PM451T - QUALITY ENGINEERING AND MANAGEMENT
Final Examination April 2007

Time: 180 minutes, Max marks: 50, All questions carry 4 marks each unless otherwise mentioned. Use of statistical tables and SQC tables are permitted

1. Explain the four major components of all TQM philosophies.

2. The hardness of castings received from two suppliers was found to be as follows. Draw a comparative box plot and draw conclusions.

Supplier A	33	33	36	37	40	37	33	35	30	37
Supplier B	39	37	41	44	35	37	35	45	40	38

3. A manufacturer of bikes claims a mileage of 80km/l. Can the claim be supported with 95% confidence, if the results on testing the mileage of ten samples of bikes are found to be:

80	81	89	86	80	81	84	89	82	88

4. What are the limitations of a one factor at a time experiment?

5. A 2^3 factorial experiment was conducted to determine the effect of Cutting velocity(A), Feed(B) and Depth of cut(C) on Tool Life. The results are given below, R1 and R2 being the two replicates. Test for significance and develop a model equation for predicting Tool Life from the coded factors.

A	B	C	R1	R2	Average	1	2	3	Div	Effects
-1	-1	-1	44	46	45	99.5	201.5	400.5	8	50.0625
1	-1	-1	53	56	54.5	102	199	76.5	4	19.125
-1	1	-1	47	46	46.5	99.5	18.5	2.5	4	0.625
1	1	-1	54	57	55.5	99.5	58	-1.5	4	-0.375
-1	-1	1	37	33	35	9.5	2.5	-2.5	4	-0.625
1	-1	1	63	66	64.5	9	0	39.5	4	9.875
-1	1	1	37	34	35.5	29.5	-0.5	-2.5	4	-0.625
1	1	1	65	63	64	28.5	-1	-0.5	4	-0.125

6. An experiment is being planned to study the factors affecting surface finish in casting. From past data, the standard deviation of surface finish is estimated to be 5μmRa. Determine the number of replications required for a full factorial experiment, if there are four factors and it is desired to detect changes in surface finish of 8μmRa with around 0.05 level of significance.

7. What are the common barriers to the success of teams in organisations? How can they be overcome?

8. Draw the OC Curve for a sampling plan with sample size 50 and acceptance number 2. Choose at least five points excluding zero.

9. Discuss the key points of "Kaizen".

10. What do you mean by supplier certification? What are the ASQ recommendations for certifying a supplier?

11. What are the benefits of ISO9000 certification?

PTO

12. A new design is being developed. To test its reliability, a prototype was made and run continuously. The accumulated running time in hours whenever a failure occurred was noted as follows:

11	74	507	1050	1134
14	93	579	1062	1141
22	101	637	1077	1142
29	115	706	1083	1150
30	123	765	1088	
37	194	832	1098	
45	251	899	1107	
46	322	960	1109	
51	386	1027	1123	
67	451	1038	1128	

Identify the constant failure rate period and determine the reliability of the product during the normal operating period, for a period of 100 hours.

(6 marks)

13. The number of pistons n produced everyday and the number rejected r after 100% inspection, for the past 30 days, are given in table below. Develop control limits for a suitable control chart.

Day	1	2	3	4	5	6	7	8	9	10
n	975	900	975	1000	975	925	950	1000	925	950
r	91	87	87	70	84	59	80	61	69	76
Day	11	12	13	14	15	16	17	18	19	20
n	950	925	1000	975	975	950	950	925	1000	1000
r	69	58	86	78	90	62	69	85	68	64
Day	21	22	23	24	25	26	27	28	29	30
n	950	925	925	925	925	950	1000	950	975	950
r	73	84	81	95	52	74	96	96	53	85

(6 marks)

14. A QFD matrix was prepared for an electric iron as given below. Compute the Customer Requirements Absolute Weight, Technical Requirements Absolute Weight, and Technical Requirements Relative Weight.

	Weight	Power	Insulation thickness	Base Material	Importance to customer	Target value	Scale-up factor	Sales point	Absolute weight
Lightweight	●	△		❍	4	4	1.3	1	
Quick to heat up	❍	●		❍	6	6	1.5	1	
Shock resistant			●		8	8	1	1	
Good looking				△	4	4	1	1.2	
Low cost	❍	❍	❍	❍	7	7	1	1.5	
Degree of technical difficulty	2	3	5	3					
Target value	4	3	5	4					
Absolute weight									
Relative weight									

SOLUTIONS TO NUMERICALS:

2.

	Supplier A	Supplier B
Max	40	45
Upper quartile	37	41
Median	35.5	38.5
Lower quartile	33	37
Min	30	35
1.5IQR	6	6
+	43	47
-	27	31

3.

Mean	84	Null	80
SD	3.71184		
to	3.40777	tcrit	1.83311

5.

Var	t	
2	51.27877	1
4.5	19.58964	A
0.5	0.640184	B
4.5	-0.38411	AB
8	-0.64018	C
4.5	10.11491	AC
4.5	-0.64018	BC
2	-0.12804	ABC
Sp	3.8125	
SE	0.976281	
tcrit	2.306006	

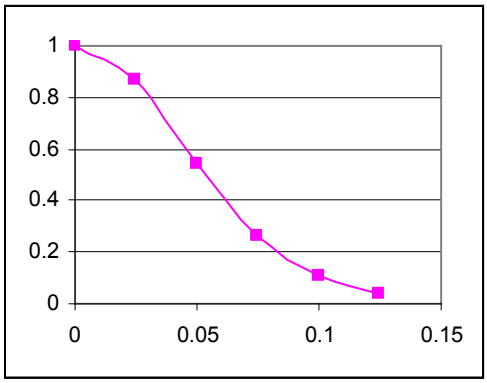
Tool Life = 50.0625 + (19.125/2)*A –(0.625/2)*C +(9.875/2)*AC

6.

nF	25
r	1.5625
Round up to	2

8.

p	P(x=0)	P(x=1)	P(x=2)	Pa
0	1	0	0	1
0.025	0.281988102	0.361523	0.227111	0.870622
0.05	0.076944975	0.202487	0.261101	0.540533
0.075	0.020280873	0.08222	0.163328	0.265829
0.1	0.005153775	0.028632	0.077943	0.111729
0.125	0.001260093	0.009001	0.031502	0.041763



12.

11	TBF		
14	3		
22	8		
29	7		
30	1		
37	7		
45	8		
46	1		
51	5		
67	16		
74	7		
93	19		
101	8		
115	14		
123	8		
194	71		
251	57		
322	71		
386	64		
451	65		
507	56		
579	72		
637	58		
706	69		
765	59		
832	67		
899	67		
960	61		
1027	67	MTBF	64.57143
1038	11	Lamda	0.015487
1050	12	R	0.21253
1062	12		
1077	15		
1083	6		
1088	5		
1098	10		
1107	9		
1109	2		
1123	14		
1128	5		
1134	6		
1141	7		
1142	1		
1150	8		

13.

p	0.09333	0.09667	0.08923	0.07000	0.08615	0.06378	0.08421	0.06100	0.07459	0.08000
	0.07263	0.06270	0.08600	0.08000	0.09231	0.06526	0.07263	0.09189	0.06800	0.06400
	0.07684	0.09081	0.08757	0.10270	0.05622	0.07789	0.09600	0.10105	0.05436	0.08947
pbar	**0.07951**									
UCL	0.1055	0.10657	0.1055	0.10518	0.1055	0.1062	0.10584	0.10518	0.1062	0.10584
LCL	0.05352	0.05246	0.05352	0.05385	0.05352	0.05283	0.05318	0.05385	0.05283	0.05318
UCL	0.10584	0.1062	0.10518	0.1055	0.1055	0.10584	0.10584	0.1062	0.10518	0.10518
LCL	0.05318	0.05283	0.05385	0.05352	0.05352	0.05318	0.05318	0.05283	0.05385	0.05385
UCL	0.10584	0.1062	0.1062	0.1062	0.1062	0.10584	0.10518	0.10584	0.1055	0.10584
LCL	0.05318	0.05283	0.05283	0.05283	0.05283	0.05318	0.05385	0.05318	0.05352	0.05318

14.

	Weight	Power	Insulation thickness	Base Material	Importance to customer	Target value	Scale-up factor	Sales point	Absolute weight
Lightweight	●	△		❍	4	4	1.3	1	5.2
Quick to heat up	❍	●		❍	6	6	1.5	1	9
Shock resistant			●		8	8	1	1	8
Good looking				△	4	4	1	1.2	4.8
Low cost	❍	❍	❍	❍	7	7	1	1.5	10.5
Degree of technical difficulty	2	3	5	3					
Target value	4	3	5	4					
Absolute weight	75	79	93	55					
Relative weight	105	118	104	79					