

KATHMANDU UNIVERSITY  
End Semester Examination  
August, 2018

Level : B. E.  
Year : III

Course : CHEG 305  
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

**AUG 08 2018**

SECTION "A"  
[20 Q. × 0.5 = 10 marks]

Select the correct answer from the given choices. Attempt *ALL* the questions.

1. What can make the modeling of chemical processes very complex?
  - (a) multiscale nature of chemical processes
  - (b) dominant geometrical scale of chemical processes
  - (c) assumptions made by modeler
  - (d) average properties of chemical processes
2. When the inputs to the process are known and the output variables are to be determined, the problem is called:
  - (a) rating problem
  - (b) design problem
  - (c) optimization problem
  - (d) stochastic problem
3. Which one of the following is a flowsheeting programme?
  - (a) Python
  - (b) C++
  - (c) DWSIM
  - (d) CFD
4. Idealization or approximation of physiochemical processes is generally called:
  - (a) simulation
  - (b) modeling
  - (c) flowsheeting
  - (d) designing
5. Getting a satisfactory agreement between the experimental data and model prediction is called:
  - (a) process modeling
  - (b) dynamic modeling
  - (c) model integration
  - (d) model validation
6. All the fluid elements in a reactor have same probability of leaving the reactor irrespective of the time they have spent in the reactor. Which kind of model is the most suitable one for this process?
  - (a) lumped model
  - (b) stochastic model
  - (c) distributed model
  - (d) population balance model
7. Which one of the following is generally used in unsteady-state lumped parameter model?
  - (a) algebraic equation
  - (b) ODEs
  - (c) PDEs
  - (d) DAEs
8. If  $q$  is kg of adsorbate per kg of adsorbent and  $C$  is the concentration of adsorbate in fluid, which adsorption isotherm will give a straight line if  $1/q$  is plotted against  $1/C$ ?
  - (a) Linear
  - (b) Freundlich
  - (c) Langmuir
  - (d) Radke and Prausnitz
9. If convection is absent during mass transfer, which model is suitable at unsteady-state condition?
  - (a) Fick's first law
  - (b) Fick's second law
  - (c) Fourier's law
  - (d) Two-film model
10. When solving cavity flow with Navier-Stokes equation in 2-D, which boundary condition will be applicable if  $u$  and  $v$  are the velocity components?
  - (a)  $u$  and  $v$  are zero in all boundaries
  - (b)  $u$  and  $v$  are non-zero in all boundaries
  - (c)  $u$  is non-zero in the lid, and  $u$  and  $v$  are zero in all other boundaries
  - (d)  $u$  is zero in the lid, and  $u$  and  $v$  are non-zero in all other boundaries

11. While solving Navier-Stokes equation numerically, what happens when the wave is traveling a distance which is greater than  $\Delta x$  over the time-step of  $\Delta t$ , where  $\Delta x$  is the length of each grid box?
- (a) it may become unstable (b) it converges to the solution slowly  
(c) it satisfies the CFL condition (d) it speeds up the convergence to the solution
12. If an area is contaminated by accidental release of a toxic liquid, which of the following models will be the most suitable to immediately predict the distribution of the liquid in the area?
- (a) lumped reactor model (b) CSTR model  
(c) advection-diffusion model (d) multi-layer perceptron model
13. In a multiphase system, if the assumption of continuum is made only for the continuous phase and the dispersed phase is treated by identifying each individual separately, which modeling approach is used?
- (a) Eulerian-CFD (b) Lagrangian-Lagrangian  
(c) Eulerian-Eulerian (d) Eulerian-Lagrangian
14. Which model is suitable for simulation of bubbles that are coalescing in a liquid system?
- (a) Navier-Stokes equation (b) diffusion-convection model  
(c) mass and energy balance model (d) population balance model
15. What is the use of `lambda` in the following Python code?
- ```
f = lambda z: z - (c*DAB/z)*math.log((1+xa1)/(1+(z/(k*c))))
```
- (a) create a variable (b) create a function  
(c) create an array (d) create a class
16. What will be the printed value of `P` from the following simple model?
- ```
from pint import UnitRegistry; ur=UnitRegistry()
R=8.314*ur.joule/ur.kelvin/ur.mole; T=290.0*ur.kelvin
n=2.0*ur.mole; V=22.4*ur.litre; P=n*R*T/V
print P.to(ur.atmosphere)
```
- (a) 215273.2 (b) 2.1 (c) 215.3 (d) 31.2
17. In the following code, what will be the second element of the `X` array?
- ```
import numpy as np; X = np.linspace(0, 4.*np.pi, 4)
```
- (a) 4.2 (b) 12.6 (c) 6.3 (d) 8.4
18. While testing a model to be applied to simulate the fluidized bed, the output for various scenarios were measured when only one of the inputs was varied. Which one of the following is the most suitable for evaluating the model?
- (a) deviation ratio (b) sensitivity coefficient  
(c) importance index (d) sensitivity index
19. In a feed-forward back propagation neural network, what is propagated back into the network?
- (a) actual output (b) desired output (c) error in output (d) weight matrix
20. In a Python program to develop a model based on Artificial Neural Network, why do you import `MLPClassifier` from `sklearn.neural_network` package?
- (a) normalization of data (b) split the train and test data  
(c) train the model (d) classify output data

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

SECTION "B"

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

1. What are the main steps in a simulation study? How does simulation differ from modeling? [2+2]
2. Provide two examples to illustrate the application of modeling and simulation in chemical engineering. All the steps in modeling and simulation have to be clearly mentioned. [2+2]
3. Differentiate between the following types of models with real-world examples of each of the models. [3+3]
  - (a) Deterministic and stochastic models
  - (b) Lumped and distributed models
4. Explain how the following simple laws are useful as sub-models in more rigorous models: [3+3]
  - (a) Peng-Robinson equation of state
  - (b) Fick's second law for diffusion
5. Briefly discuss the modeling of the Navier-Stokes equations in Computational Fluid Dynamics (CFD) simulations. [4]
6. How do you implement the tank reactors in series as a model? [4]
7. How do you avoid over-fitting and under-fitting conditions in models based on Artificial Neural Networks? [4]
8. What are the different roles of sensitivity analysis in modeling and simulation in Chemical Engineering? [4]
9. How do you solve ODEs in Python programming language using scientific libraries? Explain with an example in your field of study. [4]

