INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Autumn Semester Examination 2022-23

Subject Name: Computer aided Process Engineering — Full Marks: 30

Subject No.: CH31203 — Duration: 2 hrs

Department: Chemical Engineering

Specific charts, graph paper, log book etc., required: No

Instructions:
1. Attempt all questions
2. Assume, if necessary, clearly stating the reason
3. Answer all parts of a question together

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1. (a) Find the solution of the following system of linear equations with the help of Gauss elimination method without pivoting and with partial pivoting:

$$5.42x_1 + 16.78x_2 + 0.78x_3 = 38.0014$$
$$0.423x_1 + 2.3x_2 + 23.46x_3 = 53.97833$$
$$26.73x_1 + 1.274x_2 + 2.45x_3 = 68.74938$$

[8]

Use only seven significant digits rounding arithmetic for calculations.

(b) Compute the dew point temperature for a binary system of benzene (suffix '*B*') and toluene (suffix '*T*') based on the known information provided below: **[7]**

Vapor phase composition (y_B / y_T) 0.4/0.6 (mol fract)

Total pressure (P_t) 760 mm Hg

Antoine constants (vapor pressure in mm Hg and temperature in K) are given below.

Component	A_i	B_i	C_i
Benzene	15.9008	2788.51	−52.36
Toluene	16.0137	3096.52	−53.67

Use the N-R method (show result for 1 iteration only with an initial guess of 371.40 K) with a desired tolerance of 10^{-6}.

2 (a) Solve the nonlinear system: **[8]**

$$f_1(x_1, x_2) = x_1^3 + 3x_2^2 - 21 = 0$$

$$f_2(x_1, x_2) = x_1^2 + 2x_2 + 2 = 0$$

by the N-R method starting with the initial guess values of $x_{10} = 1$ and $x_{20} = -1$. Tabulate the results for 2 iterative steps with a desired tolerance of 10^{-6}.

(b) Solve the IVP: [7]

$$\frac{dy}{dt} = 2t - y$$

with $y(0) = -1$ and find $y(0.3)$. Use the RK2 method with step size $h = 0.1$.

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