Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIFTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
NOVEMBER 2018
SUBJECT: LINEAR AND DIGITAL CONTROL SYSTEMS (ECE - 3101)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Using signal flow graph technique determine the transfer function C/R for the diagram in **Fig. 1A.**

1B. Determine the state transition matrix $\varphi(t)$ for $\dot{x} = \begin{bmatrix} -1 & 2 & 0 \\ 0 & -1 & 2 \\ 0 & 0 & -1 \end{bmatrix} x$

(6+4)

2A. Starting from fundamentals derive the expressions for peak overshoot and peak time for a second order prototype system with unity feedback.

2B. For the mechanical system shown in **Fig. 2B**, write all governing equations and obtain Force-current analogous electric circuit.

(6+4)

3A. Check for controllability and observability of a system having following state equations:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 3 \\ -7 & 5 & 9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u \qquad y = \begin{bmatrix} 5 & 2 & 7 \end{bmatrix} x$$

3B. For the state variable description of a system given below, determine the transfer function and state transition matrix. $\begin{bmatrix} \frac{dx_1(t)}{dt} \\ \frac{dx_2(t)}{dt} \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$ and $y = [1 \quad 1]x$

(5+5)

4A. For the system with $G(s)H(s) = \frac{250(S+1)}{S^2(S+5)(S+50)}$ design a phase lead compensator to meet steady state error of 1% and at least 60° phase margin.

4B. For the sampled data control system shown in Fig. 4B, determine the range of K for stability using Jury's stability test $G(s) = \frac{K}{S(S+10)}$

(7+3)

5A A unity feedback system has open loop transfer function, $G(s) = \frac{K}{(s+1)(s+2)(s+3)}$, draw the Nyquist diagram and find the range of K for which the system remains stable.

5B For $G(s) = \frac{1}{(1+5s)}$ with unity feedback, design a deadbeat algorithm for step excitation. Assume T_S = 0.5s

(6+4)

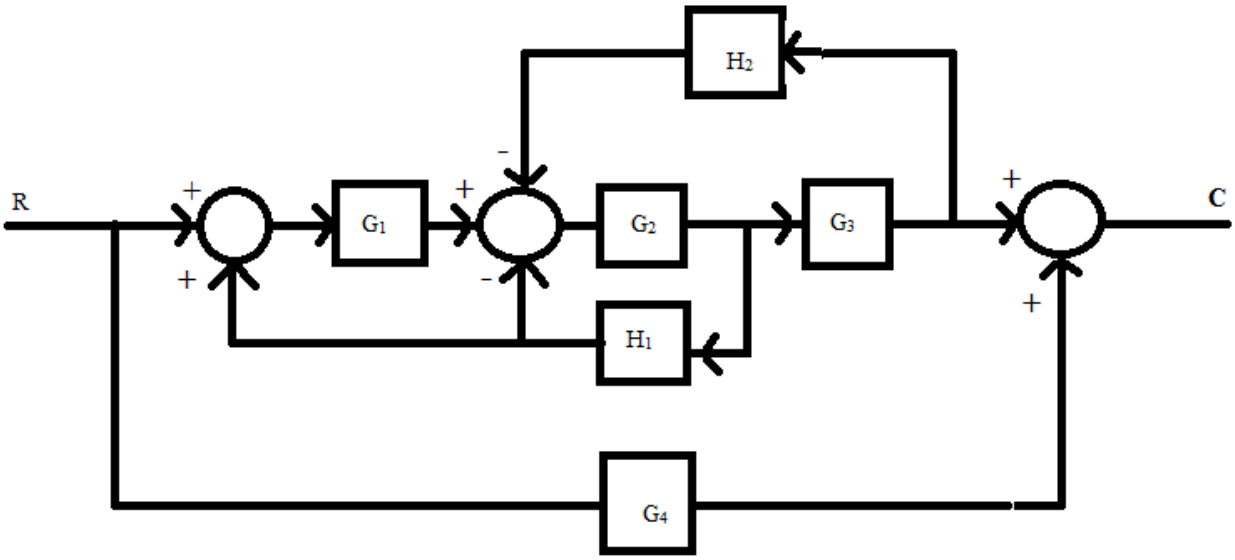

Fig. 1A

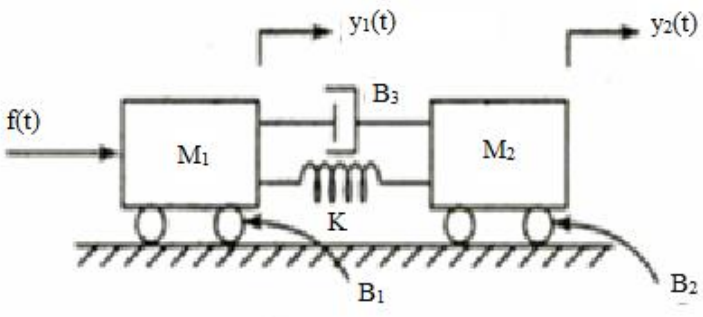

Fig. 2B

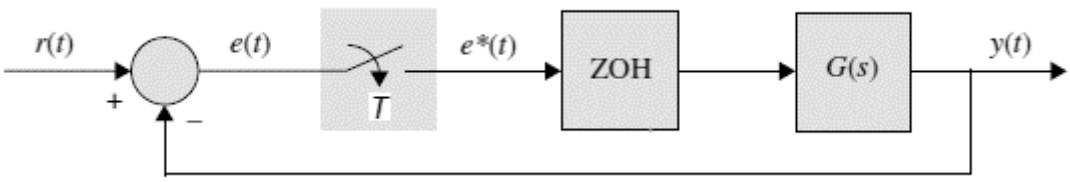

Fig. 4B