Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2713007 Date:03/01/2017

Subject Name: Numerical Methods and Statistical Analysis for Chemical Engineering

Time: 2:30 pm to 5:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Using three parameter Antoine equation for vapor pressure of any component, develop the linear regression expression for obtaining Antoine constants. Demonstrate the process with five data points. **08**

(b) Discuss convergence criteria for single variable Newton-Raphson technique for solution of non-linear algebraic equation. **06**

Q.2 **(a)** For heat capacity of a component, data is generated experimentally. Develop the linear regression expression for empirical model development. **07**

(b) Fit the data point to linear relationship and estimate the error at $x = 25$. **07**

x	y
5	0.530
10	0.716
15	0.806
20	0.869
25	0.943
30	1.013
35	1.096
40	1.160

OR

(b) Obtain the multiple roots of $F(x) = \ln(x^2 + 1) - e^{0.4x}\cos(\pi x) = 0$ using Newton-Raphson technique with incremental search for $-5 \le x \le 5$. **07**

Q.3 **(a)** Explain the method of cubic spline approximation to a function with working equations. **07**

(b) Estimate $\frac{d^2y}{dt^2}$ numerically at $t = 1.5$. **07**

t	y
0	0
0.5	1.1875
1	5.0000
1.5	18.175
2.0	52.0000
2.5	122.1875
3.0	249.0000

OR

Q.3 **(a)** Take a semicircle given by $F(x) = \sqrt{9 - (x-5)^2}$, with centre at $x = 5$, $y = 0$, and radius of 3. Take three data points, (2,0), (5,3) and (8,0). Obtain the cubic splines. **07**

(b) Using lagrangian interpolation, obtain an approximate third degree polynomial for the vapor pressure of acetone which could be used for $259.2K \le T \le 320.5K$. **07**

T(K)	P(bar)
259.2	0.04267
273.4	0.09497
290.1	0.21525
320.5	0.74449

Q.4 **(a)** Explain the Gauss Elimination technique for solution of simultaneous linear equations and highlight its strengths and limitations. **07**

(b) Develop the third order explicit Adams's integration formula for Ordinary Differential Equations (ODE) with Initial Value Problems (IVP). What is the error term. **07**

OR

Q.4 **(a)** Show that the Lagrangian interpolation formula for 2nd degree applied to equi-spaced data points gives the same result as Newton's forward difference formulae. **07**

(b) Give example of ODE with Boundary Value Problems (BVP) and explain Shooting method to solve it. **07**

Q.5 **(a)** Explain the finite difference method with example for solution of PDEs. **07**

(b) Discuss Sampling Distributions and Confidence Interval for statistical analysis. **07**

OR

Q.5 **(a)** Explain role of random variables for Stochastic Processes with example. **06**

(b) Explain Standard Deviation and Variance for Stochastic Processes along with their importance and practical application. **08**

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