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

Total Number of Pages: 03 **B.Tech.**
PET5I101

5th Semester Regular Examination 2017-18
Control Systems
BRANCH: ECE, ETC
Time: 3 Hours
Max Marks: 100
Q.CODE: B455

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions: *multiple type or dash fill up type*** **(2x10)**

a) A signal flow graph is used to determine the (A) steady-state error (B) stability of the system (C) transfer function of the system (D) dynamic error coefficient

b) The time constant of a first order system with unit step input is

(A) $\frac{1}{pole}$ (B) $\frac{2.2}{pole}$ (C) $\frac{4}{pole}$ (D) ∞

c) The open-loop transfer function of a feed back system is $G(s)H(s) = \frac{25}{s(s+8)}$.

The settling time for the unit step response is (A) 1sec (B) 2 sec (C) 3 sec (D) 4 sec.

d) The output of a standard second order system for a system for a unit step input is given by $y(t) = 1 - \frac{2}{\sqrt{3}} e^{-t} \cos\left(\sqrt{3}t - \frac{\pi}{6}\right)$. The transfer function of the system is (A) $\frac{2}{(s+2)(s+\sqrt{3})}$ (B) $\frac{1}{s^2+2s+1}$ (C) $\frac{3}{s^2+2s+3}$ (D) $\frac{4}{s^2+2s+4}$

e) For a feedback control system, the forward path transfer function is $G(s) = \frac{K(s+3)}{s(s+1)}$ and the feedback path transfer function is $H(s) = \frac{1}{s}$. The system is of (A) Type-0 (B) Type-1 (C) Type-2 (D) Type-3

f) The damping ratio of the unit step response of a second order system is 0.45. The phase margin of the system is (A) 45.5^0 (B) 47.6^0 (C) 55.6^0 (D) 60^0

g) Addition of PI controller in cascade with a plant (A) increases damping (B) increases the order of the system (C) produces the oscillation in the system (D) reduces the order of the system.

h) The Nyquist plot of a system encloses the point (-1,0). The gain margin of the system is (A) less than zero (B) greater than zero (C) zero (D) infinity

i) For a feedback system the forward-path transfer function is $G(s) = \frac{K}{s(s+5)}$.

The sensor transfer function is $H(s) = 1$. If the steady-state error is 0.025, the value of K is (A) 50 (B) 100 (C) 150 (D) 200

j) A second order system has the step response critically damped. The roots of the characteristic equation are (A) real, negative and distinct (B) real, negative and repeated (C) purely imaginary (D) Complex conjugate

Q2 **Answer the following questions: *Short answer type*** **(2x10)**

a) Distinguish between the minimum phase, non-minimum phase and all pass phase system.

b) How to improve the speed torque characteristic of a two-phase induction motor used for AC Servomotor.

c) Why steady-state error of a closed loop system is required and what are the common factor that the steady state error depends on ?

d) What are the static error constants ? Write error constants for type-0, type-1 and type-2 systems ?

e) Differentiate (at least two from each) between the degenerative and regenerative feedback systems. Give the importance of regenerative feedback systems in control systems.

f) Explain how addition of pole and zero affects to the response of the second order system.

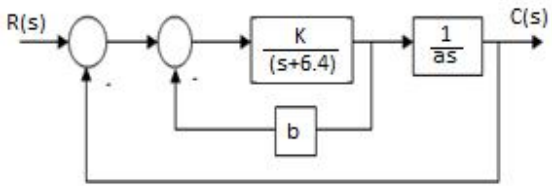
g) What do you mean by gain margin and phase margin? How stability can be checked from it ?

h) Explain how principle of arguments is used to state the Nyquist criterion for stability of linear system.

i) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{25}{s(s+25)}$ .Find the natural frequency and damping ratio.

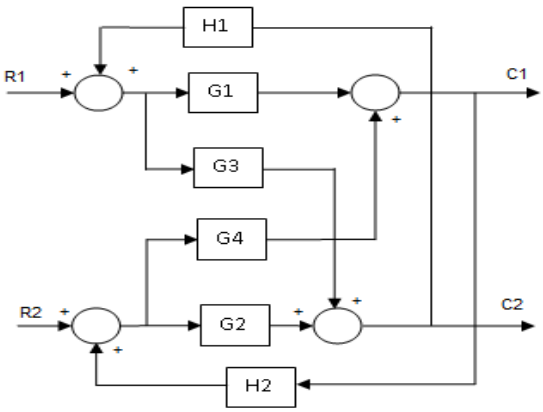
j) Determine the break away point of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+3)^2}$.

Q3 **a)** 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 **(10)**



b) Derive the expression for the effect of negative feedback on sensitivity w.r.t. plant gain of open loop and closed loop systems. **(5)**

Q4 **a)** Evaluate $\frac{C_2}{R_1}$ for the following system using block reduction technique. **(10)**



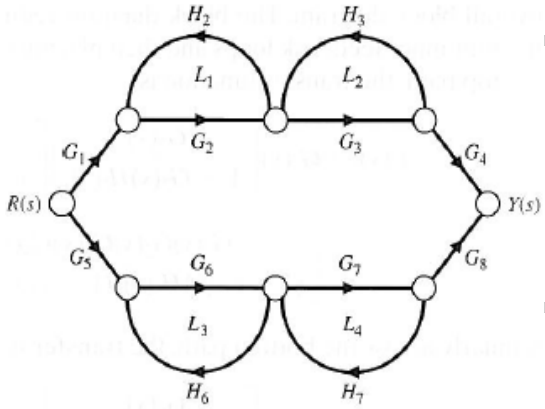
b) Write any five rules for constructing the root locus for checking stability of closed loop system. **(5)**

Q5 **a)** The open loop T.F. of a control system is $G(s)H(s) = \frac{1000}{s(5s+10)(s+10)}$. **(10)**

Draw the Bode plot and check the stability.

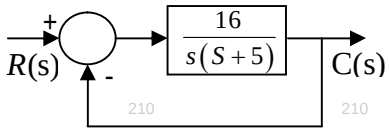
b) The unit step response of a 2nd order under-damped system with unit dc gain is given by $c(t) = 1 - 1.67e^{-4t}\sin(3t + 36.87^0)$. Estimate the transient response specifications and its transfer function. Assume 2% tolerance. **(5)**

Q6 **a)** Draw the signal flow graph from the block diagram given below. Find the overall transfer function using Mason's gain rule. **(10)**



b) Sketch the polar plot of $G(s)H(s) = \dfrac{32}{(s+4)(s^2+4s+8)}$ and find its points of intersection on real and imaginary axis. **(5)**

Q7 **a)** A second order system is shown in figure. If a proportional controller of gain K_c is added in the forward path, find its effect on the real value of the damping ratio, natural frequency and the steady-state error. Comment on the result. **(10)**



b) The characteristic of a closed loop control system is $s^3 + 7s^2 + 25s + 33 = 0$. Determine number of roots to the of vertical axis located at $s = -1$ **(5)**

Q8 **a)** Obtain the closed loop stability by using Nyquist criterion for the following open loop transfer function. **(10)**

$$G(s)H(s) = \frac{8s}{(s-1)(s-2)}$$

b) Why constant M circles and constant N circles are required ? Write some properties of constant M circles and constant N circles. **(5)**

Q9 **a)** For the system $G(s) = \dfrac{8.25}{s^2+2s+5}$, $H(s) = \dfrac{1}{s}$ **(10)**

Determine the gain margin, phase margin, gain crossover frequency and phase crossover frequency.

b) For the system $G(s) = \dfrac{K(s+3)}{s^3 + as^2 + 10s + 12}$. Find the value of a and K so that the system oscillates at a frequency of $\sqrt{18}$ rad/sec. **(5)**