

Code No: 121AL

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech I Year Examinations, May/June - 2017

MATHEMATICAL METHODS

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

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)

- l.a) Define any 4 difference operators: [2]
- b) Prove that $\frac{\Delta}{\nabla} - \frac{\nabla}{\Delta} = \Delta + \nabla$ [3]
- c) Write the iterative formula for finding the approximate solution of the initial value problem $\frac{dy}{dx} = f(x, y); y(x_0) = y_0$. [2]
- d) Find the positive square root of 12 up to 4 decimal places. [3]
- e) If $x = \sum_{n=1}^{\infty} \frac{2b_n}{\pi} \sin nx$, $0 \leq x \leq \pi$, find b_n . [2]
- f) Does the Fourier series expansion of $f(x) = 1$, $0 < x < 4$, $f(x+4) = f(x)$ exist? If so, find the constant term, coefficients of $\cos \pi x$ and $\sin \pi x$. [3]
- g) Solve $\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 1$. [2]
- h) Write all possible solutions of the equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$. [3]
- i) State Gauss divergence theorem. [2]
- j) If $\nabla \times \vec{A} = \vec{0}$, $\nabla \times \vec{B} = \vec{0}$ then find the value of $\text{Div}(\vec{A} \times \vec{B})$. [3]

PART-B (50 Marks)

- 2.a) Using Gauss's backward interpolation formula find the population for the year 1936 given that,

Year	x	1901	1911	1921	1931	1941	1951
Population	y	12	15	20	27	39	52

- b) Prove that $(E^{\frac{1}{2}} + E^{-\frac{1}{2}})(1 + \Delta)^{\frac{1}{2}} = 2 + \Delta$ [5+5]

OR

- 3.a) Using the following table, find $f(2.75)$ using Forward difference formula.

x	2.5	3	3.5	4	4.5	5
Y=f(x)	21.145	22.043	20.225	18.644	17.262	16.047

- b) Using the following table fit a curve of the form $y = ax^b$ using method of least squares.

X	1	2	3	4	5	6
y	1200	900	600	200	110	50

[5+5]

- 4.a) Find a root of the equation $x^3 - 9x + 1 = 0$ correct to 4 decimal places by bisection method.
 b) Solve the following system of equations by using Gauss-Seidal iterative method (give the solution correct to 3 decimal places) $8x - 3y + 2z = 20$; $4x + 11y - z = 33$; $6x + 3y + 12z = 35$.
 [5+5]

OR

- 5.a) By applying 4th order Runge-Kutta method obtain the values of y at $x=0.1$ and at 0.2 for the differential equation $\frac{dy}{dx} = -y$, given that $y(0) = 1$.
 b) Apply Simpson's rule to find the value of $\int_0^2 \frac{1}{1+x^3} dx$ by taking 10 points in $[0, 2]$. [5+5]

- 6.a) Obtain the Fourier series of $f(x) = f(x + 2\pi)$ and $f(x) = \frac{\pi - x^2}{4}$, $0 < x < 2\pi$.
 b) Find the half range cosine series of $f(x) = x(2-x)$ in $0 \leq x \leq 2$.
 [5+5]

OR

- 7.a) Find the half range cosine series for the function $f(x) = \begin{cases} x^2, & 0 \leq x < 1 \\ 1, & 1 \leq x \leq 2 \end{cases}$.
 b) Is the function defined as $f(x) = \begin{cases} x + \pi, & 0 \leq x \leq \pi \\ x - \pi, & -\pi \leq x \leq 0 \end{cases}$ even or odd? If $f(x + 2\pi) = f(x)$, find its Fourier series expansion.
 [5+5]

- 8.a) Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u$, where $u(x, 0) = 6e^{-3x}$.
 b) Solve $z = p^2x + q^2y$, using Charpit's method.
 [5+5]

OR

- 9.a) An insulated rod of length l has its ends A and B maintained at 0°C and 100°C respectively until steady state conditions prevail. If B is suddenly reduced to 0°C and maintained at 0°C , find the temperature at a distance x from A at time t .
 b) Solve $(x^2 - yz)p + (y^2 - xz)q = (z^2 - yx)$
 [5+5]

- 10.a) Find the directional derivative of $\phi = x^2yz + 4xz^2$ at the point $(1, -2, -1)$ in the direction of the vector $2\bar{i} - \bar{j} - 2\bar{k}$.
 b) Prove that $\nabla \times \nabla \times \bar{F} = \nabla(\nabla \cdot \bar{F}) - \nabla^2 \bar{F}$
 [5+5]

OR

11. Verify Stoke's Theorem for $\bar{A} = (2x - y)\bar{i} - yz^2\bar{j} - y^2z\bar{k}$ over upper half of the surface of the sphere of unit radius.
 [10]