FE Sem-I All Branch Dec-2025

Paper / Subject Code: N10411 / Applied Mathematics-I

FE Sem-I (NEP) / Branches - All | Q.P. code - 99303 Nov-25

(02-Hours) Marks-60

Date - 22-12-25

(1/1)

Question 1 is compulsory.
Attempt any 3 from questions 2 to 6.
A Scientific Calculator is allowed to use.

Q-1 Attempt any **Five** questions. **(Compulsory Problem)** 15

a) If $u = \frac{\sqrt{x}+\sqrt{y}}{x+y}$ find $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$. 03

b) If $z = \frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}$ and $\bar{z}$ is the conjugate of z, then prove that $(z)^{10} + (\bar{z})^{10} = 0$. 03

c) Find n^{th} derivative of $y = sin2x\ cos6x$. 03

d) Express the matrix $A = \begin{bmatrix} 2+3i & 2 & 3i \\ -2i & 0 & 1+2i \\ 4 & 2+5i & -i \end{bmatrix}$ as the sum of a Hermitian and a skew-Hermitian matrix. 03

e) Prove that $\log\left(\frac{x+iy}{x-iy}\right) = 2itan^{-1}\left(\frac{y}{x}\right)$. 03

f) Solve $10x + y + z = 12,\ x + 10y + z = 12, x + y + 10z = 12$ using the Gauss-Jacobi's method by taking two iterations. 03

Q2-a) If $z = f(x, y),\ x = rcos\theta, y = rsin\theta$ then prove that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$. 04

Q2-b) Using the Newton-Raphson method find the root of the equation $2x^3 - 3x + 4 = 0$ lying between -2 and -1, correct to four places of decimals. 05

Q2-c) If $\tan(\alpha + i\beta) = e^{i\theta}$, prove that $\alpha = \frac{n\pi}{2} + \frac{\pi}{4}$ and $\beta = \frac{1}{2}log\left[tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)\right]$. 06

Q3-a) Find the rank of the matrix by reducing it to normal form $A = \begin{bmatrix} 1 & -1 & -2 & -3 \\ 4 & 1 & 0 & 2 \\ 0 & 3 & 1 & 4 \\ 0 & 1 & 0 & 2 \end{bmatrix}$. 04

Q3-b) For $u = sin^{-1}(x^2 + y^2)^{1/5}$ deduce $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{2}{25}tanu(2tan^2u - 3)$. 05

Q3-c) If $sin^4\theta cos^3\theta = a_1 cos\theta + a_3 cos3\theta + a_5 cos5\theta + a_7 cos7\theta$, Then prove that $a_1 + 9a_3 + 25a_5 + 49a_7 = 0$. 06

Q4-a) Test the consistency and hence solve the following system of linear equations, $-2y + 3t = 2,\ 2x + y + z + t = -4, 4x - 3y + z + 7t = 8$. 04

Q4-b) Show that $\log[\sin(x + iy)] = \frac{1}{2}log\left(\frac{cosh2y - cos2x}{2}\right) + itan^{-1}(cotx\ tanhy)$. 05

Q4-c) If $u = \log(x^3 + y^3 + z^3 - 3xyz)$, prove that $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = -\frac{9}{(x+y+z)^2}$. 06

Q-5a) For the matrix $A = [a_{ij}]_{3\times 3}$, where $a_{ij} = i + j$, find the rank. 04

Q5-b) Find all the values of $\left(\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)^{3/4}$ and show that their continued product is 1. 05

Q5-c) Discuss the maxima and minima of $x^3y^2(1 - x - y)$. 06

Q6-a) Solve the following equations by Gauss-Seidel method by taking two iterations. 04
$28x + 4y - z = 32,\ 2x + 17y + 4z = 35,\ x + 3y + 10z = 24$.

Q6-b) If $y = e^{msin^{-1}x}$, prove that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - (n^2 + m^2)y_n = 0$ 05

Q6-c) Investigate for what values of λ and μ the system of equations 06
$x + y + z = 6,\ x + 2y + 3z = 10,\ x + 2y + \lambda z = \mu$ will have
(i) No Solution, ii) Unique Solution iii) Many Solutions.

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