Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Process Modelling and Simulation — **Semester : II**
Program: M. Tech Chemical Engineering — **Time : 03 hrs.**
Course Code: CHPD7009 — **Max. Marks: 100**

Instructions:

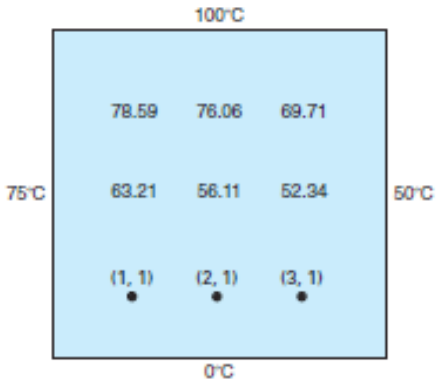
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	State the importance of assumptions in model development.	**04**	**CO1**
Q 2	Discuss the sequential modular approach of process simulation	**04**	**CO1**
Q 3	Explain about the mathematical consistency of a process model.	**04**	**CO1**
Q 4	Distinguish between steady state model and dynamic model.	**04**	**CO2**
Q 5	Discuss about distributed parameter system.	**04**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Regress the data given in Table 1 to the form $y = a(1 + x^2)^n$ using the method of least squares. Table 1: Data on x and y x: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 y: 1.00, 0.89, 0.71, 0.55, 0.44, 0.37, 0.31, 0.27, 0.24	**10**	**CO2**
Q 7	Develop the mass balance equations for a double effect evaporator system.	**10**	**CO3**
Q 8	Discuss about the formulation of Kb method used to compute new temperature profile in multicomponent distillation column. ***OR*** Write down a set of model equations for multicomponent distillation column with multiple stages.	**10**	**CO4**
Q 9	State the application of orthogonal collocation method in chemical engineering system.	**10**	**CO5**

SECTION-C
(2Qx20M=40 Marks)

Q 10	Develop a two dimensional pseudo heterogeneous model of fixed bed reactor with suitable boundary conditions. State the assumptions clearly. ***OR*** Consider a special (diameter = 10 cm) ball made of steel (k = 40 W/mK, ρ = 8000 kg/m^3, Cp = 400 J/kgk). The initial temperature of the ball is 300 K. It is immersed in a large oil tank at 400 K. The convective heat transfer coefficient, h at the sphere surface is 3000 W/m^2k. Assume that there is no radial temperature gradient inside the ball. Use the RK-4 numerical technique to solve the governing first order energy balance equation for predicting the temperature of the sphere at t = 1 min after it was immersed in the oil tank. Use Δt = 30 s. Calculate the rate of temperature-decrease at t = 0, 0.5 and 1.0 min.	**20**	**CO4**
Q 11	Apply the central difference method to Laplace equation given below to find out T(1,1), T(2,1) and T(3,1) where $\Delta x = \Delta y$. $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$  Fig. 1 A heated plate	**20**	**CO5**