B. TECH.
## THEORY EXAMINATION (SEM–VI) 2016-17
PROCESS DYNAMICS AND CONTROL

Time : 3 Hours   *Max. Marks : 100*

*Note :* *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. **Attempt all parts of the following questions:**   **10 x 2 = 20**
    (a)   What is the objective of process control?
    (b)   Differentiate between open and closed loops.
    (c)   Define over shoot.
    (d)   Differentiate between a negative feedback and positive feedback control system.
    (e)   Define Period of oscillation.
    (f)   What is the importance of initial and final theorem in the study of process dynamic control?
    (g)   What do you understand by transfer function of a system?
    (h)   Define Decay ratio.
    (i)   Define MIMO systems.
    (j)   Define step function.

SECTION – B

2. **Attempt any five parts of the following questions:**   **5 x 10 = 50**
    (a)   What are the modes of control action? Derive the transfer functions of different controllers. Discuss the advantages and limitations.

    (b)   A thermometer having a time constant of 0.2 min is placed in a temperature bath and after the thermometer comes to equilibrium with the bath, the temperature of the bath is increased linearly with time at the rate of 1 deg C / min. what is the difference between the indicated temperature and bath temperature

    (i)   0.1 min,

    (ii) 1 Min after the change in temperature begins?

    (iii) What is the maximum deviation between the indicated temperature and bath temperature and when does it occurs?

    (c)   Develop a formula for finding the time constant of the liquid-level system shown in Fig. When the average operating level is h_0, the resistance R is linear. The tank has three vertical walls and one which slopes at an angle α from the vertical as shown. The distance separating the parallel walls is 1.What do you understand by linearization of non linear system? Derive the transfer function for the linearization of non linear system?
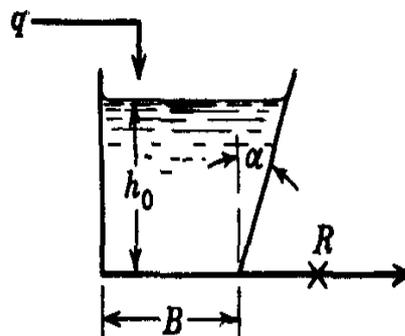
(d) Explain the Routh test for stability of a control system? Write the characteristic equation and construct the Routh array for the control system shown in Fig. Is the system stable for
 (i) $K_C = 9.5$
 (ii) $K_C = 11$,
 (iii) $K_C = 12$?
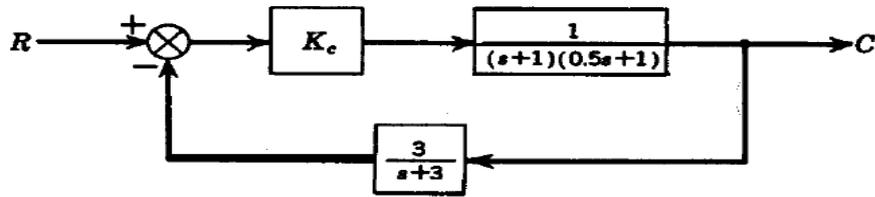
(e) Enumerate the detailed procedure for plotting the root locus of a control system? Plot the root-locus diagram for the open-loop transfer function

$$G = \frac{K}{(s + 1)(s + 2)(s + 3)}$$

(f) Explain the tuning rules for Ziegler-Nichols Rules (Z-N) and Cohen-Coon(C-C) Rules for the controller settings?

(g) Explain the analysis of cascade control? Name the main advantage and disadvantage of cascade control.

(h) Explain the following terms and give their importance in stable control system design.
 (i) Gain margin, Phase margin
 (ii) Cross over frequency

SECTION – C

Attempt any two parts of the following questions: **2 x 15 = 30**

3. The location of a load change in a control loop may affect the system response. In the block diagram shown in Fig., a unit-step change in load enters at either location 1 or location 2.
 (i) What is the frequency of the transient response when the load enters at location 1 and when the load enters at location 2?
 (ii) What is the offset when the load enters at location 1 and when it enters at location 2?
 (iii) Sketch the transient response to a step change in U_1 and to a step change in U_2.
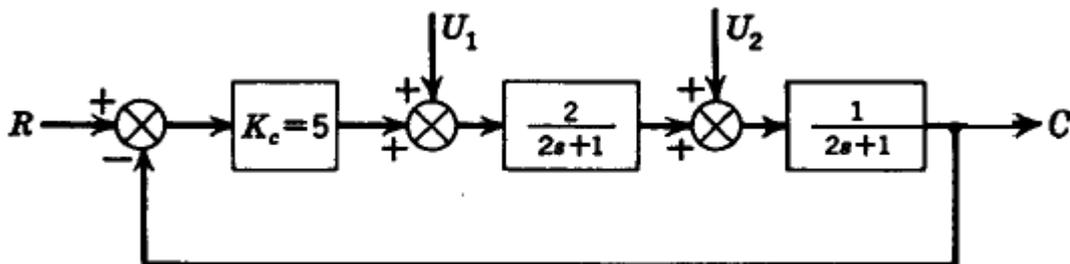
4. Evaluate the amplitude ratio and phase difference for the following by substitution rule:
 (i) First order
 (ii) Second order system
 (iii) Proportional Controller
 (iv) Proportional Integral Controller
 (v) Proportional Derivate controller

5. Discuss the concept of feed forward control, Ratio controller and gives the applications of the feed forward control, Ratio controllers.