

TECHNICAL UNIVERSITY OF KENYA

FACULTY OF APPLIED SCIENCES AND TECHNOLOGY

SCHOOL OF COMPUTING & INFORMATION TECHNOLOGY

END OF SEMESTER EXAMINATION SERIES

SECOND SEMESTER EXAMINATIONS 2018/2019

THIRD YEAR EXAMINATIONS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY IN INFORMATION TECHNOLOGY

BACHELOR OF TECHNOLOGY IN COMPUTER TECHNOLOGY

BACHELOR OF TECHNOLOGY IN COMMUNICATION AND COMPUTER NETWORKS

**ECSI 3203 DIGITALCONTROL ENGINEERING**

TIME: 2 Hours

**Instructions to candidates:**

This paper consists of FIVE Questions.

Answer Question ONE [30 Marks] and any other TWO Questions [20 Marks Each].

Write your college number on the answer sheet.

This paper consists of 5 printed pages

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**

**QUESTION ONE [COMPULSORY: 30 MARKS]**

a) Briefly explain the meaning of the following terms as used in control systems engineering:

1. Follow up Control system
2. Closed loop control system with Negative Feedback
3. Digital Control system
4. Digital regulator control system
5. Transfer function
6. A Unity Feedback control System

**(12 Marks)**

b) Explain with the aid neat sketches the principle of operation of the following devices:

i) Successive approximation 4 bit-Analog- to -digital converter

ii) A 4 -bit digital -to -analog converter (DAC) using weighted resistors

**(4 Marks)**

**c)** Obtain the z- transform of unit-step function delayed by 4 sampling periods.

**(4 Marks)**

d) Derive the following quantities from the Canonical block diagram of a closed loop control system.in terms of G and H.

1. C/R.
2. E/R.
3. B/R

**(6 Marks)**

f) Use block simplification techniques to simplify the system represented by the block diagram in Fig Q1f.



Fig Q1f.

**(4 Marks**)

**QUESTION TWO [20 MARKS**

a) Describe the sampling process in a digital control system**. (6 Marks)**

b) A microprocessor gives an output of an 8-bit word. This is fed through an 8-bit digital-to-analogue converter to a control valve which requires 6.0 V to be fully open. If the fully open state is to be indicated by the output of the digital word 11111111 what will be the change in output to the valve when there is a change of 1 bit?

**(6 Marks)**

c) Explain using a labeled block diagram of a control system what is meant by the canonical form of a closed loop control system. **(3 Marks)**

d) Find the transfer function of the system shown in Fig.Q2 (d)

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**QUESTION THREE [20 MARKS**

a) Determine:

i) The maximum frequency of a 12 bit analog to digital converter (ADC) having a conversion time *t,* of 0.25µs.

**(4 Marks)**

ii) The transfer function of the system shown in equation below, using Laplace transformation technique where *θo  is the output signal and θi is the input signal*

**(4 Marks**)

b) Describe with the help of a block diagram the principle of operation of a digitally controlled room heating system.

(8 Marks)

b) Determine the output *Y(s)* of the system shown in FigQ4b when there is an input *X(s)* to the system as a whole and a disturbance signal *D(s)* at the point indicated by showing all steps clearly.



**(8 Marks)**

c) Find

When

(4 Marks)

**QUESTION FOUR (20 MARKS)**

a) Describe briefly

i) Classification of optical fibres in terms of refractive index profile

ii) The components in an optical fibre communication system block diagram.

**(6 Marks)**

b) Calculate the z transform of



**(3 Marks)**

c) Draw the equivalent block diagram of figure Q4c



Figure Q4c

**(3 Marks)**

b) Briefly define and illustrate with the aid of labeled diagrams the following types of signals used in control engineering:

1. Continuous-time analogue signal
2. Continuous-time quantized signal
3. Sampled-data signal
4. Digital signal

**(8 Marks)**

**QUESTION FIVE (20 MARKS)**

1. Describe the classification of optical fibres in terms of :
2. Materials

ii) Transmitted modes b) (6 Marks



(**14 Marks)**