PROGRAM	:	NATIONAL DIPLOMA *ELECTRICAL ENGINEERING*
SUBJECT	:	**CONTROL SYSTEMS 2**
CODE	:	**ASY211**
DATE	:	JUNE EXAMINATION 12 JUNE 2015
DURATION	:	(SESSION 1) 08:30 – 11:30
WEIGHT	:	40 : 60
FULL MARKS	:	100

EXAMINER	:	MR BA KLETTE
MODERATOR	:	MR DR VAN NIEKERK
NUMBER OF PAGES	:	5 PAGES AND 3 ANNEXURE

2330

INSTRUCTIONS	:	POCKET CALCULATORS PERMITTED
REQUIREMENTS	:	NONE

INSTRUCTIONS TO CANDIDATES:

1. DETAILED WAVEFORMS AND CIRCUIT DIAGRAMS ARE REQUIRED FOR ALL MATHEMATICAL DEDUCTIONS, CALCULATIONS AND CIRCUIT-THEORY OR DEVICE-THEORY DESCRIPTIONS.
2. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.
3. ALL WORK MUST BE WELL PRESENTED IN YOUR EXAMINATION SCRIPT
4. ANY ASSUMPTIONS MADE SHOULD BE STATED CLEARLY.
5. ONLY DRAWINGS MAY BE IN PENCIL
6. POCKET CALCULATORS ARE PERMITTED BUT NO INFORMATION BOOKLETS ARE ALLOWED
7. QUESTIONS THAT ARE NOT CLEARLY NUMBERED WILL NOT BE MARKED
8. KEEP PARTS OF THE QUESTION TOGETHER AND WORK FROM TOP TO BOTTOM AND NOT ALL OVER THE PAGE

QUESTION 1

1.1

1.1.1 Draw and label a diagram of a closed-loop, positive feedback system in the canonical form. (2)

1.1.2 Derive the closed-loop transfer function for this system (3)

1.2 The below figure shows a signal flow diagram. By making use of Mason's Rule, determine the transfer function. (8)

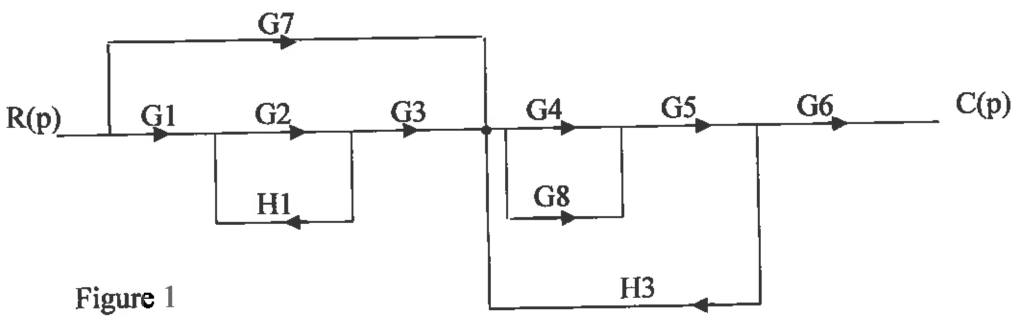


Figure 1

1.3 The below figure shows a block diagram of a flow control loop. Determine the transfer function C/R for the system using **Kirchoff's Method ONLY.** Use **X** (in the below figure) as the unknown signal. (10)

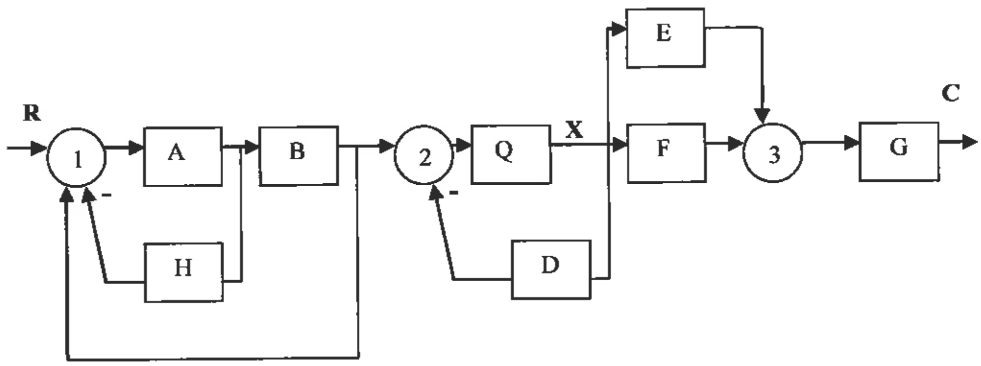


Figure 2

1.4 Determine the transfer function (C/R) of the below figure using the Block Diagram Reduction method **ONLY.** (8)

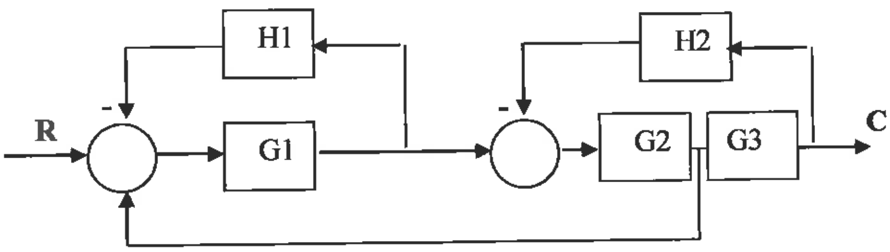
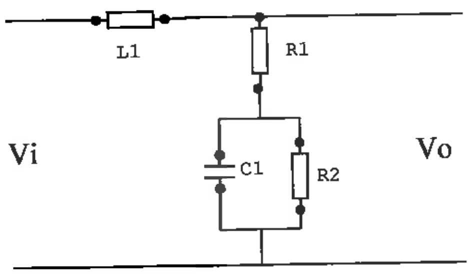


Figure 3

[31]

QUESTION 2

2.1 Determine the transfer function for the below passive network. (7)



2.2 A network has a transfer function of $G(p) = \frac{1}{p^2 + 6p + 62}$

2.2.1 Determine the transient response of the network to a step input of 10 Volts and express the output as a function of time. (12)

2.2.2 Determine the corresponding voltage at time, t = 0.05s (2)

2.3 For each of the following transfer functions find:

i) Wn
ii) Damping ratio
iii) Classify the systems in terms of overdamped, underdamped, critically damped or undamped.

2.3.1 $\frac{C}{R} = \frac{500}{P^2+10P+500}$ (3)

2.3.2 $\frac{C}{R} = \frac{800}{P^2+80P+800}$ (3)

2.3.3 $\frac{C}{R} = \frac{225}{P^2+30P+225}$ (3)

2.4 A second order system has a natural frequency of 3 Hz and a damped frequency of 2.1 Hz. What, for this damping, is:

2.4.1 The damping coefficient. (4)

2.4.2 The percentage maximum overshoot. (2)

2.4.3 The 2% and 5% settling times. (2)

2.4.4 The number of cycles of oscillations that will occur within this settling time. (2)

2.5

2.5.1 Describe the concept of the decibel. (3)

2.5.2 The transfer function of the forward path of a closed-loop system is given by:

$$G_{(P)} = \frac{300p(p^2 + 5p + 4)}{(p + 20)^2 (p + 70)}$$

The transfer function of the feedback path is:

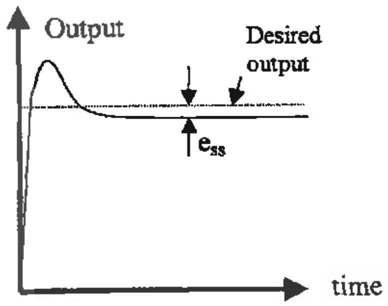
$$H_{(P)} = \frac{1}{(p + 1)}$$

Plot the bode diagram consulting of gain and phase components on the graph paper by making use of the straight line approximation method. (14)

[57]

QUESTION 3

3.1 Consider the following transient response of a system:



Which control mode should be used in order to reduce or compensate for the steady state? Give reasons for your answer by making reference to the definition of the particular control mode.

Name one disadvantage of this particular control mode. (4)

3.2 Explain Proportional and Integral control modes (4)
3.3 Why can differential control not be used on its own (1)
3.4 Draw a block diagram of a three-term controller incorporated in a plant, label all the blocks. (5)

[14]

TOTAL = 102

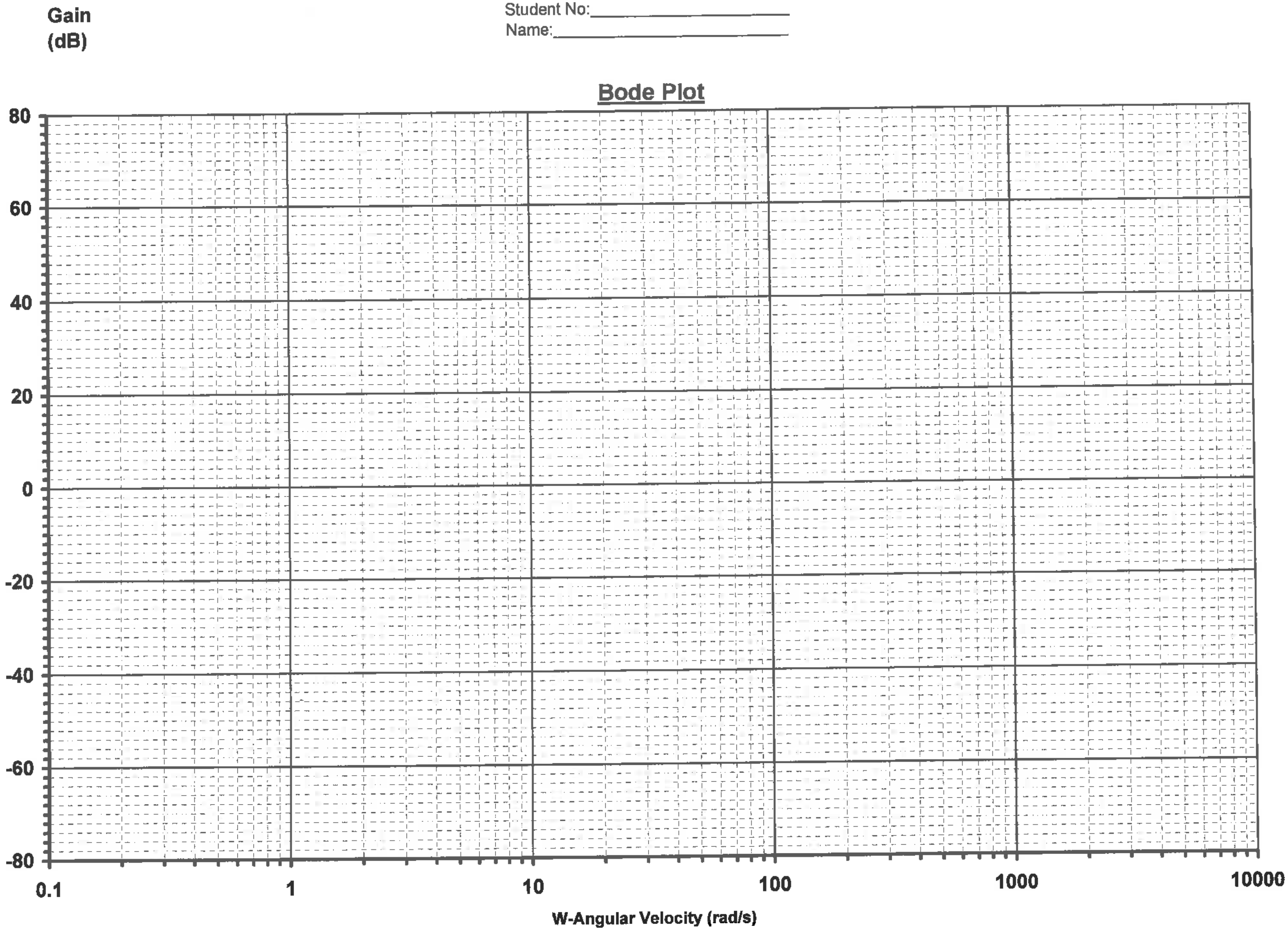
Annexure A

Laplace Transforms

TIME FUNCTION f(t)	LAPLACE FUNCTION F(p)
Unit impulse	1
Unit step	$\frac{1}{p}$
Unit ramp	$\frac{1}{p^2}$
Unit parabolic	$\frac{1}{p^3}$
Exponential (e^{-at})	$\frac{1}{p+a}$
Sinusoidal ($\sin(\omega t)$)	$\frac{\omega}{p^2+\omega^2}$
Co-sinusoidal ($\cos(\omega t)$)	$\frac{p}{p^2+\omega^2}$
$\frac{1}{(n-1)!}t^{n-1}e^{-at}$	$\frac{1}{(p+a)^n}$
$e^{-at}\sin(\omega t)$	$\frac{\omega}{(p+a)^2+\omega^2}$
$e^{-at}\cos(\omega t)$	$\frac{p+a}{(p+a)^2+\omega^2}$

Student No:____________________
Name:_______________________

Bode Plot



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Name:_______________________

Phase (Deg)

Bode Plot