

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.

Year : III

Course : CHEG 305

Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date

29 JUN 2023

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate answer.

- In a CSTR, what type of model is generally used?
a. lumped b. distributed c. stochastic d. ANN
- Estimation of parameters in a model is generally done during:
a. conceptualization b. calibration c. validation d. application
- The time constants in an unsteady catalytic tubular reactor may be very different for different phenomena. What is the time scale at which this process may be properly modeled?
a. seconds b. days c. weeks d. years
- If you want to understand the absorption process in an industry, what type of model will you use?
a. statistical b. mechanistic c. linear d. lumped
- What type of functions of specific volume can you convert the Equations of State to?
a. linear b. exponential c. quadratic d. cubic
- When a toxic chemical is accidentally released into the atmosphere, which model can be the best suitable to simulate its impact?
a. dispersion b. ANN c. fuzzy logic d. CSTR
- When you want to have an equally sliced samples over an interval, which Numpy function will you generally use?
a. curve_fit b. linspace c. meshgrid d. brentq
- Which adsorption isotherm plots a straight line if $1/(\text{adsorbate}/\text{adsorbent})$ is plotted against $1/(\text{concentration of adsorbate})$?
a. Freundlich b. Radke c. Exponential d. Langmuir
- Which one of the following models does not consist of bulk flow or convection?
a. CFD b. Eulerian c. Transport d. Lagrangian
- Which one of the following can be applied in a fluidized bed with very fine particles?
a. adiabatic b. continuum c. plug flow d. mixed flow
- What is generally valid while solving Navier Stokes equation for a cavity flow?
a. velocity components are zero everywhere
b. u -component is non-zero in lid of the cavity
c. u -component is zero in lid of the cavity
d. velocity components are zero in lid of the cavity

12. When solving Navier Stokes model numerically, what is used to check the stability of the numerical iterations?
- a. Reynolds number
 - b. Courant number
 - c. Prandtl number
 - d. Diffusivity
13. What happens to the number concentration of flocs in flocculation inside a stirred reactor tank after a long time?
- a. small flocs increase, larger flocs increase
 - b. small flocs increase, larger flocs decrease
 - c. small flocs decrease, larger flocs increase
 - d. small flocs decrease, larger flocs decrease
14. Population balance model can be used to simulate:
- a. detergent granulation
 - b. steam flow
 - c. toothpaste flow
 - d. alcohol distillation
15. Which function is generally used as activation function in feedforward ANN?
- a. sigmoid
 - b. cubic
 - c. logarithmic
 - d. Bessel
16. What acts as an activation threshold in a perceptron?
- a. weight matrix
 - b. bias
 - c. backpropagated error
 - d. hidden layer
17. When an ANN can well-simulate even the noise in the data, the condition is known as:
- a. unstable
 - b. optimal training
 - c. under-fitting
 - d. over-fitting
18. In the Python implementation of an ANN model, which one of the following can be used to normalize the data?
- a. StandardScaler
 - b. MLPClassifier
 - c. sklearn.metrics
 - d. scipy.optimize
19. What is used to investigate how the variation in the output of a numerical model can be attributed to the variation of the input factors?
- a. calibration
 - b. sensitivity analysis
 - c. stability analysis
 - d. parameter optimization
20. An example of the pattern search method in sensitivity analysis is:
- a. Monte Carlo
 - b. Direct Differential
 - c. FAST
 - d. SIMPLE

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

29 JUN 2023

Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

Course : CHEG 305
Semester : II
F. M. : 40

SECTION "B"

Attempt ALL questions. The data or information not given in the questions should be assumed properly.

1. Briefly explain five distinct and widely-known applications of modeling and simulation in chemical engineering. [5]
2. Consider a dryer, which is a long tube. Some solid particles are conveyed by superheated steam inside the dryer.
 - a. What are the main processes that may need to be modeled? [1]
 - b. How would you classify the models to represent those processes? [2]
 - c. What kind of calibration can be used in those models? [2]
 - d. Propose a method to valid those models. [1]
3. A large, poorly controlled copper smelter has a stack 150 m high and a plume rise of 75 m. It is currently emitting 1500 g/s of SO₂.
 - a. Estimate the ground-level concentration of SO₂ from this source at a distance 5 km directly downwind when the wind speed is 3 m/s and the stability class is C. Horizontal dispersion coefficient and vertical dispersion coefficient at this downwind distance for class C stability are 400 m and 300 m respectively. [4]
 - b. An engineer found that this concentration was twice the allowable. She proposed to remedy this situation by installing a higher stack. How high must this stack be approximately so that the estimated concentration will be exactly one-half of that in Q.3(a)? [2]
4. Show the data difference algebraic equivalent of the unsteady-state one-dimensional laminar flow equation. Then explain why implicit solution may solve stability problem along with the significance of time step and grid size. [3+3]
5. Consider a population of cells flowing through a plug flow reactor. The cells are characterized at time t by their position, x , and their mass, m . They are supposed to grow, to die, and to divide into two daughter cells.
 - a. Illustrate the trajectories of the cells in the physical space domain and in the mass-time domain. [2]
 - b. What will be the mass balance model for this system? [3]
6. An artificial neural network model is being used in detection and diagnosis of process faults in the absorption of CO₂ gas in monoethanolamine (MEA) in an absorption and stripping pilot plant.
 - a. How would you train the model? [2]
 - b. If the training of the model fails, what may be the causes and how will you solve them? [2]
 - c. Explain the use of simulated data as a source of data to train the model. [2]
7. Let $z(x) = (0.85 - n x)(300 + m x) - 0.55 x$ with the nominal values of $m = 9$; $n = 0.02$.
 - a. What is the absolute sensitivity of x to m ? [3]
 - b. What is the relative sensitivity of x to m ? [1]
 - c. What are the limitations of the local sensitivity analysis? [2]