Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: LINEAR AND DIGITAL CONTROL SYSTEMS (ECE - 306)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed
- Graph sheets will be issued on request

1A. For the mechanical system shown in **Fig. 1A**, equivalent T-V analogous circuit with the help of all necessary equations.

1B. For the unity feedback system represented as $G(s)=\frac{(s+1)}{s^2(s+10)}$, draw the Root Locus and comment on stability.

(5+5)

2A. For the SFG shown in **Fig. 2A**, find forward path, loop and non-touching loop gains.

2B. Derive frequency response specifications of a second order prototype system. Find the magnitude and phase responses for the system with $G(s)=\frac{10(s+3)}{s(s+5)(s+10)}$ at 500 rad/sec.

(5+5)

3A. Given the unity feedback system with the forward path transfer function $G(s)=\frac{8(1+s)}{(s-1)(s-6)}$. Draw Bode plot and find phase and gain margins. Find by what value the gain has to be increased/decreased to achieve phase margin of 45^0.

3B. Find the state variable matrix equation for the circuit shown in **Fig. 3B**. Let the state variables are $x_1=v_1,\ x_2=v_2$ and $x_3=i$.

(5+5)

4A. Explain the effect of controllers on second order prototype system. For the process $G_p(s)=\frac{100}{s(s+10)}$, find percentage peak overshoot and damping ratio for unit step input. Design a PD controller to achieve 1% steady state error for ramp input.

4B. A single loop feedback system have path gains $G(s)=\frac{2}{s+1}$ and $H(s)=\frac{1}{s+10}$. Find its response for unit step input. What is the steady state response of the system for the same input?

4C. State and prove properties of state transition matrix.

(5+3+2)

5A. Draw the Nyquist plot for the system $G(s)H(s)=\frac{K}{s(s+1)(1+2s)}$ and comment on stability.

5B. For a negative UFB system with forward path gain of G(s), find the 3rd order OLTF so that steady state error due to ramp input is 1.5 and the characteristics equation has roots at -1±j1.

5C. What are the advantages of state variable technique used in system analysis?

(5+3+2)

6A. A discrete negative UFB system has OLTF $G(s)=\frac{0.2}{s+0.2}$ in series with a ZOH. If T = 0.1 Sec., using Kalman's algorithm, find the controller function in terms of manipulating signal. Also find values of manipulating signal at various sampling times.

6B. For the system with OLTF $G_p(s)=\frac{k}{s(s+30)}$, find k so that the steady state error is 2% for unit ramp input. Design RC phase lead network so that approximate 2nd order system is critically damped. Find the values of the components.

6C. Derive for controller function using deadbeat algorithm.

(5+3+2)

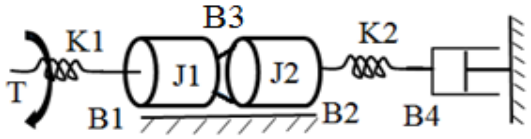

Fig. 1A

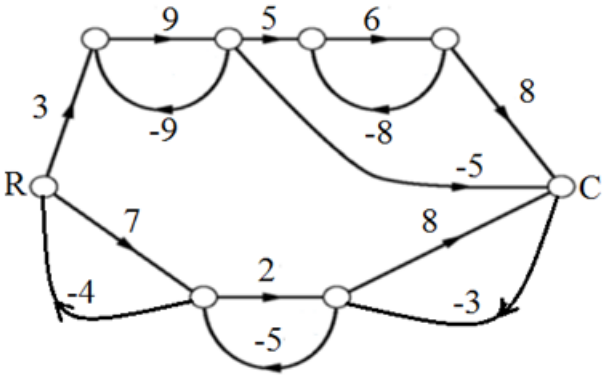

Fig. 2A

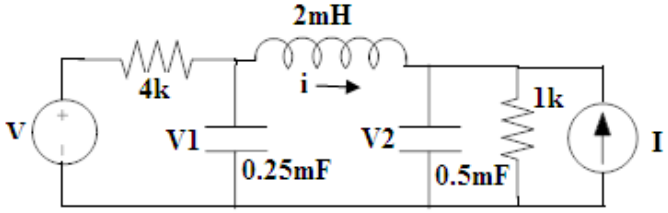

Fig 3B