BITS PILANI, DUBAI CAMPUS
Dubai International Academic City, Dubai
First Semester 2011-2012

IV Year Mechanical
MEC 443 Quality Control Assurance & Reliability
Date: 09-01-2012 AN
Time: 3 Hrs.

Comprehensive Examination
Weightage: 40%
Marks : 80

#	**Answer all questions** **Assume suitable data, if required** **Statistical tables are permitted**	Marks
1	Fault tree analysis is used to examine the explosion of a reactor. The explosion takes place if the pressure increases (A) beyond certain level and the manual (B) and automated relief valves(C) fail to open. The manual valve may fail due to any one of the following reasons: valve failure (D), and poor responsibility of the operator (E). The automated valve fails due to anyone of the following reasons: valve failure (F) and computer based controller failure (G). The controller may fail due to problems in computer (H) or pressure indicator (I). Construct a fault tree for the explosion and determine its probability of occurrence assuming 0.2 as the probability values for all the basic events.	9
2	Number of defectives noted for two different casting processes (A & B) is listed below. Construct the box plots for the data and compare the performance of the processes. Run: 1 2 3 4 5 6 7 8 9 10 Defectives in A: 12 15 23 24 30 31 33 36 50 73 Defectives in B: 6 22 26 33 35 47 54 55 62 63	9
3	The following data is related to the average number of defects observed in a foundry for 12 days for a sample size of 50. Determine the control limits and mean for the suitable chart for the data and state your inference. Day: 1 2 3 4 5 6 7 8 9 10 11 12 Defects: 3 2 4 5 1 2 4 1 2 1 3 4	9
4	Construct a sequential sampling plan for the following data: AQL= 4.5%; LTPD = 24.5%; Producer's risk = 5%; and Consumer's risk = 10%. Check the following data with the plan and comment on the result. No. Inspected: 0 2 4 6 8 10 12 Cumulative No. of Defects: 0 1 1 1 2 3 4	9

5	The performance of three different machines producing shafts (diameter in mm) is compared. Using the results given below, estimate the values of Cp and Cpk and comment on their capabilities. Machine A: Process Mean 9.2, Standard Deviation 0.5, Lower Specification, 7.5, Upper Specification 10.5 Machine B: Process Mean 8.8, Standard Deviation 0.4, Lower Specification, 7.5, Upper Specification 10.5 Machine C: Process Mean 9.4, Standard Deviation 0.6, Lower Specification, 7.5, Upper Specification 10.5	9
6	Construct the operational characteristics curve for the following single sampling plan: N=50, c=5, N=5000. Determine the producer's risk and consumer's risk if AQL= 7% and LTPD = 14%.	9
7	Breaking strength (in MPa) of a plastic part depends on injection moulding pressure (A), mould temperature (B) and setting time (C). The results obtained using 2 level L4 taguchi experimental plan with two replications are shown below: S.No: 1 — A: 1, B: 1, C: 1, Y1: 28, Y2: 32 S.No: 2 — A: 1, B: 2, C: 2, Y1: 26, Y2: 24 S.No: 3 — A: 2, B: 1, C: 2, Y1: 36, Y2: 32 S.No: 4 — A: 2, B: 2, C: 1, Y1: 28, Y2: 26 Determine the optimum combinations of the parameters to maximize the strength using signal-noise ratio and rank the variables.	11
8	An experiment was designed to study the effect of oxygen flow rate and time on the oxide thickness of wafers during dry oxidation. Each parameter was studied at two levels (low (-) and high (+) levels). Two replicates were run, and the oxide thickness was measured in (Angstroms). The data is shown in below. S.No: 1 — Factor A: +, Factor B: -, Y1: 831, Y2: 824 S.No: 2 — Factor A: -, Factor B: +, Y1: 607, Y2: 582 S.No: 3 — Factor A: +, Factor B: +, Y1: 1149, Y2: 1129 S.No: 4 — Factor A: -, Factor B: +, Y1: 854, Y2: 794 i. Estimate the factors' effects ii. Perform the analysis of variance and comment on the result. iii. Determine the appropriate regression model for predicting the oxide thickness.	15

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 2 Open book

Date: 11-12-2011
Time: 50 min.

Weightage: 20%
Marks: 40

#	**1. Answer all the questions** **2. Assume suitable data, if required** **3. Text book, statistical tables and hand written class notes are permitted**	**Marks**
1	Consider a double sampling plan with $n_1 = 50$; $c_1 = 2$; $n_2 = 100$; $c_2 = 4$. What is the probability of accepting a lot with 3% defective?	10
2	Calculate the average outgoing quality limit for a plan with n=52, c=3, and N=10000. Assume that the defective items are replaced and N is not very much greater than n.	10
3	A control chart is to be constructed for the hardness of hot rolled 1030 steel. Sample size, n= 10; Process mean and σ are 170 BHN and 12 BHN respectively. If the control limits are placed at 3 σ from the process mean, what is the probability of the Type I error? If the process mean is shifted to 174 BHN, what is the probability of concluding that the process is in control and hence making a Type II error after 5 samples?	10
4	A sample of 20 transistors is tested for 5000h. 4 components failed with prescribed test time, the failure times being 1650, 2680, 3720 and 4500h. Determine the average life and failure rate and the 90% confidence interval for the average life.	10

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 1
Date: 16-10-2011 — Weightage: 25%
Time: 50 min. — Marks: 25

#	**1. Answer all the questions** **2. Assume suitable data, if required** **3. Attach the graph and QFD chart with the answer script**	**Marks**
1	Data related to strength of plastic fibers are shown below for different samples. Construct a box plot for the data and comment on the results.	8

Tensile Strength, MPa
32.5
37.1
39.1
40.5
45.5
51.3
52.6
55.7
55.9
57.7

2	The top event (failure) of a mechanical system depends on the 8 events. The event 4 occurs if all the events 1, 2 and 3 occur. The top event occurs due to the occurrence of anyone of the events 4, 5 and 6. Event 6 will occur only if events 7 and 8 occur. (i) Construct a fault tree for the problem and determine the probability of the top event (ii) Construct a reliability block diagram and determine the system reliability for a period of 10 hrs (take the probability of each event as failure rate/hr). The probability of the event (failure rate) for the events are given below:	9

Event	1	2	3	5	7	8
Probability	0.1	0.2	0.15	0.5	0.1	0.15

3 The desired features and their relations with design features of pizza are given in the following table:

		Design features			
Desired features	Importance rating	Price	Size	Amount of Cheese	Amount of topping
Taste	4			High	Low
Nutrition	4			Medium	Medium
Appeal	3		High		High
Value	5	High	Medium		

8

High = 5; Medium =3; Low =1

The scores of our company and two competitors are listed below based on the desired characteristics and design elements are shown below:

	Our company X	Company A	Company B
Taste	4	5	4
Nutrition	3	3	4
Appeal	3	3	4
Value	5	4	5
Price	4	4	4
Size	4	4	5
Amt. of Cheese	3	3	5
Amt. of topping	5	4	4

The relations between the design features are given as follows.

Price & Size = Strong negative

Amt. of Cheese & Price = Negative

Amt. of toppings & Price = Negative

Construct the house of quality in the attached chart (fill all the values given) and prioritize the design features of the pizza using weighted absolute score. Comment on the results.

BITS PILANI, DUBAI CAMPUS
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First Semester 2011-2012 NAME:

IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Quiz 2 — ID. NO:
Date: 28-11-2011 — Weightage: 8%
Time: 20 min. — Marks: 7

#	**1. Answer all the questions** **2. Assume suitable data, if required**	**Marks**
1	Cocoa Fitzz is using three bottling machines for its production. Machine / Standard deviation A / 0.05 B / 0.1 C / 0.2 If the specifications are between 15.8 and 16.2 ounces, Identify the machine(s) which can produce with in specifications.	[3 M]
2	Define Average run length, Type I (α) and Type II (β) errors in control charts. How they are related (equations)?	[2 M]
3	How will you determine the % rejection using process capability analysis? Also, state the benefits of process capability analysis.	[2 M]

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Quiz 1
Date: 31-10-2011 — Weightage: 8%
Time: 20 min. — Marks: 8

#	**1. Answer all the questions** **2. Assume suitable data, if required**	**Marks**
1	An accounts department started an improvement project to try to reduce the number of internal purchase forms that its users completed incorrectly. As an overall measure of their success, they wanted to use a Control Chart to measure the proportion of purchase forms that were not completed correctly. Determine the mean line & control limits for the data given below.	[4 M]

Day of month	Number of purchase forms	Number of incorrect forms
1	24	14
2	35	16
3	27	12
4	23	12
5	19	5

2	Sketch the different patterns of control charts (any 2 with reasons).	[2 M]
3	Mention the rules for out-of control decision in control charts (any 4).	[2 M]