Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 712901N **Date: 11/02/2012**

Subject Name: Mathematics for Researchers

Time: 10.30 am – 01.00 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)** Discuss the properties of Fourier series for even and odd function. **07**

(b) Find all Latent roots of the matrix $A=\begin{bmatrix}1 & 6 & 1\\ 1 & 2 & 0\\ 0 & 0 & 3\end{bmatrix}$ **07**

Q.2 **(a)** Develop Parse Val's identity by using Fourier transforms. **07**

(b) Compute Total Square error of $S_N(x)$ with N = 2 relative to $f(x)=x,(-\pi<x<\pi)$ on the interval $(-\pi\le x\le\pi)$ **07**

OR

(b) Find the Fourier transform of $e^{-a^2x^2}$, $a>0$ & deduce that $e^{-x^2/2}$ is self - reciprocal with definition. **07**

Q.3 **(a)** How does a truncation error occur. Discuss the cases of truncation error for a numerical value. **07**

(b) Using 5 - digits floating point arithmetic, find the product of $x=1/3$ and $y=5/7$ **07**

OR

Q.3 **(a)** Discuss the relation between Newton's forward differences and Newton's backward differences. **07**

(b) Find the value of $\int_0^1 \frac{dx}{1+x}$ by Simpson's rule. Hence obtain approximate value of $\log_e 2$. **07**

Q.4 **(a)** Briefly discuss the Gauss elimination technique for n linear equation. **07**

(b) Apply Gauss_sediel iteration method to solve the equations. **07**

$27x+6y-z=85$

$6x+15y+2z=72$

$x+y+54z=110$

OR

Q.4 **(a)** Find the inverse of $A=\begin{bmatrix}10 & 2 & 1\\ 2 & 20 & -2\\ -2 & 3 & 10\end{bmatrix}$ using traingularization method. **07**

(b) Find the Eigen values of the matrix. **07**

$$A=\begin{bmatrix} 2 & -i & 0 \\ i & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

Q.5 **(a)** Find the solution, correct to 3 decimal positions of the first order ordinary differential equation $\frac{dy}{dx} = x + y^2$ for $x = 0.1$ when $y(0) = 1$. **07**

(b) Develop algorithm to implement the Runge-kutta 4th order methods to find the numerical solution of simultaneous first order differential equation. **07**

OR

Q.5 **(a)** Find the solution $y(0.1)$ of the initial value problem $\frac{dy}{dx} = -2xy^2$ given $y(0) = 1$ with h = 0.1, using Taylor's series method of order four. **07**

(b) Solve the partial differential equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square with sides x = 0 = y, x = 3 = y with u=0 on the boundary and mesh length = 1. **07**

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