**(Set-1)**

# B.Tech-6th
# Control System Engg.

*Full Marks* : 70

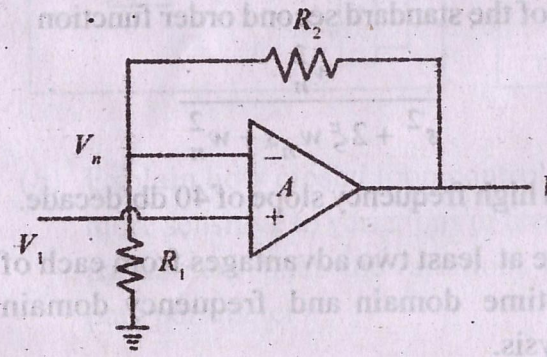
*Time* : 3 hours

**Q.No.1** is compulsory and answer any **five** from the rest

*The figures in the right-hand margin indicate marks*

**1.** Answer the following questions : $2 \times 10$

(*a*) Find the transfer function of the non-inverting OPAMP where gain $A >> 1$



(*b*) Which method of analysis of a control system i.e. transfer function or state space analysis is better and why ?

(*c*) How regenerative feedback is useful in control system ?

(*d*) A system has a transfer function

$$G(s) = \frac{50}{s+50}.$$

Find the time constant, rise time and settling time.

(*e*) What is Shannon's sampling theorem and its importance ?

(*f*) Justify the following statement that the Bode plot of the standard second order function

$$\frac{w_n^2}{s^2 + 2\xi w_n s + w_n^2}$$

has a high frequency slope of 40 db/decade.

(*g*) Write at least two advantages from each of the time domain and frequency domain analysis.



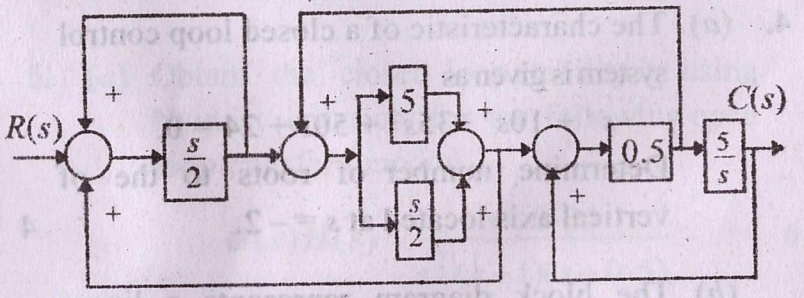


(*h*) What are the static error constants ? Write error constants for type-0, type-1 and type-2 systems.

(*i*) State and explain the Nyquist stability criterion.

(*j*) Define State and State Transition Matrix.

2. (*a*) Draw the signal flow graph from the block diagram given below. Find the overall transfer function using Mason's gain rule. 6




(*b*) Explain how closed loop control system is more sensitive to variations in feedback path parameters than the variations in forward path parameters ? 4

3. (*a*) The forward path gain for unit feedback system

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

Plot the root loci for the system. 7

(*b*) Explain how addition of pole and zero affects to the response of the second order system. 3

4. (*a*) The characteristic of a closed loop control system is given as

$$s^4 + 10s^3 + 35s^2 + 50s + 24 = 0.$$

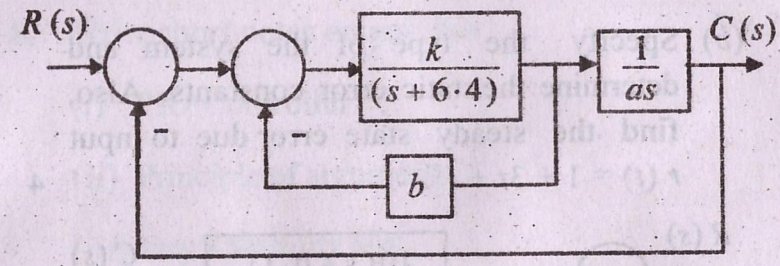
Determine number of roots to the of vertical axis located at $s = -2$. 4

(*b*) The block diagram represents a linear control system. Without the derivative feedback, the system is found to have a peak time of 0·43 sec and the settling time of 1·25 sec. When the derivative feedback is added, what must be the value of '*b*' so





that the damping factor is improved to approximately 0·7 ? 6




5. (*a*) Obtain the closed loop stability by using Nyquist criterion for the following open loop transfer function.

$$G(s)H(s) = \frac{s + 0{\cdot}25}{s^2(s+1)(s+0{\cdot}5)}.$$ 6

(*b*) Solve the following difference equation by use of the Z-transform method

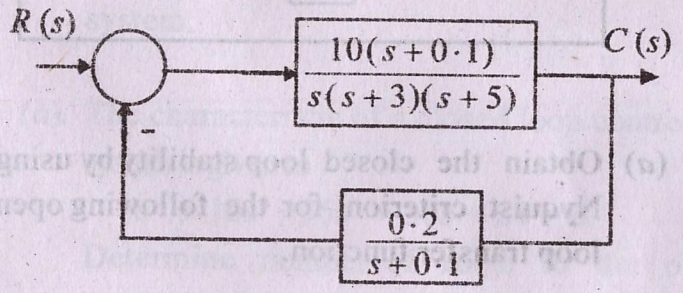
$x(k+2) + 3x(k+1) + 2x(k) = 0, x(0) = 0,$
$x(1) = 1.$ 4

6. (*a*) The open loop T.F. of a control system is

$$G(s)H(s) = \frac{1000}{s(5s+10)(s+10)}.$$

Draw the Bode plot and check the stability. 6

(*b*) Specify the type of the system and determine the static error constants. Also, find the steady state error due to input $r(t) = 1 + 3t + t^2$. 4




7. (*a*) Determine the zero input response of the system by time domain method, where system matrix, output matrix and initial condition of the state are given as

$$A = \begin{bmatrix} 0 & 0 \\ a & -a \end{bmatrix}, \quad C = [1\ 2], \quad X(0) = \begin{bmatrix} 1 \\ 2 \end{bmatrix}. \quad 5$$





(*b*) Find the Z-transform of the following function assuming sampling time $T = 2$ sec.

$f(t) = e^{-at} \cos wt$. 5

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

(*i*) PID Controller

(*ii*) Principle of arguments

(*iii*) Jury's Stability test

(*iv*) Constant *M* and *N* circle.

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