Exam Code: 0001
Sub. Code: 0045

2051

B.A./B.Sc. (General) First Semester

Mathematics

Paper – III: Trigonometry and Matrices

Time allowed: 3 Hours Max. Marks: 30

***NOTE:** Attempt <u>five</u> questions in all, selecting atleast two questions each Unit.*

*x-x-x*

## UNIT – I

I. a) If a = cis α, b = cis β, and c = cis γ and a+b+c = abc.

Prove that cos (β-γ) + cos (γ-α) + cos (α-β) + 1 = 0

b) Define primitive $n^{th}$ root of unity. Show if $\xi$ is a primitive $n^{th}$ root of unity, then $(x - \xi)(x - \xi^2)(x - \xi^3) \ldots\ldots\ldots (x - \xi^{n-1}) = x^{n-1} + x^{n-2} + \ldots\ldots\ldots +1$. (2x3)

II. a) Prove $i^i$ is wholly real and find its principal value. Also prove values of $i^i$ form a G.P.

b) If $\tan(\theta + i\phi) = \sin(x + iy)$ then prove $\coth y \sinh 2\phi = \cot x . \sin 2\theta$. (2x3)

III. a) If $\sin^{-1}(x + iy) = u + iv$, prove $\sin^2 u$, $\cosh^2 v$ are the roots of the equation,

$t^2 - t(1 + x^2 + y^2) + x^2 = 0$

b) Express $\sin^6\theta \cos^2\theta$ in terms of cosines of multiples of θ. (2x3)

IV. a) Using Gregory series, prove $1 + \frac{1}{3} - \frac{1}{5} - \frac{1}{7} + \ldots\ldots\ldots\ldots\ldots = \frac{\pi}{2\sqrt{2}}$

b) Sum the series upto infinite terms $\sin\alpha - \frac{\sin(\alpha + 2\beta)}{\lfloor 2} + \frac{\sin(\alpha + 4\beta)}{\lfloor 4} \ldots\ldots\ldots\ldots \infty$.

(2x3)

## UNIT – II

V. a) Prove every square matrix over C can be uniquely expressed as P + iQ, P,Q are Hermitian matrices.

P.T.O.

b) If A is non-zero column matrix and B is a non-zero row matrix, show $\varphi$ (AB) = 1, also define rank of a matrix. (2x3)

VI. a) If $A = \begin{bmatrix} 1 & -1 & 2 & -1 \\ 4 & 2 & -1 & 2 \\ 2 & 2 & -2 & 0 \end{bmatrix}$ find non-singular matrices P,Q s.t. PAQ is in normal form

also find rank of A.

b) For what λ the equations 2x + y + 2z = 0, x + y + 3x = 0, 4x + 3y + λz = 0 have a non-zero solution. (2x3)

VII. a) Find values of λ, u for which equations

x + y + z = 6, x + 2y + 3z = 10, x + 2y + λz = u have (i) unique solution (ii) no solution

b) Find eigen values and corresponding eigen vectors of $A = \begin{bmatrix} 3 & 1 & 1 \\ 2 & 4 & 2 \\ 1 & 1 & 3 \end{bmatrix}$ (2x3)

VIII. a) Verify Cayley-Hamilton theorem for $\begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 0 & 2 & 1 \end{bmatrix}$. Also find its inverse if exists.

b) Diagonalize the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$ if possible. (2x3)

*x-x-x*

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