Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December- 2022

Programme Name: B. Tech. (APE Upstream) **Semester: VII**
Course Name : Computational Method in Petroleum Engineering **Time: 03 hours**
Course Code : PEAU 4021P **Max. Marks: 100**
Nos. of page(s) : 03
Instructions:

i. Use of scientific calculator is allowed for calculations. Before use, please make sure that it is approved by the invigilator.
ii. Any pages used for rough work should be attach along with the answer script.
iii. Use of mobile is strictly prohibited.

SECTION A

S. No.		Marks	CO
Q 1	State the difference between Gauss elimination method and Gauss-Siedel method.	**4**	**CO1**
Q 2	You are asked to find the root of any function, $y = f(x)$ using graphical method. List down two advantages and disadvantages of the method.	**4**	**CO2**
Q 3	Write the full expression of 3rd order Newton's interpolating polynomial.	**4**	**CO3**
Q 4	How can you improve the solution obtained by Euler's method to solve ordinary differential equation? Suggest any two method.	**4**	**CO4**
Q 5	What is the difference between Dirichlet and Neumann boundary condition?	**4**	**CO5**

SECTION B

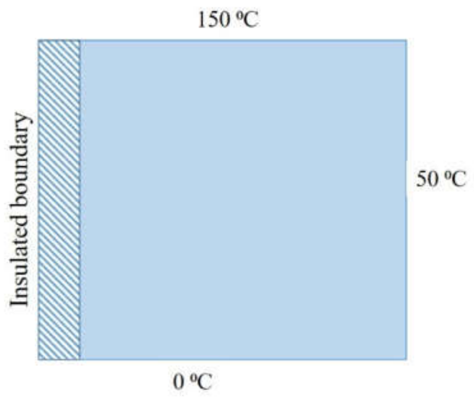
Q 6 Use a step size, (i) $h = 2$, and (ii) $h = 4$, numerically integrate the following using trapezoidal method. **10** **CO3**

$$\int_0^6 \frac{1}{1+x^2}\,dx$$

OR

Use Lagrange interpolation technique to find the value of $f(x)$ at $\boldsymbol{x = 2}$, from the following data given below. Provide the necessary conditions, wherever necessary.

x	$f(x)$
1	1.648721
3	4.481689
5	12.18249
7	33.11545

Q 7	Determine the roots of the function, $f(x)=4x^3-6x^2+7x-2.3$, using **false position** method to locate the roots. Employ an **initial guess** of, $x_l = 0$, and $x_u = 1$ and make **3** iterations and calculate the approximate error, ε_a for each iteration.	**10**	**CO2**
Q 8	Use 2th order Runge-Kutta method to numerically solve the following differential equation, $\frac{dy}{dt} = -2y + t^2$ From $t = 0$ to $t = 2$, with a step size (h) of **1**. The initial condition of $y(0) = 1$ is given.	**10**	**CO4**
Q 9	Obtain the temperature distribution of a long, thin rod by solving the partial differential with a length of 10 cm, from times, $t = 0$ s to $t = 3$ s. The material properties are given as in **Question No. 10** . Use a step size of $\Delta x = 2$ cm, and $\Delta t = 1$ s. At $t = 0$, the temperature of the rod was 5 ºC and the boundary conditions are fixed for all times at $T(0) = 200$ ºC and $T(10) = 100$ ºC. $k\frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$	**10**	**CO5**
SECTION-C			
Q 10	Use Liebmann's method to obtain the temperature distribution of the square heated plate (Fig. 1). Use a relaxation factor of **1.5**. The dimensions of the plate is 4 cm × 4 cm. Use at-least two interior nodes in both horizontal and vertical directions. Note that the material is aluminum with specific heat, $C = 0.2174$ cal/(g · ºC) and density, $\rho = 2.7$ g/cm^3. The thermal conductivity, $k' = 0.49$ cal/(s · cm · ºC), $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$ 	**20**	**CO5**
Q 11	Use **Gauss elimination method** to solve the following simultaneous linear	**20**	**CO1**

equations:

$$
\begin{gathered}
0.8x_1 - 0.4x_2 = 41 \\
-0.4x_1 + 0.8x_2 - 0.4x_3 = 25 \\
-0.4x_2 + 0.8x_3 = 105
\end{gathered}
$$

Detailed steps should be provided. Check your answers by substituting them into the original equations.

OR

Use **Gauss-Jordan** to solve the following simultaneous linear equations:

$$
\begin{aligned}
&3x_1 + 4x_2 + x_3 = 26 \\
&x_1 + 2x_2 + 6x_3 = 22 \\
&6x_1 - x_2 - x_3 = 19
\end{aligned}
$$

Detailed steps should be provided. Check your answers by substituting them into the original equations.