SET 1
CONFIDENTIAL

UNIVERSITI KUALA LUMPUR

Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	LEB20303
COURSE NAME	:	FUNDAMENTAL OF INSTRUMENTATION AND CONTROL SYSTEM
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY IN MARINE ELECTRICAL AND ELECTRONICS
DATE	:	18 MAY 2016
TIME	:	02:00 PM – 05:00 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 5 QUESTION.
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 6 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions ONLY.
Please use the answer booklet provided.

Question 1

(a) Given the differential equation in Figure 1, solve for y(t) by using Laplace Transform.

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

Figure 1

(10 marks)

(b) Evaluate the transfer function for the differential equation shown in Figure 2.

$$\frac{dc(t)}{dt} + 2c(t) = r(t)$$

Figure 2

(5 marks)

(c) Analyze the network in Figure 3, evaluate the transfer function, $I_2(s)/V(s)$.

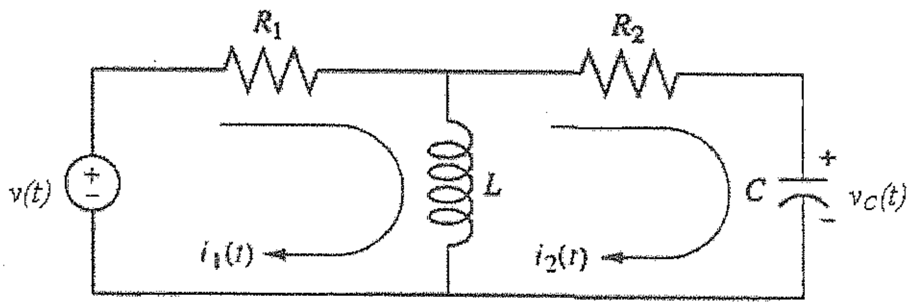

Figure 3

(10 marks)

Question 2

Two approaches are available for the analysis and design of feedback control systems. The first is known as the classical, or frequency-domain, technique. This approach is based on converting a system's differential equation to a transfer function, thus generating a mathematical model of the system that algebraically relates a representation of the output to a representation of the input. Replacing a differential equation with an algebraic equation not only simplifies the representation of individual subsystems but also simplifies modeling interconnected subsystems. The primary disadvantage of the classical approach is its limited applicability: It can be applied only to linear, time-invariant systems or systems that can be approximated as such. A major advantage of frequency-domain techniques is that they rapidly provide stability and transient response information. Thus, we can immediately see the effects of varying system parameters until an acceptable design is met. With the arrival of space exploration, requirements for control systems increased in scope. Modeling systems by using linear, time-invariant differential equations and subsequent transfer functions became inadequate. The state-space approach (also referred to as the modern, or time-domain, approach) is a unified method for modeling, analyzing, and designing a wide range of systems.

(a) Explain the state-space representation of a system.

(10 marks)

(b) Solve the state-space representation in phase-variable form for the transfer function Figure 4.

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

Figure 4

(15 marks)

Question 3

(a) A system has a transfer function, $G(s) = 20/(s+20)$. Calculate the time constants, rise time and settling time.

(10 marks)

(b) Given damping ratio is 0.35 and natural frequency is 6, evaluate:

i. The transfer function,

(3 marks)

ii. The peak time,

(3 marks)

iii. Settling time,

(3 marks)

iv. Percent overshoot,

(3 marks)

v. and sketch the response.

(3 marks)

Question 4

Multiple subsystems are represented in two ways: as block diagrams and as signal-flow graphs. Although neither representation is limited to a particular analysis and design technique, block diagrams are usually used for frequency-domain analysis and design, and signal-flow graphs for state-space analysis. Signal-flow graphs represent transfer functions as lines, and signals as small circular nodes. Summing is implicit. To show why it is convenient to use signal-flow graphs for state-space analysis and design. A graphical representation of a system's transfer function is as simple. However, a graphical representation of a system in state space requires representation of each state variable. For the system in Figure 5, solve and evaluate the:

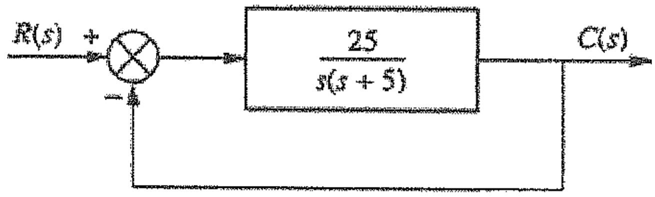

Figure 5

(a) Equivalent transfer function,

(10 marks)

(b) The peak time,

(5 marks)

(c) Percent overshoot and

(5 marks)

(d) Settling time.

(5 marks)

Question 5

Given the system in Figure 6, solve and evaluate the:

(a) Equivalent transfer function,

(10 marks)

(b) Routh table,

(6 marks)

(c) Number of poles in the left half-plane and the right half-plane,

(6 marks)

(d) Stability of the system

(3 marks)

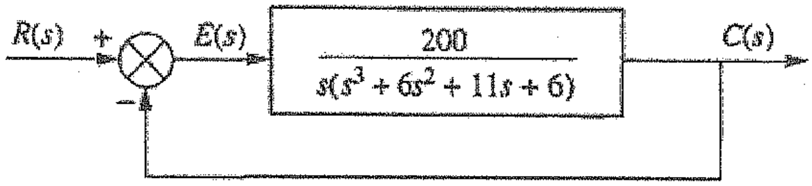

Figure 6

END OF EXAMINATION PAPER