UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	CONTROL SYSTEM
COURSE CODE	:	DAE 32103
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

TERBUKA

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) The control system can be described into **two (2)** configuration and types. State any **two (2)** real applications for both types of control system.

(4 marks)

(b) Discuss the meaning for following term in control system classification

(i) Analog
(ii) Sequential Control
(iii) Time-variant

(6 marks)

(c) An aircraft's attitude varies in roll, pitch, and yaw as defined in **Figure Q1(c)**. The system measures the actual roll angle with a gyro and compares the actual roll angle with the desired roll angle. The ailerons respond to the roll-angle error by undergoing an angular deflection. The aircraft responds to this angular deflection, producing a roll angle rate.

(i) Classify the input and output transducers, the controller, and the plant.

(4 marks)

(ii) Develop a functional block diagram for a closed-loop system that stabilizes the roll as the system has been set up.

(6 marks)

Q2 (a) State two (2) differences between translational and rotational motion in mechanical element modelling.

(4 marks)

(b) Explain the main difference between rigid and flexible shaft in terms of angular and velocity displacement with reference to rotational mechanical elements.

(4 marks)

(c) Find the transfer function, G(s) = X1(s)/F(s), for the translational mechanical system shown in Figure Q2(c).

(12 marks)

Q3 (a) **Figure Q3(a)** shows a block diagram of a system. Find the equivalent transfer function, G(s) = Y(s)/X(s). Show your reduction steps

(8 marks)

(b) The stability of a system response can be determined by finding the location of poles in the transfer function.

(i) Sketch the location of poles in s-plane and state its stability.

(6 marks)

(ii) Determine the zeros and poles for the following transfer function.

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

(5 marks)

(iii) State the system response stability in **Q3(b)(ii).**

(1 mark)

Q4 (a) Distinguish between analog control system and digital control system by.

(i) Draw the system block diagram for both system.

(5 marks)

(ii) Explain the diagram illustrated in **Q4(a)(i)**.

(4 marks)

(b) Sketch the input or output signal form of the labelled block diagram in **Figure Q4(b)**.

(4 marks)

(c) Find the output of decimal value of 8-bit ADC if the voltage input is 5V with range is 12V.

(3 marks)

(d) Calculate the 10-bit DAC resolution and find the binary value of the input if the output is 8V over $12V_{ref}$.

(4 marks)

Q5 (a) Process control is an engineering discipline that deals with architectures, mechanisms and algorithms for maintaining the output of a specific process within a desired range.

(i) Differentiate between sequential control and continuous control.

(4 marks)

(ii) **Figure Q5(a)(ii)** shows an example of continuous process control. Briefly explain the process flow.

(5 marks)

(b) The basic process control loops are open loop and closed loop control. However, there are also other control loops that can be implemented in process control.

(i) Name **two (2)** other process control loops.

(2 marks)

(ii) Draw the block diagrams for each loop in **Q5(b)(i).**

(6 marks)

(iii) Suggest the most suitable control loop for a process that involves blending and mixing as shown by **Figure Q5(b)(iii)**. Justify your answer.

(3 marks)

-END OF QUESTIONS –

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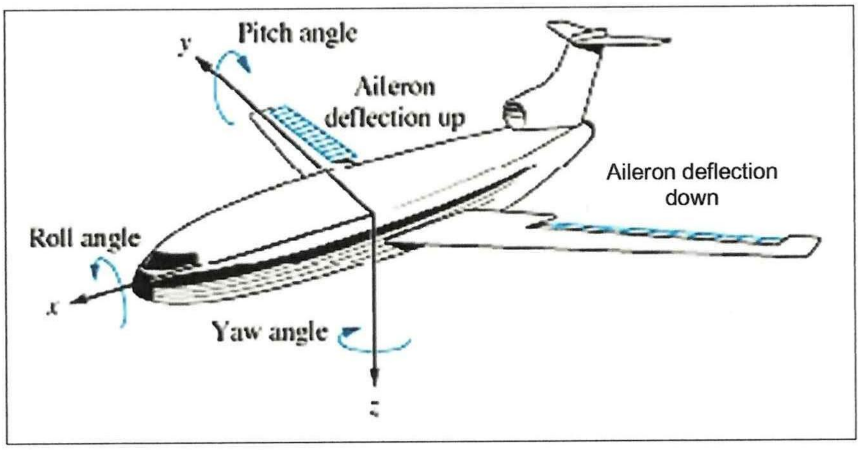

Figure Q1 (c)

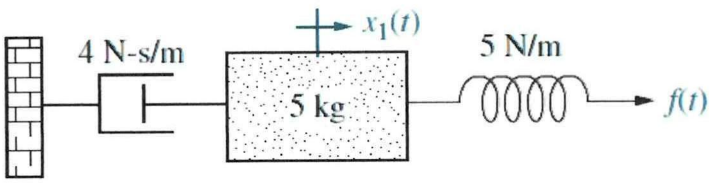

Figure Q2 (c)

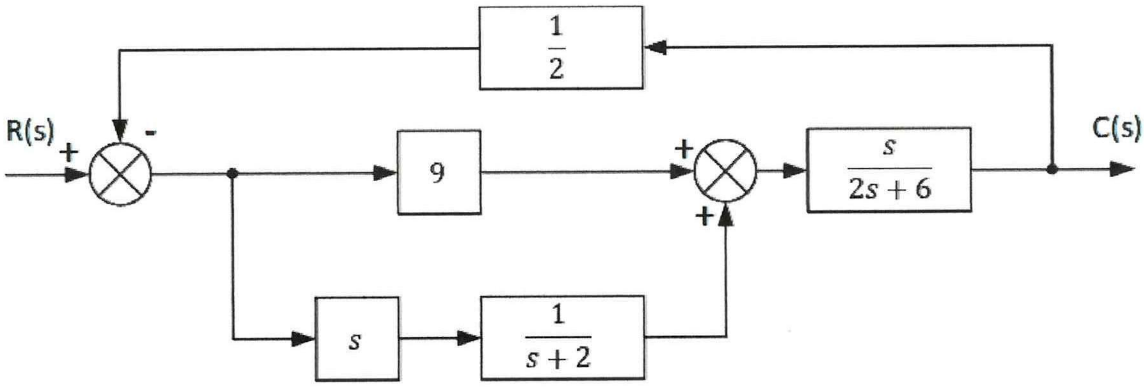

Figure Q3 (a)

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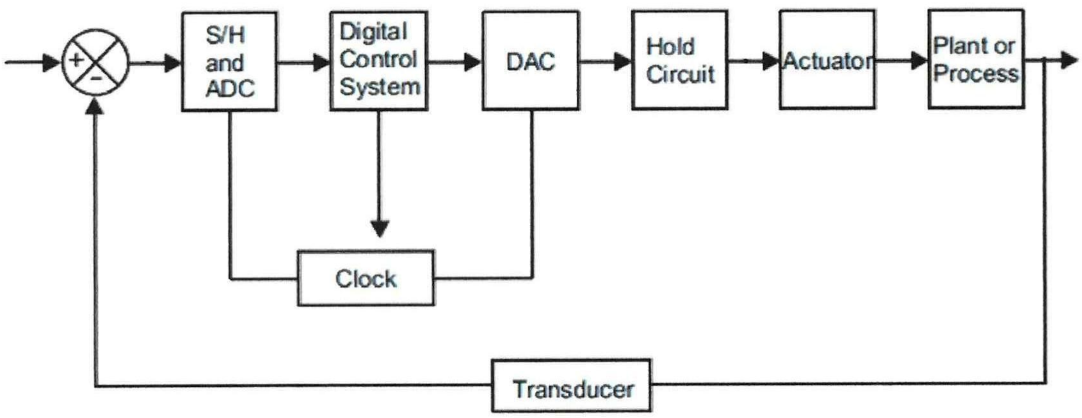

Figure Q4 (b)

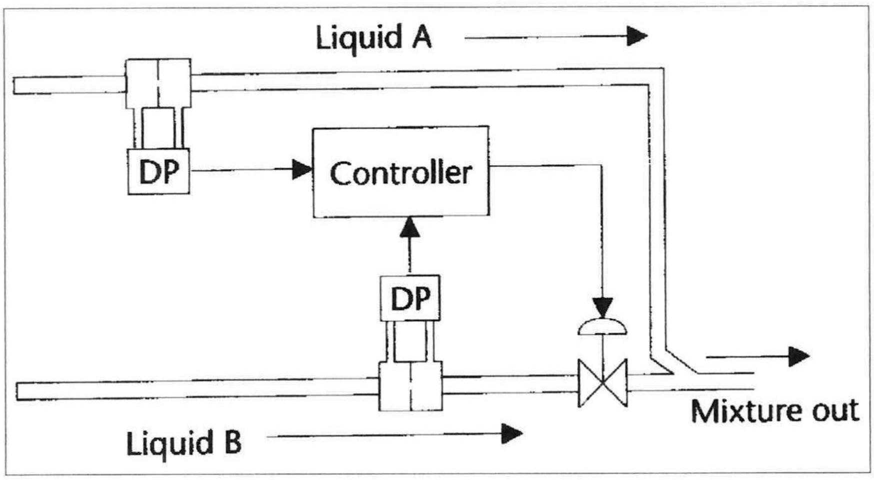

Figure Q5 (a)(ii)

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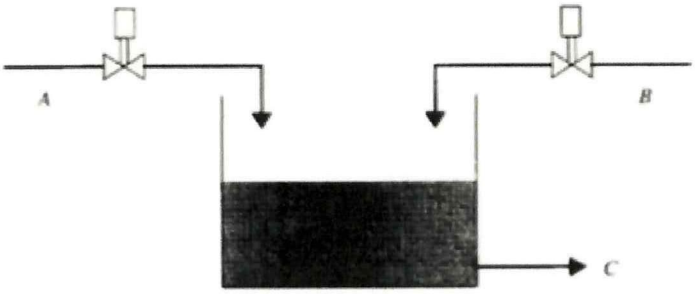

Figure Q5 (b)(iii)

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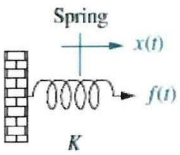
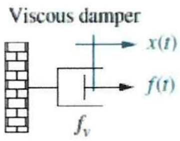
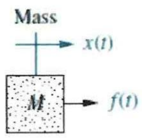
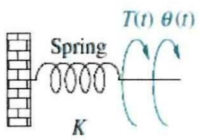
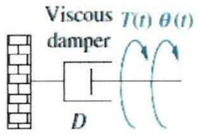
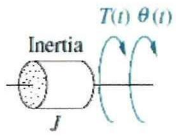
Component	Force-velocity	Force-displacement	Impedence $Z_M(s) = F(s)/X(s)$
	$f(t) = K\int_0^t v(\tau)d\tau$	$f(t) = Kx(t)$	K
	$f(t) = f_v v(t)$	$f(t) = f_v \frac{dx(t)}{dt}$	$f_v s$
	$f(t) = M\frac{dv(t)}{dt}$	$f(t) = M\frac{d^2x(t)}{dt^2}$	Ms^2

Component	Torque-angular velocity	Torque-angular displacement	Impedence $Z_M(s) = T(s)/\theta(s)$
	$T(t) = K\int_0^t \omega(\tau)d\tau$	$T(t) = K\theta(t)$	K
	$T(t) = D\omega(t)$	$T(t) = D\frac{d\theta(t)}{dt}$	Ds
	$T(t) = J\frac{d\omega(t)}{dt}$	$T(t) = J\frac{d^2\theta(t)}{dt^2}$	Js^2

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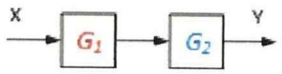
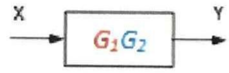
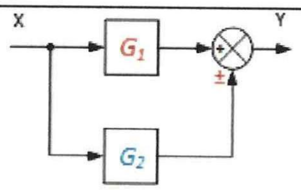
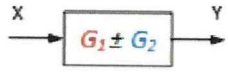
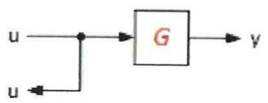
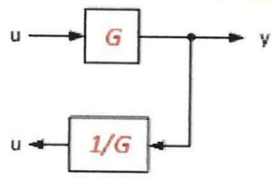
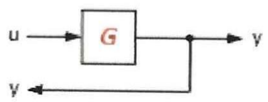
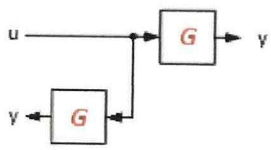
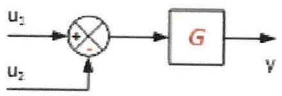
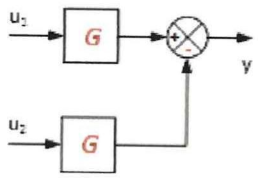
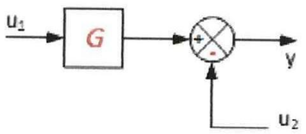
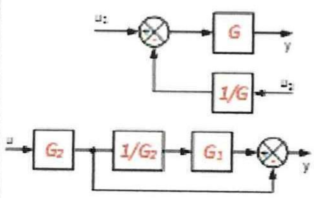
COURSE NAME : CONTROL SYSTEM COURSE CODE : DAE32103

Manipulation	Original Block Diagram	Equiv. Block Diagram	Equation
Cascade			$Y = (G_1 G_2)X$
Parallel			$Y = (G_1 \pm G_2)X$
Moving pickoff point behind a block			$y = Gu$ $u = \frac{1}{G}y$
Moving pickoff point ahead of a block			$y = Gu$
Moving a summing point behind a block			$y = G(u_1 - u_2)$
Moving a summing point ahead of a block			$y = Gu_1 - u_2$ $y = (G_1 - G_2)u$