Reg. No. | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER M.TECH. (CONTROL SYSTEMS)

END SEMESTER DEGREE EXAMINATIONS, FEBRUARY - 2021

SUBJECT: Advanced Control Theory [ICE 5152]

24-02-2021

TIME: 3 HOURS MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

1A. Plot root locus of the system $G(s)=\dfrac{K}{s(s+1)(s+2)}$ and determine the frequency of sustained oscillation and gain at that frequency.

1B. Design lag-lead compensator for the system given in Q 1A to achieve peak overshoot<=16% and steady state error for a ramp input to be less than 0.03rad.

(4+6)

2A. Consider a system $G(s)=\dfrac{1}{(5s+1)(10s+1)}$. Design PID controller using $\dfrac{1}{4}$ decay ratio method.

2C. Plot bode diagram of $G(s)=\dfrac{K}{s(s+2)(s+60)}$. Comment on closed loop stability of the system with $K_v \le 5s^{-1}$.

(5+5)

3A Apply Jury's test and determine the closed loop stability of the block given in Fig. Q3A.

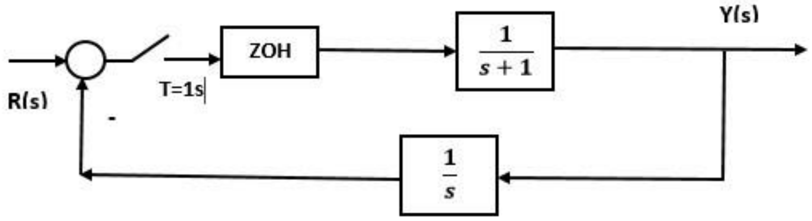

Fig. Q3A

3B Derive the pulse transfer function of the system given in Fig.Q.3B

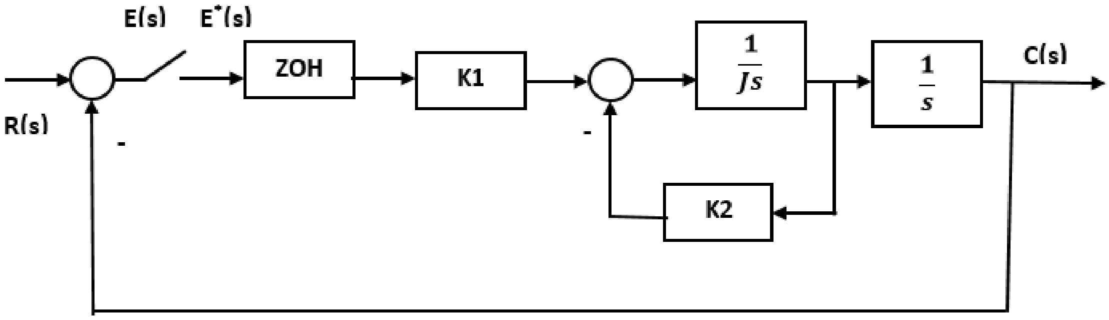

Fig.Q.3B

3C Solve the difference equation given as $x(k+2)-1.5x(k+1)+0.5x(k)=1(k)$

4+3+3

4A For the electrical system shown in Fig. Q4A select minimal state variables and find the state model in physical variable form. Take $V_o(t)$ as the output.

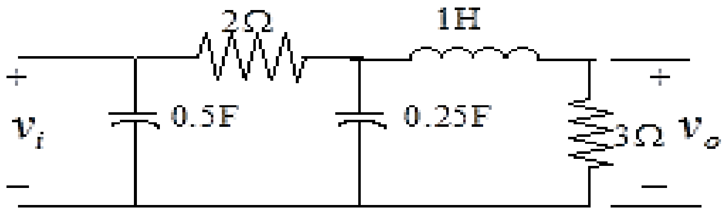

Fig. Q4A

4B Find the complete solution for the state equation for $\dot{x}=8x+2u$; y=x+u. with ramp input and initial state x(0)=1.

4C Obtain state model of the system $G(s)=\dfrac{10}{s^2}$; $H(s)=\dfrac{10}{s}$ by cascade decomposition, where G(s) is system transfer function and H(s) feedback transfer function.

(5+3+2)

5A Check for complete state controllability by diagonalisation technique,

$\dot{x}=\begin{bmatrix}0 & 2\\ -2 & -4\end{bmatrix}x+\begin{bmatrix}0\\1\end{bmatrix}u;\ y=[1\quad 0]x$;

5B Derive the observable canonical form. Draw the state diagram.

$$\frac{Y(s)}{U(s)}=\frac{s^2+6s+8}{s^3+9s^2+20s+13}$$

5C Design full order state observer using Ackermann's formula if the desired observer poles are at twice the original pole locations of the system.

$$\dot{x}(t)=\begin{bmatrix}0 & 1\\ -8 & -6\end{bmatrix}x(t)+\begin{bmatrix}0\\1\end{bmatrix}u(t)\,;\ y(t)=\begin{bmatrix}1 & 0\end{bmatrix}x\,.$$

2+3+5

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