Code No: 111AL **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B.Tech I Year Examinations, May - 2016

MATHEMATICAL METHODS

(Common to EEE, ECE, CSE, EIE, BME, IT)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) What is the principle of method of least square. [2]

b) If $f(x) = e^{ax}$, then show that $\Delta^n e^{ax} = (e^a h - 1)^n e^{ax}$, where h is the step size. [3]

c) Derive the formula to evaluate the integral $\int_a^b f(x)\,dx$ by trapezoidal rule. [2]

d) What are the limitations of Taylor's series method? [3]

e) Write the Dirichlet's conditions for the existence of Fourier series of a function $f(x)$ in the interval $(\alpha, \alpha + 2\pi)$. [2]

f) State and prove linearity property of Fourier transforms. [3]

g) Solve $\frac{\partial^2 z}{\partial x^2} = a^2 x$, given that when $x = 0, \frac{\partial z}{\partial x} = a \sin y$ and $\frac{\partial z}{\partial y} = 0$. [2]

h) Form the partial differential equation by eliminating the arbitrary function $z = f(x^2 + y^2)$. [3]

i) If ϕ satisfies Laplacian equation, show that $\nabla\phi$ is solenoidal. [2]

j) Prove that $\overline{f} = (x^2 + xy^2)i + (y^2 + x^2 y)j$ is conservative and find the scalar potential. [3]

PART-B

(50 Marks)

2.a) Consider the following data for $g(x) = (\sin x)/x^2$

x	0.1	0.2	0.3	0.4	0.5
$g(x)$	9.9833	4.9696	3.2836	2.4339	1.9177

Calculate $g(0.25)$ accurately using Newton's forward method of interpolation.

b) Fit a curve of the form $y = \frac{a}{x} + bx$ to the data given below

x	1	2	4	6	8
y	5.43	6.28	10.32	14.86	19.5

[5+5]

OR

3.a) Given $u_1 = 22$, $u_2 = 30$, $u_4 = 82$, $u_7 = 106$, $u_8 = 206$, find u_6. Use Lagrange's Interpolation formula.

b) Fit a polynomial of second degree to the data points (2, 3.07), (4, 12.85), (6, 31.47), (8, 57.38) and (10, 91.29). [5+5]

4. Solve the initial value problem $\frac{dy}{dx} = x - y^2, y(0) = 1$, find $y(0.4)$ by Milne's method, by calculating the initial three values by Runge Kutta Fourth order formula. [10]

OR

5.a) Find up to the four places of decimals the smallest root of the equation $e^{-x} = \sin x$ using Newton-Raphson method.

b) A slider in a machine moves along a fixed straight rod. Its distance x cm along the rod is given below for various values of the time t seconds. Find the velocity of the slider and its acceleration when $t = 0.3$ second. [5+5]

t	0	0.1	0.2	0.3	0.4	0.5	0.6
x	30.13	31.62	32.87	33.64	33.95	33.81	33.24

6.a) Find cosine and sine series for $f(x) = \pi - x$ in $[0, \pi]$.

b) Find Fourier sine transform of $f(x) = \frac{1}{x\left(x^2 + a^2\right)}$ and hence deduce cosine transform of $\frac{1}{x^2 + a^2}$. [5+5]

OR

7.a) Expand the function $f(x) = x^2$ in $[-l, l]$.

b) State and prove Change of scale property of Fourier transforms. [5+5]

8. The points of trisection of a string are pulled aside through the same distance on opposite sides of the position of equilibrium and the string is released from rest. Derive an expression for the displacement of the string at subsequent time and show that the mid-point of the string always remains at rest. [10]

OR

9.a) Solve $x^2(y - z)p + y^2(z - x)q = z^2(x - y)$.

b) Solve $(p+q)(px+qy) = 1$ using Charpit's method. [5+5]

10.a) Compute the line integral $\int\left(y^2dx - x^2dy\right)$ round the triangle whose vertices are (1, 0), (0, 1), (-1, 0) in the xy - plane.

b) Find the work done in moving in a particle in the force field $\overline{f} = 3x^2i + (2zx - y)j + zk$, along the curve defined by $x^2 = 4y, 3x^3 = 8z$ from $x = 0$ to $x = 2$. [5+5]

OR

11. Verify divergence theorem for $2x^2yi - y^2j + 4xz^2k$ taken over the region of first octant of the cylinder $y^2 + z^2 = 9$ and $x = 2$. [10]

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