R16

Code No: 131AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, December – 2019/January - 2020
MATHEMATICS-I
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, ETM, MMT, AE, MIE, PTM, CEE, MSNT)

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) Find an integrating factor which makes the differential equation $x^2 y dx - (x^3 + y^3) dy = 0$ into an exact differential equation. [2]

b) Find the general solution of $\frac{d^3y}{dx^3} - 14\frac{dy}{dx} + 8y = 0$. [3]

c) Define the rank of a matrix. [2]

d) If the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & k \\ 3 & 3 & 4 \end{bmatrix}$ is 2 then find the value of k. [3]

e) If $A = \begin{bmatrix} 1 & 0 \\ 2 & 4 \end{bmatrix}$ then find the Eigen values of $4A^{-1} + 3A + 2I$. [2]

f) Find the algebraic multiplicity of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ 0 & 0 & 2 \end{bmatrix}$. [3]

g) Find $\frac{\partial^2 u}{\partial x^2}$ and $\frac{\partial^2 u}{\partial y^2}$ if $u = x^3 + 3x^2 y + y^3$. [2]

h) Find the stationary points of $u(x, y) = \sin x \sin y \sin(x + y)$ where $0 < x < \pi,\ 0 < y < \pi$. [3]

i) Form the partial differential equation $z = (x + a)(y + b)$. [2]

j) Find the complete integral of $\sqrt{p} + \sqrt{q} = 1$. [3]

PART- B

(50 Marks)

2.a) Bacteria in a culture grows exponentially so that the initial number has doubled in three hours. How many times the initial number will be present after 9 hours.

b) Solve $(D^2 + 1)y = \sin x \sin 2x$. [5+5]

OR

3.a) Find the orthogonal trajectories of $y^2 = ax^3$.

b) Solve the differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = e^{2x}$. [5+5]

4.a) If $a+b+c \neq 0$, show that the system of equations $-2x+y+z=a,\ x-2y+z=b,\ x+y-2z=c$ has no solution. If $a+b+c=0$, show that it has infinitely many solutions.

b) Reduce the matrix $\begin{bmatrix} 5 & 3 & 14 & 4 \\ 0 & 1 & 2 & 1 \\ 1 & -1 & 2 & 0 \end{bmatrix}$ into Echelon form and hence find its rank. [5+5]

OR

5. Solve the following system by LU decomposition.
$2x-3y+10z=3;\ -x+4y+2z=20;\ 5x+2y+z=-12$ [10]

6. Determine the modal matrix P of $A=\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$. Verify that $P^{-1}AP$ is a diagonal matrix. [10]

OR

7. Reduce the quadratic form to canonical form by an orthogonal reduction and state the nature of the quadratic form $5x^2+26y^2+10z^2+6xy+14xz+4yz$. [10]

8.a) Prove that $u=\dfrac{x^2-y^2}{x^2+y^2}, v=\dfrac{2xy}{x^2+y^2}$ are functionally dependent and find the relation between them.

b) Discuss the maxima and minima of x^2y+xy^2-axy. [5+5]

OR

9.a) Given that $x+y+z=a$, find the maximum value of $x^m y^n z^p$.

b) A rectangular box open at the top is to have a volume of 32 cubic ft, find the dimensions of the box required least material for its construction. [5+5]

10.a) Solve $x^2p^2+y^2q^2=z^2$.

b) Solve $\left(x^2-yz\right)p+\left(y^2-zx\right)q=\left(z^2-xy\right)$. [5+5]

OR

11.a) Form the partial differential equation by eliminating the arbitrary function form $z=yf\left(x^2+y^2\right)$.

b) Solve the partial differential equation $\left(\dfrac{p}{2}+x\right)^2+\left(\dfrac{q}{2}+y\right)^2=1$. [5+5]

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