TECHNICAL UNVERSITY OF MOMBASA

Faculty of Engineering & Technology in Conjunction with Kenya Institute of Highways and Building Technology (KIHBT)

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

HIGHER DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEP 3210: PROCESS CONTROL & AUTOMATION

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2014
TIME: 2 HOURS

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
- *Answer Booklet*
- *A non-programmable Scientific Calculator*

This paper consists of **FOUR** questions. Answer any **THREE** questions
All questions carry equal marks
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One

a) Explain what is meant by the term Controller Tuning. **(4 marks)**

b) Consider the control system in figure 1b in which a PID controller is used to control the sytem. The PID controller has the transfer function:

$$ac = K_p \left(1 + \frac{1}{T_i s} + T_d s \right)$$

Apply the Ziegler ultimate cycle tuning rule to determine the values of parameters K_p, T_i and T_d.

(16 marks)

Question Two

a) Given K_p = 5, K_1 = 0.75-1, K_D = 0.55 and $P_1(0)$ = 20% for a PID controller where K_p is the proportional gain, K_1 is the integral gain, K_D is the derivative gain constant and $P_1(0)$ is controller output with no error. Plot the controller output for the error response in figure 2(a).

1   2   3   4   5   6   7

(14 marks)

b) A liquid level control system linearly converts displacement of 2-3 meetings into a 4 - to 20mA control signal. A relay closes 12mA and opens at 10Ma.
   (i) Determine the relationship between the displacement and the relay current.
   (ii) Find the neutral zone   **(6 marks)**

Question Three

a) Define the term statistical process control.   **(4 marks)**

b) Explain the following as applied to statistical process curlurt:
   (i) Time series model
   (ii) Multivavate model
   (iii) Stochastic model
   (iv) Artificial Neural Network   **(16 marks)**

Question Four

a) Name the THREE robot paradigms and draw the relationship between the primitives. **(9 marks)**

b) Describe the difference between:
   (i) Tele presence and semi-autonomous control
   (ii) Direct perception and recognition   **(8 marks)**

c) From the given figure 4 compute the vector obtained by rotating vector $^{A}P_1$ about $\hat{Z}$ by zodegrees.

Figure 4

                                                                                                     (3 marks)