5th **Semester Regular Examination 2017 - 18**
Process Simulation & Modelling
BRANCH : CHEM
Time : 3 Hours
Max Marks : 100
Question Code : B234
Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

Q1)   **Answer the following questions :**   **(2 x 10)**

   a) Plug flow reactor is an example of
       i.   Lumped model
       ii.   Distributed model
       iii. Both of above
       iv. None of above

   b) $P = \sum_{i=1}^{N} x_i r_i P_i^s$ represents

       i.   Activity coefficient
       ii.   Relative volatility
       iii. Phase equilibrium
       iv. Roult's law
       v.

   c) Arrhenius temperature represents
       i. $K = \alpha e^{-ERT}$
       ii. $K = \alpha e^{-E/RT}$
       iii. $K = \alpha e^{-ER/T}$
       iv. $K = \alpha e^{E/RT}$
       v.

   d) Intermediate point of dichotomous method is determined when
       i.   Function values at the interval are having same value
       ii.   Function values at the interval are having equal sign
       iii. Function values at the interval are having opposite sign
       iv. All of above
       v.

   e) The symbol represents

       i.   Heat exchanger
       ii.   Pump
       iii. CSTR
       iv. Crusher
       v.

   f) An output stream of a unit affects at least one input stream in a simulation
       flow sheet is known as
       i.   Serial process
       ii.   Adjacency matrix process
       iii. Recycle process
       iv. All of above

g) An objective function having single extremum is
- i. Unimodal function
- ii. Multimodal function
- iii. Both of these
- iv. None of these

h) To convert the ≤ type constraint into equation, the variable used is
- i. Slack variable
- ii. Surplus variable
- iii. Artificial variable
- iv. No variable is used.
- v.

i) An array with 3 entries per row is
- i. Stream connection matrix
- ii. Process matrix
- iii. Incidence matrix
- iv. None of these
- v.

j) Modularity is
- i. Ability to determine a sequence of calculation
- ii. Allows changes to be made in how units are connected
- iii. Interpretation of result
- iv. None of above

Q2) **Answer the following questions :** **(2 x 10)**
- **a)** Define degrees of freedom.
- **b)** What is chemical equilibrium?
- **c)** What is process simulator?
- **d)** Define equation of state.
- **e)** Differentiate between lumped & distributed model.
- **f)** Define Wegstein method.
- **g)** Write the limitations of Fibonacci method.
- **h)** What is golden ratio?
- **i)** What are recycle set in simulation?
- **j)** Name any two software available for simulation.

Q3. **a)** Explain the energy equation of a Plug flow reactor with a neat sketch. **(4)**

b) Write the component continuity equation desiring CSTR with simultaneous first order isothermal reaction.

(3)

$$A \xrightarrow{k1} B \quad A \xrightarrow{k2} C$$

c) Develop the model equation of Flash drum vapor-liquid system with a neat sketch. **(8)**

Q4. **a)** How LPP is converted into standard form? **(5)**

b) Solve the following LPP using simple method. **(10)**
Max $Z = 3X_1 + 2X_2 + 5X_3$
Subject to,
$X_1 + 2X_2 + X_3 \leq 430$
$3X_1 + 2X_3 \leq 460$
$3X_1 + 4X_2 \leq 420$
$X_1, X_2, X_3 \geq 0$

Q5. **a)** An automobile production line turns out about 100 cars a day but deviation **(10)**
occurs owing to many causes. The production is more accurately described
by the probability distribution. Finished cars are transported by a ferry. If the
ferry has a space for 101 cars, what will be the average number of cars
waiting to be shipped & what will be the average number of empty space on
the ship for 15 days?

Production/Day	Probability	Production/Day	Probability
95	0.03	101	0.15
96	0.05	102	0.10
97	0.07	103	0.07
98	0.1	104	0.05
99	0.15	105	0.03
100	0.2	---	---

b) Describe different types of process simulation problem. **(5)**

Q6. **a)** Describe the design equation of an ideal distillation column. Define the state **(10)**
variables for it.
b) Why differential equations are commonly used in model building? **(5)**

Q7. Consider the following system & develop the mathematical model for it. **(15)**
What are the state variables for it & what type of balance equations have
used?
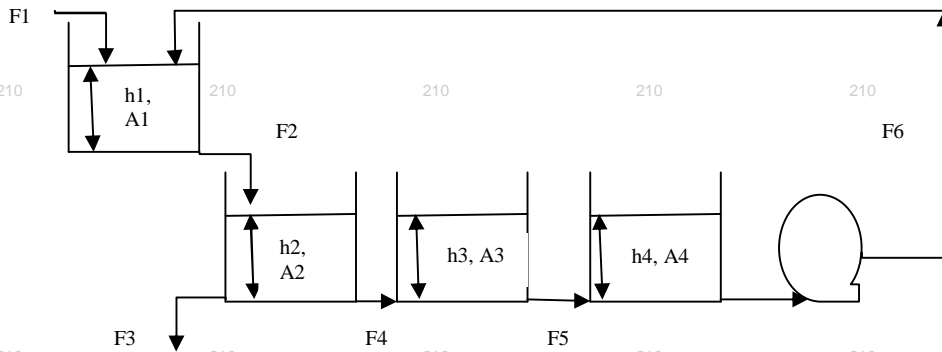
Q8. Describe the design equation of LPG vaporizer. What are the assumptions **(15)**
made for it? Define the state variables for it. Plot a neat sketch.

Q9. **a)** Discuss the Newton-Raphson method. **(5)**
b) What do you understand by formulation of mathematical model. **(5)**
c) Discuss about non-isothermal CSTR. **(5)**