Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech

PCEC 4303

Fifth Semester Regular Examination – 2014

CONTROL SYSTEM ENGINEERING

BRANCH : EEE, ELECTRICAL

QUESTION CODE : H 132

Full Marks – 70

Time : 3 Hours

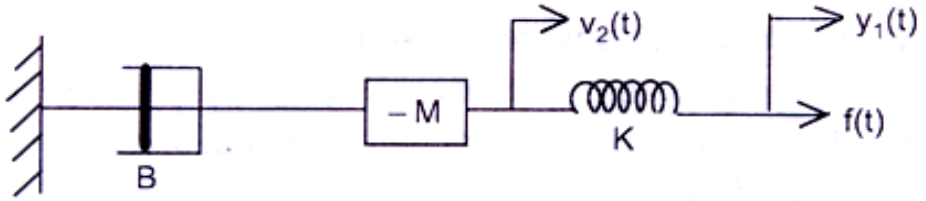
*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 ×10

(a) What do you mean by 'Impulse Response' of a transfer function ? Why is it named so ?

(b) Say with reasons, whether the system described by the relationship $y(t) = t\frac{d}{dt}u(t)$ is linear or non-linear, time-varying or time-invariant.

(c) Write down the differential equation for the mechanical system shown in figure.



(d) The closed loop transfer function of a control system is given by $\frac{C(s)}{R(s)} = \frac{1}{1+s}$

For the input r(t)=cos (t), determine the steady state response c(t).

(e) What do you mean by the term 'Root Locus ? Write down the magnitude and angle criteria for a point to be on the root locus, giving justification for your answer.

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(f) How does the polar plot get modified when

(i) A non-zero pole is added to the open loop transfer function ?

(ii) A pole at the origin is added to the open loop transfer function ?

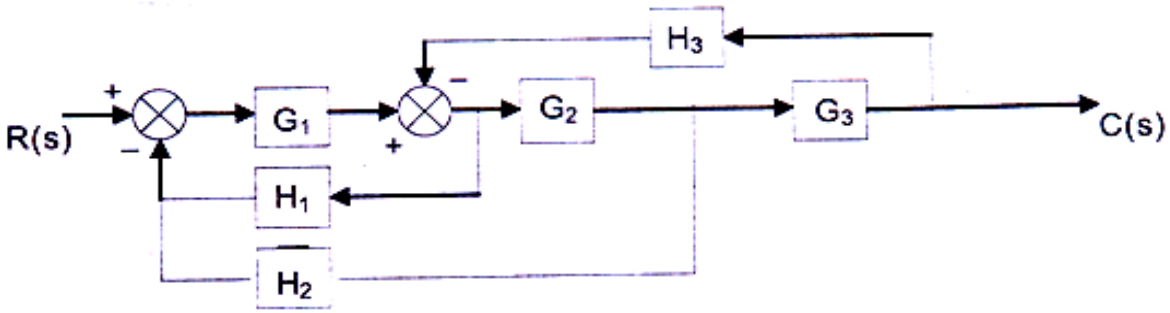
(g) Determine the phase angle for the transfer function $G(s) = \frac{1}{(1+sT)^3}$ at the corner frequency.

(h) What inference is drawn if there is a row of zeros in the Routh Array ?

(i) A unity feedback system has the forward path transfer function $G(S)\,H(S) = \frac{25}{s(s+4)}$. What are the resonant frequency and damped natural frequency of the closed loop frequency response in rad/sec ?

(j) Write down the usefulness of different control actions for a PID controller.

2. (a) Obtain the overall transfer function of the system shown in figure. 5



(b) In which aspects does a two-phase AC servomotor differ from a normal two-phase induction motor ? 5

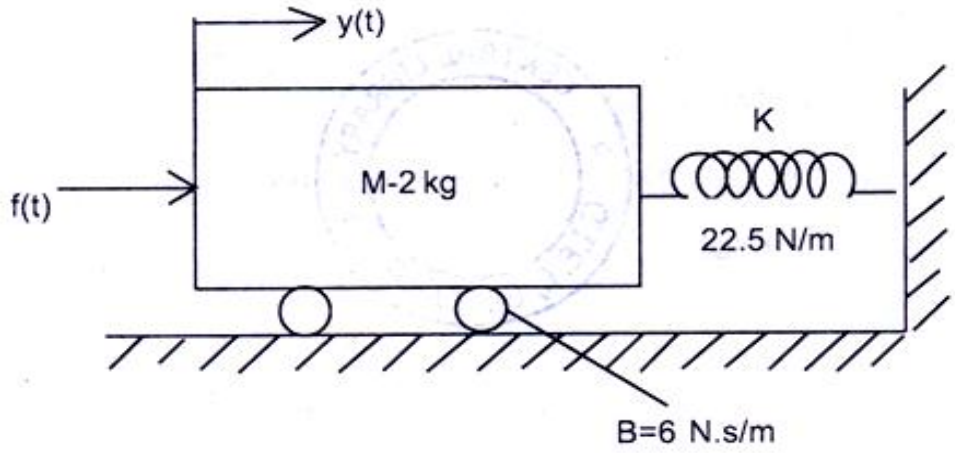
3. (a) What do you mean by dominant closed poles of a system ? How does the addition of pole and zero to a second order system affect the nature of response ? Under what circumstances the effect of additional poles/ zeros becomes insignificant ? 5

(b) The open loop transfer function of a unity negative feedback system is

$$G(s) = \frac{K}{s(s+15)}$$

If K=225, what change must be made in the system to reduce the peak overshoot by 50%, keeping the settling time the same ? Also, find the new transfer function. 5

4. A mechanical system shown below is initially at rest. If the mass is moved with a unit impulse force, find the displacement of the mass after one second, the damping ratio and peak overshoot. 10



5. (a) The open loop transfer function of a unity feedback system is given by 6

$$G(s) = \frac{K(s+1)}{s^2\left(s^2+8s+15\right)}$$

Find an expression for error E(s) and find the value of K when the steady state error due to a parabolic input is 0.3.

(b) Is the above system stable for the value of K determined ? 4

6. (a) Find the angle of arrival of the root locus at the complex zeros of the open loop transfer function of a unity feedback system, 5

$$G(s) = \frac{K\left(s^2+4\right)}{s(s+2)}.$$

(b) Explain about the different measures of relative stability in frequency domain. 5

7. (a) Sketch the Polar Plot for 5

$$G(s) = \frac{K}{s(s+2)^2}.$$

(b) Determine the phase crossover frequency and the gain margin for the above system. 5

8. Write short notes on any **two** of the following : 5 × 2

(a) Bode Plot

(b) Nyquist Stability Criterion

(c) Zigler- Nichol's Method of tuning PID Controllers

(d) Constant M-circles.