Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2015

SUBJECT: LINEAR CONTROL THEORY [ELE 301]

REVISED CREDIT SYSTEM

Time: 3 Hours 25 NOVEMBER 2015 MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.
- Semilog graph sheets may be used

1A. A signal flow graph for the system is shown in the Fig. 1.A; determine the overall gain using the Mason's Gain formula.

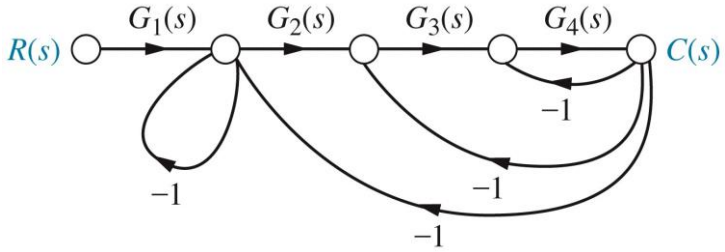

Fig. 1.A **(05)**

1B. For the system shown in Fig.1.B., draw the mechanical equivalent network and find the transfer function $G(s) = \dfrac{X_2(s)}{F(s)}$.

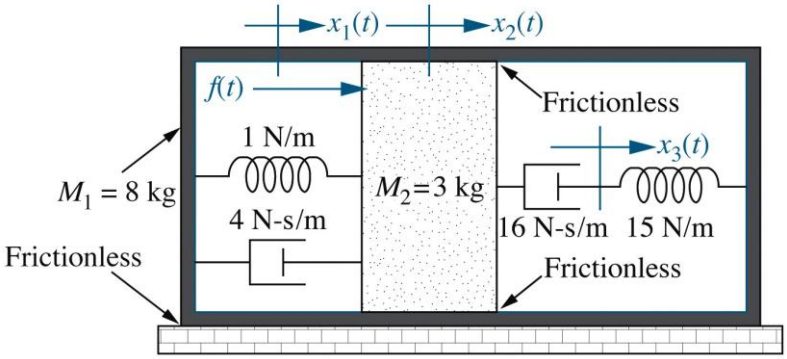

Fig.1.B **(05)**

2A. For the closed loop transfer function $T(s) = \dfrac{K_1 s + K_2}{s^4 + K_1 s^3 + s^2 + K_2 s + 1}$, find the constraints on K_1 & K_2 such that the function will have only 2 jω poles. **(05)**

2B. For the block diagram shown in Fig.2.B find the overall transfer function $\dfrac{C(s)}{R(s)}$ using block diagram reduction technique. **(05)**

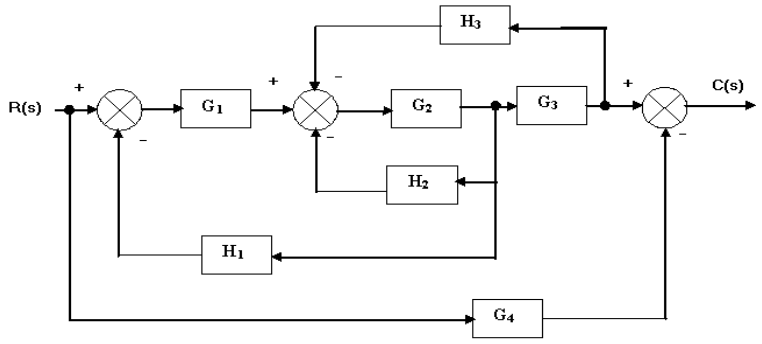

Fig.2.B

3A. A unity feedback system has an open loop transfer function $G(s)=\dfrac{K}{s(s+a)^2}$, determine the values of 'K' and 'a' for which the gain margin is 9.54 dB and the phase cross over frequency is 3 rad/sec. **(04)**

3B. A negative unity feedback system has open loop transfer function $G(s)H(s)=\dfrac{(1-s)}{s(1+2s)^2}$, investigate the stability of the system by applying Nyquist stability criterion. **(06)**

4A. Sketch the root locus for a unity feedback system with open loop transfer function $G(s)H(s)=\dfrac{K(s^2+4)}{s(s+4)}$. Is the system stable for all values of K? **(07)**

4B. Find the value of 'K' for the unity feedback system with $G(s)=\dfrac{K(s+2)}{s^2(s+4)}$, if the input is $10t^2u(t)$ and the desired steady state error is 0.01 for this input. **(03)**

5A. Sketch the Bode plot for a unity feedback system with open loop transfer function $G(s)H(s)=\dfrac{K(1+5s)}{s^2(1+0.5s)}$, i) find the phase margin when K=1 ii) determine the value of K for a phase margin of 45^o. **(07)**

5B. The response to a unit step input of a second order system has a peak overshoot of 16.3% and a settling time of 0.8 second. Find the location of the system poles and transfer function, if the dc gain is unity. **(03)**

6A. For the unity feedback system with $G(s)=\dfrac{K}{(s+1)(s+4)}$, design a PID controller to yield a peak time of 1.047 sec and a damping ratio of 0.6, with zero error for a step input. Also design an initial stable controller using Zeigler – Nichols tuning method. **(07)**

6B. Find the state space representation of the electrical network shown in Fig.6.B in physical variable form. The output is $i_R(t)$.

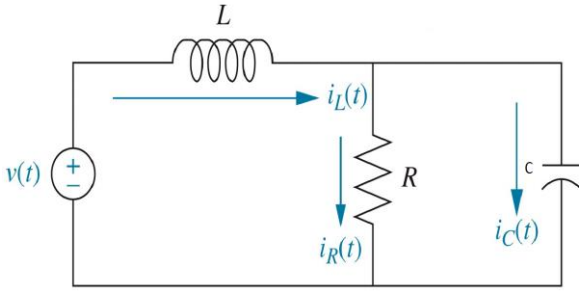

Fig.6B **(03)**