Reg.No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (AERONAUTICAL/AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2016

SUBJECT: LINEAR CONTROL THEORY [AAE2204]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX.MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Find the transfer function $X_2(s)/F(s)$, of the system shown figure 1 in page 2 **(03)**

1B. Reduce the system shown in figure 2 to a single transfer function. **(05)**

1C. Demonstrate the rule of elimination of negative feed back **(02)**

2A. Obtain the transfer function of the signal flow graph in figure 3 using mason's gain formula. **(04)**

2B. The closed loop transfer function of an first order system is given by $\frac{C(s)}{R(s)} = \frac{1}{(Ts+1)}$. Determine its response to a unit step input. **(02)**

2C. For a unity feedback control system, the open loop transfer function is given by $G(s) = \frac{10(2+s)}{s^2(s+1)}$. Find the steady state error when the input is $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^3}$. **(04)**

3A. Sketch the Bode plot for the following open loop transfer function **(04)**

$$G(s) = \frac{40(1+s)}{(1+5s)(s^2+2s+4)}$$

3B. Determine the phase margin and gain margin from the Bode plot in 3A. **(02)**

3C. Sketch the polar plot of the following transfer function **(04)**

$$G(s) = \frac{10(s+1)}{(s+10)^2}$$

4A. The unity feedback system of an open loop transfer function is **(05)**

$$G(s) = \frac{K}{s(s^2+4s+13)}$$

Sketch the root locus.

4B. Determine the dominant pole of unity feedback control system having a forward path transfer function **(03)**

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

The centroid is found to be at -3.33, break away point is at 7 and -48 and the point which crosses the imaginary line is found to be at +j4 and –j4. The lag compensator should meet the following specifications I) Percentage overshoot

≤ 16% for unit step input II) Steady state error ≤ 0.125 for unit ramp input.

4C. What are lead and lag compensators? **(02)**

5A. What are all the issues when the state variables exceeds or less the required number of variables to determine the dynamics of the system completely? **(02)**

5B. Derive the state space model from the translational mechanical system shown in figure 4 **(05)**

5C. Derive the transfer function model from the given linear state space model **(03)**

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u \; ; y = \begin{pmatrix}1 & 0\end{pmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + (0)u$$

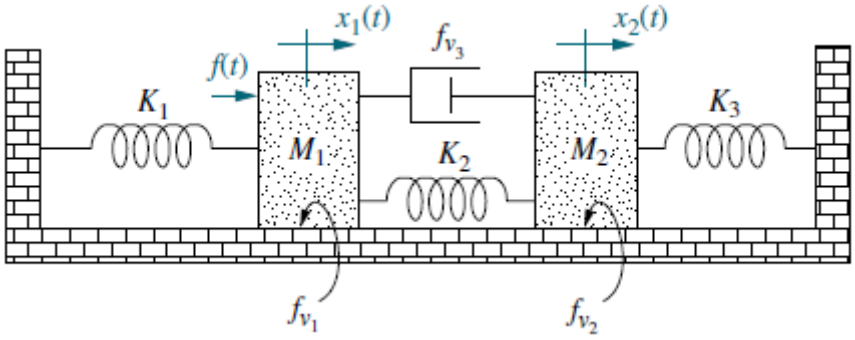

Figure 1

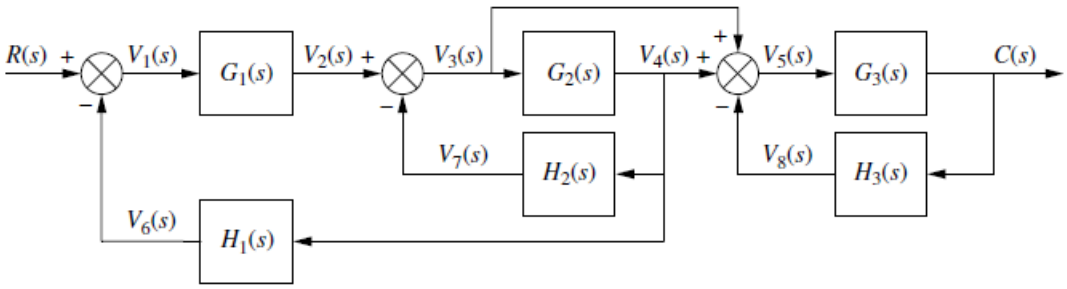

Figure 2

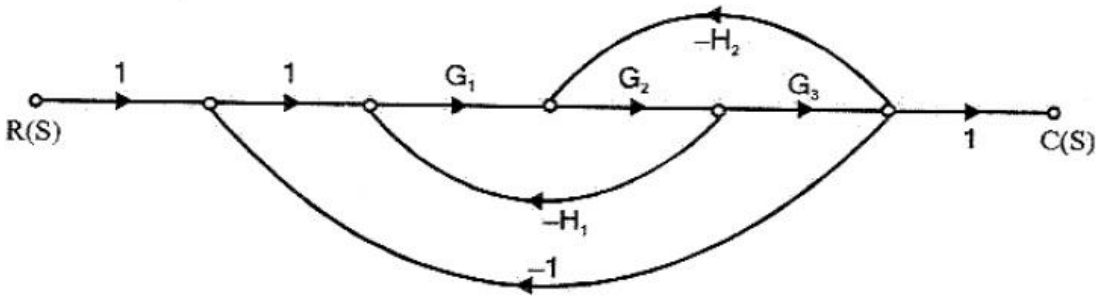

Figure 3

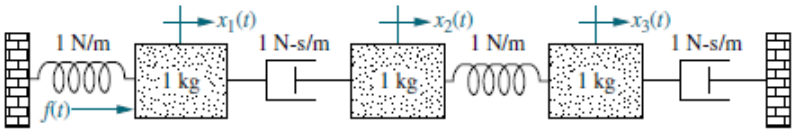

Figure 4