Total No. of Questions—8] [Total No. of Printed Pages—4

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# [5352]-537

## S.E. (Electronics/E & TC) (II Sem.) EXAMINATION, 2018
## CONTROL SYSTEMS
## (2015 PATTERN)

**Time : Two Hours** **Maximum Marks : 50**

***N.B.*** :— (*i*) Neat diagrams must be drawn wherever necessary.
(*ii*) Figures to the right indicate full marks.
(*iii*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(*iv*) Assume suitable data, if necessary.

**1.** (*a*) Determine the transfer function $\frac{V_o(s)}{V_{in}(s)}$ for the system shown in Fig. 1 : [6]

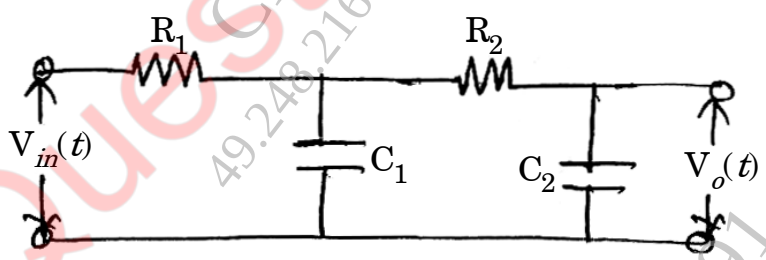


Fig. 1

(*b*) For the unity feedback system with open loop transfer function $G(s) = \frac{10(s+3)(s^2+4s+12)}{s(s+4)(s+6)(s^2+s+5)}$, determine type and order of the system, $k_p$, $k_v$, $k_a$ and steady state error for ramp input. [6]

P.T.O.

*Or*

**2.** (*a*) Determine the overall transfer function of the system shown in Fig. 2 using block diagram reduction rules : [6]

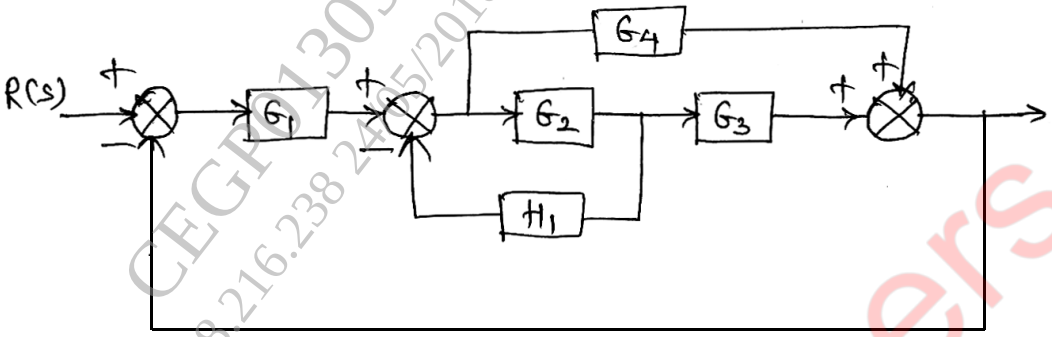


Fig. 2

(*b*) For the system with closed loop transfer function $G_{CL}(s) = \frac{k_1}{s^2 + k_2 s + k_1}$ determine $k_1$ and $k_2$ if $\xi = 0.5$ and setting time for 2% setting is 4 sec. Also find peak time, peak overshoot and rise time. [6]

**3.** (*a*) Investigate the stability of system with characteristic equation $Q(s) = s^4 + 6s^3 + 15s^2 + 5s + 3 = 0$. [4]

(*b*) Draw Bode plot of the system with open loop transfer function $G(s) = \frac{50}{s(s+5)(s+10)}$ and determine $w_{gc}$, $w_{pc}$, gain margin and phase margin. [8]

*Or*

**4.** (*a*) For the system with closed loop transfer function $G_{CL}(s) = \frac{400}{s^2 + 20s + 400}$, determine resonant peak, resonant frequecny, damping factor and natural frequency. [4]

(*b*) Sketch root locus of the system with open loop transfer function : [8]

$$G(s) = \frac{k}{s(s+2)(s+3)}.$$

**5.** (*a*) Obtain the expression for state transition matrix using Laplace transform method and state any four properties of state transition matrix. [6]

(*b*) Investigate for complete state controllability and observability of the system with state model : [7]

$$\dot{x} = \begin{bmatrix} 0 & 0 & -3 \\ 1 & 0 & -4 \\ 0 & 1 & -1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix} u$$

$$y = [0 \quad 0 \quad 1]\, x.$$

*Or*

**6.** (*a*) Obtain the controllable canonical and observable canonical state models for the system with transfer function : [6]

$$G(s) = \frac{s^2 + s + 9}{s^3 + 4s^2 + 11s + 3}.$$

(*b*) Determine the transition matrix of the state equation : [7]

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix} x.$$

**7.** (*a*) Draw the ladder diagrams for Ex-OR, NOR and NAND gates. [6]

(*b*) Draw and explain block diagram of digital control system. [7]

*Or*

**8.** (*a*) Explain Ziegler and Nichol PID tuning method. [6]

(*b*) Determine pulse transfer function and step response of : [7]

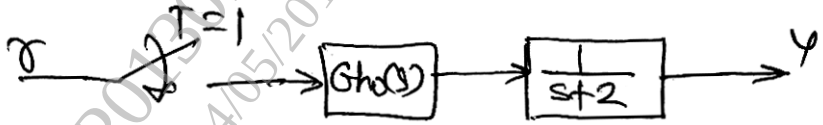


Fig. 3