BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - IV CHEMICAL : WINTER- 2022
SUBJECT : NUMERICAL METHODS FOR CHEMICAL ENGINEERING

Day : Thursday — Time : 02:30 PM-05:30 PM

Date : 24-11-2022 — **W-24440-2022** — Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data **WHEREVER** necessary.

Q.1 Elaborate the following terminologies related to error analysis and also write mathematical expressions for it. **(10)**

i) True percent relative error (ε_t)
ii) Percent relative error (ε_a)
iii) Prespecified percent tolerance (ε_s)
iv) Numerical error (E_t)

OR

Q.1 Set up an analysis of variance table for the following per acre production data for three varieties of wheat, each grown on 4 plots. Use short-cut method for one-way ANOVA. **(10)**

Plot of Land	Per Acre Production Data — Variety of wheat		
	A	B	C
1	6	5	5
2	7	5	4
3	3	3	3
4	8	7	4

Q.2 Find a real root of the equation $x^3 - 2x - 5 = 0$ using secant method. Let the two initial approximations be given by $x_1 = 2$ and $x_0 = 3$. **(10)**

OR

Q.2 By using Muller method, determine the root of equation $f(x) = x^3 - 13x - 12$ Initial guesses are $x_0 = 4.5$, $x_1 = 5.5$, $x_2 = 5$. **(10)**

Q.3 It is known that tensile strength of plastic increases as a function of time as it is heat treated and following data is collected. **(10)**

Time (x)	10	15	20	25	40	50	55	60	75
Tensile Strength (y)	4	20	18	50	33	48	80	60	78

Fit a straight line equation to this data and use that equation to determine tensile strength at time (t) = 30 minutes.

OR

Q.3 Find viscosity at temperature 140^{0}C by Lagrange's formula: **(10)**

Temperature ^{0}C	110	136	160	190
Viscosity kg/m sec	10.8	8.1	5.5	4.8

P.T.O.

Q.4 Using Euler's method find an approximate value of y corresponding to $x = 1$. Given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$. **(10)**

OR

Q.4 Expand log sin x in power of (x-2) by Taylor's theorem. **(10)**

Q.5 The vertical distance in meters covered by a rocket from $t = 8$ to $t = 30$ seconds is given by **(10)**

$$S = \int_{8}^{30} \left[2000 \ln \left[\frac{140000}{140000 - 2100t} \right] - 9.8t \right] dt$$

Use Simpson's 3/8th rule to find the approximate value of the integral

OR

Q.5 What is Romberg integration method? Prove that $I \cong \frac{4}{3} I(h_2) - \frac{1}{3} I(h_1)$. **(10)**

Q.6 **(a)** Elaborate the difference between finite difference method and finite element method. **(04)**

(b) Elaborate various steps of one-way ANOVA technique **(06)**

OR

Q.6 **(a)** What is finite difference approximation? How this is applicable to solve chemical engineering problems? **(05)**

(b) Elaborate the importance of the formulation of mathematical model based on experimental data of chemical engineering process **(05)**

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