

UNIVERSITY OF SWAZILAND
FACULTY OF SCIENCE
DEPARTMENT OF ELECTRONIC ENGINEERING

SUPPLEMENTARY EXAMINATION JULY 2007

TITLE OF PAPER: LINEAR SYSTEMS

COURSE CODE: E352

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1. Answer all four questions.
2. Each Question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin

This paper has 6 pages including this page.

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Question 1

- A) (I) What is of a causal system? (3 marks)
(II) Define linearity in relation to linear systems. (3 marks)
(III) What is the difference between continuous time systems and discrete time systems? (4 marks)
- (III) Does the system $y(k) = \frac{1}{2}u(k) + u(k-1)$ satisfy the property of superposition?
(5 marks)
- B) Draw a model of an armature - controlled dc motor with a constant field current.
Label all necessary parameter. (10 marks)

Question 2

A non-linear amplifier is described by the following characteristic:

$$v_o(t) = \begin{cases} v_{in}^2 & v_{in} \geq 0 \\ -v_{in}^2 & v_{in} < 0 \end{cases}$$

This amplifier is operated over a range for v_{in} of ± 0.5 volts at the operating point.

Determine the linear approximation of this amplifier. (25 marks)

Question 3

A) Define Mason's gain rule (Mason's signal-flow gain formula) and what is this rule used for?

(13 marks)

B) Define rise time for (i) a first order system, and
(ii) for a second order system.

(12 marks)

Question 4

Use phase variable format to obtain state variable equations for whose transfer function is

$$\frac{Y(s)}{R(s)} = \frac{s(s+10)+20}{(s+0.5)(s+2)^2} \quad (25 \text{ marks})$$