

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VII Examination-Nov/Dec.-2011

Subject code: 171701**Date: 19/11/2011****Subject Name: Control System Design****Time: 10.30 am-01.00 pm****Total marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Brief about controllability and observability in context of state space analysis. Also comment on state transition matrix. Draw the block diagram of open loop and closed loop systems in state space. **07**
- (b)** Discuss about internal model design for step input tracking with mathematical arguments. **07**

- Q.2 (a)** Consider the third order system given by, **07**

$$\frac{d^3 y}{dt^3} + 5 \frac{d^2 y}{dt^2} + 3 \frac{dy}{dt} + 2y = u$$
 (Convert the system in to well known state space form preferably controllable canonical form for the further procedure.)
 If the desired characteristics equation is,

$$s^3 + 14.4s^2 + 82.1s + 172.8$$
 then find out the feedback gain/matrix required for the same.
- (b)** Discuss the optimal control systems in detail with necessary equations and also brief about the procedure to find out feedback gain for the systems. **07**

OR

- (b)** State the condition for observability. Discuss the state observer design with necessary equations and block diagram. **07**
- Q.3 (a)** List the steps to design Robust PID controlled systems. **07**
- (b)** Give the stability criteria for additive perturbation and multiplicative perturbation. Also find out the relationship between sensitivity function S_G^T and transfer function of the system T, where G is the plant's transfer function. **07**

OR

- Q.3 (a)** Explain the Pseudo Quantitative Feedback Theory with suitable example. **07**
- (b)** Explain the systems with pre-filter. **07**

- Q.4 (a)** What is dead beat response? Give the design procedure for obtaining dead beat response. **07**
- (b)** Discuss the lag compensation technique based on frequency response (bode plot). List the necessary steps. **07**

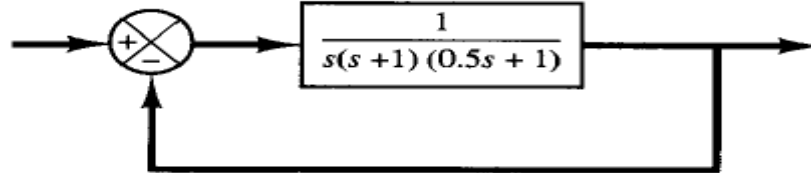
OR

- Q.4 (a)** Discuss the lead compensation technique based on frequency response (bode plot). List the necessary steps. **07**

Q.4 (b)

Consider the system as shown by the figure below:

07



Design a lag compensator so that the above system has phase margin of 40 degree and velocity error constant is $K_v=5 \text{ sec}^{-1}$.

Q.5 (a)

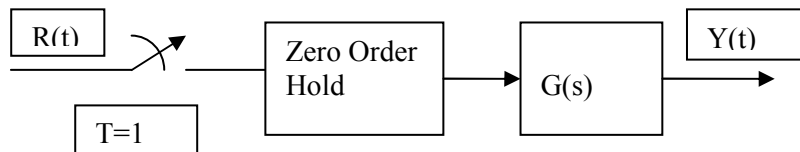
Determine the z transform for $f(t) = \sin(\omega t)$ and $f(t) = e^{-at}$.

07

(b)

Derive the open loop transfer function for the open loop system shown in the figure. T is sampling interval and is 1 second. Where $G(s) = \frac{1}{s(s+1)}$

07

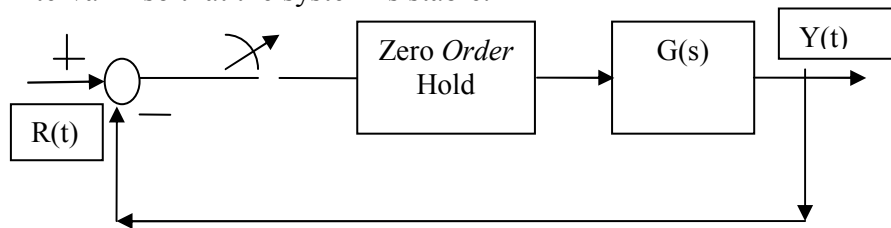


OR

Q.5 (a)

In the fig shown below $G(s) = \frac{10}{s+1}$. Determine the range of sampling interval T so that the system is stable.

07



(b)

Obtain the z transform of

07

$$X(s) = \frac{1-e^{-sT}}{s} \frac{1}{s+1}.$$

Where, T is the sampling interval.
