Exam Date & Time: 27-Jul-2022 (09:00 AM - 12:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI Semester End Semester Examination (Make Up) - July 2022
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) Define the following terms.
a) Manipulated variable
b) Controlled variable
A) c) Disturbances (4)
d) Setpoint.
Explain the significance of each term in the study of control system

B) Find y(t) for the following equation (4)

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

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

C) Define transfer function. Why is it useful? (2)

2) A thermometer showing steady state temperature of 25°C is suddenly immersed into a hot water bath at 115°C which follows first order dynamics (τ_P = 0.75 sec & K_P = 1). Determine the following

A) a. Thermometer reading after 0.5 sec (4)

b. Thermometer reading after 1.5 sec

B)

$$G(s) = \frac{y(s)}{x(s)} = \frac{2}{20s+4}$$

Consider the following transfer function: (4)

a. If input change by step form of magnitude 10, what is the value of the output y(t) when $t \to \infty$?

b. For the same input change as in (a), what is the value of the output when t = 10?

C) Write short note on underdamped response (2)

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

A)
$$G(s) = \frac{10}{s^2+1.6s+4}$$ (4)

Find

a) overshoot percentage
b) rise time
c) period of oscillation
d) response time (± 2%)

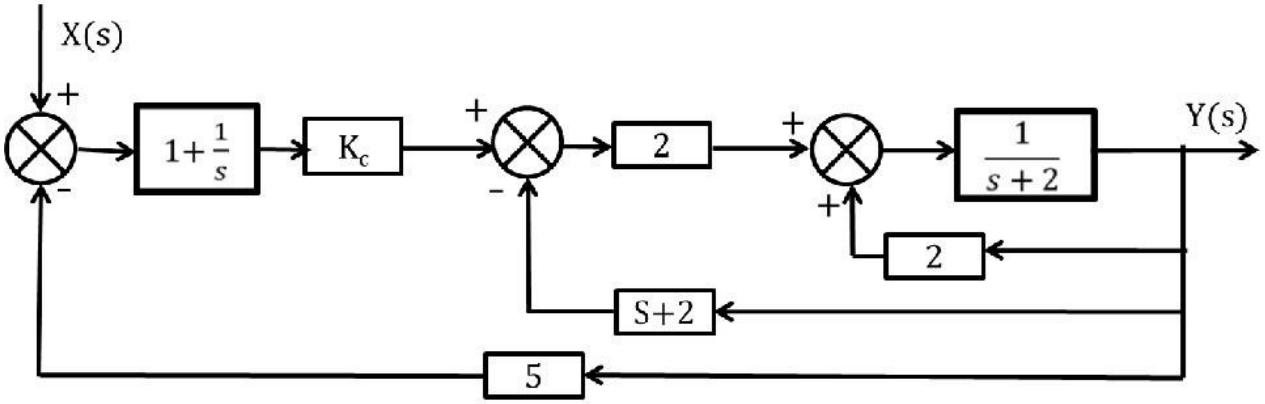
B) Explain Proportional Mode of control. Draw the error vs. time curve, show the effect of K_p on offset, draw the step response of P controller for various value of K_p (4)

C) A closed loop control system has two first order systems in series with time constants of 1 and 2 min and gains of 4 and 5 respectively. Proportional control is used. For a servo problem determine, what value of K_c gives a damping coefficient of 0.65 for closed loop response? (2)

4) Explain the composite PI controller with equation, transfer function and draw the response of PI controller to step input of error (4)

A)

B) By means of the Routh Hurwitz method, determine the value of K_c for the below mentioned closed loop system which leads to stable response



(4)

C) How to derive the parameters of FOPDT model from Process Reaction Curve? (2)

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

A) $$G(s) = \frac{1}{2s+1} e^{-0.1s}$$ (4)

B) For the given open loop transfer function $G_{OL}(s) = K_c / (s+1)(3s+1)(5s+1)$; determine the maximum controller gain for a stable closed loop response. Also find the controller gain with a gain margin of 1.7 (4)

C) Briefly discuss override control and selective control scheme (2)

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