**SOUTH EASTERN KENYA UNIVERSITY**

**UNIVERSITY EXAMINATIONS 2016/2017**

**FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR**

**SCIENCE IN ELECTRONICS**

**ELC 300: ELECTROMECHANICAL CONTROL SYSTEMS**

**7TH DECEMBER, 2016**

**INSTRUCTIONS TO CANDIDATES**

**TIME: 4.00-6.00 P.M**

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Question one carries 30marks while the rest carry 20marks each

Answer **Question One** and any **other two** questions

**Question One (30mks)**

**a)** Explain what is meant by the following as used in electromechanical systems

**(i)** Process

**(ii)** System

**(iii)** Control

**(iv)** Actuators

**b)** State three variables that defines interactions in control systems

**c)** Highlight any four differences between open and closed loop systems

**d)** Briefly explain what is meant by BIBO Stability

**e)** What are the basic elements used for modeling mechanical translational system.

**f)** Explain how systems are classified depending on the value of damping?

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(2mks)

(2mks)

(2mks)

(2mks)

(3mks)

(4mks)

(2mks)

(3mks)

(4mks)



**g)** (i) Explain the concept of *frequency response*

(ii) Give four advantages of frequency response analysis

**Question Two (20mks)**

**a)** (i) What is a closed loop control system?

(ii) State and explain the main elements of a closed control system.

**b)** (i) Explain what is meant by Transfer function

(2mks)

(4mks)

(2mks)

(10mks)

(2mks)

(ii)

Given the following system:

*H* (*s*)

*x*(*s*) 3

*u*(*s*) 0.5*s* 1

Find the differential equation from the transfer function hence draw a block diagram of the

system

**Question Three (20mks)**

**a)** The diagram below show a form of a speed governor for a steam engine.

(i) Explain how it controls the speed of the engine

(ii) Sketch a block diagram of all elements

**b)** Design an automatic water flushing system that can be used to for domestic use

**c)** The figure below shows an industrial production of sheets of metal

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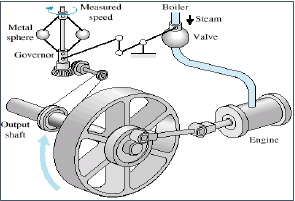
(4mks)

(4mks)

(4mks)

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(6mks)





(i) Explain how it works in controlling the sheet thickness

(ii) Explain the all the elements of control depicted in the diagram

**Question Four (20mks)**

Indicate the basic and auxiliary functional elements of the device shown below in parts (a) to (b)

(4mks)

(4mks)

**a)** Diaphragm type liquid level gauge

**b)** A spring balance with electrical read out

**c)** Mechanical type of displacement measuring dial gauge

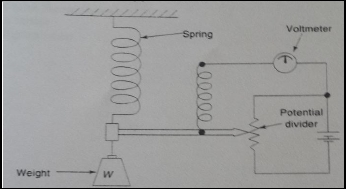
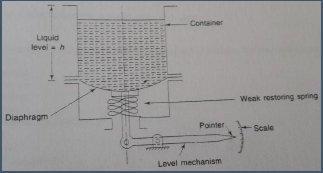
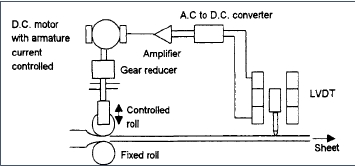
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(6mks)

(7mks)

(7mks)



**Question 5 (20 marks)**

For the system with the block diagram shown below and taking 𝐾 = 200

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K

+

u(t)

1

10𝐷

c(t)

Controller

Find the

**a)** The closed loop transfer function

**b)** Transient response for the unit step reference input 𝑟(𝑡)

**c)** Steady state error for the unit ramp reference input 𝑟(𝑡)

**d)** Steady state error for the unit step disturbance input 𝑢(𝑡)

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System

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(3mks)

(5mks)

(6mks)

(6mks)

