

Code No: **R201101**

R20

SET - 1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA VIZIANAGARAM
I B. Tech I Semester Supplementary Examinations June-2025

MATHEMATICS-I

(Common to all Branches)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions. **ONE** Question from **Each unit**

All Questions Carry Equal Marks

UNIT-I

1. a) Examine the convergence of $\sum \left(\frac{[(n+1)!]^2 x^{n-1}}{n!} \right)$ for $x > 0$. [7M]
b) Find Maclaurin's series expansion of the $f(x, y) = \sin^2 x$ and hence find the approximate value of $\sin^2 16^\circ$. [7M]

(OR)

2. a) Examine the convergence of $\frac{3}{5} - \frac{5}{7} + \frac{7}{10} - \frac{9}{13} + \dots$ [7M]
b) Find Taylor's series expansion of the $f(x, y) = \cos x$ about $x = 3/\pi$ and hence find the approximate value of $\cos 35^\circ$. [7M]

UNIT-II

3. a) Solve $(x+2y^3)\frac{dy}{dx} = y$. [7M]
b) Find bacteria after 3 hours if bacteria in a culture increase from 100 to 400 grams in 10 hours. [7M]

(OR)

4. a) Find the orthogonal trajectories of $r^2 = a \sin \theta$. [7M]
b) Solve $(x y \sin x y + \cos x y) y dx + (x y \sin x y - \cos x y) x dy = 0$. [7M]

UNIT-III

5. a) Solve $(D^3 - D)y = 4 \cos x + 2e^x$. [7M]
b) Find the charge on the capacitor for $t > 0$ if the charge $q(t)$ on the capacitor is given by the differential equation $(10D^2 + 120D + 1000)q = 17 \sin(2t)$, where $D = \frac{d}{dt}$. And, at initial time the current is zero and the charge on the capacitor is 0.0005 coulomb. [7M]

(OR)

6. a) Solve $(D^2 + 1)y = \operatorname{cosec} x$ by the method of variation of parameters. [7M]
b) Solve $(x^2 D^2 + 3x D + 1)y = 1/(1-x)^2$. [7M]

UNIT-IV

7. a) Find the minimum value of $x^2 + y^2 + z^2$ given $x + y + z = 3a$. [7M]
b) Prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \tan u$ if $u = \sin^{-1}[(x^2 + y^2)/x + y]$. [7M]

- (OR)
8. a) Prove that $u = (x^2 - y^2)/x^2 + y^2$, $v = 2xy/x^2 + y^2$ are functionally dependent and find the relation between them. [7M]
- b) Expand $e^x \cos y$ by Taylor's theorem about the point $(1, \pi/4)$ up to the second degree terms. [7M]

UNIT-V

9. a) Evaluate $\iint r \, dr \, d\theta$ bounded by the inside cardioid $r = a(1 + \cos\theta)$ and outside the circle $r = a$. [7M]
- b) Using spherical polar coordinates, evaluate $\iiint xyz \, dx \, dy \, dz$ taken over the volume bounded by the sphere $x^2 + y^2 + z^2 = a^2$ in the first octant. [7M]

- (OR)
10. a) Evaluate $\iint_R xy \, dx \, dy$ where R is the region bounded by the x -axis, ordinate $x = 2a$ and the curve $x^2 = 4ay$. [7M]
- b) Evaluate $\int_0^1 \int_x^{2-x} x/y \, dx \, dy$ by change of order of integration. [7M]
