Exam Date & Time: 17-May-2022 (10:00 AM - 01:00 PM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VI Semester External Examination
Process Dynamics and Control (CHE 3252)

PROCESS DYNAMICS AND CONTROL [CHE 3252]

Marks: 50 **Duration: 180 mins.**

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

1) Differentiate between open loop and close loop system (2)

A)

B) What is an input – output model and how can you develop it for a process? (3)

C) Find y(t) for the following equation

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} - 3y = \sin t$$

$$y(0) = 0;\ y'(0) = 0$$

(5)

2) A thermometer showing steady state temperature of 30°C is suddenly immersed into a hot water bath at 150°C which follows first order dynamics (τ_P = 0.5 sec & K_P = 1). Determine the following

A)

a. Thermometer reading after 1.5 sec

b. Time required to read 75°C on Thermometer

(2)

B) Elaborate on the characteristics of an underdamped response for a second order system with a neat diagram (3)

C) Determine the dynamic response of an over damped second order system (τ_{P1} = 1 sec & K_{P1} = 2; τ_{P2} = 2 sec & K_{P2} = 4) to the following changes of input

a. impulse of magnitude 5

b. step of magnitude 5

(5)

3) Brief the role of inherent and installed characteristics of control valve on the performance of a valve (2)

A)

B) Consider a second order system with the following transfer function

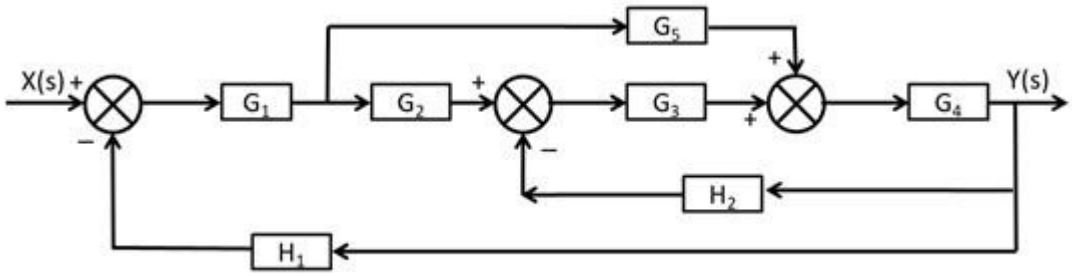
$$G_p(s) = \frac{1}{(S^2+2S+4)}.$$ (3)

Find a) overshoot percentage b) rise time c) period of oscillation

C) A process with two major time constants of 2 and 5 mins and process gains of 1 and 2 is controlled by a proportional controller. Determine the controller gain to produce a damping ratio of 0.7. Determine the maximum value of response, if the system has been disturbed by a unit step change in set point (5)

4) Determine the overall transfer function Y(s) / X(s) for the system shown in below figure

A)



(4)

B) Check for stability using Routh test

a) $s^4 + 3s^3 + 5s^2 + 4s + 2 = 0$

b) $s^5 + s^4 + 6s^3 + 11s^2 + 36s + 120 = 0$ (4)

C) What do you mean by tuning of controller? (2)

5) Sketch BODE plot for the system which has a transfer function

$$G(s) = \frac{1}{(5s+1)} e^{-s}$$ (4)

A)

B)

$$G_{OL}(s) = \frac{K_C}{(s+1)(2s+1)(3s+1)}$$

For the given open loop transfer function ; determine the maximum controller gain for a stable closed loop response (3)

C) Discuss the rationale of a cascade control system and demonstrate why it provides better response than simple feedback (3)

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