing

- (i) 2% non-conforming
- (ii) 8% non-conforming.

- Q.3 Describe any TWO of the following topic with definition, description (Procedure) and example. [5+5] 3 2

a) Affinity Diagram, b) Activity Network Diagram, c) Quality Function Deployment

- Q.4 A metal-manufacturing firm wants to test the tensile strength of a given metal under varying conditions of temperature. Suppose that in the design phase, the metal is processed under five different temperature conditions and that random samples of size five are taken under each temperature condition. The data is given below. Perform suitable ANOVA test to identify if any of the sample is different from other or not. (Confidence level = 95%) [10] 4 3

1	2	3	4	5
2.46	2.38	2.51	2.49	2.56
2.51	2.34	2.48	2.47	2.57
2.43	2.31	2.46	2.48	2.53
2.47	2.4	2.49	2.46	2.55
2.46	2.32	2.5	2.44	2.55

Q.5(a) Describe with example various type of S/N ratios in Taguchi robust design. What is [3+2] 5 2
orthogonal array?

Q.5(b) What is six sigma? Describe in brief about various steps in DMAIC. [1+4] 5 2

.....25/04/2024 E:.....

F table

/	df ₁ =1	2	3	4	5	6	7	8	9	10	12	15	20
df ₂ =1	161.4476	199.5000	215.7073	224.5832	230.1619	233.9860	236.7684	238.8827	240.5433	241.8817	243.9060	245.9499	248.0131
2	18.5128	19.0000	19.1643	19.2468	19.2964	19.3295	19.3532	19.3710	19.3848	19.3959	19.4125	19.4291	19.4458
3	10.1280	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123	8.7855	8.7446	8.7029	8.6602
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	5.9988	5.9644	5.9117	5.8578	5.8025
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725	4.7351	4.6777	4.6188	4.5581
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990	4.0600	3.9999	3.9381	3.8742
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767	3.6365	3.5747	3.5107	3.4445
8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881	3.3472	3.2839	3.2184	3.1503
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729	3.0061	2.9365
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.9130	2.8450	2.7740
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962	2.8536	2.7876	2.7186	2.6464
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964	2.7534	2.6866	2.6169	2.5436
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144	2.6710	2.6037	2.5331	2.4589
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	2.6022	2.5342	2.4630	2.3879
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	2.5437	2.4753	2.4034	2.3275
16	4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377	2.4935	2.4247	2.3522	2.2756
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943	2.4499	2.3807	2.3077	2.2304
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	2.4117	2.3421	2.2686	2.1906
19	4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	2.3779	2.3080	2.2341	2.1555
20	4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140	2.4471	2.3928	2.3479	2.2776	2.2033	2.1242