BITS, PILANI – DUBAI
Second Semester 2009-2010

IV Year Mechanical
ME C443 Quality control, Assurance & Reliability **Comprehensive Exam**
Date: 23.05.2010 **Weightage: 40%**
Time: 3 Hrs. **Marks: 80**

SNo.	**1. Answer all the questions** **2. Assume relevant data if required.** **3. Statistical tables are permitted** **4. Use graph sheet for Q2&Q3**	**Marks**
1	Assume that six samples were taken from the production line of a company manufacturing certain electrical parts. Each sample contained 50 parts. After a careful inspection, it was concluded that samples 1, 2, 3, 4, 5, and 6 contain 2, 4, 10, 6, 5, and 8 defective parts, respectively. Construct the *p*-chart for electrical parts.	10
2	The tensile strength data (in MPa) of aluminum welds is give below. Check the data for normal distribution using a probability plot and write your comments. 133, 139, 146, 150, 151, 152, 153, 153, 162, 162	10
3	Construct the OC curve for a single sampling plan with N=10000, n=100 and c=4. If AQL and LTPD are 2% and 8% respectively, determine the producer's risk and consumer's risk.	10
4	The relative humidity in a green house is expected to be between 65% and 85%. Random samples taken over a span of one week yield the following values: 60,78,70, 84, 81, 80, 85, 60, 88 and 75. Find the Cp value and interpret the result.	10
5	A total of 30 identical engineering items were tested for 300 h, out of which six items failed. None of the failed items were replaced. The failure times of the failed items are given in table. **Determine MTTF intervals at 95% confidence level (use chi-square table)** **No. Item Failure** / **Time (h)** 1 / 10 2 / 20 3 / 25 4 / 40 5 / 50 **6** / **65**	8
6	A windowless room has two light bulbs and one switch. The room can only be dark if the switch fails to close, there is no electricity, or both the bulbs burn out. Develop a fault tree for the occurrence of undesired event (top event) "dark room," more specifically, the room without light.	8

7	In this experiment, the process engineer's goal is to determine how the yield of an adhesive application process can be improved by adjusting three (3) process parameters: mixture ratio, curing temperature, and curing time. For each of these input parameters, two levels will be defined for use in this 2-level experiment. The output response monitored is process yield. Assume further that the data were gathered by performing just a single replicate (n=1) per combination treatment. Form the regression model for the data. Results of the Example 2^3 Factorial Experiment	12
8	Consider an experiment that seeks to determine a method to assemble an elastomeric connector to a nylon tube while delivering the requisite pull-off performance suitable for an automotive engineering application. The primary design objective is to maximize the pull-off force. The L9 orthogonal experimental design (taguchi) used is shown below. The experiments are repeated 8 times each, in different noise conditions. Determine the SN ratio for the data and find out the optimum conditions for the different factors considered for the study.	12

RUN	Comb.	Factors			Yield
		Mix Ratio	Temp	Time	
1	(1)	45% (-)	100°C (-)	30m (-)	8
2	a	55% (+)	100°C (-)	30m (-)	9
3	b	45% (-)	150°C (+)	30m (-)	34
4	ab	55% (+)	150°C (+)	30m (-)	52
5	c	45% (-)	100°C (-)	90m (+)	16
6	ac	55% (+)	100°C (-)	90m (+)	22
7	bc	45% (-)	150°C (+)	90m (+)	45
8	abc	55% (+)	150°C (+)	90m (+)	56

Standard Order	Run Order	A:Interference (s)	B:Wall Thickness (cm)	C:Insertion Depth (V)	D:Percent Adhesive	Noise Condition 1	Noise Condition 2	Noise Condition 3	Noise Condition 4	Noise Condition 5	Noise Condition 6	Noise Condition 7	Noise Condition 8
1	4	Low	Thin	Shallow	Low	15.6	9.5	16.9	19.9	19.6	19.6	20	19.1
2	3	Low	Medium	Medium	Medium	15	16.2	19.4	19.2	19.7	19.8	24.2	21.9
3	9	Low	Thick	Deep	High	16.3	16.7	19.1	15.6	22.6	18.2	23.3	20.4
4	2	Medium	Thin	Medium	High	18.3	17.4	18.9	18.6	21	18.9	23.2	24.7
5	5	Medium	Medium	Deep	Low	19.7	18.6	19.4	25.1	25.6	21.4	27.5	25.3
6	1	Medium	Thick	Shallow	Medium	16.2	16.3	20	19.8	14.7	19.6	22.5	24.7
7	7	High	Thin	Deep	Medium	12	19.1	18.4	23.6	16.8	18.6	24.3	21.6
8	8	High	Medium	Shallow	High	14.2	15.6	15.1	16.8	17.8	19.6	23.2	24.2
9	6	High	Thick	Medium	Low	15	19.9	19.3	17.32	23.1	22.7	22.6	28.6

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 2 Open book
Date: 18-04-2010 — Weightage: 20%
Time: 50 min. — Marks: 40

#		Marks
	1. Answer all the questions 2. Assume suitable data, if required 3. Use graph sheets only for sampling plans problems 4. Text book and hand written notes are allowed.	
1	Plot the OC curve for a single sampling scheme with n = 50 and c = 2. Taking the producer's risk and consumer's risk as 0.05 and 0.1 respectively, use the graph to estimate the AQL and LTPD. [Take the value of p as 0, 0.02, 0.04, 0.06, 0.08, 0.10, 0.12 and 1.0]	10
2	A double sampling scheme has $n_1 = 50$, $n_2 = 70$, $c_1 = 1$ and $c_2 = 3$. Plot the ASN for the scheme. [Take the values of p as 0, 0.02, 0.04, 0.06,0.08, 0.10, 0.12, 0.14, 0.16, 0.18 and 0.20]	10
3	Construct a suitable control chart for the following data related to number of injuries in a construction site and write your inference.	10
4	As part of its TQM program, a clothing company has started tracking the delivery time for some of its orders. The following table shows seven samples of randomly selected orders. Company tells its customers, it will deliver their order within 3 business days anywhere in the state.	10

Month	1	2	3	4	5	6	7	8	9	10
Injuries	8	6	10	5	8	12	7	9	4	6
Month	11	12	13	14	15	16	17	18	19	20
Injuries	8	8	7	7	7	8	6	5	4	8

Sample	Delivery time (in days)							
1	2	4	3	4	3	2	3	1
2	3	3	4	4	1	1	2	6
3	4	3	4	6	2	5	4	2
4	1	1	5	3	4	5	3	2
5	4	4	1	4	4	4	5	4
6	4	4	4	2	4	5	3	4
7	1	2	4	3	5	4	5	3

Using control chart, analyze the problem and write your inference.

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 1
Date: 07-03-2010 — Weightage: 25%
Time: 50 min. — Marks: 50

#	**1. Answer all the questions** **2. Assume suitable data, if required** **3. Return the QFD sheet with answer script** **4. Copy of Appendix A3 is permitted**	**Marks**

1 The failure data related to an electrical pressure cooker is given below. Form FMEA table and calculate RPN for the data and write your inference.

Components	Types of failures	Reasons for failure	Effects of failure	Severity	Frequency	Detection possibility
Electrical system	No current flow	Defective cord	Cooking interruption	Very high	1 in 3	High
	Current flow in alternate direction	Faulty insulation	Shock	Moderate	1 in 8	Very low
Safety valve	Open	Broken valve spring	Increased cooking time	Moderate	1 in 20	High
	Closed	Corrosion	Over pressurization	High	1 in 80	Moderate

Use the table below for rating.

Score	Severity Criteria	Occurrence		Detection
10	Hazardous w/o warning	>=1 in 2	Very High	Absolute Uncertainty
9	Hazardous with warning	1 in 3	Very High	Very Remote
8	Very High	1 in 8	High	Remote
7	High	1 in 20	High	Very Low
6	Moderate	1 in 80	Moderate	Low
5	Low	1 in 400	Moderate	Moderate
4	Very Low	1 in 2,000	Moderate	Moderately High
3	Minor	1 in 15,000	Low	High
2	Very Minor	1 in 150,000	Low	Very High
1	None	< 1 in 500M	Remote	Almost uncertain

10

2 The data pertaining to defects in a production line is given below.

Defects	0	1	2	3	4	5
Units	65	15	5	4	0	1

Determine the probability of having 2 defects and RTY for the above data. If there are 6 opportunities for defect, what will be DPO and DPMO?

10

3	Fill the data (related to chocolate cake) in the QFD chart, estimate the absolute score for the characteristics and comment on the results. Requirements (with importance): 1. Good texture (5) 2. Size (10) 3. Taste (25) 4. Low price (20) 5. Appetizing appearance (15) Properties affecting the requirements (with importance): 1. Baking time (10) 2. Baking temperature (6) 3. Quality of ingredients(6) 4. Weight (9) 5. Thickness (2) 6. Density of chocolate chips (3) Interaction between properties: Negative between: 1&2, 1&3, 1&5, 3&5, 4&5 Positive between: 2&4, Strong positive between: 1&4, 2&6 Strong negative : NIL Interaction between requirements & properties: Strong between: 1&6, 2&4, 3&6, 4&6, 5&6 Medium between: 1&2, 2&5,3&3, 4&2 Weak: NIL	10
4	The following set of numbers is the strength in MPa for fifteen different specimens (they are arranged from least to greatest). 18 27 34 52 54 59 61 68 78 82 85 87 91 93 100 Estimate the essential points for the box plot and comment on the results.	10
5	The specification limits for the diameter of a component is given as 35± 15mm. A sample of 25 components yields a mean of 32mm and a standard deviation of 3mm. Calculate the process capability index C_{pk}, and comment on the process performance. If the process is not capable, what proportion of the product is nonconforming, assuming a normal distribution of the characteristic ?	10

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MEC 443 Quality Control, assurance & Reliability **Quiz 2** **B**

Marks: 7x2 =14 **Time: 20 min.**

Name: **ID No.:** **Date: 05.05.10**

1. List the advantages and limitations of Attribute control charts.
2. List the preliminary decisions to be taken, before construction of control charts.
3. Explain briefly, the stratification pattern in control charts with a simple sketch.
4. Differentiate common causes and special causes with examples.
5. Define ATI. State the expression.
6. Specify the switching rules for normal to reduced inspection in sampling plans.
7. Show the effect of sample size and acceptance number on OC curves.

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MEC 443 Quality Control, assurance & Reliability **Quiz 1 B**

Marks: 8x2 =16 **Time: 20 min.**

Name: **ID No.:** **Date: 24.03.10**

1. List the benefits of control charts.
2. Construct the fishbone diagram for poor surface finish in lathe.
3. Sketch the conditions for the following case: lower tolerance limit is exceeding the lower specification limit. Also specify the type of remedial action.
4. Differentiate control limits and specification limits
5. Differentiate the nominal and interval scales of measurement with example.
6. List the steps involved in FMEA.
7. How targets are fixed in QFD?
8. Name the type of quality costs for the following.
   i. Measurements ii. Service iii. Malfunction iv. Quality audit