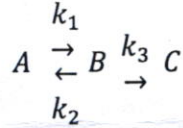




Note: Answer four questions only

Q1) In a semi batch reactor of volume (m^3), substance (B) produced from raw material (A) according to:



All reactions are first order. If the volumetric flow rate inlet to the empty reactor is Q (m^3/min). The concentration of A is C_0 . Prove that the solution of the differential represent the number of moles of B:

$$\frac{d^2 N_B}{dt^2} + P \frac{dN_B}{dt} + R N_B = S$$

Where: $P = k_1 + k_2 + k_3$

$$R = k_1 k_3$$

$$S = Q C_0 k_1$$

(25 Mark)

Q2) Two concentric cylindrical metallic shells are separated by a solid material. If two material are maintained at different temperature (constant). What is the steady state temperature distribution within the separating material? (25 Mark)

Q3) Solve the following differential equations:

A) $y \frac{d^2 y}{dx^2} - y^2 = y e^x$ (10 Mark)

B) $(5y^4 x^3 - 2y^7) dy - (x^7 - 3x^2 y^5) dx$ (15 Mark)

Q4) Solve the following second order differential equation:

$$4x \frac{d^2 y}{dx^2} + 6 \frac{dy}{dx} + y = 0$$
 (25 Mark)

Q5) A) Solve the following differential equation by using Laplace transformation:

$(ty'' - ty' + y = 0)$ at $(y'(0) = 1 \text{ and } y(0) = 0)$ (10 Mark)

B) Prove that: $L^{-1} \frac{s}{(s^2+a^2)^2} = \frac{t}{2a} \sin at$ (15 Mark)

GOOD LUCK



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 م. جواد