THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN CHEMICAL ENGINEERING

ECL 2340
CONTROLS AND INSTRUMENTATION I

YEAR 3 SEMESTER II

SPECIAL/SUPPLEMENTARY EXAMINATIONS

SERIES: MARCH, 2012

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination

- Answer booklet
- Drawing instruments
- Drawing paper A2

This paper consists of FIVE questions.
Question ONE is COMPULSORY
Answer question ONE and any other TWO questions.
Maximum marks for each part of a question are as shown.
This paper consists of ***THREE printed pages.***

QUESTION ONE

In the liquid-level system of Figure 1 assume that the outflow rate Q m^3/sec through the outflow valve is related to the head H m by '

$$Q = K\sqrt{H} = 0.01\sqrt{H}$$

Assume also that when the inflow rate Q, is 0.015 m^3/sec the head stays constant.

For $\boldsymbol{t} < 0$ the system is at steady state (Q, = 0.015 m^3sec). At $t = 0$ the inflow valve is closed and so there is no inflow for $t \geq 0$. Find the time necessary to empty the tank to half the original head. The capacitance C of the tank is 2 m^2 (20 marks)

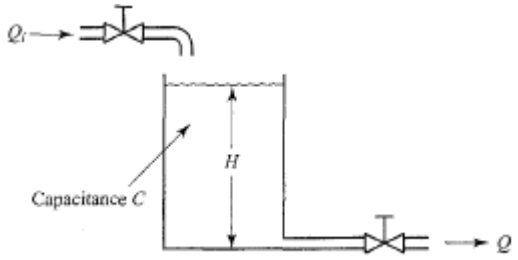

Figure 1

QUESTION TWO

Using the following parameters of a PID controller come up with its transfer function

K_p	T_i	T_d
$1.2\frac{T}{L}$	$2L$	$0.5L$

$r(t)$	0	1	2	4	8	12	20	30
$c(t)$	0	0.2	0.5	1	5	9	11	11

(20 marks)

QUESTION THREE

Explain the operations of the following instruments

i. Hydrometer
ii. Orsat gas analyzer
iii. Orifice meter
iv. Venturimeter

(20 marks)

QUESTION FOUR

a. Define the following terms

i. Variables
ii. Dead time
iii. MIMO
iv. SISO

(6 marks)

b. Give three characteristics of each of the following controllers

i. Derivative
ii. Integral
iii. P+I

(9 marks)

a. List five properties of a feedback control system

(5 marks)

QUESTION FIVE

For a system whose transfer functions is given by: $\frac{C(s)}{R(s)} = \frac{25}{3s^2+5s+25}$

Determine

i. Natural frequency
ii. Damping ratio
iii. Damped frequency
iv. Time constant

(20 marks)