Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	CONTROL SYSTEM
COURSE CODE	:	DAE 32103
PROGRAMME	:	2 DAE
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) State **four (4)** control system components.

(4 marks)

(b) Draw a complete system block diagram based on antenna pointing system shown in **Figure Q1 (b)**.

(4 marks)

(c) Close loop system is also known as feedback system.

(i) State **five (5)** advantages of close loop system.

(5 marks)

(ii) State **two (2)** disadvantages of close loop system.

(2 marks)

(d) List **four (4)** control system clasifications.

(4 marks)

(e) As a R&D engineer, you are assigned to design an aircraft control system. Explain the **sixth (6)** steps in design the control system.

(6 marks)

Q2 (a) With reference to the **Table 1**, solve the ramp response for a system whose transfer function is

$$G(s) = \frac{s}{(s^2 - 2s - 35)}$$

(13 marks)

(b) Find the transfer function for an electrical circuit shown in **Figure Q2(b)** with reference to the **Table 2**.

(12 marks)

Q3 (a) For the following transfer function, calculate

$$\frac{\theta_o(s)}{\theta_i(s)} = \frac{144}{s^2 + 20s + 144}$$

(i) The natural frequency (ω_n).

(3 marks)

(ii) The damping ratio (ζ).

(3 marks)

(iii) The type of response and sketch the damping ratio, ζ response.

(3 marks)

(iv) Rise time, t_r.

(3 marks)

(v) Settling time, t_s for 2% criterion.

(2 marks)

(b) Determine the stability of the system shown in **Figure Q3(b)** with aid of pole-zero plot.

(11 marks)

Q4 (a) Nowadays, digital control system are widely use in modern technology compared to analog control system. Discuss **five (5)** advantages of digital control system.

(5 marks)

(b) In digital control system, there are several types of signals that are always use.

(i) Name the **four (4)** types of signal

(4 marks)

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

(4 marks)

(c) Data acquisition and data distribution system are main process in digital control system. Explain the function of each component of block diagram in **Figure Q4 (c)**.

(12 marks)

Q5 (a) Analog to Digital Converter (ADC) is one of the main component in Digital Control System. **Figure Q5 (a)** shows the 8-bit ADC block diagram.

(i) Counter type are known as the simplest type of ADC circuit. Explain the principle of operation of Counter type ADC circuit.

(5 marks)

(ii) List down another **three (3)** types of available ADC circuit.

(3 marks)

(iii) Discuss **four (4)** main factors that will be considered in choosing the type of ADC.

(4 marks)

(iv) Calculate the output of binary value based on **Figure Q5 (a).**

(3 marks)

(b) Explain **five (5)** Process Control terminologies.

(10 marks)

Q6 (a) Every controlled system has its own time response where it depends on the design of the system. The time response of a continuous-action controller is determined by the PID component.

(i) Determine the meaning of acronym 'P-I-D' controller.

(3 marks)

(ii) Explain the function of each P-I-D controller by the aid of graph.

(9 marks)

(b) (i) Bourdon Tubes Gauge is shown in **Figure Q6 (b)**. Determine the type of process control measurement for Bourdon Tubes Gauge.

(1 marks)

(ii) Explain briefly the operation of Bourdon Tubes Gauge.

(12 marks)

- END OF QUESTIONS –

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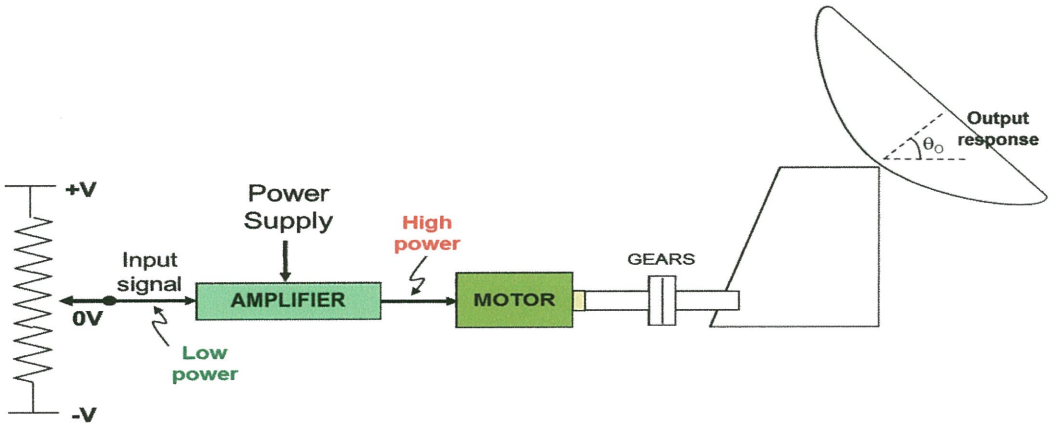

FIGURE Q1 (b)

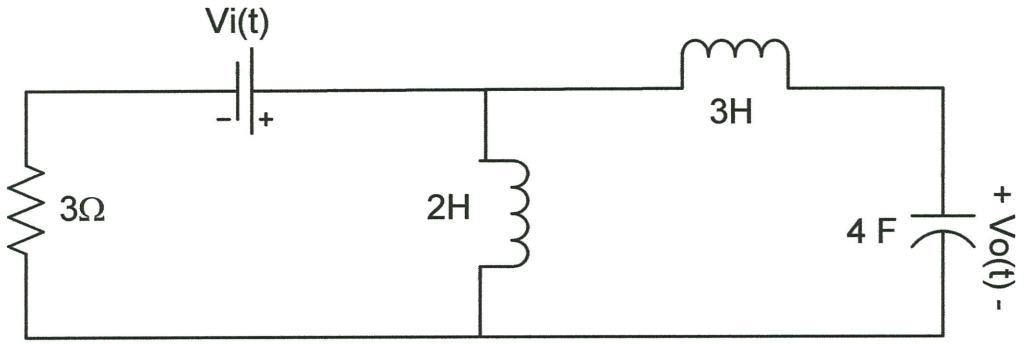

FIGURE Q2 (b)

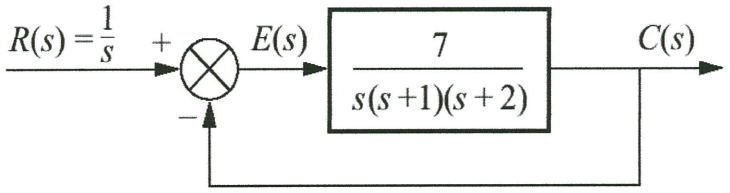

FIGURE Q3 (b)

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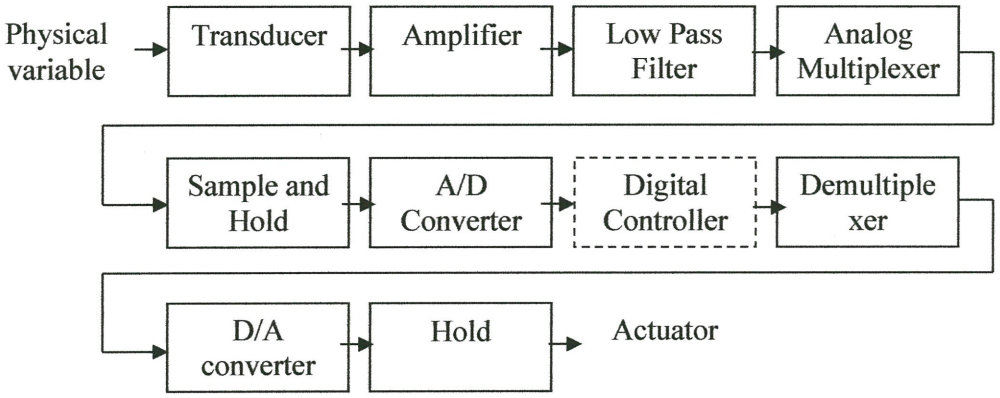

FIGURE Q4 (c)

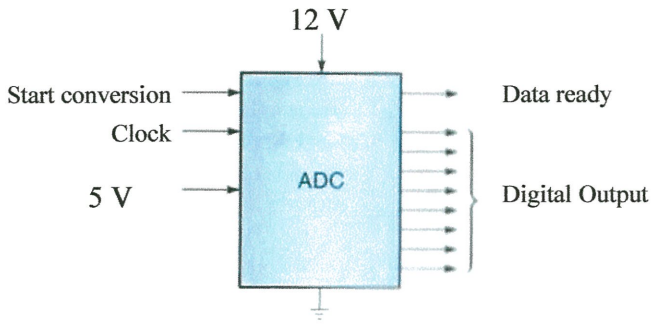

FIGURE Q5 (a)

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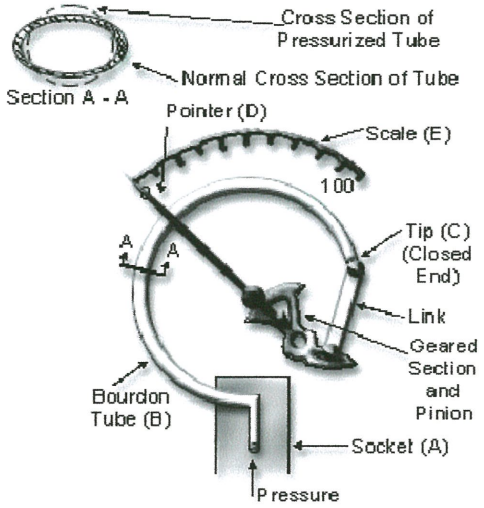

FIGURE Q6 (b)

TABLE 1: Laplace Transform Table

Item no.	*f(t)*	*F(s)*
1.	$\delta(t)$	1
2.	$u(t)$	$\frac{1}{s}$
3.	$tu(t)$	$\frac{1}{s^2}$
4.	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5.	$e^{-at}u(t)$	$\frac{1}{s+a}$
6.	$\sin \omega t u(t)$	$\frac{\omega}{s^2+\omega^2}$
7.	$\cos \omega t u(t)$	$\frac{s}{s^2+\omega^2}$

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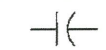
TABLE 2: Electrical Component Table

Component	Voltage-current	Current-voltage	Voltage-charge	Impedance $Z(s) = V(s)/I(s)$	Admittance $Y(s) = I(s)/V(s)$
 Capacitor	$v(t) = \frac{1}{C}\int_0^t i(\tau)\,d\tau$	$i(t) = C\frac{dv(t)}{dt}$	$v(t) = \frac{1}{C}q(t)$	$\frac{1}{Cs}$	Cs
 Resistor	$v(t) = Ri(t)$	$i(t) = \frac{1}{R}v(t)$	$v(t) = R\frac{dq(t)}{dt}$	R	$\frac{1}{R} = G$
 Inductor	$v(t) = L\frac{di(t)}{dt}$	$i(t) = \frac{1}{L}\int_0^t v(\tau)d\tau$	$v(t) = L\frac{d^2q(t)}{dt^2}$	Ls	$\frac{1}{Ls}$

Note: The following set of symbols and units is used throughout this book: $v(t)$ = V (volts), $i(t)$ = A (amps), $q(t)$ = Q (coulombs), C = F (farads), R = Ω (ohms), G = Ʊ (mhos), L = H (henries).

FORMULA

Unity feedback system	$T(s) = \frac{G(s)}{1+G(s)H(s)}$