REG. NO.:

VIT

Vellore Institute of Technology

SCHOOL OF CHEMICAL ENGINEERING

CONTINUOUS ASSESSMENT TEST -II

FALL SEMESTER 2025-2026

SLOT: D1+TD1

Programme Name & Branch	**: B. Tech (Chemical Engineering)**
Course Code	**: BCHE201L**
Course Name	**: Computational Methods in Chemical Engineering**
Faculty Name(s)	**: Prof. Monash P. /Dr. Anand VP Gurumoorthy**
Faculty Emp ID	**: 14831/13332**
Class Number(s)	**: VL2025260101219/VL2025260101223**
Date of Examination	**: 08-10-2025** — **Time: 2:00 PM – 3:30 PM**
Exam Duration	**: 90 minutes** — **Maximum Marks: 50**

General instruction(s):

Assume data wherever necessary

Use four decimal places of accuracy, unless otherwise stated.

Course Outcomes:

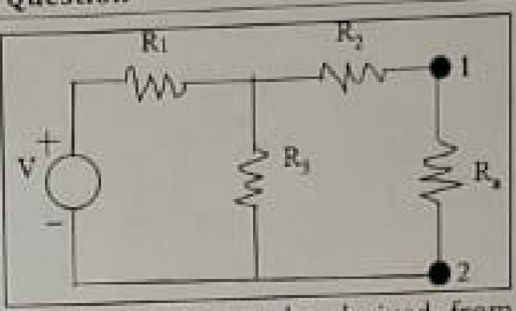
CO3: Select suitable numerical regression and interpolation techniques for data analysis.

CO4: Compute numerical integration and optimization.

CO5: Determine the numerical solution for ordinary and partial differential equations.

Q. No	Question	Marks	CO	BL
1.	The rheological properties of a particular suspension can be approximated using a power law model and represented by the following equation. $\tau_w = k\gamma^n$ where, τ_w is shear stress at wall in N/m^2, γ is the shear strain rate in s^{-1}, k is the consistency coefficient and n is the flow behavior index. Experimental data of shear stress vs. shear strain rate is given in the following table. Shear Strain Rate, γ, s^{-1}: 1, 5, 10, 15, 20, 25 Shear Stress, τ_w, N/m^2: 0.5, 4, 11, 20, 31, 44 Apply suitable regression method to determine the consistency coefficient and the flow behavior index. Identify the given non-newtonian fluid and determine the shear stress when shear strain rate of 23 s^{-1}.	10	3	3
2.	Velocity of a free-falling parachutist with respect to time is given in the following Table. t, (seconds): 0, 1.5, 3, 4.5, 6, 7.5, 9 v, (m/s): 0, 12.8, 22.6, 30.1, 35.6, 39.9, 43.2 Compute the distance of fall of the parachutist between the time 0 and 9 seconds using multiple application trapezoidal method and Simpson's method.	10	4	3

<table>
<tr><th>Q. No</th><th>Question</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>3.</td><td>
The simple resistor circuit contains three fixed resistors and one adjustable resistor as shown in the figure. The values for the parameters are V = 90 V, R_1 = 9 Ω, R_2 = 6 Ω, and R_3 = 4 Ω.



The expression for power for the circuit can be derived from Kirchhoff's laws.

$$P(R_a) = \frac{\left[\dfrac{V R_3 R_a}{R_1(R_a + R_2 + R_3) + R_3 R_a + R_3 R_2}\right]^2}{R_a}$$

Apply suitable 1-D unconstrained optimization method that maximizes the power transfer across the terminals 1 and 2 by changing the value of the adjustable resistance R_a over the range from 0 Ω to 10 Ω. Solve for the specified error, ε_s = 5.
</td><td>10</td><td>4</td><td>3</td></tr>
<tr><td>4.</td><td>
A small refinery receives up to 120 m^3 of crude feed per week and has 100 production hours available per week. On-site total storage capacity is unlimited. Profit per tonne and resource usage per tonne of products are given below.

<table>
<tr><th rowspan="2">Resource</th><th colspan="3">Product</th></tr>
<tr><th>Regular Unleaded (R)</th><th>Premium Unleaded (P)</th><th>Ethanol-Blended (E)</th></tr>
<tr><td>Crude feed (m^3/tonne)</td><td>9</td><td>8</td><td>7</td></tr>
<tr><td>Production time (h/tonne)</td><td>6</td><td>8</td><td>4</td></tr>
<tr><td>Profit ($/tonne)</td><td>200</td><td>220</td><td>180</td></tr>
</table>

Develop linear programming to maximize the profit using SIMPLEX method.
</td><td>10</td><td>4</td><td>3</td></tr>
<tr><td>5.</td><td>
Formulate a model (differential equation) of a falling parachutist using Newton's second law. The two forces acting on the parachutist are the downward pull of gravity F_D and the upward force F_U due to drag as a second-order rate resistance (i.e. $F_U = -cv^2$). The drag coefficient, c, is 0.225 kg/m and the mass of the parachutist is 68 kg. Apply Euler method to determine the time and velocity for 10 seconds. Initial Condition: At time t = 0 s, velocity, v = 0 m/s (i.e. v(0) = 0). Take time step as 2 s (Δt = 2) and g = 9.81 m/s^2.
</td><td>10</td><td>5</td><td>3</td></tr>
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