02/06/2025 BE CHEMICAL SEM-VII C-SCHEME IPDC QP CODE: 10082828

(3 hour) **[Total marks: 80]**

N.B.:

1) Question-1 is compulsory. Answer any three questions from remaining
2) Assume data if necessary and specify the assumptions clearly
3) Draw neat sketches wherever required
4) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other

Q.1) a) Write controller equation and derive transfer function for PID controller (5)

b) Explain Phase Margin and Gain Margin (5)

c) Determine the stability of a system that has the characteristic equation $s^4+5s^3+3s^2+1=0$ (5)

d) Write short note on classification of variables in process control (5)

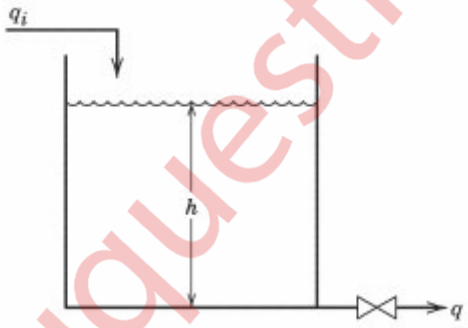
Q.2) a) A liquid surge tank has the following transfer function of $\frac{H(s)}{Q(s)} = \frac{10}{50s+1}$ (10)

The system is operating at the steady state with qis=0.4m^3/s, and hs=4m when the inlet flow rate fluctuates as a sine wave with an amplitude of 0.1m^3/s and a cyclic frequency of 0.002 cycles/s. What is the maximum and minimum value of the level after 10 min?

b) Explain continuous cyclic tuning method with the help of Zeigler Nichols controller tuning relations (10)

Q.3) a) Derive transfer function for mercury in glass thermometer system with necessary assumptions (10)

b) A simple surge tank with a valve on the exit line is illustrated in Figure. (10)



If the exit flow rate is proportional to the square root of the liquid level, an unsteady-state model for the level in the tank is given by

$$A\frac{dh}{dt} = q_i - C_v h^{1\backslash 2}$$

By assuming that the process initially is at steady state, Find the transfer function H'(s)/Qj(s). Put the transfer function in standard gain/time constant form.

Q.4) a) Draw a standard block diagram for a feedback control system. Derive closed loop transfer function for set point changes and disturbance changes (10)

b) For a system with $G(s)H(s) = \frac{K(1+s)^2}{s^3}$ find range of 'K' for system to be stable (10)

Q.5) a) For the unity feedback control system, (15)

$$G(s) = \frac{80}{s(s+2)(s+20)}$$

Draw the bode plot. Determine GM, PM, ω_{gc}, ω_{pc} Comment on stability.

b) Explain gain cross over frequency and phase cross over frequency (5)

Q.6) a) Write short note on turbine flow transmitter with neat sketch (10)

b) Write short note on Bourdon gauge for pressure measurement (10)

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