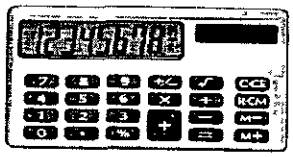
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

CSY3601

January/February 2017

CONTROL SYSTEMS III (THEORY)

Duration 3 Hours

100 Marks

EXAMINERS

FIRST	PROF Z WANG
SECOND	DR X YE
EXTERNAL	DR AA YUSUFF

Programmable pocket calculator is permissible

Closed book examination

This examination question paper consists of 3 pages including this "cover" page,

Partial Open book exam Ogata, K Modern Control Engineering

Answer all the questions

PLEASE NOTE: IF YOU HAVE THE OPINION THAT INSUFFICIENT INFORMATION IS SUPPLIED FOR YOU TO ANSWER A PARTICULAR QUESTION, MAKE A REALISTIC ASSUMPTION, MOTIVATE IT AND THEN ANSWER THE QUESTION.

QUESTION 1

Consider the circuit shown in Figure 1

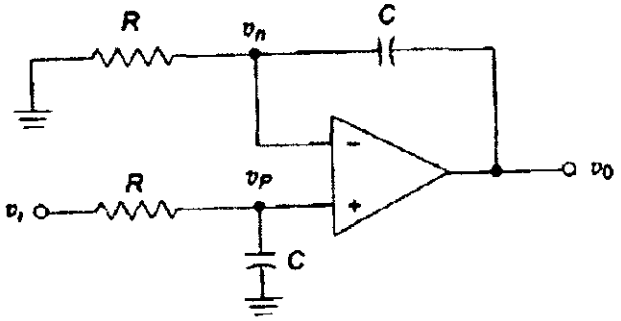


Figure 1: Circuit for Question 1

Find the transfer function $H(s)=\frac{V_o(s)}{V_i(s)}$ of this system

[18]

QUESTION 2

The dynamic equation of a second order system is given by

$$\frac{d^2y(t)}{dt^2}+\frac{4dy(t)}{dt}+16y(t)=16x(t),$$

and all initials are zero

Determine:

2.1 Transfer function $G(s)=\frac{Y(s)}{X(s)}$, (5)

2.2 Damping factor ξ, (3)

2.3 Undamped natural frequency ω_n, (3)

2.4 Damped natural frequency ω_d, (3)

2.5 Delay time t_d, (3)

2.6 Rise time t_r, (3)

2.7 Peak time t_p; (3)

[TURN OVER]

2.8 Maximum overshoot M_p, (3)

2 9 Settling time t_s (5% criterion) (3)
[29]

QUESTION 3
The open-loop transfer function G(s) of a unity negative feedback system is given by

$$G(s)=\frac{K}{s(s+2)(s+4)}$$

3 1 Calculate the break-away points (8)

3 2 Determine the $j\omega$-axis crossings and the gain, K, at the $j\omega$-axis crossing based on the Routh's stability criterion (13)

3 3 Sketch the root locus (12)
[33]

QUESTION 4

The open loop transfer function of a unity feedback system is given by

$$G(s)=\frac{2\times10^2 s(s+2)}{(s+1)\ (s+20)}$$

Sketch the Bode diagrams of the system using the asymptotic method.

Hint the procedure is necessary

[20]

TOTAL: 100