ORDRE DES INGÉNIEURS DU QUÉBEC

May 2015 SESSION

Open-book examination
Non-programmable calculators: only authorized models
Duration : 3 hours

14-IN-A5 Quality planning, control and assurance

QUESTION #1 (8 points)

The fraction of nonconforming product manufactured by a company is 99.9945%. Can we say that the company is Six Sigma? Justify your answer quantitatively.

QUESTION #2 (14 points)

a) On a production line, an automatic process eliminates the pieces having a length of less than 9 cm or greater than 11 cm. Knowing that the length of the parts is normally distributed with a mean of 10 cm and a standard deviation of 0.4 cm, how many parts have to be produced to get 1000 good parts? (10 pts)

b) MicroTek manufactures switches with indicator lights. According to the test results accumulated in recent months, the fraction of nonconforming switches is 10%. We take, randomly from the production, 12 switches to inspect them. What are the chances in percentage, to observe exactly four nonconforming switches? (4 pts)

QUESTION #3 (25 points)

Control charts for $\bar{X}$ and *R* are maintained on a process. After 20 preliminary subgroups each of size 3 are evaluated, you have the following data:

$$\sum_{i=1}^{20} \bar{x}_i = 5502 \quad \text{and} \quad \sum_{i=1}^{20} R_i = 60$$

a) Set-up the control charts using these data (6 pts).

b) Assume that the process exhibits statistical control. Estimate the process mean and standard deviation (4 pts).

c) Suppose that the quality characteristic is normally distributed with specification at 275 ± 6. Estimate the fraction nonconforming produced by this process (8 pts).

d) How much reduction in process variability would be required to make this a Six Sigma process? (7 pts)

QUESTION #4 (17 points)

A control chart is used to control a plastic part manufactured in an injection molding process. Ten subgroups yield the data in table 1.

Table 1: Date for question #4

Sample Number	Sample Size	Number nonconforming
1	100	10
2	100	15
3	100	31
4	100	18
5	100	24
6	100	12
7	100	23
8	100	15
9	100	8
10	100	8

a) Set-up an appropriate control chart for this process (8 pts)

b) Is the process in statistical control? Justify your answer. (5 pts)

c) What center line and control limits should be used for controlling future production? (4 pts)

QUESTION #5 (20 points)

The molecular weight of a particular polymer should fall between 2100 and 2350. Fifteen samples of this material were analyzed. The results are presented in table 2. Assume the molecular weight is normally distributed.

Table 2: data for question #5

2232	2305	2169	2404	2304
2251	2369	2326	2295	2272
2153	2304	2283	2259	2241

a) Estimate the potential capability of the process and interpret this ratio (4 pts)

b) Estimate the actual process capability and interpret this ratio (10 pts)

c) Compare the potential and actual ratios. What do you conclude? (6 pts)

QUESTION #6 (16 points)

A company wants to design a single-sampling plan such that the probability of acceptance is 95% for lots with fraction defective of 1% and the probability of acceptance is 10% for lots with defective of 8%. A consultant suggests the following single-sampling plan: n = 75, c = 1.

Does the company should use this plan? Does the plan meet the desired probabilities? Use the operating-characteristic curve to justify your answer quantitatively.