



**UNIVERSITY OF GHANA**

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**BSc. (Eng) MATERIALS SCIENCE AND ENGINEERING**

**FIRST SEMESTER EXAMINATIONS 2016/2017**

**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 categories. State and explain the categories **(4 marks)**
- b. State four (4) important characteristics of process control systems **(2 marks)**
- c. The intensive care unit lab 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 lab wants to have 4-sigma performance for her lab. Is the lab 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 5 concepts of Control Engineering **(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. State the laws of process control (3 marks)
- b. At Oyster chemical company, lumps in their sealing compound could cause difficulties in dispensing a smooth bead from its tube. Even when the process is in control, there will still be an average of four (4) lumps per tube of sealant. Testing for the presence of lumps destroys the product. So Oyster takes random samples and the results of the study are shown in table 1. Determine the c-chart six sigma upper and lower control limits for this process. (8 marks)

**Table1.Oyster Random Sampling**

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

- c. In the final step of Accra Brewery's beer production process, the bottles pass through a machine that measures various product quality characteristics. When the beer production process is in control, it averages twenty (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 malt from a different supplier, had five (5) defects. Is the beer production process in control? (2 marks)
- d. Using the appropriate formulae, explain the following: Process Capability Index,  $C_{pk}$  and Process Capability Ratio,  $C_p$ . (10 marks)

4.

- 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)