TECHNICAL UNIVERSITY OF MOMBASA

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN INSTRUMENTATION AND CONTROL ENGINEERING

ECI 2303 : PROCESS CONTROL I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: Sep 2018

Instructions to Candidates
You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of FIVE questions. Attempt any THREE **Questions**
**Do not write on the question paper.**

Question ONE

a) Define the following terms as used in process control
   i) Control Lag
   ii) Dead band
   iii) Process variable
   iv) Controlling variable
   v) Dead time   (**5 Marks**)

b) i) With the aid of a block diagram, describe the major components of a process control loop
   ii) Explain any **THREE** objectives of process control

                                                                   (**12 Marks**)

c) State any THREE reasons why controllers need tuning   (**3 Marks**)

Question TWO

a) i) Figure 1.0 shows an analogue process control loop for regulation of temperature
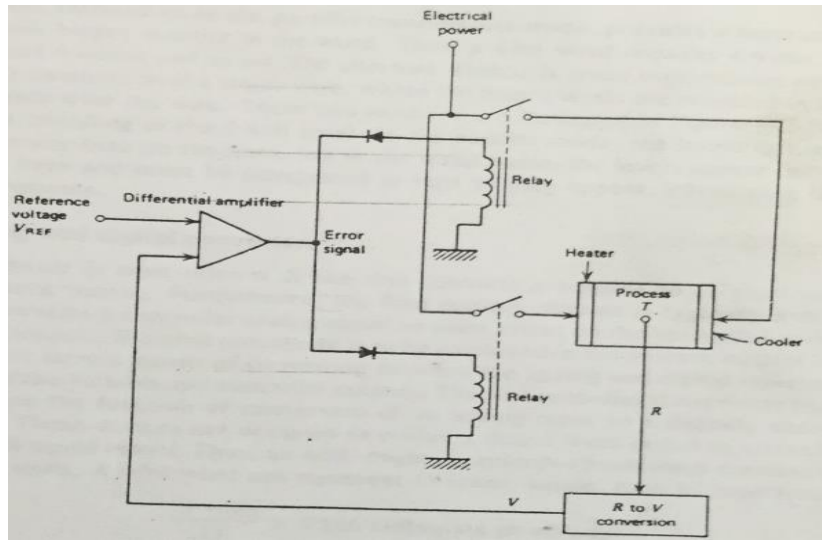
Required:

       I)   Explain the operation the system.

       II)   Implement the process control loop using a computer in a supervisory capacity

       III)   Describe the role of the computer in (II).

(8 Marks)

ii)   Define the following

       I)   Discontinuous control mode

       II)   Continuous control mode

       III)   Proportional control mode

       IV)   Integral control mode

       V)   Derivative control mode

(5 Marks)

b) i) Explain with the aid of error and controller output time relation the single speed floating control action.

ii) State the **TWO** criteria used to evaluate system performance

(7 Marks)

Question THREE

a)   List **TWO**benefits of using analogue computers   **(2 Marks)**

b) i) The behaviour of a physical system is described by the differential equation

$$4\ddot{x}+200\dot{x}+28000x=1400 \quad \text{Given that } X_0 = \dot{X}_0 = 0$$

Derive a scaled diagram to enable x and $\dfrac{dx}{dt}$ to be found. Employ time scaling such that "computer time is 50 times real time". For amplitude scaling purposes take maximum amplitude as follows:

$$|x|_{max} = 0.1 \text{ units and } |\dot{x}|_{max} = 5 \text{ units}$$

    ii) Explain the need for amplitude scaling in analogue computer simulation.

(14Marks)

c)   With the aid of a block diagram describe the operation of a digital control system
(4Marks)

Question FOUR

a) i)   State the analytic expression of the derivative control mode

    ii) Give any THREE characteristics of the controller in (i)

(5 Marks)
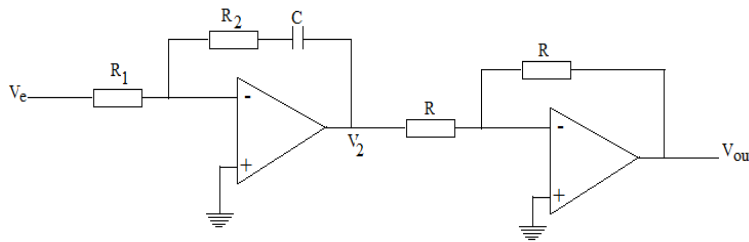
b) Figure 2.0 shows an analogue electronic controller

Fig. 2.0

    i)   State what type of controller it is
    ii)   Derive the equation for its output   **(8 Marks)**
c) i)   List any **TWO** elements used in analogue computing
    ii) With the aid of a circuit diagram derive the expression for the output voltage of a summing amplifier.   **(7Marks)**

Question FIVE

a) i)   With the aid of a schematic diagram explain the principle of speed-controlled d.c motor dive
    ii) Give the main constructional differences betweensynchro transmitter and receiver
(5 Marks)
b)   Explain with the aid of schematic diagrams the following
           I)   a synchro data transmission system
           II)   Drag-cup tachogenerator   **(15 Marks)**