Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EE)/SEM-1/PEM-101/2012-13

2012

ADVANCED CONTROL SYSTEMS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) Explain the term sensitivity of a system.

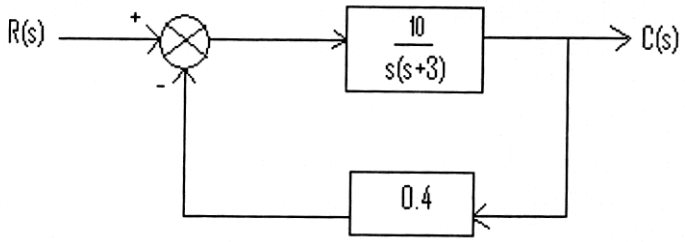
   b) Prove that the sensitivity of an open loop system is unity.

   c) Find out the sensitivity of the following closed loop system with respect to

      i) the forward path transfer function

      ii) the feedback path transfer function

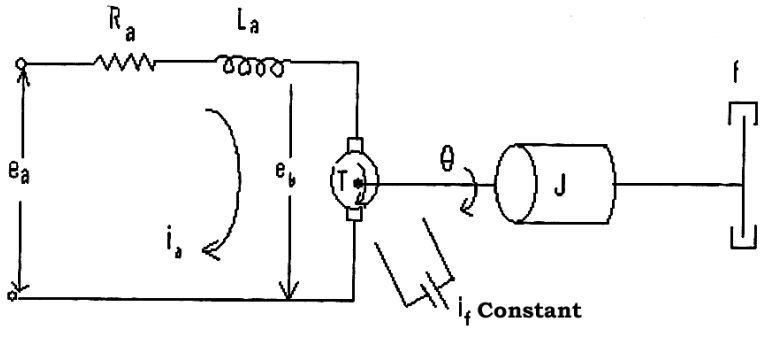
      at ω = 1·3 rad/sec



2. a) Explain the necessity of modelling a system ?

   b) Write down the steps for modelling a system.

   c) Find out the transfer function of the following system neglecting the inductance (L_a) of the armature circuit. (Notations carry their usual meaning).



2 + 2 + 10

3. The state equation of a linear invariant system is given below :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

   Find out

   a) state transition matrix

   b) the complete solution $x(t)$ of the state equation at $t > 0$ due to application of a unit step input under initial conditions $x(0) = -1$

   c) controllability of the system. 5 + 5 + 4

4. a) What do you understand by the terms controllability and observability ?

   b) A system is characterised by the transfer function

$$\frac{Y(s)}{U(s)} = \frac{2}{s^3 + 6s^2 + 11s + 6}$$

   Find the controllability and observability of the system.

4 + 10

5. a) Explain describing function and state its use in non-linear control systems.

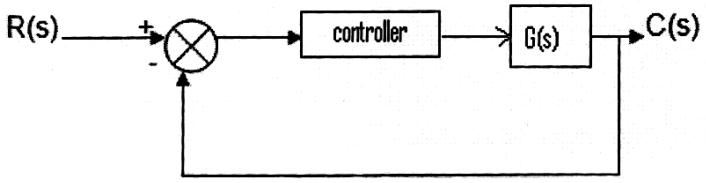
   b) What are the limitations of describing function method ?

   c) Derive the describing function of an ideal relay.

3 + 3 + 8

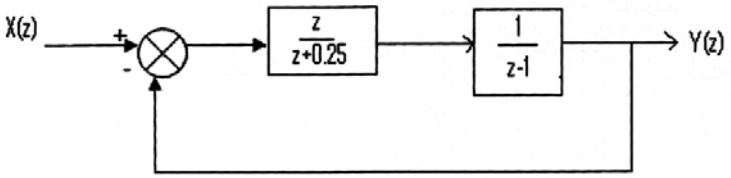
6. a) What is the purpose of using a resent controller ?

   b) Using Ziegler-Nichols tuning rules find the P, PI and PID controller settings for a plant whose transfer function is $G(s) = \frac{6}{(s+1)(s+2)(s+3)}$ and connected with a controller as given below :



5 + 9

7. a) Determine the pulse transfer function of the following system :



   b) Comment on stability of the above system.

c) Solve the following difference equation by use of *Z*-transform method :

$$x(k+2)+3x(k+1)+2x(k)=0, x(0)=0, x(1)=1$$

6 + 2 + 6

8. Write short notes on any *two* of the following : 2×7

a) Disturbance signal and its rejection

b) Lyaponov's method of stability analysis

c) Limit cycles

d) Transportation Lag in a system.

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