SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (ELECTRONIC)

ELC 405: ANALOG COMPUTATION AND SIMULATIONS

6TH DECEMBER, 2016 **TIME: 1.30-3.30 P.M**

INSTRUCTIONS:

1. Attempt question **ONE** and any other **TWO** questions
2. Question one carries **30 marks** while the rest carry **20 marks each**

QUESTION ONE (30 MARKS)

(a) Deduce the differential equation for a rocket. (6Marks)

(b) Set up an operational amplifier (OP-AMP) as a summer. (6Marks)

(c) (i) Name the commonly used operation modes of an analog computer. (3Marks)

(ii) Use an integrator circuit to show how the above modes are implementated. (4Marks)

(d) (i) What do you understand by the term generating functions? (3Marks)

(ii) Why is it necessary in a differential equation? (3Marks)

(iii) Given a differential equation, clearly explain how you proceed with time scaling (5Marks)

QUESTION TWO (20 MARKS)

(a) Generate the following function on an analog computer

$f(t) = .5t^2 + 10e^{-2t} \qquad for\ 10 \geq t \geq 0$ (14Marks)

(b) Amplitude scale the equation (4(a) for an analog computer. (6Marks)

QUESTION THREE (20 MARKS)

(a) What is transport delay simulation? (3Marks)

(b) Give examples where the necessity of simulating lag arises (5Marks)

(c) Discus transfer function simulation with RC network (12Marks)

QUESTION FOUR (20 MARKS)

The equation of motion of a drop hammer is given by

$m\ddot{x} + B\dot{x} + kx =$, where $m = \frac{\omega_{1+\omega_2}}{g}$

$x(0) = 0 \qquad \dot{x}\ (0) = \frac{\omega_1 \int 2gh}{\omega_1 + \omega_2}$

Take ω_1 = 2000Newtons

ω_2 = 10000 Newtons

K = 5000 N-S/M

g = 9.81 m/sec^2

h = 3 meters

(a) Time and amplitude scale the above equation (10Marks)

(b) Obtain a computer diagram for it (note: You are to estimate the maximum values of the variables) (10Marks)

QUESTION FIVE (20 MARKS)

Assume a simple pendulum is displaced from its position of rest by an angle θ_0 at t = 0 and released. The equation of motion of the pendulum for small oscillations is given by

$$\frac{d^2\theta}{dt^2} + \frac{g}{l}\theta = 0$$

$$\theta(0) = \theta_0, \qquad \dot{\theta}(0) = 0$$

(a) Normalise the equation (12Marks)

(b) Set up an analog computer to solve it. (8Marks)