### UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
### End Semester Examination, December 2020

Programme: B. Tech-ADE                     Semester      : VII
Course Name: Modeling and Simulation       Max. Marks   : 100
Course Code: MECH4006P                     Max. Time    : 03 Hours.

### SECTION A (30 Marks)

1. All questions are compulsory in this section.
2. Total 06 questions are there in this section and each question is of 5 Marks.
3. Short answer type questions.
4. Assume any missing data if required.

| Q1 | A system for the storage of thermal energy is to be designed using an underground tank of water. The tank is buried at a depth of 3 m and is a cube of 1 m on each side. The water in the tank is heated by circulating it through a solar energy collection system. A given heat input to the water may be assumed due to the solar energy flux. Characterize the design problem in terms of the fixed quantities and design variables. | 5 | CO1 |
|---|---|---|---|
| Q2 | Distinguish between static and dynamics system with suitable example. | 5 | CO1 |
| Q3 | Discuss system hierarchy with applications, advantages and disadvantages. | 5 | CO2 |
| Q4 | Comprehend different type of models for modeling a system. | 5 | CO3 |
| Q5 | Formulate various optimizations methods. | 5 | CO4 |
| Q6 | Explain downsides in simulation approach. | 5 | CO5 |

### SECTION B (50 Marks)

1. All questions are compulsory in this section.
2. Total 05 questions are there in this section and each question is of 10 Marks.
3. Write brief notes.
4. Assume any missing data if required.

| Q7 | Comprehend various steps in modeling thermal system . | 10 | CO2 |
|---|---|---|---|
| Q8 | Obtain a linear best fit to the data given below from a chemical reactor by using the method of least squares: <br><br> Concentration(g/m³): 0.1, 0.2, 0.5, 1, 1.2 <br> Reaction rate(g/s): 1.75, 1.92, 2.12, 2.32, 2.5 <br><br> Is a linear fit satisfactory in this case? | 10 | CO3 |
| Q9 | Minimize $f(x) = \frac{1}{3}(x_1^2 + x_2^2 + 3x_3^2)$ <br> Subject to <br> $\quad g_1(x) = x_1 - 2x_2 = 0$ <br> $\quad g_2(x) = x_1 + x_2 + x_3 = 1$ | 10 | CO4 |

| Concentration(g/m³) | 0.1 | 0.2 | 0.5 | 1 | 1.2 |
|---|---|---|---|---|---|
| Reaction rate(g/s) | 1.75 | 1.92 | 2.12 | 2.32 | 2.5 |

| Q10 | Summarize various types of simulations stating merits and demerits of each. | 10 | CO5 |
|---|---|---|---|
| Q11 | Design the steps in a sound simulation study. | 10 | CO5 |

### SECTION C (20 Marks)

**1. Please solve one question out of two.**

**2. Write long answers.**

**3. Assume any missing data if required.**

| Q12 | A department store plans to construct a one-story building with a rectangular planform. The building is required to have a floor area of 22,500 ft2 and a height of 18 ft. It is proposed to use brick walls on three sides and a glass wall on the fourth side. Find the dimensions of the building to minimize the cost of construction of the walls and the roof assuming that the glass wall costs twice as much as that of the brick wall. **Note: Validate your answer.** <br><br> **OR** <br><br> Minimize $f(x) = 9 - 8x_1 - 6x_2 - 4x_3 + 2x_1^2 + 2x_2^2 + x_3^2 + 3x_1x_2 + 2x_1x_3$ <br> Subject to $x_1 + x_2 + 2x_3 = 3$ <br> By <br> 1) Direct Substitution <br> 2) Constrained Variation <br> 3) Lagrange multiplier Method | 20 | CO4 |