UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
SEPTEMBER 2016 SEMESTER

COURSE CODE	: LEB21003
COURSE NAME	: CONTROL SYSTEMS
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MARINE ELECTRICAL AND ELECTRONIC
DATE	: 25 JANUARY 2017
TIME	: 09.00 AM – 12.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of FIVE (5) questions.
4. Answer FOUR (4) questions ONLY.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language ONLY.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions ONLY.

Please use the answer booklet provided.

Question 1 (CLO 1)

(a) Given the differential equation in Figure 1, solve for y(t) if all initial condition are zero by using Laplace Transform.

(10 marks)(C3)

$$12\frac{dy}{dt} + \frac{d^2y}{dt^2} = 32y + 32u(t)$$

Figure 1

(b) Analyze the circuit given in Figure 2, then evaluate for transfer function, G(s) = $V_L(s)/V(s)$

(15 marks) (C5)

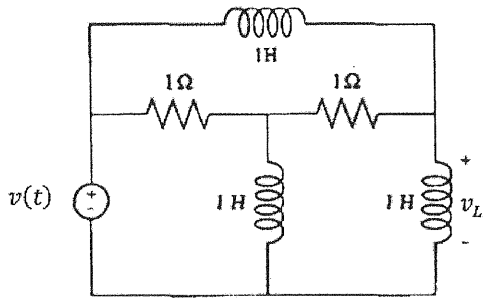

Figure 2

Question 2 (CLO 2)

a) The state-space approach is a unified method for modeling, analyzing, and designing a wide range of systems. For example, the state-space approach can be used to represent non linear systems that have backlash, saturation, and dead zone. Derive the state space representation with equivalent block diagram showing phase variable for the given transfer function in Figure 3.

(10 marks)(C3)

$$\frac{C(S)}{R(S)} = \frac{24}{S^3 + 9S^2 + 26s + 24}$$

Figure 3

b) Given the system defined in Figure 4, evaluate the transfer function, T(s)=Y(s)/U(s), where U(s) is the input and Y(s) is the output.

(15 marks)(C5)

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} u$$

$$y = [1 \quad 0 \quad 0]x$$

Figure 4

Question 3 (CLO 1)

(a) The output response of a system is the sum of two responses: the forced response and the natural response. Although many techniques, such as solving a differential equation or taking the inverse Laplace transform, enable us to evaluate this output response, these techniques are laborious and time-consuming. Productivity is aided by analysis and design techniques that yield results in a minimum of time. Calculate the time constants, rise time and settling time for a given transfer function, G(s) = 20/(s+20)

(10 marks)(C3)

(b) A second-order system exhibits a wide range of responses that must be analyzed and described. Whereas varying a first-order system's parameter simply changes the speed of the response, changes in the parameters of a second-order system can change the form of the response. Given damping ratio is 0.35 and natural frequency is 6, evaluate the transfer function, peak time, settling time, percent overshoot and sketch the response.

(15 marks)(C5)

Question 4 (CLO 3)

The number of poles in each section of the s plane can be find but not their coordinates using a method called the Routh-Hurwitz criterion for stability. The method requires two steps: (1) Generate a data table called a Routh table and (2) interpret the Routh table to tell how many closed-loop system poles are in the left half-plane, the right half-plane, and on the jw-axis. Given the system in Figure 5, solve and evaluate:

i. the equivalent transfer function

(10 marks)(C3)

ii. Routh table, number of poles in the left half-plane and the right half-plane and stability of the system

(15 marks)(C5)

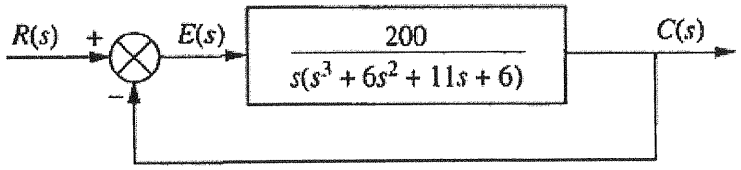

Figure 5

Question 5 (CLO 1)

(a) Reduce the system shown in Figure 6 to a single transfer function.

(10 marks)(C3)

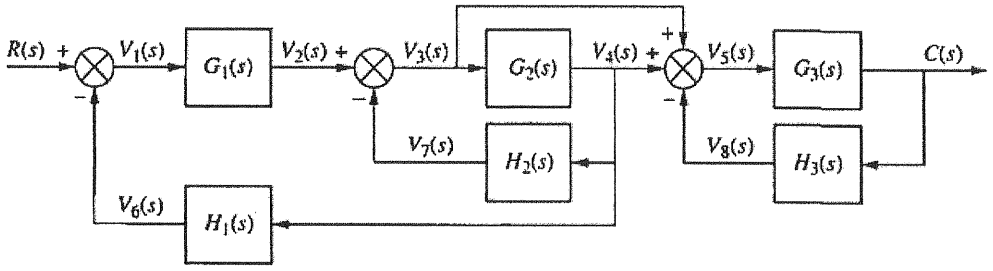

Figure 6

(b) For the system in Figure 7, solve and evaluate:

i. Equivalent transfer function

(7 marks)(C5)

ii. Peak time

(4 marks)(C5)

iii. Percent overshoot

(2 marks)(C5)

iv. Settling time.

(2 marks)(C5)

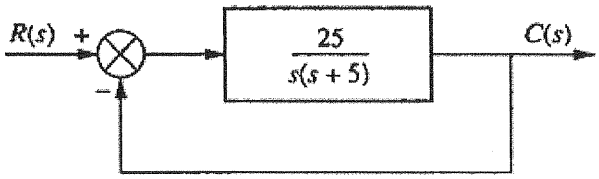

Figure 7

END OF EXAMINATION PAPER