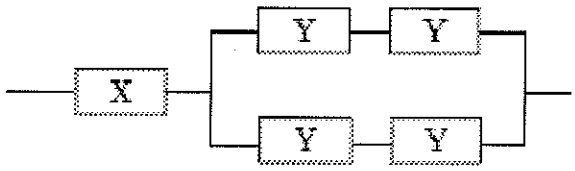
BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
Second Semester 2011-2012

IV Year Mechanical ME C443 Quality control, Assurance & Reliability Comprehensive Examination
Date: 07-06-2012 Weightage: 40% Time: 180 min. Marks: 80

S.No	1. **Answer all questions** 2. **Assume suitable data, if required**	**Marks**
1	List the advantages of attribute and variable control charts	4
2	Explain the use of pareto diagram with an example	4
3	List the benefits of process capability analysis	4
4	Explain the failure rate curve and specify the type of distributions to be used in the various stages of the curve	4
5	Explain the use of flow charts in quality control with an example	4
6	For the following data related to tensile strength of high carbon steel specimens, construct box plot and comment on the results. 570 500 625 611 706 673 705 622 654 632 875 807 827 837 794	8
7	 A system consists of five units, as shown above. The reliability of the X unit is 0.9900. The other four units are identical. If the system reliability goal is 0.9896, what is the minimum reliability that each of the Y units must have?	8
8	Construct FMEA table for a soap manufacturing company and write your inference. The problems are related to size, shape and fragrance. The customers will be dissatisfied if the fragrance or the shape is not proper. The company may incur loss if the size is bigger. The mould design will be the prime factor affecting shape and size. The chemicals added to the soap will affect fragrance. The failures related to design are less frequent (one in every 15000) and the effect is also minor. A failure related to fragrance occurs for every 2000 soaps and its effect on the customer is moderate. The probability of detecting failures related to mould design is moderate whereas chance of identifying the fragrance defect is remote. After a period of time, the design was modified and quality control inspection was carried out to improve the situation. It was noticed that the frequency of defects reduced in all defects by 2 steps whereas other characteristics remain the same.	8
9	A computer fails to work due to power supply, key board and hardware problems. The hardware problem may be attributed to mother board and hard drive. The computer is having a battery to support the system during power cut. The computer is used to control the temperature of a chemical plant. The failure of the process also depends on the temperature sensor and the data acquisition system. Construct a fault tree for the problem using logical sequences and derive the equation to be used for the estimation of the probability of top event.	8
10	Using AHP take a decision on the car you want to purchase. The factors to be considered are fuel economy, reliability and style. Hint: For fuel economy, directly divide the column total to get priority vector.	8

Factors

	Interior	Reliability	Fuel Econ.
Interior	1	0.5	3
Reliability		1	4
Fuel Econ.			1

Reliability

	A	B	C	D
A	1	2	5	3
B		1	3	2
C			1	0.25
D				1

Fuel econ.

	miles/Gall.
A	34
B	27
C	24
D	28

Interior

	A	B	C	D
A	1	0.25	4	0.167
B		1	4	0.25
C			1	0.2
D				1

11 The marketing group in an airline wanted to increase the number of business class seats sold on its off-peak flights. Key factors were identified as advertising level (A) and pricing strategy (B). They tried two advertising campaigns and two pricing strategies in geographically separate but demographically similar areas. As there were a small number of possible trials, they performed a full factorial experiment, as illustrated. The number of increased seats is shown from three replications. Determine the regression model for the case. 10

Expt. No	A	B	Y (3 Rep.)
1	1	1	12,13,14
2	1	2	8,9,6
3	2	1	2,3,4
	2	2	5,2,1

12 A cake manufacturer, wants to optimize the process parameters involved in the manufacturing process. He identified some parameters and used L9 orthogonal array for the analysis. The results are shown below. Determine the optimum levels for the parameters considered. Surface peak should be maximum for better taste. 10

#	A	B	C	D	Surface peak, cm	
	Mixing Time A (min)	Mixing Time B (min)	Baking Temp (°C)	Baking Duration (min)	Replicate 1	Replicate 2
1	1	5	175	45	9.60	9.68
2	1	7	180	50	9.68	9.91
3	1	9	185	55	9.94	10.01
4	1.5	5	180	55	9.92	10.02
5	1.5	7	185	45	9.93	9.96
6	1.5	9	175	50	9.94	9.67
7	2	5	185	50	9.68	10.01
8	2	7	175	55	9.97	10.14
9	2	9	180	45	10.0	9.92

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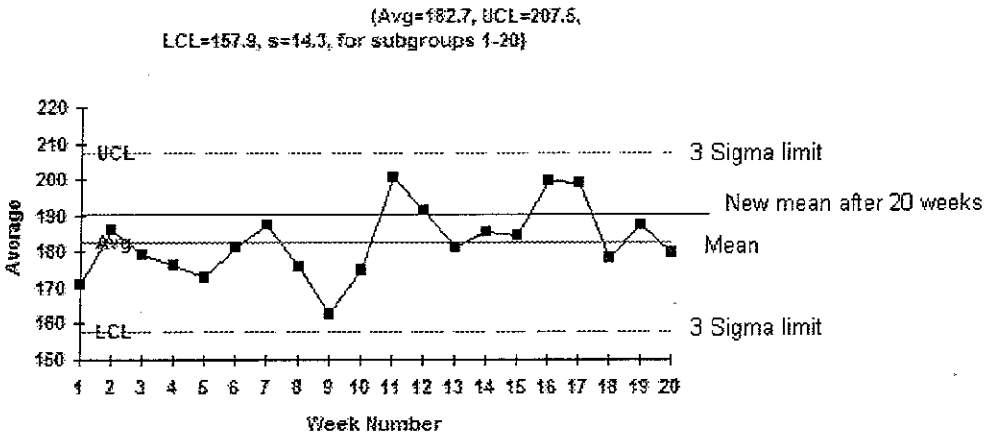
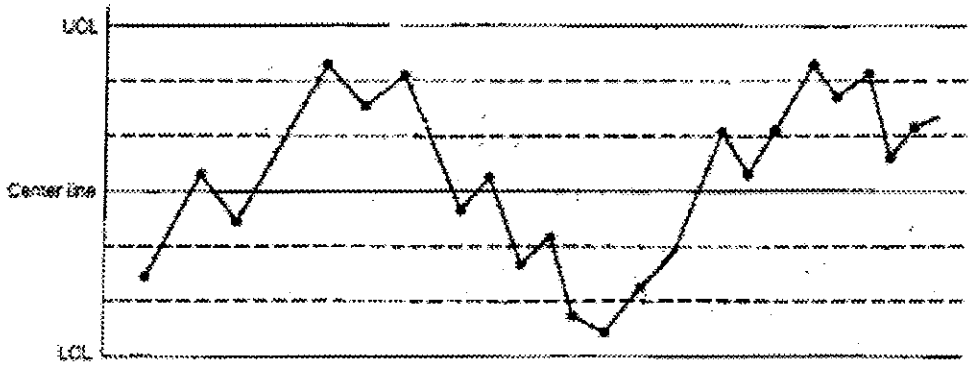
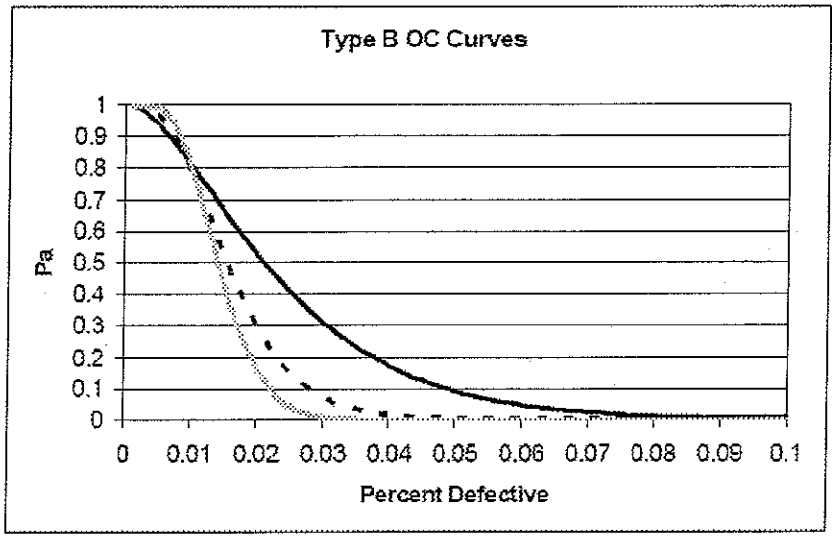
IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 2
Date: 30-04-2012 — Weightage: 20%
Time: 50 min. — Marks: 40

S.No	**Answer all questions** **Assume suitable data, if required**	**Marks**
1	Determine the length of time for out of control signals for the following control chart. (n=4) 	8
2	Identify the possible out of control signals in the following control chart and specify the reasons. 	8

3	Below are three OC Curves. One is for plan n=80, c=1; another is for n=240, c=3; and the last is for n=480, c=6. (a) Which curve belongs to which plan? (b) Which of the 3 plans above is the most economical for inspection in order to obtain a consumer's risk of < 10% at p = 0.03 and producer's risk of < 5% at p= 0.005?  	8
4	Consider the following attribute sampling plan: N = 1,000, n = 80, c = 3. (a) Plot the AOQ and ATI curves. Use Poisson distribution and run proportion defectives from 0 to 10%. (b) Calculate AOQL.	8
5	25 tyres were tested in test rigs of a tyre manufacturing company to determine how long the tyres can be used. The test was ended after 5 tyres were completely worn out with no replacement for wornout tyres was made. Tyres | 1 | 2 | 3 | 4 | 5 Duration,hrs | 4000 | 4500 | 6100 | 6600 | 7200 Estimate the average life of the tyres and determine 95% confidence interval for the average life.	8

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Test 1
Date: 12-03-2012 — Weightage: 25%
Time: 50 min. — Marks: 25

<table>
<tr><th>#</th><th>Answer all questions
Assume suitable data, if required</th><th>Marks</th></tr>
<tr><td>1</td><td>The requirements for an electric drill with importance ratings are as follows: Making holes faster (9); drive the screw also (6); light in weight (3); reversible (6); Easy to use (3) and Last long (6). The requirements can be met by incorporating following characteristics in the drill. The best score obtained by the leading companies for each feature is also mentioned. Durability (5), more power (3), less weight (4), reversing attachment (4) and more torque (5). The relationship between requirements and product characteristics are given below.
<table>
<tr><th></th><th>Making holes faster</th><th>drive the screw also</th><th>light in weight</th><th>reversible</th><th>Easy to use</th><th>Last long</th></tr>
<tr><td>Durability</td><td></td><td></td><td></td><td></td><td></td><td>9</td></tr>
<tr><td>more power</td><td>9</td><td>3</td><td>3</td><td></td><td></td><td></td></tr>
<tr><td>less weight</td><td></td><td></td><td>9</td><td></td><td>3</td><td></td></tr>
<tr><td>Reversing attachment</td><td></td><td>3</td><td></td><td>9</td><td>3</td><td></td></tr>
<tr><td>More torque</td><td>6</td><td></td><td>3</td><td></td><td></td><td></td></tr>
</table>
Power and torque are directly proportional to each other and they are inversely proportional to weight. Fill the given data in a house of quality chart and prioritize the characteristics based on the weighted absolute score.</td><td>7</td></tr>
<tr><td>2</td><td>A top event occurs due to the simultaneous occurrence of events A, B & C. The event C normally occurs due to the failure of any one of the events D&E. The failure of events F&G may result in the failure of B. Construct a fault tree for the case and determine the probability of the top event if the probability of the following individual events are as follows: D = E =0.05; F=0.015; G=0.012 and A = 0.01</td><td>7</td></tr>
<tr><td>3</td><td>A cash dispenser may fail by not dispensing the cash or dispensing too much or too less cash. The severity of the failures is very high for incorrect cash dispensing and it is high for not dispensing. One in 2000 transactions may lead to excess dispensing whereas 1 in 15000 transactions may lead to non-dispensing and low dispensing. Chance of detecting Cash non-dispensing error is high whereas in-correct dispensing of the machine is remote. The dispenser will not work due to power failure. Excess dispensing is due to sticking of bills together and less dispensing would occur due to denominations in wrong ways. The customers will be dissatisfied if any of these failures occur and bank will lose money if excess cash is dispensed. The non-dispensing failure can be controlled by visual inspection by personnel frequently and the incorrect dispensing can be controlled by proper loading procedures. Construct FMEA table for the problem and prioritize the failures.</td><td>7</td></tr>
<tr><td>4</td><td>a. Compare craftsmanship, mass production and lean production based on the competitive priorities.
b. Give two examples each for the following: Appraisal cost & External failure cost</td><td>4</td></tr>
</table>

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Quiz 2
Date: 01-04-2012 — Weightage: 7%
Time: 20 min. — Marks: 14

Name: **ID No.:**

1. Assume that in different time periods 4 randomly selected patients rated their satisfaction with our services as follows:

Time Period	Ratings of 1st Patient	Ratings of 2nd Patient	Ratings of 3rd Patient	Ratings of 4th Patient
1	80	84	82	80
2	70	72	74	70
3	76	78	76	78
4	80	78	78	80

The ratings less than 80 may be treated as not satisfactory. Select a proper control chart for the data and determine the control limits. [6 Marks]

2. In a health care unit, a new device is being used. It rarely produces one kind of infection, but you want to track how often that happens. Number of days the device is used in a month (in different centres) and the corresponding number of infections are listed below. Determine the control limits for the chart to be used. [6 Marks]

Month	Number of Device-Days	No. of Infections (c)
Jan	2500	5
Feb	4000	4
Mar	1000	3
Apr	3500	6

3. Construct stratification pattern & cyclic pattern control charts and give reasons. [2 Marks]

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IV Year Mechanical
ME C443 Quality control, Assurance & Reliability — Quiz 1
Date: 26-02-2012 — Weightage: 8%
Time: 20 min. — Marks: 25

Name: **ID No.:**

1. Construct the box-and-whisker plot for the following data set related to breaking strength of a plastic fiber in MPa:
   77, 79, 80, 86, 87, 87, 94, 99 [3 Marks]
2. Complete a stem-and-leaf plot for the following list of marks on a recent test:
   73, 42, 67, 78, 99, 84, 91, 82, 86, 94 [3 Marks]
3. Mention the benefits of the following quality tools.
   Fishbone diagram, Pareto analysis and Scatter plots [2 Marks]