Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

FIFTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: LINEAR AND DIGITAL CONTROL SYSTEM (ECE - 3101)

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

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- Centimeter and semilog graph sheets will be supplied

1A. For the mechanical system shown in Figure (1A), write the equations governing the system motion using free body diagram and obtain force to voltage and force to current analogue.

1B. Consider the servomechanism shown in Figure (1B), determine the value of K and k so that the maximum overshoot in unit step response is 25% and the peak time is 2 sec.

1C. The Nyquist plot of a system encloses the point (-1, 0). The gain margin of the system is ------

a) Less than zero. b) Greater than zero c) zero d) infinite.

(5+3+2)

2A. Draw the signal flow graph and find the transfer function using Mason's gain formula for the block diagram shown in Figure (2A).

2B. Design D(z) of a digital controller such that the response of the system to unit step function will be $C(t) = (1 - e^{-0.5t})$. The transfer function of the plant is $\frac{1}{(1+5s)}$ and the sampling period T = 1 second.

2C. A process has open loop transfer function $G_p(s)=100/(s(s+10))$. Find its percentage overshoot and damping ratio with unit step input and unity feedback. Design PD controller to achieve a steady state error of 1 % for unit ramp input.

(5+3+2)

3A. Obtain the root locus for a unity feedback system with open loop transfer function $G(s) = \frac{K}{s(s^2 + 6s + 25)}$.

3B. Find $\frac{C(z)}{R(z)}$ for the sampled data control system shown in Figure (3B).

3C. Discuss merits and demerits of Phase lead controller.

(5+3+2)

4A. Starting from fundamentals derive the expressions for peak overshoot and peak time for a second order prototype system with unity feedback.

4B. Check the stability of a digital system with characteristic equation $P(z) = 0.8 + 3z + 3.3z^2 + z^3$ using Jury's test.

4C. With block diagram, explain the principle of feedforward controller.

(5+3+2)

5A. Find the transfer function for the system which is represented in state space representation as follows $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ and $y = [0\ 1\ 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$.

5B. A state space representation for a dynamic system is $\dot{X} = \begin{bmatrix} -3 & 1 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} r$ and

y = [2 -1] $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. The system is ------ a) Controllable and observable. b) Controllable but not observable. c) Not controllable but observable. d) Neither controllable nor observable

5C. Describe PID controller functions along with the help of characteristics and transfer function.

(5+3+2)

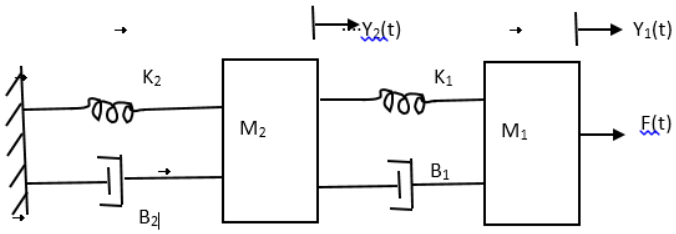

Figure (1A)

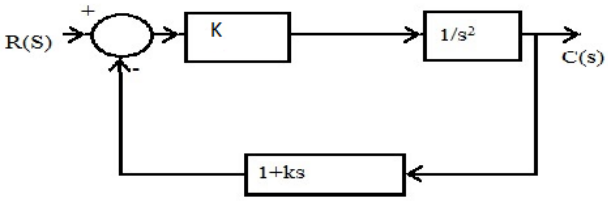

Figure (1B)

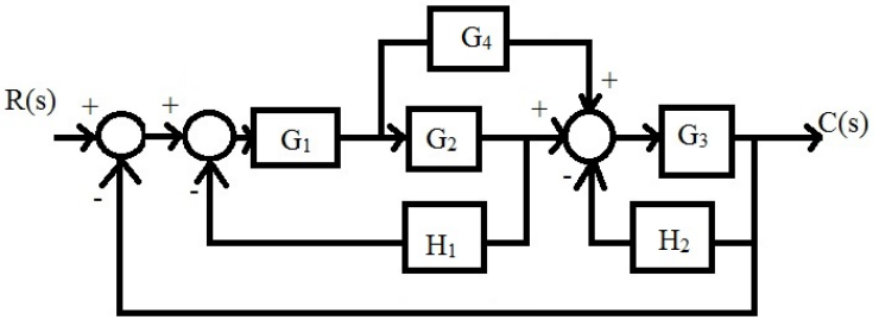

Figure (2A)

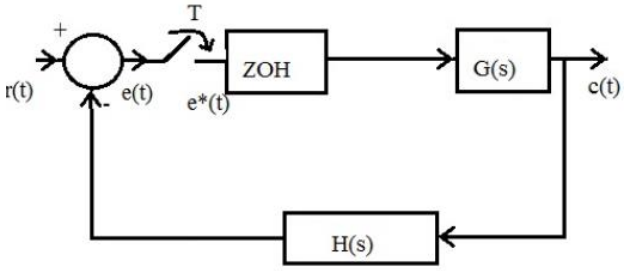

Figure (3B)