KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks scored:

Level : B.E.
Year : III

Course : CHEG 305
Semester: II

Exam Roll No.:

Time: 30 mins.

F.M. : 10

Registration No.:

Date :

SECTION "A"
[20Q × 0.5 = 10 marks]

Encircle the correct answer from the given choices.

1. Which one of the following models explicitly include the physical and chemical processes between the state variables?
   a. probabilistic b. deterministic c. empirical d. mechanistic

2. What is the method to determine which variables, parameters, or other inputs have the most influence on the model output?
   a. uncertainty analysis b. calibration
   c. validation d. sensitivity analysis

3. A reactor contains a fluid that has elements having the same probability of leaving the reactor irrespective of the time they have spent in the reactor. Which type of model will be the most appropriate for the reactor?
   a. lumped model b. stochastic model
   c. distributed model d. population balance model

4. If an industrial area is contaminated by accidental release of a toxic fluid, what will you use to simulate the impact of the process immediately?
   a. lumped model b. advection-diffusion model
   c. CSTR model d. multi-layer perceptron model

5. In CFD modeling of a fluidized bed, what happens when the wave is traveling a distance that is less than dx over the time-step of Δt, where dx is the length of each mesh grid?
   a. it may become unstable b. it may converge to the solution
   c. it fails the CFL condition d. it slows down the time for the solution

6. For a given industry, what can be used to simulate the process and display the outcome in real time and a real environment?
   a. process simulator b. conceptual model
   c. stochastic simulator d. ANN model

7. Which type of equation is found in 1D steady-state distributed model?
   a. DAE b. PDE c. FDE d. ODE

8. What is generally used to find solutions of models in design of industrial products?
   a. statistical analysis b. optimization
   c. molecular simulation d. CFD

9. Which type of model is based on cause and effect analysis?
   a. stochastic b. empirical c. deterministic d. discrete

10. For diffusional mass transfer, which model is suitable at unsteady-state condition?
a. Henry's law
b. Fick's second law
c. Burger's equation
d. PFR model

11. A parameter such as friction factor appears on both sides of an equation. What is the best way to solve the equation?
a. ode_int
b. FDM
c. scikit_learn
d. Python root solver

12. Which model is the most suitable when selecting the cleanliness parameter in a washing machine?
a. mechanistic model
b. fuzzy model
c. deterministic model
d. dynamic model

13. Which software cannot handle molecular level simulations?
a. Openfoam
b. Fluent
c. Polymath
d. COMSOL

14. If you import sympy Python library and then run the command: y = phi.diff(x), where phi is a sympy equation, what does "y" represent?
a. partial derivative
b. difference between phi and x
c. total derivative
d. finite difference

15. Read the following Python code to find concentration of a chemical: R = 8.2057E-5 # m^3 atm / K /mol; pso2 = 0.1 # atm; MWso2 = 64 # g/mol; T = 25+273 # K. Which statement will be the next one to correctly calculate the concentration?
a. Ca0 = pso2/MWso2*R/T/1000. # kg/m^3
b. Ca0 = pso2*MWso2/R/T*1000. # kg/m^3
c. Ca0 = pso2*MWso2/R*T/1000. # kg/m^3
d. Ca0 = pso2*MWso2/R/T/1000. # kg/m^3

16. Where is the assumption of a continuum acceptable?
a. fluidized bed with fine particles
b. slurry bubble column
c. Gas-liquid interphase
d. Solid-gas interphase

17. Which one of the following can be used to test the ANNs?
a. null matrix
b. confusion matrix
c triangular matrix
d. diagonal matrix

18. Which one of the following activation functions gives only positive values?
a. hyperbolic tangent sigmoid
b. saturation
c. log sigmoid
d. arctangent

19. When do you adjust the weights associated with the connections between nodes in a neural network?
a. training
b. prediction
c. splitting
d. validation

20. Which model uses assumption of continuum for only the continuous phase and not for the dispersed phase in a multiphase system?
a. Eulerian-Lagrangian
b. Eulerian-Eulerian
c. Fick's first law
d. Fick's second law

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SECTION "B"

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

1. What are the consequences of developing an unnecessarily complex models? Explain with any application in chemical engineering. Then provide solutions to make the models robust. [3+3]

2. What type of models can be used to simulate a CSTR and a PFR? Use the various model classifications that are applicable to them. [2+2]

3. Discuss the role of models in process simulation of adsorption and diffusion. [2+2]

4. How do you solve Burger's equations through numerical equations in CFD modeling? What is the role of CFL condition in CFD? [5+2]

5. State some of the ways to overcome over-fitting and under-fitting in ANN modeling. Then provide an example of the use of ANN in process modeling and monitoring. [3+3]

6. Describe the following concepts used in modeling and simulation of chemical processes: [3×3=9]
   a. Validation of dynamic models
   b. Role of sensitivity in optimal process design
   c. Modeling the multiphase systems having a dispersed phase

7. What are the roles of the following Python functions in modeling and simulation? [4]
   a. classification_report
   b. meshgrid
   c. fsolve
   d. StandardScaler