FE-Sem I / C-Scheme / Nov-25 / Engg. Maths I 12/11/25

Q.P. Code 94570 (1/2)

Time: 3 Hours Marks: 80

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.

1 a Evaluate $[\frac{1+\sin\alpha+i\cos\alpha}{1+\sin\alpha-i\cos\alpha}]^n$ [5]

b Expand $x^5 - x^4 + x^3 - x^2 + x - 1$ in powers of (x-2) by using Taylor's series [5]

c Show that the matrix $A = \begin{bmatrix} \alpha+i\gamma & -\beta+i\delta \\ \beta+i\delta & \alpha-i\gamma \end{bmatrix}$ is unitary [5]

if $\alpha^2+\beta^2+\gamma^2+\delta^2 = 1$.

d If $u = x^2\tan^{-1}\left(\frac{y}{x}\right) - y^2\tan^{-1}\left(\frac{x}{y}\right)$ then show that $\frac{\partial^2 u}{\partial x\partial y} = \frac{x^2-y^2}{x^2+y^2}$ [5]

2 a By using De Moivre's Theorem expand $\sin^4\theta\cos^3\theta$ [6]

b If $z = \tan(y+ax) + (y-ax)^{\frac{3}{2}}$ show that $\frac{\partial^2 z}{\partial^2 x} = a^2\frac{\partial^2 z}{\partial^2 y}$ [6]

c Find the two non-singular matrices P & Q such that PAQ is in normal form [8]

where $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & -1 \\ 3 & 1 & 1 \end{bmatrix}$

3 a Show that $\tan 7\theta = \frac{7\tan\theta - 35\tan^3\theta + 21\tan^5\theta - \tan^7\theta}{1-21\tan^2\theta+35\tan^4\theta-7\tan^6\theta}$ [6]

b Expand log(1+x) by using Maclaurin's series [6]

c If $y = e^{\tan^{-1}x}$ then prove that [8]

$(1+x^2)y_{n+2} + [2(n+1)x-1]y_{n+1} + n(n+1)y_n = 0$

4 a Find an approximate root of the equation $e^{-x} - \sin x = 0$ by using Newton Raphson method. [6]

b Solve the equation for real values of x; [6]

17coshx + 18sinhx = 1.

c Find all the stationary points of the function $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$. [8]
Examine whether function is maximum or minimum at those points.

X385YAD5D7CX385YAD5D7CX385YAD5D7CX385YAD5D7C

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5 a Find n^{th} derivative of $\frac{x^3}{(x+1)(x-2)}$ **[6]**

b Solve the following equations by Gauss-Siedel Method **[6]**

$27x + 6y - z = 85$, $6x + 15y + 2z = 72$, $x + y + 54z = 110$ (Take three iterations).

c Solve $x^5 = 1 + i$ and find the continued product of the roots. **[8]**

6 a Separate into real part and imaginary part of $cos^{-1}\left(\frac{3i}{4}\right)$ **[6]**

b Test the consistency and if possible, solve **[6]**

$2x - 3y + 7z = 5$, $3x + y - 3z = 13$, $2x + 19y - 47z = 32$

c If $\sinh(\theta + i\varphi) = e^{i\alpha}$ then prove that $\sinh^4\theta = \cos^2\alpha = \cos^4\varphi$ **[8]**
