



UNIVERSITY OF GHANA

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BSc. (Eng) MATERIALS SCIENCE AND ENGINEERING

FIRST SEMESTER EXAMINATIONS 2017/2018

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MTEN 405: PROCESS AND QUALITY CONTROL (3 CREDITS)

TIME- 2½HRS

ANSWER ALL QUESTIONS

1.

- 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)**

2.

- a. Explain the 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)**

3.

- a. The cost of quality is generally classified into four categories. State and explain the categories **(4 marks)**
- b. State 4 Important Characteristics of Process Control Systems **(2 marks)**
- c. The quality control laboratory of the Tema Oil Refinery testing process has an average turnaround time of 26.2 minutes and a standard deviation of 1.35 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 6 control objectives you will consider when you want to attain a process desired value. **(6 marks)**
- e. Briefly state and explain 5 concepts of Control Engineering **(10 marks)**

4.

- a. State the laws of process control **(3 marks)**
- b. In the Coca Cola Bottling Company's final step in their beverage drinks production process, the product passes through a machine that measures various product quality characteristics. When the beverage production process is in control, it averages 20 defects per batch.
 - i. Using two-sigma control limits, set up a control chart for the number of defects per batch. **(2 marks)**
 - ii. Five batches had the following number of defects: 16, 21, 17, 22, and 24, respectively. The sixth batch, using raw materials from a different supplier, had 5 defects. Is the beverage production process in control? **(2 marks)**
- c. Using the appropriate formulae, explain the following: Process Capability Index, C_{pk} and Process Capability Ratio, C_p **(10 marks)**
- d. At Deloitte chemical processing company, lumps in the sealing compound could cause difficulties in dispensing a smooth bead from the tube. Even when the process is in control, there will still be an average of 4 lumps per tube of seal. Testing for the presence of lumps destroys the product. So, Deloitte takes random samples. The results of the study are shown in table 1. Determine the c-chart six sigma upper and lower control limits for this process.

Table1:

Tube #	Lumps	Tube #	Lumps
1	6	7	1
2	5	8	6
3	0	9	5
4	4	10	0
5	6	11	9
6	4	12	2