Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - NOV/DEC 2016

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.
- Graph sheets will be provided.

1A. For the block diagram shown in Fig Q1A, draw the signal flow graphs to determine the transfer ratios C(s)/R(s) and C(s)/D(s).

1B. For the mass-spring dashpot system shown in Fig Q1B, obtain the transfer function. Obtain the force-voltage analogy.

1C. Evaluate the transfer function for the network shown in Fig Q1C.

(5+3+2)

2A. Using the Routh criterion, check whether the system represented by the following characteristic equation is stable or not. Comment on the location of the roots. Determine the frequency of sustained oscillations if any.

$s^4 + 2s^3 + 6s^2 + 8s + 8 = 0.$

2B. Determine the value of "K" and "a" such that the system has a damping ratio of 0.7 and an undamped natural frequency of 4 rad/sec for the system shown in Fig Q2B.

2C. If the transfer function of a system is e^{-2t} and applied input is $4e^{-5t}$, determine the response of the system.

(5+3+2)

3A. Draw the Nyquist plot and assess the stability of the closed loop system whose open-loop transfer function is $G(s)H(s) = \dfrac{(s+2)}{(s+1)(s-1)}$

3B. With reasons, explain why the proportional controller and integral controller not used individually. How these drawbacks are overcome in PID controller?

3C. The open-loop transfer function of a feedback system is given.

$$G(s)H(s) = \frac{9}{s(s+3)}$$

The unit step response has a peak overshoot of ---------

(i) 0.143 (ii) 0.153 (iii) 0.163 (iv) 0.173

(5+3+2)

4A. The open loop transfer function of a unity feedback system is $G(s) = \dfrac{K}{s(s+1)}$

It is desired to have the velocity error constant K_V = 12 sec^{-1} and phase margin as 40^0. Design a phase lead compensator to meet the above specifications.

4B. Using Jury test, find the stability of the system with the characteristic equation $2z^4 + 7z^3 + 10z^2 + 4z + 1 = 0$

4C. Obtain C(z)/R(z) for a closed loop unity feedback system after introducing a sampler in the feedback path.

(5+3+2)

5A. (i) State and prove properties of state transition matrix.

(ii) Obtain state transition matrix for $A = \begin{bmatrix} 2 & 0 \\ -1 & -1 \end{bmatrix}$

5B. Determine D(z) for a digital controller such that the response of the system to a unit step function will be $c(t) = 1 - e^{-0.5t}$. Given $G_p(s) = \frac{1}{5s+1}$ and T = 1 sec.

5C. A state space representation for a dynamic system is

$$\dot{X} = \begin{bmatrix} -3 & 1 \\ 0 & 2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} r \text{ and } y = [2 \quad -1]$$

The system is ---------

(i) Controllable and observable. (ii) Controllable but not observable. (iii) Not controllable but observable. (iv) Neither controllable nor observable.

(5+3+2)

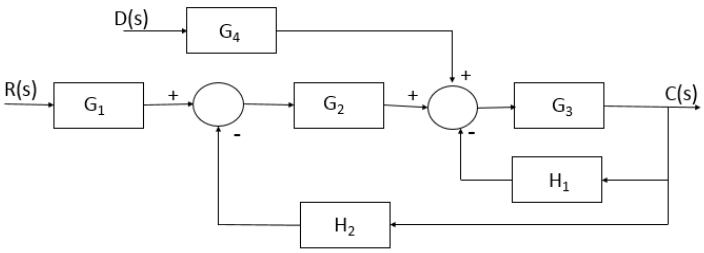

Fig Q1A

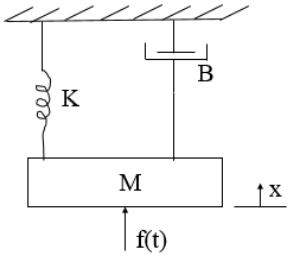

Fig Q1B

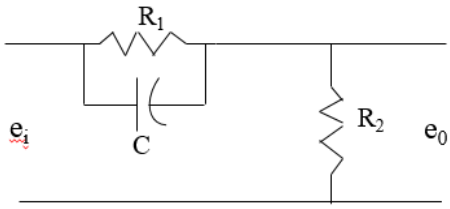

Fig Q1C

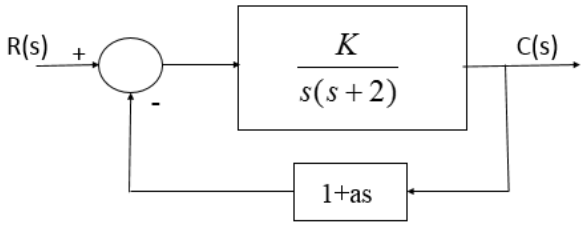

Fig Q2B