ROLL NO. _____

Code: DE120 **Subject: CONTROL ENGINEERING**

DipIETE – ET (New Scheme)

Time: 3 Hours **DECEMBER 2018** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. The most commonly used input signal(s) in control system is/are
(A) step function **(B)** ramp function
(C) accelerating function **(D)** All of these

b. What is the characteristic of a good control system?
(A) sensitive to parameter variation
(B) insensitive to input commands
(C) neither sensitive to parameter variation nor sensitive to input commands
(D) insensitive to parameter variation but sensitive to input commands

c. The system described by the equation y = a + bx, a>0, b>0 is
(A) dynamic **(B)** linear
(C) non linear **(D)** time varying

d. In a control system, the use of negative feedback
(A) eliminates the chances of instability
(B) increases the reliability
(C) reduces the effects of disturbance & noise signals in the forward path
(D) increases the influence of variations of component parameters on the system performance

e. Mason's rule is applied to
(A) signal flow graph **(B)** block diagram reduction technique
(C) hydraulic system **(D)** rotational system

f. Indicate type one system out of the transfer functions given below
(A) $\frac{s(s+4)}{(s+1)(s+8)}$ **(B)** $\frac{(s+2)}{s(s+6)}$
(C) $\frac{(s+3)(s+5)}{s^2(s+4)(s+8)}$ **(D)** $\frac{s}{(s+4)(s+5)}$

g. The ratio of damped frequency to natural frequency of the given system having damping ratio (δ) is
(A) $\frac{1}{\eta}$ **(B)** δ
(C) δ^2 **(D)** $\sqrt{1-\delta^2}$

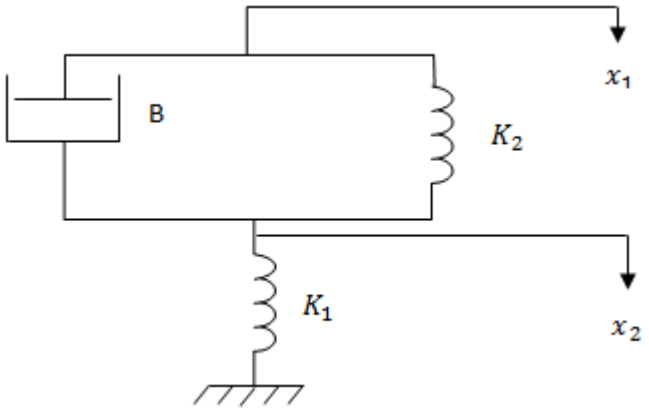
h. A second order system is said to be critically damped if the damping ratio (δ) is
(A) δ>1 **(B)** δ<1
(C) δ=1 **(D)** δ=0.707

i. Which of the following is frequency domain specification
(A) bandwidth **(B)** maximum overshoot
(C) settling time **(D)** All of these

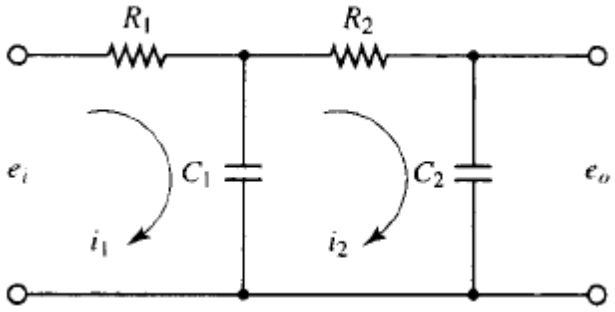
j. A phase lead compensation network
(A) decreases the system bandwidth
(B) speeds up the dynamic response
(C) is applied when error constants are specified
(D) reduces the steady state error

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Draw the electrical analogous circuit (use f-v) analogy & derive their transfer functions. **(8)**

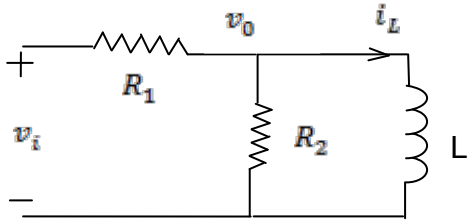


b. What assumptions have to be made for deriving transfer function of the physical systems? Derive the transfer function for the following network when, $R_1 = R_2 = R$ & $C_1 = C_2 = C$. **(8)**

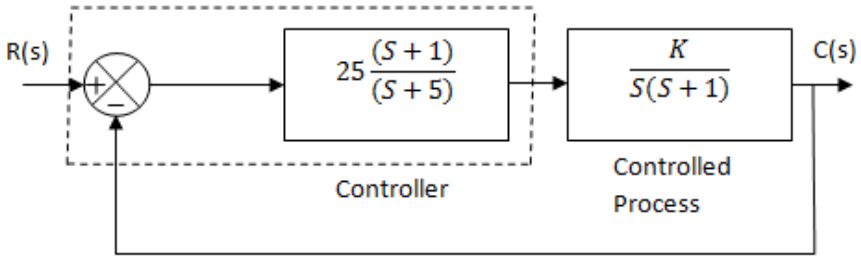


Q.3 a. Derive the expression for close loop Transfer function when feedback is **(8)**
(i) Positive (ii) Negative

b. Draw the block diagram for the circuit, where v_i & i_L are the input and output variables respectively. Also determine the T.F. by reduction technique. **(8)**



Q.4 a. Determine the sensitivity of transfer function T(s) = C(s)/R(s), to variations in parameter K, for the following network, where the normal value of process parameter K is 1. **(8)**



b. Explain Time response specifications of second order systems. **(8)**

Q.5 a. Determine the time response for second order system to the unit step input. **(8)**

b. Using Routh criterion, determine the stability for the following characteristic equation:

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$ **(8)**

Q.6 Sketch the root-locus of a system having open loop transfer function as

$G(s)H(s) = \frac{K}{s(s+3)(s^2+2s+2)}$, K is varied from 0 to infinity. **(16)**

Q.7 a. Sketch polar plot for RC filter circuit. **(8)**

b. Describe the concept of all pass and minimum phase systems. **(8)**

Q.8 a. Explain constant M and N circles. **(8)**

b. A unity feedback control system having open loop transfer function as $G(s)H(s) = \frac{K}{s(s^2+s+4)}$, obtain the stability using Nyquist criteria. **(8)**

Q.9 a. What is lead compensation network? Describe effects & limitations of a lead compensator. **(8)**

b. A unity feedback system has a plant transfer function of $G(s) = \frac{K(s+4)}{(s-1)(s-2)}$. For K=8, draw the bode plot & find the PM & GM. **(8)**