Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (New) • EXAMINATION – WINTER 2016

Subject Code: 2140505 **Date: 18/11/2016**

Subject Name: Chemical Engineering Maths

Time:02:30 PM to 05:30 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 **Short Questions** **14**

1 If 0.333 is the approximate value of 1/3, find the absolute and relative errors.

2 The sum of the roots of an equation $x^3-2x^2+x-1=0$ is …….

3 The Newton-Raphson iterative formula to find $\sqrt[3]{N}$ is …….

4 The condition of convergence of Gauss-Seidal method is that the equations of the system are ……

5 Inverse of $A=\begin{bmatrix}5 & 3\\ 3 & 2\end{bmatrix}$ is …….

6 Give the normal equations to fit the straight line $y=a+bx$ to n observations.

7 $\Delta\tan^{-1}x=$.....

8 If $f(x)=\dfrac{1}{x}$ then the divided difference $[a\ \ b]=$.....

9 Give the formula for $f'(x)$ in terms of forward difference operator Δ.

10 If $f(0)=1, f(0.5)=0.8, f(1)=0.5,$ find the value of $\int_0^1 f(x)dx$ using Trapezoidal rule.

11 Write the Taylor's series formula for the solution of $y'=f(x,y), y(x_0)=y_0$.

12 The Euler's formula for the numerical solution of first order ODE-IVP is …….

13 The partial differential equation.

$$A(x,y)u_{xx}+B(x,y)u_{xy}+C(x,y)u_{yy}+F(x,y,u,u_x,u_y)=0$$

is elliptic if

$(a)\ B^2-4AC<0 \quad (b)\ B^2-4AC=0 \quad (c)\ B^2-4AC>0$

14 The finite difference form of $\dfrac{\partial^2 u}{\partial x^2}$ is …….

Q.2 **(a)** Solve the equation $x^3-7x^2+36=0$, given that one root is double of another. **3**

(b) Find the root of the equation $\cos x = xe^x$ using the method of false position correct to four decimal places. **4**

(c) Solve the non-linear equations $x^2-y^2=4$ and $x^2+y^2=16$ numerically with $x_0=y_0=2.828$ using Newton-Raphson method. (Carry out two iterations) **7**

OR

(c) The pressure and volume of a gas are related by the relation $pV^{\alpha}=k$, where α and k being constants. Find this relation for the following set of observations: **7**

$p(kg/cm^3)$:	0.5	1.0	1.5	2.0	2.5	3.0
$V(liters)$:	1.62	1.00	0.75	0.62	0.52	0.46

Q.3 **(a)** Apply Gauss-Seidal iteration method to solve the following equations: **3**

$$20x+y-2z=17,\quad 3x+20y-z=-18,\quad 2x-3y+20z=25.$$

(b) Find the inverse of the matrix $A=\begin{bmatrix}2 & 1 & 1\\ 0 & 1 & 0\\ 1 & 1 & 2\end{bmatrix}$. **4**

(c) Find the largest eigen value and corresponding eigen vector of the matrix $\begin{bmatrix}25 & 1 & 2\\ 1 & 3 & 0\\ 2 & 0 & -4\end{bmatrix}$, taking $\begin{bmatrix}1 & 0 & 0\end{bmatrix}^T$ as initial eigen vector. **7**

OR

Q.3 **(a)** The below table shows the temperature $f(t)$ as a function of time t: **3**

t:	1	2	3	4	5	6	7
$f(t)$:	81	75	80	83	78	70	60

Using Simpson's $\frac{1}{3}$ rule evaluate $\int_1^7 f(t)\,dt$.

(b) Solve the following system of equations using Gauss elimination method: **4**

$$x+4y-z=-5,\quad x+y-6z=-12,\quad 3x-y-z=4.$$

(c) From the following data, estimate number of persons getting wages between Rs. 10 and 15: **7**

Wages in Rs.:	0-10	10-20	20-30	30-40
Frequency:	9	30	35	42

Q.4 **(a)** Find the numbers of positive, negative and imaginary roots of the equation $2x^7-x^5+4x^3-5=0$. **3**

(b) Given that **4**

x:	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y:	7.898	8.403	8.781	9.129	9.451	9.750	10.031

Find $\frac{dy}{dx}$ at $x=1.1$.

(c) Using Newton's divided difference formula, evaluate $f(8)$ and $f(15)$ from below table: **7**

x:	4	5	7	10	11	13
$f(x)$:	48	100	294	900	1210	2028

OR

Q.4 **(a)** Using Lagrange's formula express $\frac{3x^2+x+1}{(x-1)(x-2)(x-3)}$ as a sum of partial fraction. **3**

(b) Establish Newton's backward interpolation formula. **4**

(c) The table gives the distance in nautical miles of the visible horizon for the given height in feet above the earth's surface: **7**

$x=$ height:	100	150	200	250	300	350	400
$y=$ distance:	10.63	13.03	15.04	16.81	18.42	19.90	21.27

Find the value of y when (a) $x=160$ *ft.* and (b) $x=410$ *ft.*

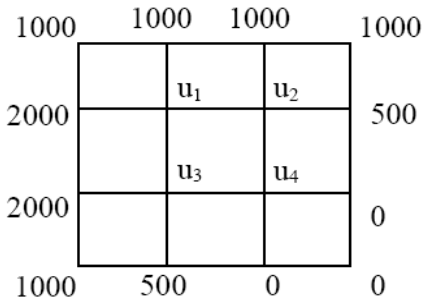
Q.5 **(a)** Using modified Euler's method, find an approximate value of y when $x=0.3$, given that $\frac{dy}{dx}=x+y$ with initial condition $y(0)=1$. **7**

(b) Using finite difference method, find $y(0.25), y(0.5), y(0.75)$ satisfying the differential equation $\frac{d^2y}{dx^2} + y = x$, subject to the boundary conditions $y(0) = 0, y(1) = 2$. **7**

OR

Q.5 **(a)** Using Runge-Kutta method of order 4, solve $\frac{dy}{dx} = xy + y^2$ with initial condition $y(0) = 1$ for $x = 0.1, 0.2$. **7**

(b) Using Gauss Seidel method up to three iterations, solve the two dimensional Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the following square mesh with boundary values as shown in below diagram. **7**



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