Registration No. | | | | | | | | | |

**M.E./M.Tech. Degree Examinations, January 2017**

**First Semester**

**MECHATRONICS ENGINEERING**

**MS16104 – DYNAMICS AND CONTROL SYSTEMS**

**(Regulation 2016)**

**QP Code: 239266**

**Time: Three hours** **Maximum : 100 marks**

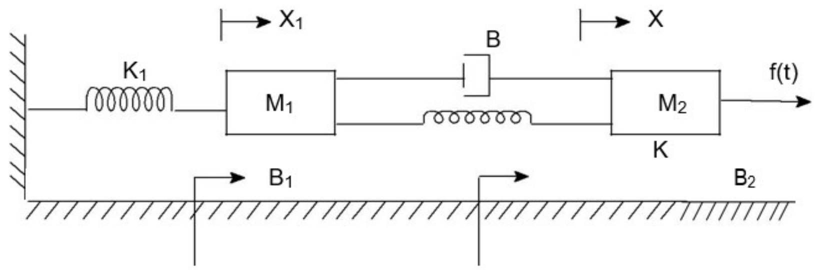
Answer **ALL** questions

**PART A - (10 X 2 = 20 Marks)**

1. Briefly explain Mason's Gain formula.
2. List the basic elements used for modeling of mechanical translational and rotational system?
3. Draw the approximate polar plot of the system with transfer function $G(s) = 1/s^2(s+4)(s+3)$.
4. List out the frequency domain specifications and condition for a stable system.
5. Compare lag and lead compensators.
6. What is a minimum phase/non-minimum phase system?
7. What is nyquist stability criterion?
8. List out some implementation issues of PID controller.
9. Define setpoint and manipulated variable.
10. Write the selection criteria for PI, PD and PID controllers?

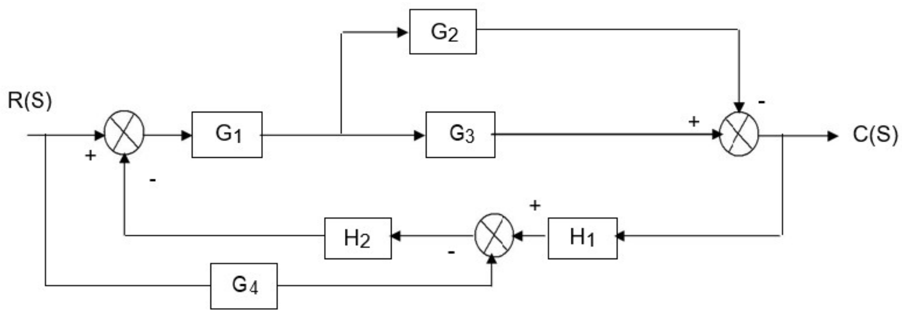
**PART B - (5 X16 = 80 Marks)**

11. (a) Write the differential equations governing the mechanical systems shown below. Obtain the transfer function X(s)/F(s) and also draw the force-voltage electrical analogous circuits and verify by writing mesh equations. **(16)**




**(OR)**

(b) Draw a signal flow graph and evaluate the closed loop transfer function of a system and verify with block diagram reduction technique. **(16)**

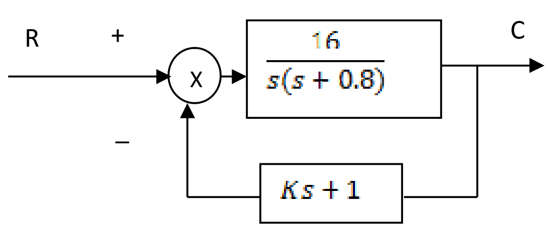



12. (a) Explain the characteristics of on-off, P, PI controller, PID controller and enumerate the effect of controllers on a plant. **(16)**

**(OR)**

(b) Explain the tuning methods of PID controllers in detail. **(16)**

13. (a) A positional control system with velocity feedback is shown in fig. What is the response of the system to the unit step input? Given that ς =0.5.and also calculate rise time, peak time, maximum overshoot and settling time. **(16)**




**(OR)**

(b) Sketch the root locus of the system whose open loop transfer function is **(16)**

$$G(S) = K / s\ (s^2+4s+13)$$

Find the value of K for continuous oscillations and determine frequency of oscillations.

14. (a) (i) Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies **(10)**

$$G(s) = 10 / s\,(1+0.4s)\,(1+0.1s).$$

(ii) Using Routh's criterion determine the stability of the system whose characteristics equation is 9s5- 20s4 +10s3-s2 -9s-10 =0. **(6)**

**(OR)**

(b) Design a suitable lag compensator for the given system with the following specifications by drawing bode plot and verify the design. **(16)**

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

(a) Phase Margin >= 40 degree. (b) Steady State Error for ramp input < =0.2

15. (a) Derive the transfer function model of AC and DC servomotors from the basic concepts, for speed control. **(16)**

**(OR)**

(b) (i) For a servomechanism with open loop transfer function G(s)=10/s2(s+4)(s+3).What type of input signal gives constant steady state error and calculate its value. **(8)**

(ii) The gain limit of the controller is defined as the highest proportional gain that can be assumed, without integral and derivative actions, the closed loop transfer function is **(8)**

$$\frac{W_1(s)}{W_R(s)} = \frac{9.8082x10^6\left(s+4.3229x10^6\right)K_c}{s^4+4.3306x10^6 s^3+3.326x10^{10} s^2+4.7x10^{12}\cdot s+5.5921x10^{12}+4.24x10^{13} K_c}$$

Find the limit of $K_c$.