M. TECH. –I (CHEMICAL ENGINEERING) (CBCS – 2015 COURSE)
: WINTER - 2017

SUBJECT: APPLIED MATHEMATICS FOR CHEMICAL ENGINEERING

Day: **Monday** Time: **11.00 AM TO 02.00 PM**
Date: **15/01/2018** **W-2017-2796** Max Marks: 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use of non-programmable **CALCULATOR** is allowed.
4) Answers to both the sections should be written in **SEPARATE** answer books.

SECTION -I

Q.1 Write note on:

a) Data uncertainty **(04)**

b) Truncation error **(03)**

c) Round off errors **(03)**

OR

Q.1 Explain stepwise two way ANOVA technique **(10)**

Q.2 Determine the highest real root of **(10)**
$f(x) = x^3 - 6x^2 + 11x - 6.1$ using the Secant method (three iterations $x_{i-1} = 2.5$ and $x_i = 3.5$)

OR

Q.2 The velocity v of a falling parachutist is given by **(10)**

$$v = \frac{gm}{c}[1 - e^{-(\frac{c}{m})t}]$$

where, g = 9.8 for a parachutist with a drag coefficient c = 14 kg/s, compute the mass m so that the velocity v is 35 m/s at t = 7 sec. Use the False position method to determine m to level of $\varepsilon_s = 0.1\%$.

Q.3 Given the data **(10)**

x	5	10	15	20	25	30	35	40	45	50
y	16	25	32	33	38	36	39	40	42	42

Use least square regression to fit a straight line.

OR

Q.3 It is known that tensile strength of plastic increases as a function of time as it is heat treated. Following data were collected **(10)**

Time (x) sec.	10	15	20	25	40	50	55	60	75
Tensile strength (y) meters	4	20	18	50	33	48	80	60	78

Fit a straight line to this data and use the equation to determine tensile strength at t= 30 meters.

P.T.O.

SECTION – II

Q.4 **a)** Apply trapezoidal rule to evaluate **(07)**

$$I = \int_{-2}^{2} \frac{t}{5+2t}\, dt$$

b) Quantitatively discuss Newton-Cots integration method **(03)**

OR

Q.4 Evaluate **(10)**
$f(x) = 0.2 + 25\,x - 200\,x^2 + 675\,x^3 - 900\,x^4 + 400\,x^5$
Use Simpson's $3/8^{th}$ rule for 3 segments, a=0 and b=0.8

Q.5 A mass balance for chemicals in a completely mixed reactor can be written as **(10)**

$$V\frac{dc}{dt} = F - QC - kVC^2$$

where V is volume (10 m^3), C is concentration, F is Feed rate (200g/min), Q is flow rate (1 m^3/min) and k is reaction rate (0.1 m^3/g.min). If at t=0, C_o=0. Find the concentration at t= 2min, taking h=1. Use 4^{th} order Runge-Kutta method

OR

Q.5 Describe in detail Crank-Nicholson method **(10)**

Q.6 What are the different statistical tests commonly used for the analysis of engineering data? **(10)**

OR

Q.6 Why is it necessary to develop mathematical model for the experimental data? Explain with one example **(10)**