QP Code : 1858

(3 Hours) [Total Marks : 100

N.B. : (1) Question no. **1** is **compulsory**
(2) Attempt **any four** questions from the remaining **six** questions.
(3) Use graph paper and semi log paper where necessary

1. (a) Explain how type of any system affects the steady state error of the system?   5
   (b) Define controllability and observability.   5
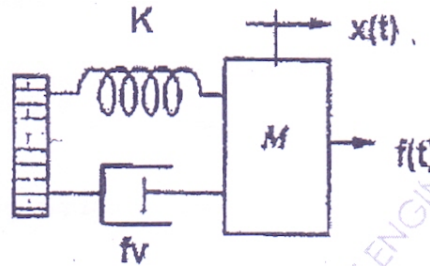   (c) Find the transfer function, $X(s)/F(s)$, for the system of Figure 1   5

Figure 1(Q.1 c)

   (d) State any four rules for construction of root locus.   5

2 (a) Reduce the system shown in Figure 2 to a single transfer function,   10
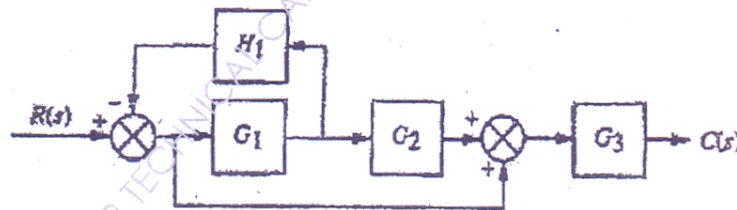 $T(s) = C(s)/R(s)$. Use block diagram reduction technique.

Figure 2 (Q.2 a)

   (b) For the given second order specification, find the location of second order pair of   10
   poles with % OS = 10% and Tp = 5 sec. Obtain characteristic equation and state
   whether the system is overdamped, underdamped or oscillatory.

3. (a) Find the transfer function, C(s)/R(s) for the signal-flow graph in Figure 3. Use Mason's gain formula.   10
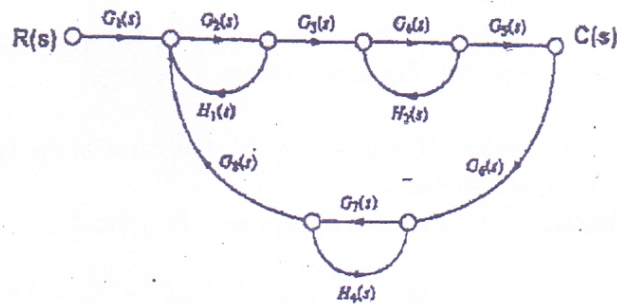

Figure 3(Q.3 a)

  (b) Derive the transfer function of DC servo motor.   10

4. (a) A unity feedback system is characterized by open loop transfer function as   10

$$G(s) = \frac{1}{s(1+0.5s)(1+0.2S)}$$

Determine steady state error for unit step, unit ramp and unit acceleration.

  (b) Examine the stability by Routh's Criterion for the given polynomial. Comment on stability.   10

$$s^5+s^4+2s^3+2s^2+3s+15=0$$

5. (a) Draw the root locus for $0 \le K < \infty$ for a unity feedback system with transfer function.   10

$$\frac{K}{s(s+1)(s+2)(s+3)}$$

  (b) Represent the system below in state space in phase-variable form. Draw the signal-flow graph.   10

$$G(s) = \frac{s^2 + 2s + 6}{s^3 + 5s^2 + 2s + 1}$$

6. (a) For given unity feedback system draw Bode plot and determine G.M., P.M., ω gc and cope. ω pc. **12**

$$G(s) = \frac{3000}{(s+2)(1+0.1s)(s+50)}$$

(b) Explain Nyquist stability criteria. **8**

7. Write short note on **any TWO**
   (a) Time response of second order system and time response specifications **20**
   (b) Stepper motor
   (c) Steady state error constants from Bode plot