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

FIRST SEMESTER M.TECH. (CONTROL SYSTEMS)

END SEMESTER DEGREE EXAMINATIONS, NOVEMBER - 2019

SUBJECT: ADVANCED CONTROL THEORY [ICE 5152]

TIME: 3 HOURS MAX. MARKS: 50

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

1A. Mention FOPDT model and with the help of graph elaborate each variable.

1B. Determine the type of the system,
$G(s) = \frac{K}{s^3+8s^2+17s}$ with the help of steady state error and its corresponding gains.

1C. Design a lag compensator using time domain approach for the system,

$G(s) = \frac{K}{s(s+1)}$ to satisfy the design specification of overshoot 10% and ramp error gain 10. Also plot the root locus after compensation.

(2+3+5)

2A. Find the solution of $y(k+2)+3y(k+1)+2y(k)=r(k)$; *r(k)* is unit step function.

2B. Plot bode diagrams of
$G(z) = \frac{10}{z(z-1)}$; with T= 1 s. Also comment on closed loop stability of the system.

2C. Derive Pulse transfer function of the system shown in Fig. Q2C.

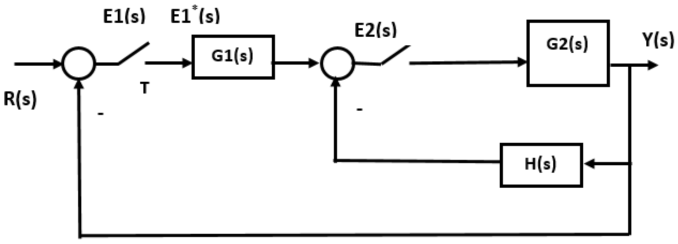

Fig. Q2C.

(2+3+5)

3A. Obtain the dominant pole locations of a second order discrete system if damping ratio is 0.5, settling time is 1 s and sampling period is 1 s.

3B. For the electrical system shown in Fig. Q3B, select minimal state variables and find the state model in physical variable form. Take $V_o(t)$ as the output.

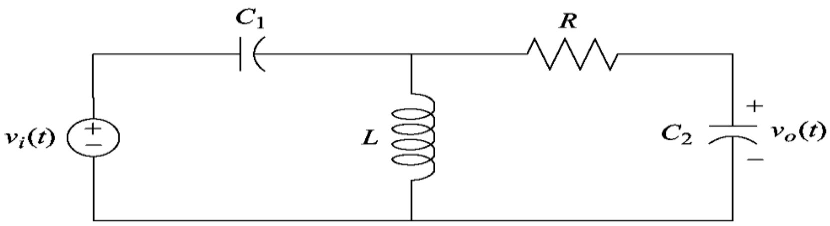

Fig. Q3B

3C. Diagonalize the system

$$\frac{Y(s)}{U(s)} = \frac{s+3}{s^3+9s^2+24s+20}$$

(2+3+5)

4A. Design state feedback control law by direct substitution method for the regulator system

$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$; $C = [1 \quad 0]$;

The closed loop Eigen values to be placed at three times the open loop pole locations.

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. Derive the observable canonical form of

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

(3+3+4)

5A. Check the complete state observability of $x(k+1) = \begin{bmatrix} 1 & 0 \\ 0 & 0.5 \end{bmatrix} x(k) + \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} u(k)$;

$y(k) = [1 \quad 1]x(k)$.

5B. Obtain state model of the system by direct decomposition. Draw the state diagram.

$$G(z) = \frac{3}{(z+2)^3}$$

5C. Given the continuous state model find the discrete state model of the system for T=1s. Also find its pulse transfer function.

$\dot{x} = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$; $y = [0 \quad 1]x + 0.5u$

(2+3+5)

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