MEC612 - QUALITY ENGINEERING AND MANAGEMENT
Final Examination April 2007

Time: 180 minutes, Max marks: 50, all questions carry 4 marks each except where otherwise mentioned. Use of approved Statistical / SQC Tables is permitted

1. Discuss the various issues involved in the development of a Quality Control System for an organisation.

2. Briefly explain Deming's principles for transformation of management.

3. What is the significance of safety margin in design for reliability? A bolt is subject to a stress of 12MPa with standard deviation 1Mpa. The bolt material has a mean strength of 15Mpa with standard deviation 1.2MPa. Estimate the reliability of the bolt.

4. A test was carried out to determine the reliability of a special motor, which is not repairable. Fifteen motors were run continuously for 1000hrs. The first two motors failed at 150 and 200 hrs and were replaced. The next three failures occurred at 350, 500 and 750 hours but were not replaced due to nonavailability of motors. There were no further failures before the test ending time. Estimate the reliability of the motor for a time period of 100 hours.

5. Differentiate between mission, vision and quality statements with examples.

6. Discuss empowerment in the context of Total Quality Management.

7. Discuss the points to consider while implementing changes according to "The Seven Step" problem solving process.

8. The various elements of quality costs in an organization for a period of one year are as follows:

	Element	**Rupees in lakhs**
a	New product testing at customer's end	2.5
b	Measurement of customer satisfaction	1.5
c	Administration of Quality department	4.0
d	For replacing goods rejected by customer	5.5
e	Warranty repair	3.8
f	Product modification due to design mistakes	5.5
g	Inspection of components machined in house	2.2
h	Supplier visit before order placement	3.0
i	Supplier visit for inspection of material	7.5
j	Cost to obtain replacement for rejected materials from supplier	0.5
k	Training of workers in Quality Circles	2.5
l	Visits to customer to investigate complaint	4.2
m	Repair and rework inhouse	2.4
n	Assembly inspection and testing	4.7
o	Lost sales	4.8

Determine the preventive cost, appraisal cost, internal failure cost and external failure cost.

9. A factory produces eight generators everyday. It is planned to monitor the no load voltage output using control charts for Average and Range with subgroup size 8. After 30 samples, $\sum \bar{x} = 7040$ and $\sum R = 580$. Determine trial control limits and Cpk, if the specification limits are 230+/- 20 Volts.

10. A control chart for average with subgroup size 4 has 2.5σ control limits. Samples are taken every two hours. Determine the ATS if the mean has shifted by 1.0σ.

PTO

11. The concentration of sugar in a bath is required to be maintained at 100g/l. The past standard deviation was 1.6g/l. It is required to quickly detect a shift to 104g/l. Construct an algorithmic cusum table and identify out of control points if any from the data for ten days as follows:

97	96	102	104	105	102	103	104	103	99

(6 marks)

12. At a final inspection station, various types of defects are identified and grouped into three categories: Critical, Major and Minor. Using weights of 10, 5 and 1 respectively, calculate trial control limits for a demerits chart from the following data and identify the out of control days if any. Do not recalculate control limits or plot graph.

Day	No of units	Critical	Major	Minor
1	13	1	4	15
2	10	1	1	44
3	17	3	8	14
4	18	4	10	47
5	19	1	2	26
6	18	1	2	14
7	19	2	8	32
8	15	2	2	16
9	20	3	7	15

(6 marks)

13. Explain a sequential approach for an organisation to achieve ISO9000 certification.

14. Construct an FMEA diagram for a Personal Computer, listing at least two failure modes.

15. Explain the difference between the Goalpost philosophy and Taguchi philosophy.

16. What do you mean by OA16 in Taguchi's experimental design? How many effects can be estimated from this design?

(2 marks)

SOLUTIONS TO NUMERICALS:

3.

S	15
sigma S	1.2
L	12
sigma L	1
SM	1.9205532
Reliability	0.972606

4.

	350
	500
	750
	12000
Mean Life	2720
Failure Rate	0.0003676
t	100
Reliability	0.9639029

8.

Prevention = a) 2.5 + b) 1.5 + c) 4.0 + h) 3.0 + k) 2.5 = 13.5
Appraisal = g) 2.2 + i) 7.5 + n) 4.7 = 14.4
Internal Failure = f) 5.5 + j) 0.5 + m) 2.4 = 8.4
External Failure = d) 5.5 + e) 3.8 + l) 4.2 + o) 4.8 = 18.3

9.

Sigma xbar	7040	D4	1.864	d2	2.847
Sigma R	580	D3	0.136	s	6.790774
N	30	UCLR	36.03733	USL	250
Rbar	19.333333	LCLR	2.629333	LSL	210
xbarbar	234.66667	A2	0.373	Cpu	0.752655
n	8	UCLxbar	241.878	CpL	1.210793
		LCLxbar	227.4553		

10.

n	4	Beta	0.691459
L	2.5	ARL	2.241061
k	1	ATS	4.482122
L-k*sqrt(n)	0.5		
"-L-k*sqrt(n)	-4.5		

11.

x	C+	C-
97	0	1
96	0	2
102	0	0
104	2	0
105	5	0
102	5	0
103	6	0
104	8	0
103	9	0
99	6	0

12.

Sum	149	18	44	223	623
		0.120805	0.295302	1.496644	4.181208
		12.08054	7.38255	1.496644	20.95973

Demerits	D/u	sU	UCL	LCL
45	3.461538	1.269759	7.990484	0.371932
59	5.9	1.447748	8.524451	-0.16203
84	4.941176	1.110372	7.512323	0.850093
137	7.611111	1.079087	7.41847	0.943946
46	2.421053	1.050307	7.332128	1.030289
34	1.888889	1.079087	7.41847	0.943946
92	4.842105	1.050307	7.332128	1.030289
46	3.066667	1.182081	7.727451	0.634965
80	4	1.023712	7.252345	1.110072