



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023**

- COURSE NAME : CONTROL SYSTEM
- COURSE CODE : DAE 32103
- PROGRAMME CODE : DAE
- EXAMINATION DATE : JULY / AUGUST 2023
- DURATION : 2 HOURS 30 MINUTES
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
  2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
  3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA **CLOSED BOOK**

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

**TERBUKA**

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**Q1** Based on **Figure Q1**, answer the following:

- (a) Identify the type of control system. (2 marks)
- (b) Justify the answer in **Q1(a)(i)** (3 marks)
- (c) Illustrate the functional block diagram of the electrical tumble dryer. (5 marks)
- (d) List the input, the controller, the controller output, the process and the output of this system. (5 marks)
- (e) User plan to upgrade system in **Figure Q1** rather than use time baseline into a system that able monitor clothes cleanliness quality. Draw the function block diagram for new improvement above. (5 marks)

**Q2** (a) By using block diagram, describe transfer function applied in the Closed Loop System.

(5 marks)

(b) Given that transfer function as below

$$G(s) = \frac{s}{(s + 4)(s + 8)} \quad R(s) = \frac{1}{s^2}$$

- (i) Calculate system response . C(s) (5 marks)
- (ii) Identify the type of input function in the **Q2(b)(ii)** (1 mark)
- (iii) Sketch input function signal. (2 marks)
- (c) Reduce the block diagram shown in **Figure Q2(c)** into a single block diagram. (7 marks)

- Q3** (a) List **two (2)** analysis technique in s-Domain Circuit Analysis. (2 marks)
- (b) Discover the transfer function  $G(s)=(V_c(s))/(V(s))$  for the following RLC network using Mesh analysis. Given that the value of  $R_1 = R_2 = 1\Omega$  meanwhile L and C are as shown in **Figure Q3(b)**. (7 marks)
- (c) Given a spring-mass-damper system as shown in the **Figure Q3(c)**
- (i) Illustrate the free-body diagram of a system and assume the mass is traveling toward the right. (4 marks)
- (ii) Construct differential equation of motion using Newton's Law. (2 marks)
- (iii) Compute the transfer function. (5 marks)
- Q4** (a) Block diagram of 8 bit Analog to Digital Converter(ADC) is shown in **Figure Q4(a)**.
- (i) Briefly describe **three (3)** functions of ADC (6 marks)
- (ii) Sketch the output of ADC in the **Figure Q4(a)** (3 marks)
- (b) Describe the reason of digital control system is widely applied rather than analog control system in term
- (i) Cost
- (ii) Flexibility (4 marks)
- (c) User request a control system that able to measure the height of water in a 10-ft tall storage tank using an instrument with a 12-bit ADC.
- (i) Determine how much physical water level will be represented in each *step* of the ADC. (2 marks)
- (ii) If the 12-bit ADC in **Q4(c)(i)** has a maximum range of 24 V. Calculate the input voltage of the ADC and height of the water in the tank (in ft) if the output of the ADC is 1000 1111. (5 marks)

- Q5 (a) **Figure Q5(a)** shows unity feedback system for controlling temperature of steam distillation process.
- (i) Define the function of Proportional component and Integral component in PID controller. (3 marks)
  - (ii) Illustrate PID controller block diagram for the system when the parameters of the controller are given as:  
Proportional,  $K_p = 5$   
Integral,  $K_i = 1$   
Derivative,  $K_d = 2$  (5 marks)
  - (iii) If the Set Point (SP) = 85 °C and Process Variable (PV) = 79 °C, interpret the operation of the system. (4 marks)
- (c) **Figure Q5(b)** is an example of liquid tank storage control system.
- (i) Identify the type of control process applied in **Figure Q5(b)**. (1 mark)
  - (ii) Justify answer in **Q5(b)(i)** (2 marks)
  - (iii) Illustrate the functional block diagram. (5 Marks)

-END OF QUESTIONS -

**FINAL EXAMINATION**

SEMESTER / SESSION : SEM II 2022/2023  
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PROGRAMME CODE : DAE  
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**List of Formula : Laplace Transform Table**

$f(t), t \geq 0$	$F(s)$
1. $\delta(t)$	1
2. $u(t)$	$\frac{1}{s}$
3. $t$	$\frac{1}{s^2}$
4. $t^n$	$\frac{n!}{s^{n+1}}$
5. $e^{-at}$	$\frac{1}{s+a}$
6. $te^{-at}$	$\frac{1}{(s+a)^2}$
7. $t^n e^{-at}$	$\frac{n!}{(s+a)^{n+1}}$
8. $\sin bt$	$\frac{b}{s^2 + b^2}$
9. $\cos bt$	$\frac{s}{s^2 + b^2}$
10. $e^{-at} \sin bt$	$\frac{b}{(s+a)^2 + b^2}$
11. $e^{-at} \cos bt$	$\frac{s+a}{(s+a)^2 + b^2}$
12. $t \sin bt$	$\frac{2bs}{(s^2 + b^2)^2}$
13. $t \cos bt$	$\frac{s^2 - b^2}{(s^2 + b^2)^2}$

FINAL EXAMINATION

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List of Formula : Block Diagram Transformation

	Original Block Diagrams	Equivalent Block Diagrams
1		
2		
3		
4		
5		

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023  
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PROGRAMME CODE : DAE  
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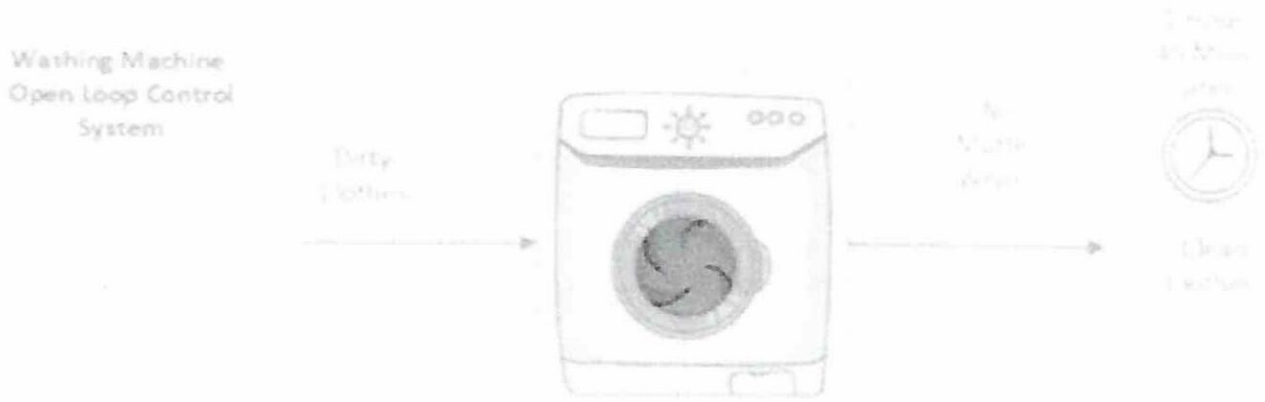


Figure Q1

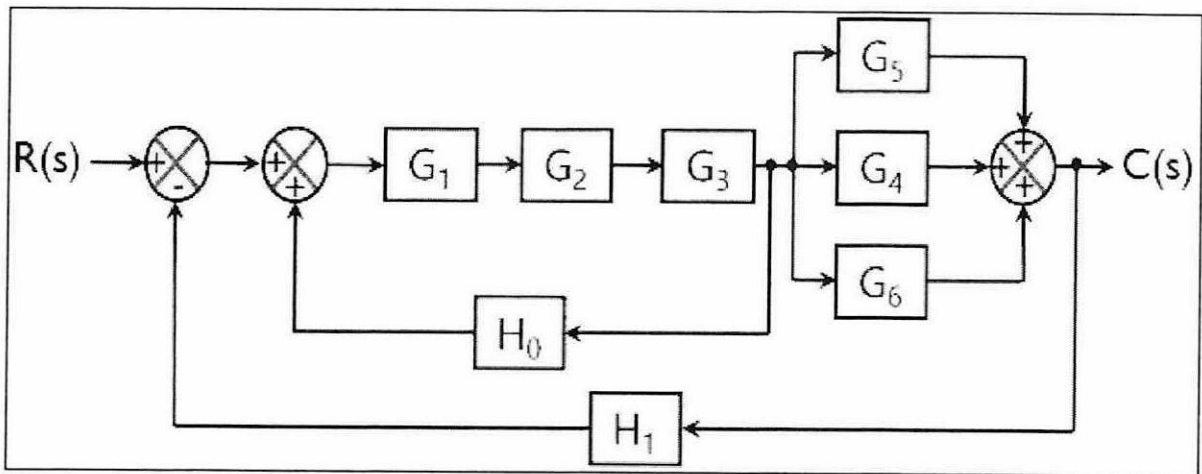
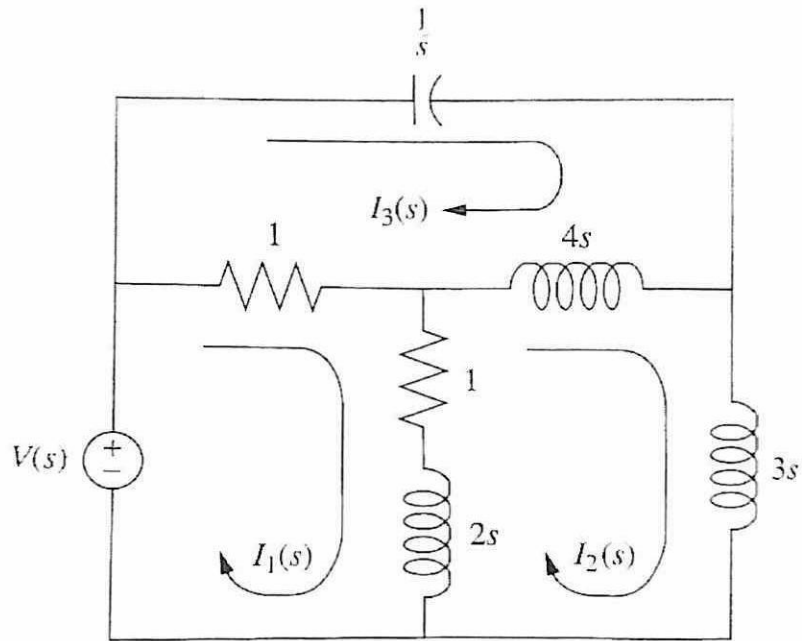


Figure Q2(b)

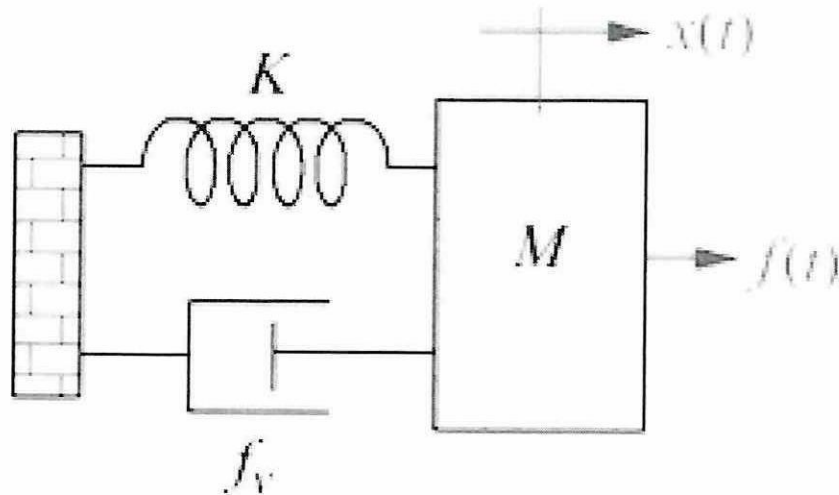
**FINAL EXAMINATION**

SEMESTER / SESSION : SEM II 2022/2023  
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PROGRAMME CODE : DAE  
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**Figure Q3(b)**



**Figure Q3(c)**



FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023  
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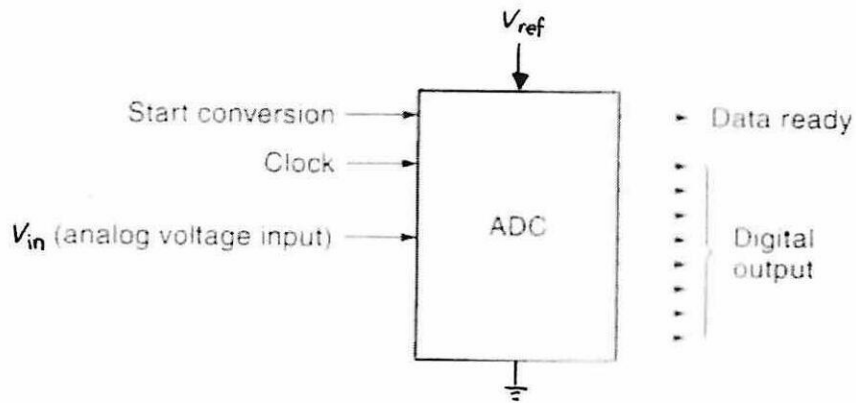


Figure Q4(a)

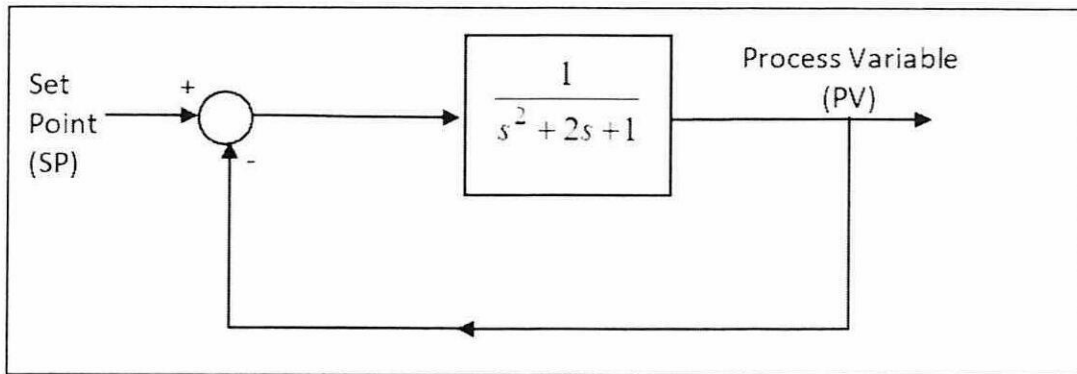


Figure Q5(a)

FINAL EXAMINATION

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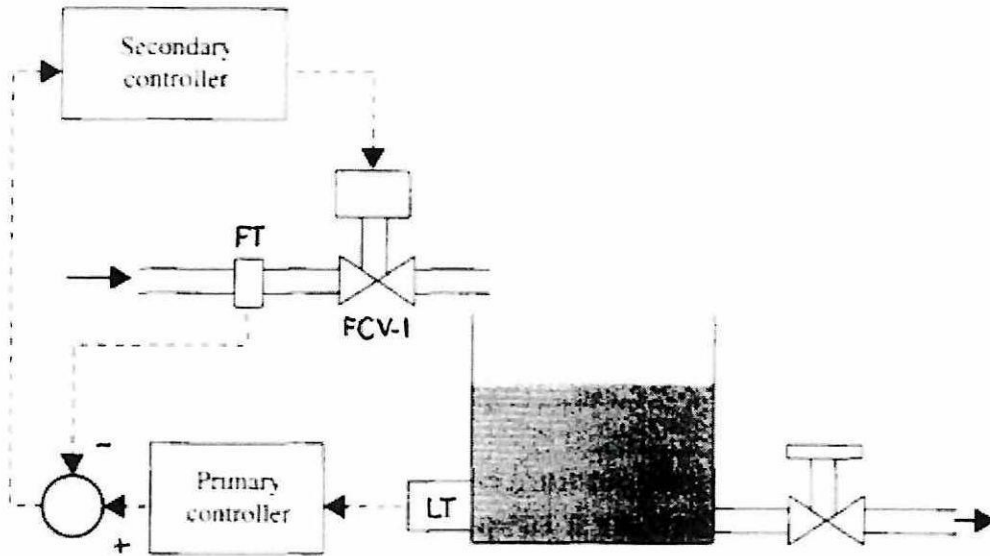


Figure Q5(b)