UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY [**BEng Tech**] IN ELECTRICAL ENGINEERING. B6ELEQ & B6ELXQ
MODULE	:	**CONTROL SYSTEMS ENGINEERING 3B**
CODE	:	**CTLELB3**
DATE	:	SUMMER SUPPLEMENTARY EXAMINATION JANUARY 2020
DURATION	:	3 HOURS
WEIGHT	:	40 : 60
NQF	:	7
TOTAL MARKS	:	100

EXAMINER	:	PROF THOKOZANI C SHONGWE
MODERATOR	:	J. SEBASTIAN
NUMBER OF PAGES	:	4 PAGES, INCLUDING 1 FORMULAE SHEET

INSTRUCTIONS	:	CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)
	:	USE ONLY THE ANSWER SHEET PROVIDED WITH THIS PAPER

INSTRUCTIONS TO CANDIDATES:

1. 100 MARKS = 100%

2. ATTEMPT ALL QUESTIONS.

3. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.

4. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF QUESTION MUST BE KEPT TOGETHER.

5. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND IN PROPORTION.

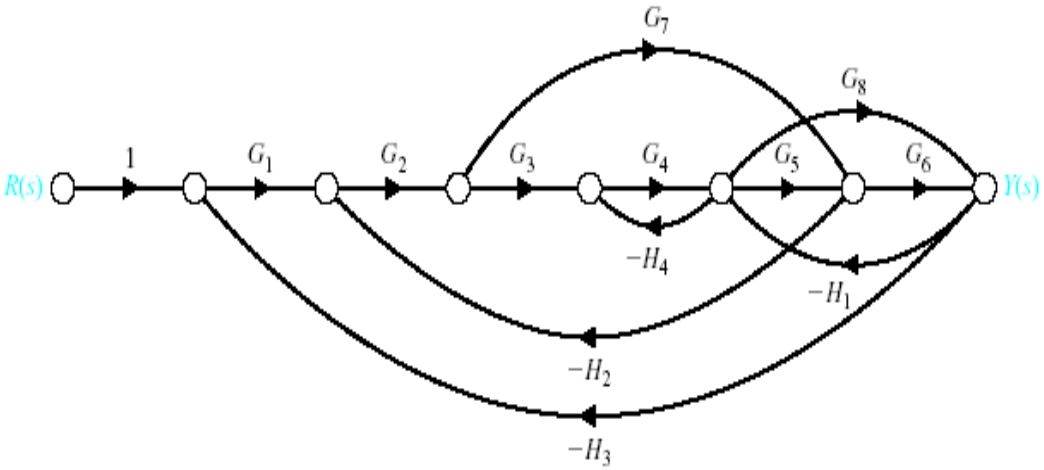
6. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.

7. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK.

8. NOTE: MARKS WILL BE DEDUCTED FOR WORK WHICH IS POORLY PRESENTED.

9. NEGATIVE MARKING APPLIES IF YOUR ANSWER DOES NOT COMPLY WITH THE DETAIL REQUIRED AS REQUESTED IN CERTAIN QUESTIONS.

QUESTION 1



Formulate the transfer function of the diagram above, using **Mason's Rule.**

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QUESTION 2

A network has a transfer function of

$$G(p) = \frac{1}{p^2+6p+62}.$$

Formulate the transient response of the network to a step input of 10 Volts and express the output as a function of time.

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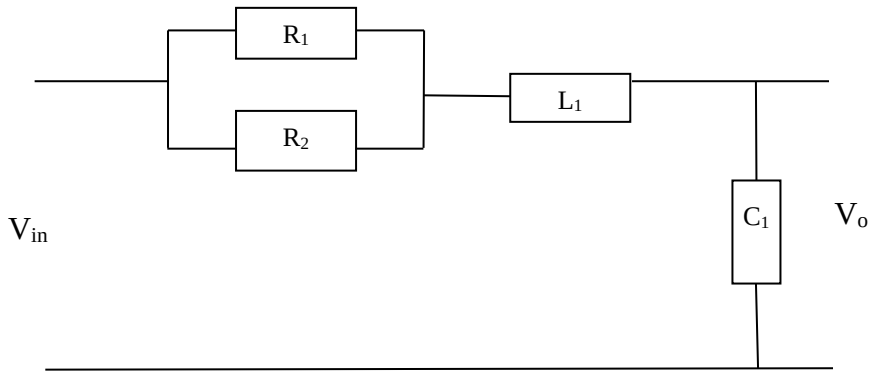
QUESTION 3

Consider the passive network below and:

(a) Formulate the transfer function of the passive network below in terms of R_1, R_2, L_1 and C_1. (16)

(b) Formulate the transient response $V_o(t)$ of the network if it is subjected to $V_i(t)$ which is a ***unit step*** input, if R_1 = 2 kΩ, R_2 = 2 kΩ, C_1= 0.1 μF and L_1 = 10 mH. (24)

(c) Formulate the transient response $V_o(t)$ of the network if it is subjected to $V_i(t)$ which is a ***unit impulse*** input, if R_1 = 3 kΩ, R_2 = 1.5 kΩ, C_1= 100 nF and L_1 = 10 mH. (27)



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TOTAL MARKS : 100

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