Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	CONTROL SYSTEM
COURSE CODE	:	DAE 32103
PROGRAMME	:	2 DAE
EXAMINATION DATE	:	DECEMBER 2016/JANUARY 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) In modern technology, control system is a vital. There are two types configuration commonly used in control system; open loop and close loop system.

(i) Give **two (2)** examples of an open loop system and **two (2)** close loop system.

(4 marks)

(ii) Define feedback system.

(1 mark)

(iii) Give **one (1)** reason why feedback is important and **one (1)** reason for not using them.

(2 marks)

(iv) An open loop system has a transfer function, $G(s) = \frac{5}{s(s+5)}$. A unity feedback is then added to the system to correct errors. Find its equivalent transfer function, *M(s)* and draw its block diagram.

(6 marks)

(b) A control system need to be design properly and tested with an input signals.

(i) Briefly describe each steps involved in designing a control system.

(6 marks)

(ii) State and sketch **three (3)** types of the input function.

(6 marks)

Q2 (a) Given the following differential equation

$$\frac{d^2y(t)}{dt^2} + 21\frac{dy(t)}{dt} + 110\,y(t) = 10u(t)$$

(i) Solve *y(t)* using Laplace transform method if all initial conditions are zero.

(14 marks)

(ii) Determine the transient response and steady state based on answer in **Q2(a)(i).**

(2 marks)

(b) Solve the transfer function, *G(s) = V(s) / Vc(s)* for the following RLC network in **Figure Q2(b)** using mesh analysis. Given that the value of R = 10Ω, L = 5H and C = 1F.

(9 marks)

Q3 (a) Given a block diagram as shown in **Figure Q3(a)**, find the equivalent single block that represents the transfer function, $T(s) = C(s) / R(s)$. Show your calculation.

(11 marks)

(b) Based on the answer in **Q3(a)**, find the

(i) natural frequency

(1 mark)

(ii) damping ratio

(2 marks)

(iii) percentage overshoot

(2 marks)

(iv) settling time of 2% criterion

(2 marks)

(v) peak time

(2 marks)

(vi) damped frequency of oscillation

(2 marks)

(vii) rise time

(2 marks)

(viii) type response of the system

(1 mark)

Q4 (a) The use of digital control systems have grown significantly over the past three decades as the price and reliability of digital computers have improved dramatically.

(i) State the main difference between analog and digital control system.

(2 marks)

(ii) Draw the general block diagram of a digital control system.

(6 marks)

(iii) Describe the applications of digital control system.

(3 marks)

(iv) Discuss the advantages of digital controls system.

(4 marks)

(b) There are several types of signals involved in digital control system.

(i) Name all the **four (4)** types of signals.

(4 marks)

(ii) Sketch all signals stated in **Q4(b)(i)** accordingly.

(4 marks)

(iii) Classify the type of signal produced by an analog to digital converter (ADC) and digital to analog converter (DAC).

(2 marks)

Q5 (a) There are **three (3)** types of digital controller commonly used in digital control system. Name all of them.

(3 marks)

(b) Analog to digital converter (ADC) converts analog signal in the form of voltage and current into a digital signal which is numerically coded signal or binary number.

(i) Name **two (2)** common methods used in ADC.

(2 marks)

(ii) ADC requires three operations in sequence. Describe each sequence.

(6 marks)

(iii) Given an 8 bit ADC with input 0 – 12V. Calculate the quantization level.

(2 marks)

(iv) Calculate the output value of the ADC in **Q5(b)(iii)** if the input voltage is 3V. Present the final answer in binary.

(3 marks)

(c) After processing the inputs, the digital computer provides an output in digital form. This output is then converted to analog form by the digital to analog converter (DAC).

(i) Determine the number of bits a DAC converter must have to provide output increments of 0.04V. The reference voltage is 10V.

(5 marks)

(ii) Determine the digital input of the DAC in **Q5(c)(i)** if the output voltage is 6V.

(4 marks)

Q6 (a) List **two (2)** types of process control.

(2 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 **Q6(b)(i)**.

(6 marks)

(iii) Suggest the most suitable control loop for a process that involves blending and mixing as shown by **Figure Q6(b)(iii)**. Justify your answer.

(3 marks)

(c) PID controller is a proportional, integral and derivative controller.

(i) Sketch the time response for P and I component.

(4 marks)

(ii) Discuss why a PD controller is seldom used compared to PID controller.

(4 marks)

(d) Explain why instrumentation such as indicators, annunciators, alarms, switches and sensors are very important in process control.

(4 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2016/2017 PROGRAMME : 2 DAE
COURSE NAME : CONTROL SYSTEM COURSE CODE: DAE 32103

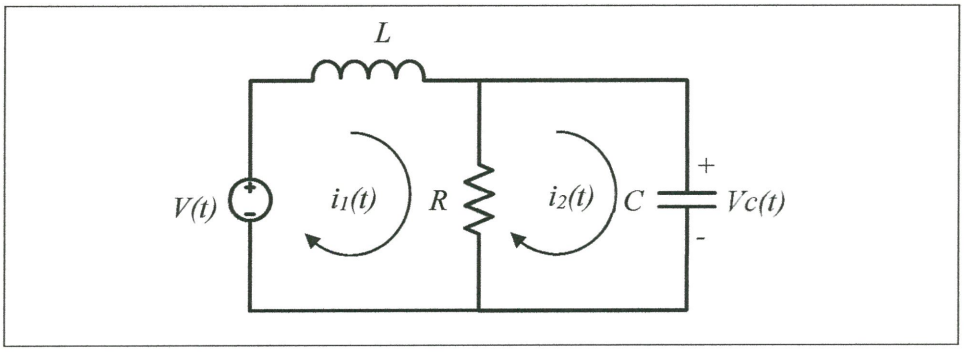

FIGURE Q2(b)

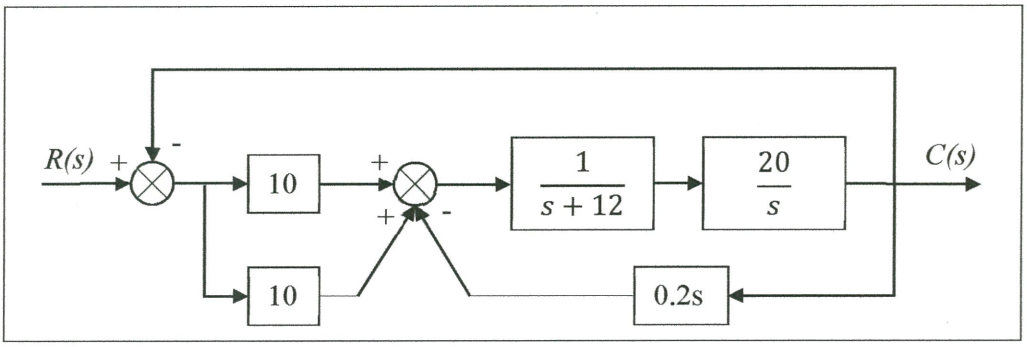

FIGURE Q3(a)

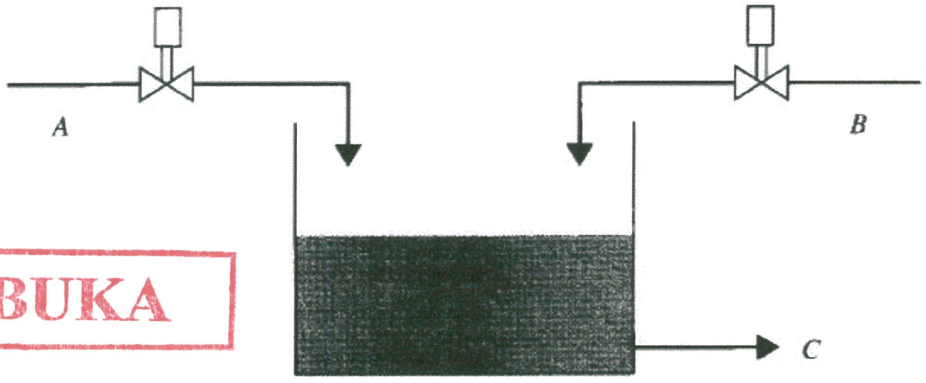

FIGURE Q6(b)(iii)