Program: **Certificate** Class: **UG**	Year: **First**	Semester: **II**
Subject: **Mathematics**		
Course Code: **MJ-2**	Course Title: **Matrices**	

Course Learning Outcomes: This course will enable the students to:

a) Understand and apply fundamental concepts in number theory, including well-ordering property, division algorithm, congruence relations, mathematical induction, and the fundamental theorem of arithmetic.
b) Gain a thorough understanding of matrices, including types of matrices, determinants, operations, invertibility, matrix rank, normal forms, and the rank-nullity theorem.
c) Gain a strong grasp of systems of linear equations, including their matrix form, augmented matrices, consistency (both necessary and sufficient conditions), and methods for solving homogeneous and non-homogeneous linear equations.
d) Find eigenvalues and corresponding eigenvectors for a square matrix.

Credit: **4 (Theory)**	**Compulsory**
Full Marks: **75**	Time: **3 Hours**

Unit	Content	Hours
I	**Theory of numbers**: Well-ordering property (WOP) of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, Fundamental Theorem of Arithmetic.	**15 h**
II	**Matrices**: Matrices and types of matrices, determinants, operations on matrices, submatrix, block Matrix, Invertible Matrices, Uniqueness of Inverse Matrix, Rank of a matrix, Normal form PAQ, Canonical or Echelon form, Rank-Nullity Theorem of a Matrix.	**15 h**
III	**System of linear equations**: Matrix form of system of linear equations, augmented matrix, consistent and inconsistent system of linear equations, necessary and sufficient condition consistency of a system of linear equations, method of solving of homogeneous and non-homogeneous linear equations.	**15 h**
IV	**Eigen values and Eigen vectors of matrices**: Characteristic polynomial of a matrix, Eigen values and Eigen vectors, A.M. and G.M. of Eigen values, Theorems on Eigen values and Eigen vectors, Minimal Polynomial, Cayley-Hamilton theorem.	**15 h**

Sessional Internal Assessment (SIA) Full Marks – 25 Marks
A – Internal written Examination – 20 Marks (1 Hr)
B – Over All Performance including Regularity – 05 Marks

Books Recommended:

1. David M. Burton (2007). *Elementary Number Theory* (7th edition). McGraw-Hill
2. Vasishtha A. R., Vasishtha A. K. (2011). Matrices . Krishna's prakashan Media (P) Ltd .
3. Bernard Kolman & David R. Hill (2003). Introductory Linear Algebra with Applications (7th edition). Pearson Education Pvt. Ltd. India.
4. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). Linear Algebra and its Applications (5th edition). Pearson Education Pvt. Ltd. India.
5. Pankaj Kumar Manjhi (2018). Algebra. (1st edition) Pragati Prakashan, Meerut.

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Program: **Certificate** Class: **UG**	Year: **First**	Semester: **II**
Subject: **Mathematics**		
Course Code: **MJ-3**	Course Title: **Analytic Geometry and Trigonometry**	

Course Learning Outcomes: This course will enable the students to:

a) Develop skills in two-dimensional analytical geometry, including transformations of rectangular axes, reduction of general equations to normal form, analysis of conic systems, and understanding the polar equation of conics.

b) Gain proficiency in three-dimensional analytical geometry, including the concepts of direction cosines, straight lines, planes, spheres, intersecting spheres, spheres passing through a given circle, cones, and cylinders.

c) Gain the ability to analyze and classify conicoids, understand their plane sections, determine generating lines, reduce equations to normal form, and classify quadrics.

d) Develop concepts in trigonometry, including the polar form of complex numbers, DeMoivre's theorem, and its applications in trigonometric function expansions.

e) Develop proficiency in working with hyperbolic and exponential functions, understanding their properties and applications.

Credit: **4 (Theory)**	**Compulsory**
Full Marks: **75**	Time: **3 Hours**

Unit	Content	Hours
I	**Analytical geometry of two dimensions:** Transformation of rectangular axes, General equation of second degree and its reduction to normal form, Systems of conies, Polar equation of a conic.	**15 h**
II	**Analytical geometry of three dimensions:** Direction cosines, Straight line, Plane, Sphere, Two Intersecting Spheres, Spheres Through a Given Circle Cone, Cylinder.	**15 h**
III	**Conicoid:** Central conicoids, paraboloids, plane sections of conicoids, Generating lines. Reduction of second-degree equations to normal form; classification of quadrics.	**15 h**
IV	**Trigonometry:** Polar form of complex number, Nth roots of unity, DeMoivre's Theorem, Applications of DeMoivre's Theorem in expansions trigonometric function, Hyperbolic function, Exponential Function and their properties.	**15 h**

Sessional Internal Assessment (SIA) Full Marks – 25 Marks
A – Internal written Examination – 20 Marks (1 Hr)
B – Over All Performance including Regularity – 05 Marks

Books Recommended:

1. Loney, S. L., Elements of Coordinate Geometry.
2. Shanti Narayan, Analytical Geometry of Three Dimensions.
3. Bell, R- J. T., Elementary Treatise on Coordinate Geometry.
4. Chaki, M. C, A Textbook of Analytical Geometry, Calcutta Publishers.
5. Chakraborty, J. G., and Ghosh, P. R., Advanced Analytical Dynamics.
6. Titu Andreescu, & Dorin Andrica (2014). Complex Numbers from A to...Z. (2nd edition). Birkhäuser.
7. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill International Edition, 2009.

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