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SF-7027

B. E. - III (Sem. VI) (Chemical) Examination

May / June – 2011

Chemical System Modelling

Time : Hours] [Total Marks :

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - III (Sem. VI) (Chemical)**

Name of the Subject :

☛ **Chemical System Modelling**

☛ Subject Code No. : **7 0 2 7** ☛ Section No. (1, 2,.....) : **1,&2**

Seat No. :

Student's Signature

(2) Answer each section in separate answerbook.
(3) Figure to the right indicate full marks.
(4) Assume suitable data wherever requiered.
(5) Symbols used have conventional meaning.

SECTION - 1

1 (a) Lisout advantages of modelling of chemical systems discussing them. **06**

(b) Explain the various steps involved in the development of mathematical model for the chemical systems. **06**

(c) Briefly explain fundamental laws of physics and chemistry used in chemical system modelling. **06**

2 Answer any two : **08×02-16**

(a) What is black-box modelling ? Discuss its benefits and limitations.

(b) Differentiate steady state and dynamic modelling with examples of each.

(c) Write a mathematic model for binary ideal system separation in distillation column. Show schematic diagram and mention all assumptions.

3 Answer any two. **08×2=16**

(a) Consider a perfectly stirred tank critically containing Vm^3 of pure water for producing brine. m kg/hr of saltand Q kg/hr water are continuously fed to the tank. p kg/hr of brine flows out from the tank continuously. Derive the equation which can provide concentration of salt in the outgoing stream.

(b) Develop a model energy equation for a jacketed tubeler reactor. Clearly mention all assumptions.

(c) A constant volume batch reactor undergoes the series reaction sequence $A \xrightarrow{k_1} B \xrightarrow{k_2} C.$. The initial concentration of A is CA_0 and initially B and C are NIL.

$R_A = k_1 C_A \quad R_B = k_1 C_A - k_2 C_B^2$

Derive equations showing C_A and C_B as function of time.

SECTION - 2

4 (a) Answer the following. **5×2=10**

(1) Show the geometric interpretation of second order Range-Kutta method and write its formula.

(2) Define interpolation and Extrapolation.

(3) In a typical industry. What are the three main levels where optimization is used ?

(4) Give Measoni simplon's $1/3^{rd}$ rule gives more accurate opproximation of the integral value compared to tropezoidal rule.

(5) State which method can be used to find the pressure at 167^0F for the table given below

$Temp(^0F)$	100	110	120	130
$Pressure(lb/in^2)$	211.9	247.0	286.4	330.0

(b) Maximize f = $8.1x_1+10.8x_2$ subject to the following constraints. **10**

$$0.8x_1 + 0.44x_2 \leq 24000$$
$$0.05x_1 + 0.1x_2 \leq 2000$$
$$0.1x_1 + 0.36x_2 \leq 6000$$

Use simplex method of linear programming.

5 Attempt any two. **16**

(a) Calculate the value of integral $\int_1^5 e^{\left(-\frac{1}{2}x\right)}$ using

Trapezoidal rule for four intervals.

(b) Calculate the activation energy for the decomposition of benzene diazonium chloride using the following information for this first order reaction by using curve fitting by method of loast quares.

$K(\sec^{-1})$	0.0043	0.0103	0.018	0.0355	0.0717
$T(^\circ K)$	313	319	323	328	333

(c) Using the data given in the table below, estimate the vapour pressure and density of ammonia vapour at 167^0F. Latent heat of ammonia = 544 Btu/lb.

$Temp(^0F)$	70	80	90	100	110	120	130	140
$Pressure lb/in^2$	128.8	153.0	180.6	211.9	247.0	286.4	330.3	379.1

6 Attempt any two. **14**

(a) A solid of revolution is formed by retating about the x axis, the area between the x axis, line x = 0, x = 1 and a curve through the points with co-ordinates.

X	0	0.25	0.5	0.75	1.0
y	1	0.989	0.958	0.908	0.841

Estimate the area of the solid formed wing Simpson's $1/3^{rd}$ rule.

(b) Explain hierarchy of solving optimization problem in any process industry and discuss the obstacles in solving optimization problem.

(c) Solve the equation by using Tartaglia's method.