Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: CONTROL SYSTEMS DESIGN [AAE-303]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. Sketch the signal $x(t)=r(t)-2r(t)+r(-2+3t)$. Where $r(t)$ is ramp input. (02)

1B. A control system for an automobile suspension tester has negative unity feedback and a process (04)

$$L(s)=G(s)_C G(s)=\frac{K(s^2+4s+8)}{s^2(s+4)}$$

We desire the dominant roots to have ς equal to 0.5.Using the root locus, show that *K* = 7.35 and the dominant roots are $S=-1.3\pm j2.2$

1C. Explain the stability of a below given system for K, Where $-\infty<K<+\infty$. (04)

$$\frac{d^5y(t)}{dt^5}+20\frac{d^4y(t)}{dt^4}+K\frac{d^3y(t)}{dt^3}+100\frac{d^2y(t)}{dt^2}+96\frac{dy(t)}{dt}+50y(t)=\frac{d^2x(t)}{dt^2}+20\frac{dx(t)}{dt}+96x(t)$$

2A. Find whether the following systems with impulse response $h(t)$ is stable or not $h(t)=te^{-t}u(t)$. (02)

2B. Find the Laplace transform and their Region of Convergence(ROC) of following: (03)
(i) $x(t)=e^{-5t}u(t)+e^{-8t}u(-t)$ and (ii) $x(t)=t^2e^{-2t}u(t)$.

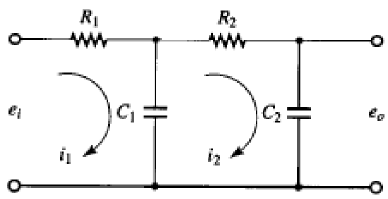
2C. Consider a unity feedback system has a loop transfer function (05)

$$L(s)=G(s)_C G(s)=\frac{K(s+8)}{s^2+15s+10)}$$

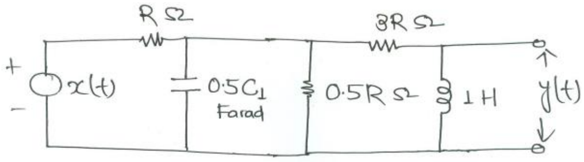
Sketch the Bode plot of the loop transfer function and indicate how the magnitude $20\log|L(j\omega)|$ plot varies as *K* varies. Develop a table for *K* = 2 and 10, and for *K=2* determine the crossover frequency (ω_c for $20\log|L(j\omega)|=0$), the magnitude at low frequency and high frequency.

3A. Explain the open loop and closed loop system with one example. (02)

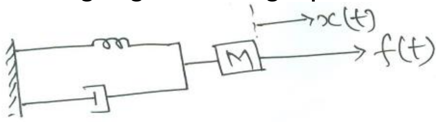
3B. Derive the transfer function of a given RLC circuit and sketch the signal flow graph. (03)



3C. Derive the state and state variable model and sketch signal flow of a system given below: (05)



4A. Derive the transfer function using signal flow graph model of given system below:- (02)



4B. Derive the equation of nth system using signal flow graph model. (03)

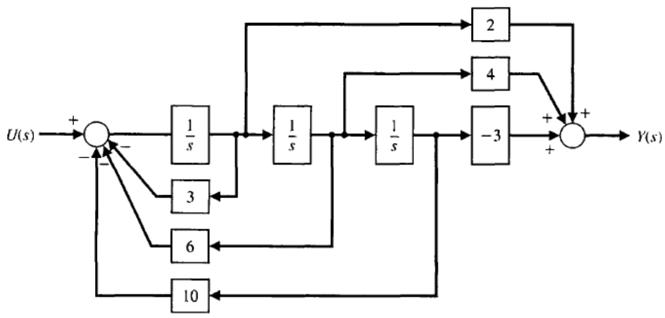
4C. Realize the transfer function of the system given in direct form-1. (05)

$$\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+9y(t)=3\frac{d^2x(t)}{dt^2}+9\frac{dx(t)}{dt}+7x(t)$$

5A. Explain steady state error of a first order electrical circuit. (02)

5B. Derive the state transition matrix of mass-spring-damper system. (03)

5C. Consider the block diagram model in below figure. Write the corresponding state variable model in the state space model form. Determine the state variable feedback gains to achieve a settling time (with a 2% criterion) of 5 second and an overshoot of about 10%. (05)



State variable block diagram.

6A. Define the system realization. (01)

6B. Find the total response of the system, (04)

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=\frac{dx(t)}{dt}+4x(t) \quad \text{where, } x(t)=\sin 2tu(t), y(0^+)=5, \frac{dy(0^+)}{dt}=0.$$

6C. Derive the transfer function of a given mechanical system. Find the output response, % maximum overshoot, peak time and settling time. (05)