B.E./B.TECH. Degree Examination, December 2020

Fifth Semester

OE18603 – Control System Engineering

(Regulation 2018)

Time: Three hours Maximum : 80 Marks

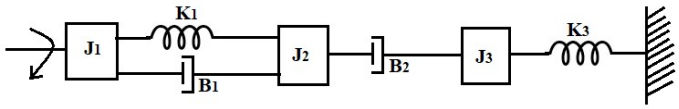
Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. For open control system which of the following statements is incorrect?
   (a) Less expensive
   (b) Recalibration is not required for maintaining the required quality of the output
   (c) Construction is simple and maintenance easy
   (d) Errors are caused by disturbances
2. The type 0 system has _____ at the origin.
   (a) No pole
   (b) Net pole
   (c) Simple pole
   (d) Two poles
   (e) None of the above
3. _____ can be extended to systems which are time-varying?
   (a) Bode-Nyquist stability methods
   (b) Transfer functions
   (c) Root locus design
   (d) State model representatives
4. Addition of zeros in transfer function causes which of the following?
   (a) Lead-compensation
   (b) Lag-compensation
   (c) Lead-lag compensation
   (d) None of the above
5. Contrast the systems with and without feedback.
6. Specify the conditions for phase margin and gain margin.
7. Bring up the advantages of PI Controller.
8. Express the condition for observability.

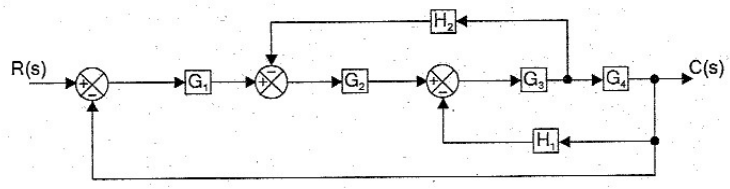
PART B - (4 X16 = 64 marks)

09. (a) Write the differential equations governing the mechanical rotational system shown in Figure below. Draw the torque-voltage and torque-current analogous circuits and verify by writing relevant mesh and node equations. **(16)**



(OR)

(b) Derive the overall transfer function for the system shown below: **(16)**



10. (a) For a unity feedback control system, the open loop transfer function,

$$G(s) = \frac{10(s+2)}{s^2(s+1)}.$$

Find **(16)**

(i) the position, velocity and acceleration error constants.

(ii) The steady state error when then input is R(s) = $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^3}$

(OR)

(b) Depict the root locus for the unity feedback system whose open loop transfer function is

$$G(s) = \frac{k}{s(s^2+6s+10)}$$ **(16)**

11. (a) (i) Use the routh stability criterion to determine the location of roots on the s-plane and hence the stability for the system represented by the characteristics equation. **(08)**

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$$

(ii) Determine the range of k for stability of unity feedback system whose open loop transfer function is **(08)**

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

(OR)

(b) Sketch the bode plot for the following transfer function and determine phase and gain margins

$$G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$$ **(16)**

12. (a) A feedback system has a closed loop transfer function,

$$\frac{Y(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$$ **(16)**

Construct the state model for this system and give its block diagram representation.

(OR)

(b) Convert the following system matrix to canonical form and hence calculate its state transition matrix.

$$A = \begin{bmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{bmatrix}$$ **(16)**