B.TECH. SEM -VI ELECTRICAL 2014 COURSE (CBCS) :
SUMMER - 2018
SUBJECT: MODERN CONTROL SYSTEMS

Day: Wednesday **Time:** 02.30 PM TO 05.30 PM
Date: 06/06/2018 **S-2018-2415** **Max. Marks: 60**

N.B:

1) All question are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data if necessary.
4) Use of non-programmable **CALCULATOR** is allowed.

Q.1 **a)** Compare state variable analysis with the classical approach of transfer function. **(04)**

b) Obtain state model by direct decomposition of system with transfer function. **(06)**

$$Y(s)/U(s) = (5s^2 + 6s+8)/(s^3+3s^2+7s+9)$$

OR

Q.1 **a)** Define state, state space, state variable, state vector. **(04)**

b) What is Jordan canonical form? **(06)**

Q.2 **a)** State properties of state transition matrix. **(04)**

b) Obtain S.T.M. for the state model with matrix. **(06)**

$$A=\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$

OR

Q.2 **a)** State Kalman's test for controllability and observability. **(04)**

b) Find controllability and observability of the system described by state equation: **(06)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix}=\begin{bmatrix} 3 & 0 \\ 2 & 4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}+\begin{bmatrix} 0 \\ 1 \end{bmatrix} u \quad and \quad Y=\begin{bmatrix} 1 & 0 \end{bmatrix}[X]$$

Q.3 **a)** Describe jump resonance and limit cycle phenomenon in nonlinear system. **(04)**

b) Compare phase plane method with describing function method of analysis. **(06)**

OR

Q.3 Sketch location of roots in S plane and phase plane trajectories for the system with equation $\frac{d^2x(t)}{dt^2}+2\xi\omega_n\frac{dx(t)}{dt}+\omega^2{}_n\,x(t)=0$ **(10)**

for $\xi=0, 0<\xi<1 \; and \; \xi=1$

Also comment about stability for each case.

Q.4 **a)** Draw block diagram of discrete data control system and describe functions of each block. State merits and limitations of discrete data system. **(05)**

b) Solve the difference equation: **(05)**

c (k+2) +3 c (k+1)+ 2c (k) = u (k)

c (0) = 1; c (k) = 0 for k< 0

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OR

Q.4 **a)** Describe the operation of ZOH with input-output waveforms and mathematical equation. **(05)**

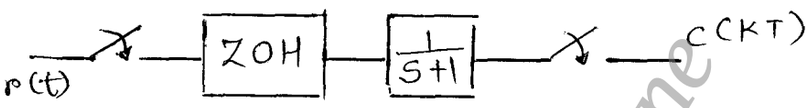
b) Find Z transform of following: **(05)**

i) e^{-at} ii) $\frac{s}{s^2+\omega^2}$

Q.5 **a)** Check stability of system. **(04)**

$z^4 - 1.7z^3 + 1.04z^2 - 0.268z + 0.024 = 0$

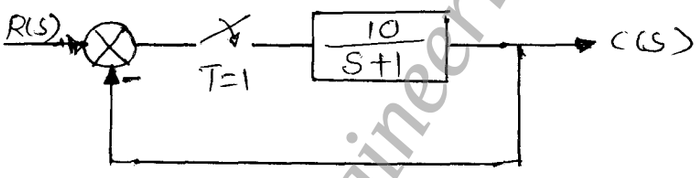
b) Find $\frac{C(z)}{R(z)}$ for the following: **(06)**



OR

Q.5 **a)** Show mapping of S plane to Z plane and state condition of stability in Z plane. **(04)**

b) Determine the stability of closed loop system in Z plane as shown in Fig. below for T = 1. **(06)**



Q.6 Draw block diagram Model Reference Adaptive Control and explain all the components and working. Describe applications. **(10)**

OR

Q.6 Explain fuzzy sets theory and operation for temperature control application. **(10)**

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