Reg. No. :

Question Paper Code : X 60499

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fourth Semester
Electrical and Electronics Engineering
EE 2253/EE 44/EE 1253 A/080280033/10133 IC 401 – CONTROL SYSTEMS
(Common to Instrumentation and Control Engineering and Electronics and Instrumentation Engineering)
(Regulations 2008/2010)
(Also common to PTEE 2253 – Control Systems for B.E. (Part-Time) Third Semester – Electronics and Instrumentation Engineering – Regulations 2009 and 10133 IC 401 – Control System for B.E. (Part-Time) Third Semester – EEE – Regulations 2010)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions

PART – A   **(10×2=20 Marks)**

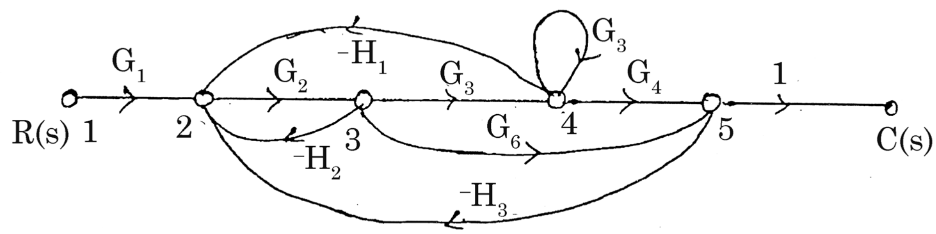
1. State the advantages of closed loop system over the open loop system.
2. Write the force balance equation of ideal dashpot and ideal spring.
3. What is meant by time constant of the system ?
4. Determine the type and order of the following system

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

5. Draw the polar plot of G(s) = 1/(1+sT).
6. Define phase and gain margin.
7. What is the condition for the system $G(s) = \dfrac{k(s+a)}{s(s+b)}$ to have a circle in its root locus ?
8. State Nyquist stability criterion.
9. Write the need for compensation.
10. Draw the circuit of lag-lead compensator.

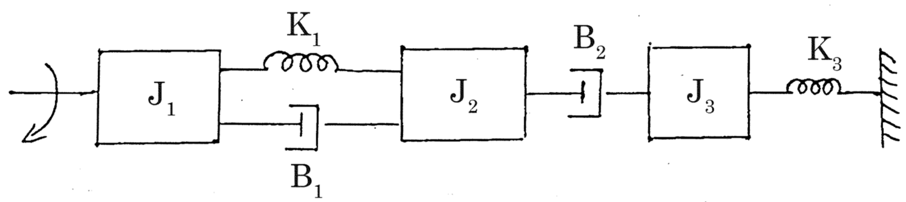
PART – B **(5×16=80 Marks)**

11. a) Find the overall gain for the signal flow graph shown.



(OR)

b) Write the differential equation governing the mechanical rotational system shown and draw the torque voltage and torque-current electrical analogous circuits and verify by writing mesh equations.



12. a) i) A unity feedback control system has the open loop transfer function $G(s) = \frac{K}{(s+A)(s+2)}$. Find the values of K and A, so that the damping ratio is 0.707 and the peak time for unit step response is 1.8 sec. **(8)**

ii) Obtain the impulse and step responses of the following unity feedback control system with open loop transfer function $G(s) = \frac{6}{s(s+5)}$. **(8)**

(OR)

b) i) For the unity feedback system whose forward path transfer function $G(s) = \frac{1}{s(s+1)}$ and the input signal is $r(t) = 4 + 6t + 2t^3$. Find the generalized error coefficients and steady state error. **(10)**

ii) Explain the effect of P, PI and PID controllers on the system performances. **(6)**

13. a) For the following transfer function, sketch the Bode magnitude and phase plot $G(s) = \frac{40(1+s)}{(5s+1)(s^2+2s+4)}$. **(16)**

(OR)

b) Obtain the relationship between any three frequency domain specifications in terms of time domain specifications. **(16)**

14. a) Determine the stability of the given characteristic equation using Routh-Hurwitz Criterion

i) $S^5 + 4S^4 + 8S^3 + 8S^2 + 7S + 4 = 0$. **(8)**

ii) $S^6 + S^5 + 3S^4 + 3S^3 + 3S^2 + 2S + 1 = 0$. **(8)**

(OR)

b) Sketch the root locus of the system $G(s) = K/[s(s+2)(s+4)]$ and determine the value of K such that the damping ratio of the closed loop system is 0.5.

15. a) The open loop transfer function of the uncompensated system is $G(s) = \frac{5}{s(s+2)}$.

Design a suitable compensator for the system so that the static velocity error constant K_v is 20/sec, the phase margin is atleast 55° and the gain margin is atleast 12 dB. **(16)**

(OR)

b) Open loop transfer function of the uncompensated system is $G(s) = \frac{1}{s(s+1)(s+2)}$. Compensate the system by cascading suitable lag-lead compensator so that the compensated system has the static velocity error constant of 10/sec, the phase margin of 45° and gain margin of 10 dB or more. **(16)**