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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013**

COURSE NAME : MODELLING AND SIMULATION
COURSE CODE : BDC 4083
**PROGRAMME : BACHELOR IN MECHANICAL
ENGINEERING**
EXAMINATION DATE : JUNE 2013
DURATION : 2 HOURS 30 MINUTES
INSTRUCTIONS : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF FOUR (4) PRINTED PAGES

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Q1 a) A control system can be modeled in state-space representation. Explain the difference between *Space*, *Space Variable* and *Space Vector*. (5 marks)

b) A control block diagram in frequency domain of an engineering plant is shown in **FIGURE Q1**. In order to simulate the system's performance in terms of the plant output x_1 , controller output x_2 and sensor output, x_3 , please find the a state-space model of the system. (20 marks)

Q2 a) Consider the liquid-level system shown in **FIGURE Q2**. In the system, \bar{Q}_1 and \bar{Q}_2 are steady-state inflow rates and \bar{H}_1 and \bar{H}_2 are steady-state heads. The quantities q_{i1} , q_{i2} , h_1 , h_2 , q_1 , and q_o are considered small. Find the equations that relate C_1 and h_1 , R_1 and q_1 , C_2 and h_2 , h_2 and q_o . (5 marks)

b) Obtain a state-space representation for the system when h_1 and h_2 are the outputs and q_{i1} and q_{i2} are the inputs. (20 marks)

Q3 a) What is Non-linear System? Explain your answer with one (1) example. (5 marks)

b) A system is found to be non-linear in nature. This system however can be simplified as a linear system in the region defined by $2 \leq x \leq 4$, $10 \leq y \leq 12$. Please linearize the system in the said region if the nonlinear equation is given by,

$$z = x^2 + 8xy + 3y^2$$

(20 marks)

- Q4** a) Elaborate the procedure of both structure and parameter identifications when a system identification is performed.

(10 marks)

- b) A system is given a set of input X as shown in **TABLE Q4**. These inputs correspond to output data set Y respectively. Please perform system identification to the given data via least square method. Find also the trend values and show that,

$$\sum(Y - \hat{Y}) = 0,$$

TABLE Q4

X	1	2	3	4	5
Y	2	5	3	8	7

(15 marks)

FINAL EXAMINATION

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 COURSE CODE : BDC 40703

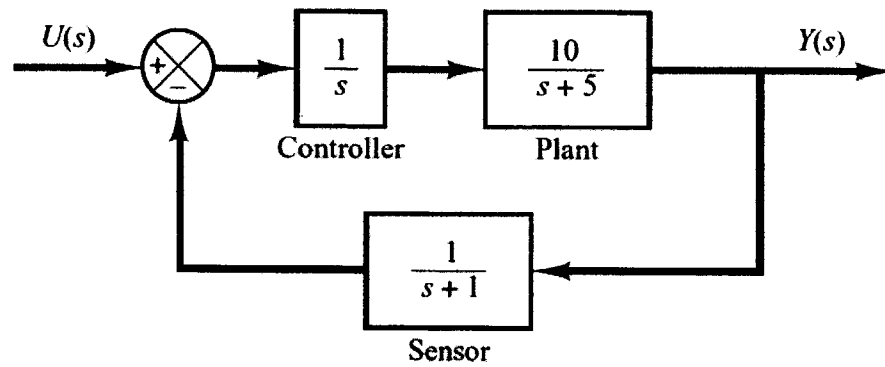


FIGURE Q1

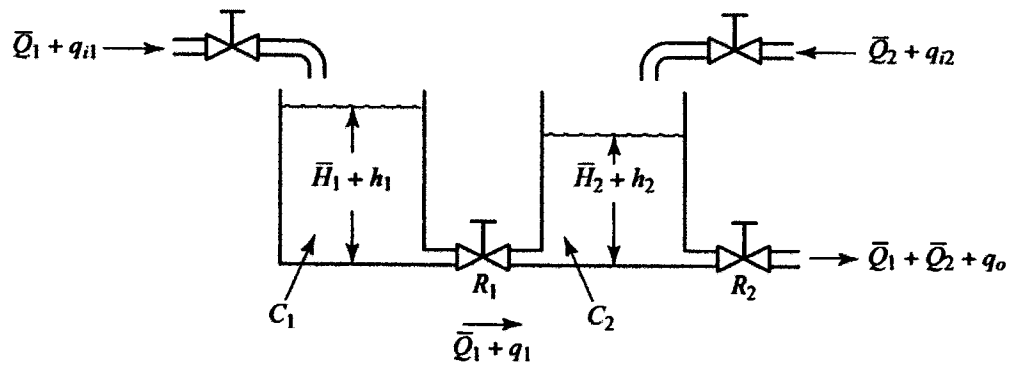


FIGURE Q2