Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION – NOV. / DEC.2016

SUBJECT: DYNAMICS OF SYSTEMS (ME 244)

(OLD SCHEME)

(BRANCH: MECH)

Thursday, 24 November 2016

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE FULL Questions.**
- ✓ **Missing data may be suitably assumed.**
- ✓ **Semi – log & Graph sheets will be provided.**

1(A) Determine the transfer function [x(s)/f(s)] of the mechanical system shown in Figure 1(A). 10

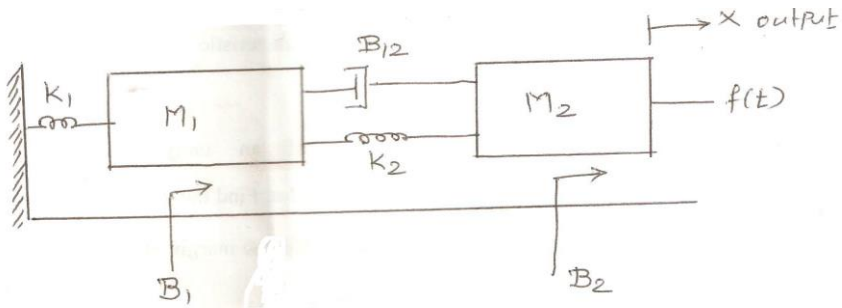

Figure 1(A).

(B) With neat sketches, derive the transfer function of field controlled DC Servo motor. 10
Note: Vi(s) is supply voltage to the motor; Ø(s) is angular displacement of a motor.

2(A) Simplify the block diagram shown in figure 2(A) using block reduction rules and obtain the closed loop transfer function C(s)/ R(s). 10

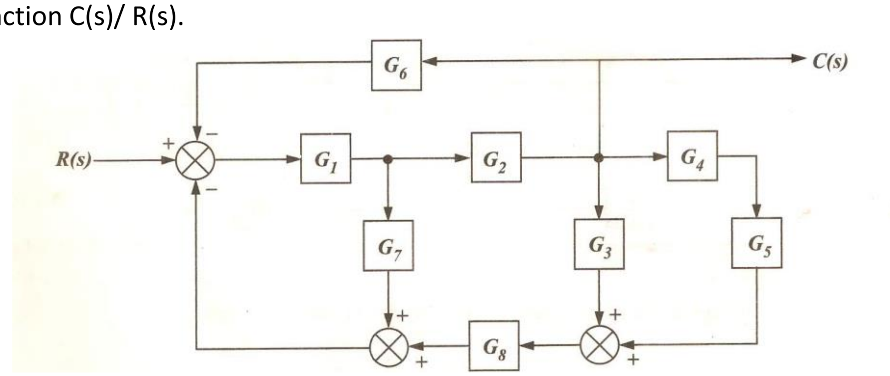

Figure 2(A)

(B) Obtain the state model for the following transfer function using phase variables. 10

$$\frac{Y(s)}{U(s)} = \frac{b_2 s^2 + b_1 s + b_0}{s^3 + a_2 s^2 + a_1 s + a_0}$$

3(A) For a closed loop second order system 10

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

Derive expression for (i) resonant frequency (ii) peak Overshoot.

(B) A unity feedback control system is characterized by an open loop transfer function is given by 10

$$G(s) = \frac{2}{s(s+2)}$$

Find the following:

I) Time to first maximum

II) Time to first minimum

III) Time to second maximum

IV) Time to second minimum

Assume the system is subjected to a step of 1V.

4(A) Obtain transfer function between $Y_7(s)$ and $Y_1(s)$ for the following signal flow graph shown in figure 4(A) using mason's gain formula. 11

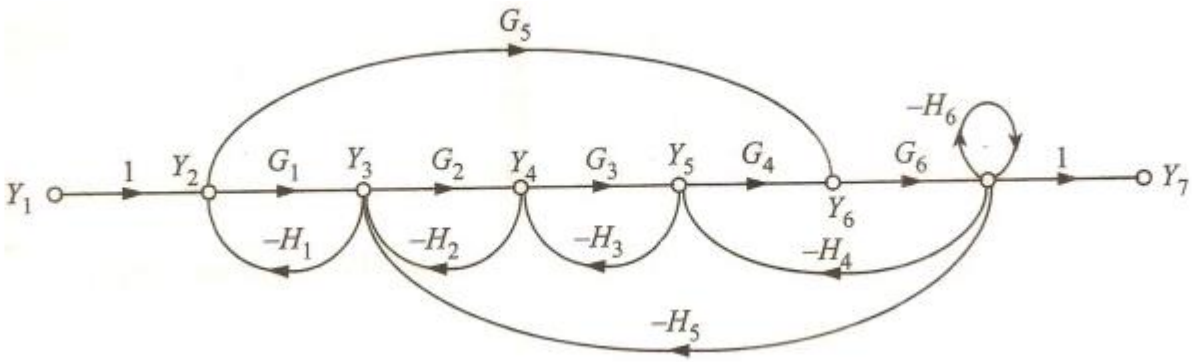

Figure 4(A)

(B) A unity feedback control system characterized by an open loop transfer function 09

$$G(s) = \frac{10}{s(0.1s+1)(1+0.5s)}$$

Determine the steady state errors for unit step, unit ramp, unit acceleration input.

5(A) Sketch the Bode plot for open loop transfer function of a unity feedback control system is given by 12

$$G(s) = \frac{K\, e^{-0.2s}}{s(s+2)(s+8)}$$

i. Find the value of K such that the gain margin of the system is 6 dB.

ii. Find the value of K such that the phase margin of the system is 45^0.

(B) The open loop transfer function of a unity feedback system is given by 08

$$G(s) = \frac{K}{s^3 + 8s^2 + Ts}$$

Using Routh stability criteria determine the range of values of K and T which corresponds to a stable system.

6(A) With neat diagrams, explain the working of P+I+D controller. 08

(B) Consider a negative feedback system characterized by 12

$$G(s)H(s) = \frac{K}{s(s+2)(s+4)}$$

Sketch the root locus plot for all values of K ranging from 0 to ∞. Also determine the value of K so that the dominant pair of complex pole has a damping ratio of 0.5

7(A) A unity feedback system is given by 12

$$G(s)H(s) = \frac{K(4s+1)}{s(s-1)}$$

Sketch the Nyquist plot and calculate the range of 'K' for which the system is stable.

(B) Evaluate state controllability and observability of the system with 08

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}, \qquad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \qquad C = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix}.$$

8. Consider the linear system described by the transfer function 20

$$\frac{Y(s)}{U(s)} = \frac{10}{s(s+2)(s+1)}$$

Design a state feedback controller so that the closed loop poles are placed at -2, -1±i.