UNIVERSITY OF GHANA

BSc. (Eng) MATERIALS SCIENCE AND ENGINEERING

FIRST SEMESTER EXAMINATIONS 2018/2019

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MTEN 405: PROCESS AND QUALITY CONTROL (3 CREDITS)

TIME- 2½HRS

ANSWER ALL QUESTIONS

1.

    a. The cost of quality is generally classified into four (4) categories. State and explain the categories **[4 marks)**

    b. State four (4) important characteristics of process control systems **[2 marks]**

    c. The testing process at the quality control laboratory of the Ghana oil company (GOIL) has an average turn-around time of 27.3 minutes and a standard deviation of 1.25 minutes. The nominal value for this service is 25 minutes with an upper specification limit of 30 minutes and a lower specification limit of 20 minutes. The administrator of the laboratory wants to have a 4-sigma performance for her laboratory. Is the laboratory process capable of this level of performance?

[3 marks]

    d. State six (6) control objectives you will consider when you want to attain a process desired value. **[6 marks]**

    e. Briefly state and explain five (5) concepts of Control Engineering **[10 marks]**

2.

    a. Briefly explain the following terms **Six (6) Sigma, four (4) Sigma, and two (2) Sigma** processes **[3 marks]**

    b. At Osikani accounting firm, the marketing team has been working on improving the processing of invoices. The team aims at reducing the cost of processing invoices by decreasing the number of invoices with errors. The team developed the following operational definition for a defective invoice: an invoice is defective if it has *incorrect price, incorrect quantity, incorrect coding, incorrect address,* or *incorrect name*. The team decided to investigate a random sample of 100 invoices per day. If the invoice had one or more errors, it was defective. The data from the last 25 days

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are given in the table 1. Using a three – sigma control limit approach, determine if the process is in statistical control.

Table 1.

Day Number	Number Defective		Day Number	Number Defective
1	22		14	24
2	33		15	22
3	24		16	22
4	20		17	29
5	18		18	31
6	24		19	21
7	24		20	26
8	29		21	24
9	18		22	32
10	27		23	17
11	31		24	25
12	26		25	21
13	31			

[10 marks]

c. Using the appropriate formulae, explain the following: Process Capability Index, C_{pk} and Process Capability Ratio, C_p [8 marks]

d. In the final step of Nestle's canned Carnation milk production process, the canned milk product passes through a machine that measures various product quality characteristics. When the milk production process is in control, it averages 18 defects per batch.

   i. Using two-sigma control limits, set up a control chart for the number of defects per batch. [2 marks]

   ii. Six (6) batches had the following number of defects: 10, 16, 21, 17, 22, and 24, respectively. The seventh (7th) batch, using raw materials from a different supplier, had six (6) defects. Is the milk production process in control? Give reasons. [2 marks]

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3.

    a. Briefly explain the following terms: Statistical process control, Variables, Attributes, Sampling plan, Sample size, Process capability, Nominal value, Tolerance, Quality engineering. **[9 marks]**

    b. Briefly discuss the terms associated with statistical process control: control (c-) chart, range (R-) chart, mean ($\bar{x}$) chart. **[6 marks]**

    c. State and describe the control limits for the $\bar{x}$ chat and R-charts **[10 marks]**

4.

    a. Explain the three (3) main types of control **[3 marks]**

    b. With reference to the International Standards Organization's standards, briefly explain four (4) standard quality management principles. **[4 mark]**

    c. State the five (5) sections under the ISO 9001 that specify activities that need to be considered when implementing this system. **[5 marks]**

    d. Briefly describe the five principal approaches in defining quality. **[10 marks]**

    e. State six (6) Characteristics of a Total Quality Management Leader. **[3 marks]**

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