PROGRAM	:	NATIONAL DIPLOMA *ELECTRICAL ENGINEERING*
SUBJECT	:	**CONTROL SYSTEMS 2**
CODE	:	**ASY211**
DATE	:	JUNE EXAMINATION 13 JUNE 2014
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 CALCULTATORS 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 Define the following terms as applied to control systems:

1.1.1 Transfer Function (3)

1.1.2 Frequency Response (3)

1.1.3 Unstable System (2)

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

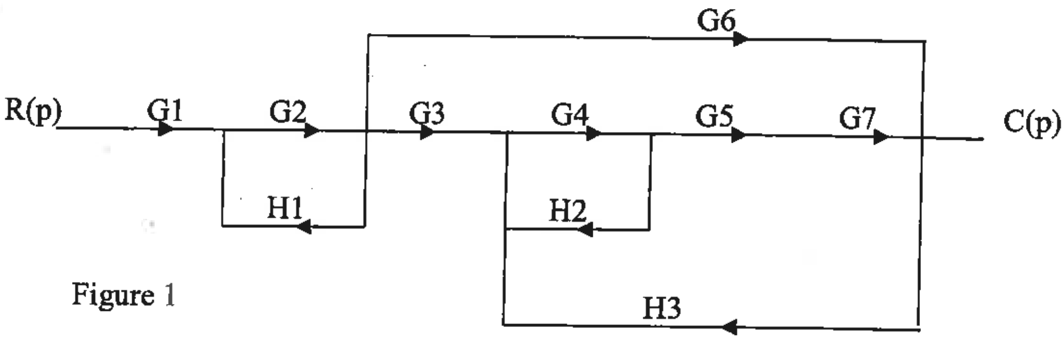


Figure 1

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. Use summing junctions 1 and 3 to solve for **X.** (9)

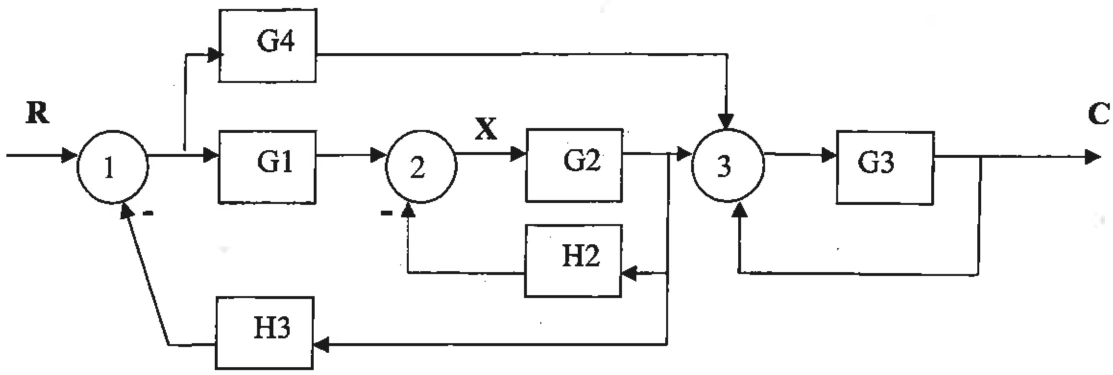


Figure 2

[25]

QUESTION 2

2.1 An electrical network consists of a capacitor, inductor and resistor connected in series with the output across the capacitor. The values of the components are as follows:
R=100 ohm
L=10 mill Henry
C= 0.1 micro Farad

2.1.1 Determine the transfer function of the circuit (3)
2.1.2 If a 1V step input is applied determine the output in terms of time. (12)

2.2 In the under damped circuit in 2.1 and by making use of the standard equation, determine the following:

2.2.1 The natural undamped frequency (2)
2.2.2 The damping coefficient (2)
2.2.3 Maximum overshoot (3)
2.2.4 Peak time (3)
2.2.5 Settling time (2% and 5%) (3)

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 $\frac{C}{R} = \frac{300}{P^2 + 9P + 300}$ (3)

2.3.2 $\frac{C}{R} = \frac{1900}{P^2 + 180P + 1900}$ (3)

2.3.3 $\frac{C}{R} = \frac{400}{P^2 + 40P + 400}$ (3)

2.4 Determine the transfer function for the passive network in Figure 4. (7)

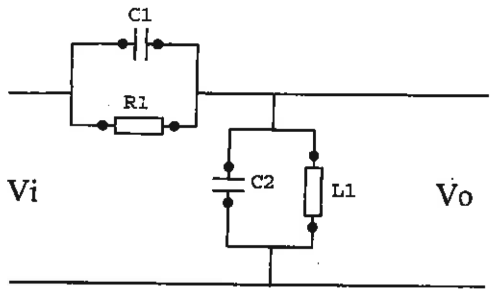


Figure 4

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:

$$G_{(P)} = \frac{P(P^2 + 5P + 6)}{(P+3)(P+80)}$$

The transfer function of the feedback path is:

$$H_{(P)} = \frac{(P+200)^2}{20P^3}$$

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

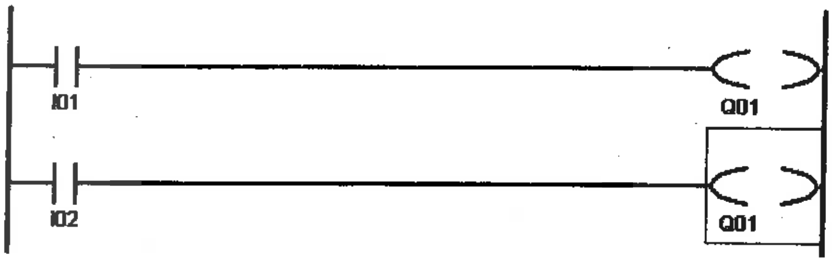
[61]

QUESTION 3

3.1 If in the below figure, toggle switch I01 is an open switch and toggle switch I02 is a closed switch:

3.1.1 What will the state of output Q01 be? (1)

3.1.2 Describe in point form why this is the case. (4)



3.2

3.2.1 Define the three main control modes of an automatic industrial controller. (3)

3.2.2 Name three possible types of signal standards employed in automatic industrial controllers. (3)

3.2.3 Name six different considerations that might influence the kind of controller used in a plant. (3)

[14]

TOTAL = 100

Annexure A

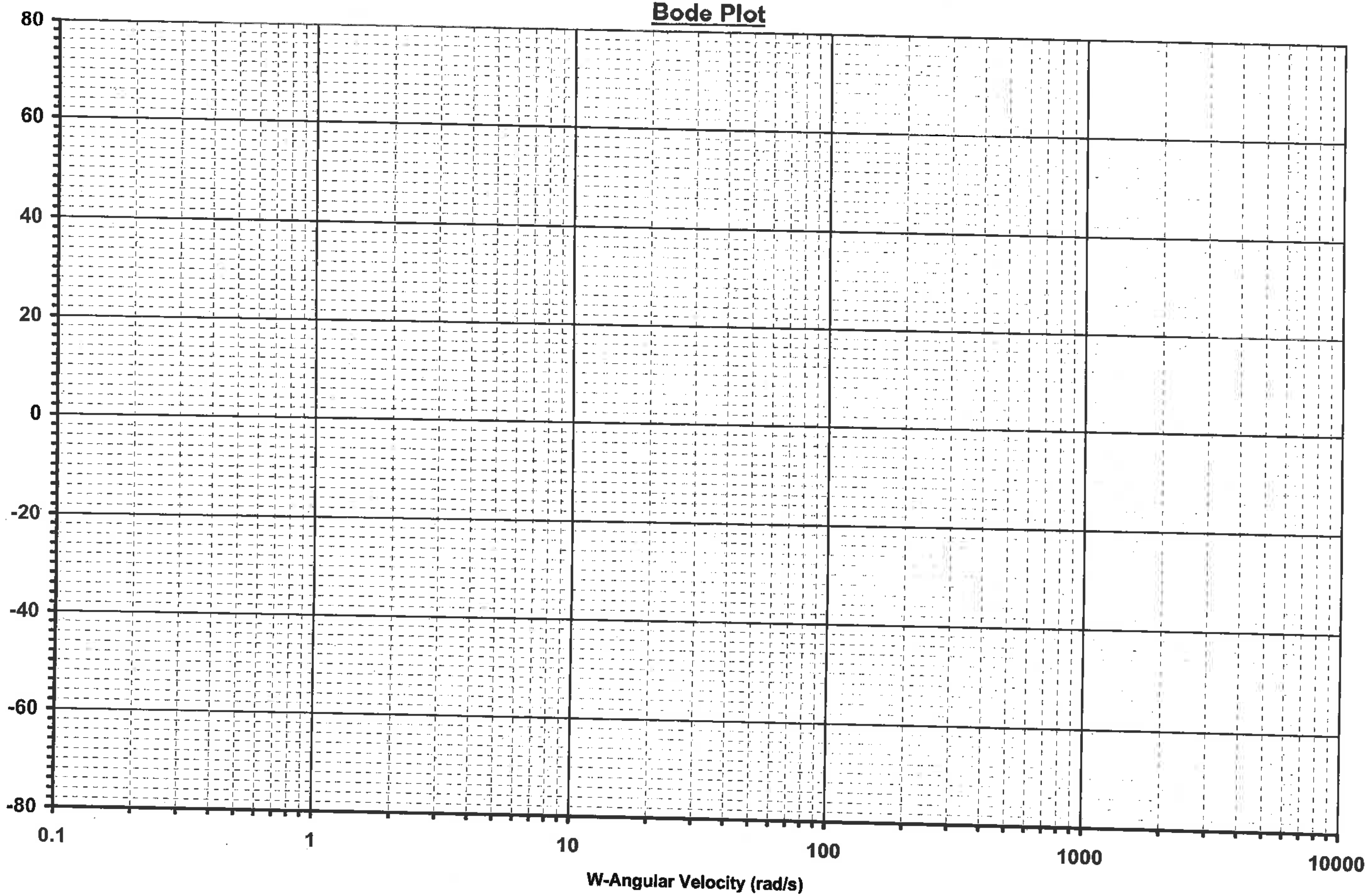
Laplace Transforms

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 ($\cos(\omega t)$)	$\frac{p}{p^2+\omega^2}$
$\frac{1}{(n-1)!}t^{n-1}e^{-at}$	$\frac{1}{(p+a)^n}$
$e^{-at}\sin(\omega t)$	$\frac{\omega}{(p+a)^2+\omega^2}$
$e^{-at}\cos(\omega t)$	$\frac{p+a}{(p+a)^2+\omega^2}$

Gain
(dB)

Student No:______________
Name:______________

Bode Plot



Student No:____________________

Name:____________________

Bode Plot