**B.TECH. SEM -V ELECTRICAL 2014 COURSE (CBCS) :**
**SUMMER - 2018**
**SUBJECT : LINEAR CONTROL SYSTEMS**

Day : **Monday**
Date : **21/05/2018**

**S-2018-2342**

Time **10.00 AM TO 01.00 PM**
Max. Marks : 60

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**N.B.**

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Use of non programmable calculator is allowed.
4) Assume suitable data if necessary.

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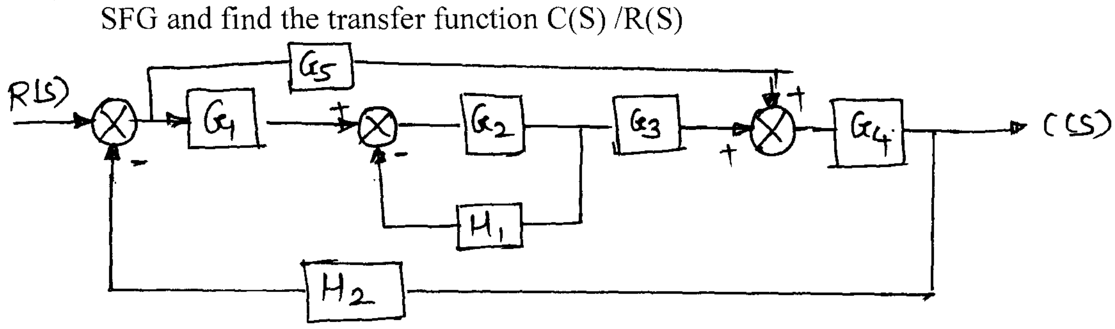
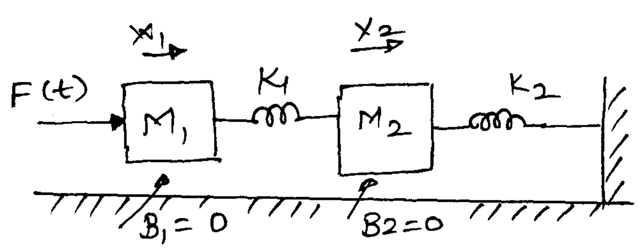
**Q.1** **a)** What are the limitations of open loop system over closed loop system? List the advantages of closed loop over open loop system. **(04)**

**b)** A block diagram representation for a system is shown in figure. Draw the SFG and find the transfer function C(S) /R(S) **(06)**




**OR**

**Q.2** **a)** Explain D'alemberts principle and write the differential equation describing dynamics of system and find the transfer function of the system shown in figure. **(06)**




**b)** Derive the transfer function of potentiometer and write its specifications. **(04)**

**Q.3** **a)** Explain unit step response for a first order system.. **(04)**

**b)** Determine the values of the damping ratio and the natural frequency of oscillations for each of the following systems and hence specify and draw the nature of the step response with respect to the value of the damping ratio. **(06)**

**i)** $C(S)/R(S) = 8/(S^2 + 3S + 8)$

**ii)** $C(S)/R(S) = 2/(S^2 + 4S + 2)$

**iii)** $C(S)/R(S) = 16/(S^2 + 16)$

**OR**

**Q.4** **a)** The open loop transfer function of unity feedback system is $G(S) = 4/S(S+1)$. Determine the nature of response of the closed loop system for unit step input. Also determine the rise time, peak time, peak overshoot and settling time. **(05)**

**b)** Define the steady state error and error constants with respect to unit step unit velocity and unit acceleration inputs. **(05)**

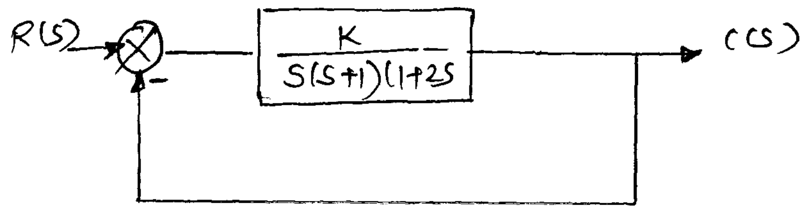
**Q.5** The open loop transfer function of a system is given by **(10)**

$$G(S)H(S) = \frac{K(S+12)}{S^2(S+20)}$$ . Draw root locus.

**OR**

P.T.O.

**Q.6** a) Using Routh's stability criterion determine the range of K for which the system shown in figure will remain stable. **(05)**




b) Define following terms (a) Stable system (b) Critically stable system (c) Conditionally stable system. **(05)**

**Q.7** A system has transfer function $G(S)H(S) = \frac{20}{S^2 + 10S}$. Draw closed loop system response to unit step input. A PD controller is added with $K_p$ = 300 and $K_d$ = 10. Draw block diagram with controller and write down mathematical equation of closed loop system. Determine over shoot and settling time and sketch the step response of system with controller. **(10)**

**OR**

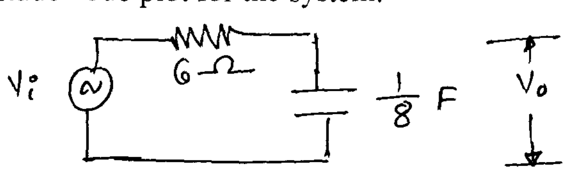
**Q.8** A system has transfer function $G(S)H(S) = \frac{20}{S^2 + 10S}$. Draw closed loop system response to unit step input. A PI controller is added with $K_p$ = 30and $K_i$ = 70. Draw block diagram with controller and write down mathematical equation of closed loop system. Calculate steady state error of the system without controller and with controller. **(10)**

**Q.9** a) Determine resonance peak Mr and resonant frequency ωr for the system whose transfer function is $\frac{C(S)}{R(S)} = \frac{5}{S^2 + 2S + 5}$. **(05)**

b) State Nyquist's stability criteria. Describe gain margin and phase margin on Nyquist plot for stable and unstable system. **(05)**

**OR**

**Q.10** a) Sketch magnitude bode plot for the system. **(04)**




b) Sketch frequency response of second order system $\frac{C(S)}{R(S)} = \frac{\omega^2_n}{S^2 + 2\zeta\omega_n S + \omega^2_n}$ for different values of $\zeta$. Show all performance specifications on the graph. **(06)**

**Q.11** a) Draw lag network and sketch its bode plot. **(04)**

b) Describe stepwise procedure for design of phase lead compensator using bode plot. **(06)**

**OR**

**Q.12** a) If the maximum phase lead provided by network is $30^0$ at frequency 5 rad/sec, determine the parameters of lead network. **(04)**

b) Draw lead compensating network. Write its transfer function and sketch its bode plot. What are the performance improvement of system due to lead compensator. **(06)**

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