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

CLASS: ME **SEMESTER : I**
BRANCH: MECHANICAL **SESSION : MO/17**

SUBJECT: MPE1005 QUALITY ENGINEERING & ROBUST DESIGN

TIME: 3. Hours **FULL MARKS: 60**

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
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.

Q.1(a) What is control chart? Write down the sensitizing rules for Shewhart control charts. [6]

Q.1(b) A process produces rubber belts in a lot of size 2500. Inspection records on last 15 lots reveals the following data [6]

Lot Number	Number of Non-Conforming Belts	Fraction defective
1	230	0.092
2	435	0.174
3	221	0.0884
4	346	0.1384
5	230	0.092
6	327	0.1308
7	285	0.114
8	311	0.1244
9	342	0.1368
10	308	0.1232
11	456	0.1824
12	394	0.1576
13	285	0.114
14	331	0.1324
15	198	0.0792

(i) Compute the trial limit for a fraction nonconforming control charts
(ii) If you want to set up a control chart for controlling future production, how would you use these data to obtain the centerline and control limits for the chart?

Q.2 A Company manufactures a range of domestic electrical appliances. The concern is being expressed about the warranty claims on one product. The customer service department provides the following data relating the claims to the failed part. [12]

Component part	Number of claims	Average cost of warranty work (per claim)
Drum	110	48.1
Casing	12842	1.2
Worktop	142	2.7
Pump	246	8.9
Electrical motor	798	48.9
Heater unit	621	15.6
Door lock mechanism	18442	0.8
Stabilizer	692	2.9
Powder additive unit	7562	1.2
Electric control unit	652	51.9
Switching mechanism	4120	10.2

Using Pareto technique and Ishikawa diagram give your suggestions. .

Q.3(a) Draw OC curve and explain effects of n (sample size) and c (acceptance number) on it. Briefly describe AQL, LTPD, and AOQL [6]

Q.3(b) With a suitable example explain the construction of QFD. [6]

Q.4 A manufacturer of U bolt for the auto industry measures and records thread length on bolts that it produces. Fifteen subgroups each of size n=5 consecutive bolts were obtained and thread lengths were measured in cm. Using a suitable control chart give your comments about the capability of the manufacturer. Engineering specification given by designer is 11±1cm [12]

PTO

Subgroup	Thread lengths				
1.	11	14	14	10	8
2.	14	10	11	10	11
3.	8	13	14	13	10
4.	11	8	13	11	13
5.	13	10	11	11	11
6.	11	10	10	11	13
7.	8	9	11	11	11
8.	10	11	10	14	10
9.	11	8	11	8	10
10.	6	11	13	12	11
11.	11	14	13	8	11
12.	8	11	10	11	14
13.	11	11	13	8	13
14.	11	8	11	11	11
15.	11	11	13	11	11

Q.5 The Pratt and Whitney plant want to determine the best method of applying the reflective stripe that is used to guide the Automated Guided Vehicles (AGVs) along with their path. There are two ways of applying the stripe (paint or coated adhesive tape) and three types of flooring (linoleum, I concrete or II concrete) in the facilities that use the AGVs. Engineers have set up two identical "test tracks" on each type of flooring and applied the stripe using the two methods under study. They run 3 replications in random order and count the number of tracking errors per 1000 ft of track. The results are as follows: [6+6]

	Linoleum	I Concrete	II concrete
Paint	10.7	10.8	12.2
	10.9	11.1	12.3
	11.3	10.7	12.5
adhesive	11.2	11.9	10.9
	11.6	12.2	11.6
	10.9	11.7	11.9

Make an ANOVA analysis at the 5% significance level

Q.6 Investigation is carried out to determine the effect of steel formula(A) (1045 and 1144), austenitizing temperature(B) (800 ºC and 1000 ºC), and cooling rate(C) (furnace and oil quench) on the hardness of heat treated steel. A full factorial experiment is carried out and the output result is summarized for the hardness value. [12]

	Hardness		
	HRC- 1	HRC-2	HRC-3
(1)	186	191	187
a	202.5	204	202
b	146	153	147
ab	154	156	156.5
c	222.5	230	221.5
ac	239.5	248.5	249
bc	268	278	272.5
abc	297.5	296	299

Take 95% confidence level for estimating the main effects. Determine the factor(s) which are affecting the process. Write down the conclusion.

Q.7(a) Define six-sigma. How DMAIC is different from DFSS [6]

Q.7(b) Make a short note on MIL-STD 105E [6]

:::::01-12-2017 E:::::