بسم الله الرحمن الرحيم

EL-Mansoura University
Faculty of Engineering
Computers & Systems Engineering Dept.

9 A.M., Saturday, 5^{th} Jan. 2013
1^{st} Year Students

First Term Exam: Jan., 2013
Subject: Control System Eng. (1)
Time allowed: Three Hours

Attempt The Following Questions:

1-(a) Define the following terms:

i - Open loop transfer function.
ii- System order.
iii- Capacitance of a tank.
iv- Resistance of flow in a pipe.

(6 marks)

(b) Find the transfer function for the network shown in Fig. (1), then determine the system order & the system type.

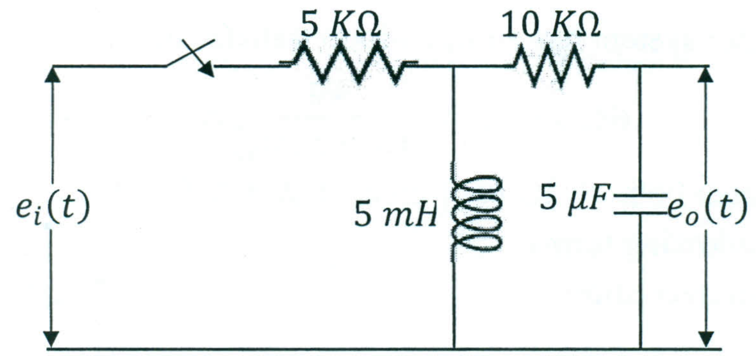

Fig. (1)

N.B: $1\ K\Omega = 10^3\Omega,\ 1\ mH = 10^{-3}\ H,\ 1\ \mu F = 10^{-6}\ F$ (12 marks)

2-(a) A seismograph has an input $x_i(t)$ and output $x_o(t)$, show its construction & method of operation, then find: $\frac{X_o(S)}{X_i(S)}$ (8 marks)

(b) Reduce the block diagram shown in Fig. (2), then find the system transfer function and determine the system order.

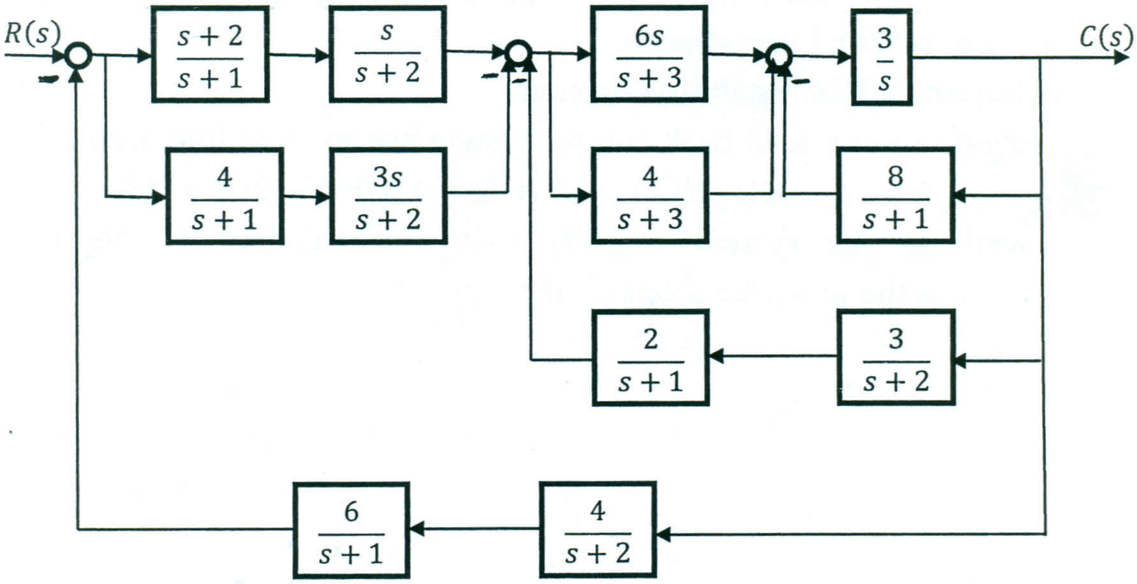

Fig. (2) (18 marks)

P.T.O.

3-(a) Define the following terms:

i – Stable system.

ii- Natural undamped frequency.

iii- Steady state error.

iv- Rise time.

(5 marks)

(b) An armature controlled DC-motor has the following parameters:

$K_b = 1\ volts\ sec/rad,\ \ K_a = 6 \times 10^{-5}\ N.m/amp,\ \ J = 10^{-5}\ N.sec^2/rad$

$B =$ coefficient of friction$4 \times 10^{-4}\ N.m.sec/rad$

$R_a = 5\ \Omega, \qquad L_a = 0.1\ H$

Derive the motor transfer function $\frac{\theta(s)}{E_a(s)}$, then construct its block diagram

(14 marks)

4-(a) A second order system has an open-loop transfer function as:

$$G(s)H(s) = \frac{\omega_n^2}{s(s + 2\xi\omega_n)} \ \& \quad R(s) = \frac{1}{s}$$

Find and sketch both $c(t)$& $e(t)$ given that $0 < \xi < 1$ (8 marks)

(b) Define the following terms:

i – Maximum over-shoot.

ii-Super position principle.

(4 marks)

(c) A control system has an open-loop transfer function as:

$$G(s)H(s) = \frac{9}{s(s + 4.2)} \ \& \quad R(s) = \frac{4}{s}$$

Find:

i -% Maximum over-shoot.

ii- Peak time.

iii- Settling time for 2% error.

iv-Steady state error.

(12 marks)

5-(a) Illustrate how the proper choice of the feed-back element can overcome the effect of external disturbance. (6 marks)

(b) StateRouth's-Huritzstabilitycriterion (5 marks)

(c) A negative unity feed-back control system has an open-loop transfer function as:

$$G(s)H(s) = s^4 + 5s^3 + 10s^2 + 20s + 23$$

Investigate the system stability using Routh's-Huritz criterion, and then determine the poles locations on the s-plane. (12 marks)

With my best wishes,

Prof. Dr. Fayez F.G. Areed.

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