Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2015

Subject Code: 2140505 **Date:26/05/2015**

Subject Name: Chemical Engineering Maths

Time: 10:30am-1.00pm **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)** 1) Evaluate the sum $S=\sqrt{3}+\sqrt{5}+\sqrt{7}$ to 4 significant digits and find its absolute and relative error. **03**

2) Using Bisection method find a real root of the equation $x^3-2x-5=0$ correct to 3 decimal places. **04**

(b) 1) The table below gives the temperature $T(\text{in }°\text{C})$ and length $l(\text{in }mm)$ of a heated rod. If $l=a_0+a_1T$, find the best values for a_0 and a_1. **03**

$T(\text{in }°\text{C})$	20	30	40	50	60	70
$l(\text{in }mm)$	800.3	800.4	800.6	800.7	800.9	801.0

2) Using second order Runge-Kutta method find an approximate value of y corresponding to $x=0.2$, taking $h=0.1$, given that $\frac{dy}{dx}=y-x,\quad y(0)=2.$ **04**

Q.2 **(a)** 1) The out flow chemical concentration (c) from a completely mixed reactor is measured at various time (t) as **03**

$t(min)$	0	2	4	6	8	10	12	14
$c(mg/m^3)$	12	22	32	45	58	70	75	78

For an out flow of $Q=0.3\ m^3/s$, estimate the mass of chemical in grams by using the formula $M=Q\int_{t=0}^{t=14} c\,dt$.

2) Using Newton's divided difference formula find $f(8)$ and $f(15)$ from given table: **04**

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

(b) 1) Solve the equation $x^3-7x^2+36=0$, given that one root is double of another, by using the relations of roots. **03**

2) Transform the equation $x^3-6x^2+5x+8=0$, into another in which the second term is missing, by using synthetic division. **04**

OR

(b) 1) Find the real root of the equation $\cos x = xe^x$ using regula falsi method correct to four decimal places. **03**

2) Use the multiple-equation Newton-Raphson method to determine roots of equations $x^2+xy=10$ and $y+3xy^2=57$ with guesses of $x_0=1.5$ and $y_0=3.5$. **04**

Q.3 **(a)** 1) Using Gauss-Seidel method, find the solution, to three decimals, of the system **03**

$$83x+11y-4z=95$$
$$7x+52y+13z=104$$
$$3x+8y+29z=71.$$

2) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ **04**

(b) 1) Find the inverse of the matrix $\begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{bmatrix}$ **03**

2) Determine the constants a and b by the method of least square such that $y = ae^{bx}$ fits the following data: **04**

x	2	4	6	8	10
y	4.077	11.084	30.128	81.897	222.62

OR

Q.3 **(a)** 1) Using iterative power method, find the largest eigen value and corresponding eigen vector of the matrix **03**

$$\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

2) Using Jacobi method solve the system of equations, **04**

$$10x + 2y + z = 9$$
$$2x + 20y - 2z = -44$$
$$-2x + 3y + 10z = 22.$$

(b) 1) Use Gauss elimination to solve the system **03**

$$2x_1 + x_2 - x_3 = -1$$
$$x_1 - 2x_2 + 3x_3 = 9$$
$$3x_1 - x_2 + 5x_3 = 14.$$

2) Fit a function of the form $y = ax^b$ to the following data: **04**

x	1	2	3	4	5
y	7.1	27.8	62.1	110	161

Q.4 **(a)** 1) Find $\frac{dy}{dx}$ at $x = 1.1$, using following data: **03**

x :	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y :	7.989	8.403	8.781	9.129	9.451	9.750	10.031

2) Values of x (in degree) and $\sin x$ are given in the following table: **04**

x	15	20	25	30	35	40
$\sin x$	0.2588190	0.3420201	0.4226183	0.5	0.5735764	0.6427876

Using Newton's backward difference formula find the value of $\sin 38°$.

(b) 1) Applying Lagrang's formula, find a cubic polynomial which approximates the following data: **03**

x	-2	-1	2	3
$y(x)$	-12	-8	3	5

2) Using the Euler's method find $y(0.04)$, given that $y' = -y,\ y(0) = 1$ with $h = 0.01$. **04**

OR

Q.4 (a) 1) Find $f'(10)$ from the following data: **03**

x	3	5	11	27	34
$f(x)$	-13	23	899	17315	35606

2) From thr following table, estimate the number of students who obtain marks bewseen *40* and *45*. **04**

Marks	*30-40*	*40-50*	*50-60*	*60-70*	*70-80*
No. of students	*31*	*42*	*51*	*35*	*31*

(b) 1) Apply Simpson's rule to evaluate $\int_0^1 \sqrt{1-x^2}\,dx$, using $h=10$. **03**

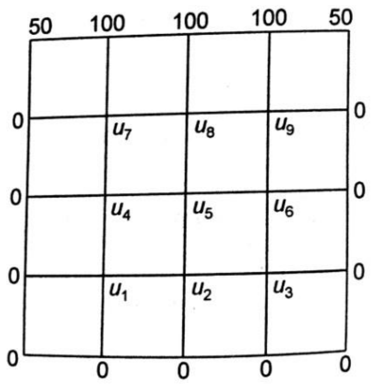
2) Solve the differential equation $y' = x - y^2$ with the condition $y(0)=1$ at $x=0.2$, by using Taylor series. **04**

Q.5 (a) 1) Apply Runge-Kutta fourth order method, to find an approximate value of $y(0.2)$, given that $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0)=1$. **03**

2) Using modified Euler's method, obtain a solution of the equation $\frac{dy}{dx} = x + y$ with initial coordinate $y=1$ at $x=0$ for $x=0.3$ with $h=0.1$. **04**

(b) 1) what is the classification of the partial differential equation $f_{xx} + 2f_{xy} + f_{yy} = 0$. **02**

2) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for following mesh-grid: **05**



OR

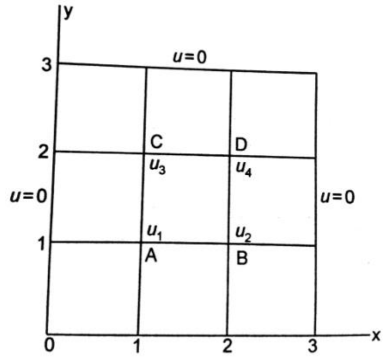
Q.5 (a) 1) The differential equation $y' = 1 + y^2$ satisfies the following data. Use Milne's Predictor-Corrector method to find $y(0.8)$. **03**

$x:$	0	0.2	0.4	0.6
$y:$	0	0.2027	0.4228	0.6841

2) Solve the boundary value problem $\frac{d^2y}{dx^2} - y = 0$ with $y(0)=0$ and $y(2)=3.62686$, using finite difference method. **04**

(b) 1) Determine whether the following equation is elliptic or hyperbolic? **02**
$(x+1)u_{xx} - 2(x+2)u_{xy} + (x+3)u_{yy} = 0.$

2) Solve the partial differential equation $u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$ in the following domain. **05**


y
3
$u=0$
C
D
2
u_3
u_4
$u=0$
$u=0$
1
u_1
u_2
A
B
0
1
2
3
x

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