

MATHEMATICS - SYLLABUS - PO, PSO and CO

Programme Outcomes

Program Outcomes for General Undergraduate Programs (Suggested): Students of all undergraduate general degree programs at the time of graduation will be able to

| PO NO | Expected Programme Outcomes |
|-------|---|
| 1 | Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. |
| 2 | Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes |
| 3 | Computational Thinking: Understand data-based reasoning through translation of data into abstract concepts using computing technology based tools. |
| 4 | Problem Solving: Identify and formulate problems, and integrate resources to reach decisions, make recommendations or implement action plans. |

Program Specific Outcomes

Program: B. Sc. Mathematics

| PSO NO | Expected Program Specific Outcomes |
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| 1 | Understand the foundations of mathematics and the importance of logic. |
| 2 | Solve problems of physics using differential equations and vector algebra |
| 3 | Solve problems in algebra, analysis and numerical analysis. |
| 4 | Translate real world problems into mathematical models. |

COURSE OUTCOMES

FIRST SEMESTER

MM1CRT01: FOUNDATION OF MATHEMATICS

| CO NO | EXPECTED COURSE OUT COME |
|-------|---|
| 1 | To explain the concepts of mathematical logic methods. |
| 2 | Define proposition and argument. |
| 3 | Explain propositional connectives. |
| 4 | Explain and exemplify truth value status of a proposition. |
| 5 | Explain and exemplify validity of an argument, tautology, contradiction |
| 6 | Construct truth table of a proposition. |
| 7 | Interpret the concepts of sets and functions. |
| 8 | Analyse statements using truth tables; |
| 9 | Construct simple proofs. |
| 10 | Demonstrate the concepts of relations |
| 11 | Determine equivalence relation and partial ordering. |
| 12 | Represent the relation using graph and matrix. |
| 13 | Determine the solution of the polynomial equation up to the 4th degree. |

SECOND SEMESTER

MM2CRT01: ANALYTIC GEOMETRY, TRIGONOMETRY & DIFFERENTIAL CALCULUS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | To interpret the ideas of conic sections, tangents and normal to a conic and their properties. |
| 2 | find the polar equation of a line, circle, tangent and normal to conics. |

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| 3 | To compute summation of infinite series using C+ iS method |
| 4 | Understand the idea about circular and hyperbolic functions. |
| 5 | Enhance problem solving skill by applying the expansion technique to simplify and analyse complex trigonometric expressions. |
| 6 | Familiarize successive differentiation and indeterminate forms. |

THIRD SEMESTER

MM3CRT01: CALCULUS

| CO NO | EXPECTED COURSE OUT COME |
|-------|---|
| 1 | Find the higher order derivatives of product of functions. |
| 2 | Learn the concept of expanding functions using Taylor's and Maclaurin's series. |
| 3 | Come across the idea of concavity and points of inflection and apply the concept in solving problems. |
| 4 | Learn about curvature and develop the skill of solving problems related to that. |
| 5 | Comprehend the idea of evolutes, involutes, asymptotes and envelope and attain competency in finding the evolutes, involutes, asymptotes and envelope of a given curve. |
| 6 | Develop the idea of partial differentiation, the chain rule and it's applications. |
| 7 | Comprehend the idea of extreme values and saddle points. |
| 8 | Distinguish the difference between local extrema and absolute extrema. |
| 9 | Understand the first and second derivative tests for finding out local extreme values. |
| 10 | Grasp the idea of Lagrange multipliers and develop the competency in working out problems related to it. |
| 11 | Understand the applications of single integrals and multiple integrals. |
| 12 | Apply the different methods to find out the area and volume using integration. |
| 13 | Evaluate the integral when the curves are given in the parametric form. |
| 14 | Get a consolidated idea about multiple integrals. |
| 15 | Explore the vast area of integral and differential calculus and generate interest in it |

FOURTH SEMESTER

MM4CRT01: VECTOR CALCULUS, THEORY OF NUMBERS AND LAPLACE TRANSFORM

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Get a review of vectors. |
| 2 | Distinguish between vector equations and parametric equations for lines and equation for a plane in space. |
| 3 | Understand the concept of vector functions. |
| 4 | Analyse vector functions to find derivatives, tangent lines, integrals, arc length, and curvature. |
| 5 | Explain vector differentiation. |
| 6 | Get familiar with the idea of directional derivatives and gradient vectors and apply the concept in solving problems. |
| 7 | Comprehend the idea of vector integration. |
| 8 | Apply Green's theorem, Stoke's theorem, Divergence theorem in solving problems. |
| 9 | Get familiarised with the various areas of vector differentiation and vector integration. |
| 10 | Develop the idea of Theory of Numbers. |
| 11 | To know Basic Properties of congruences, Fermat theorem, Wilson theorem and Euler's phi function and problems based on these. |
| 12 | Grasp the concept of Laplace Transforms, Linearity of Laplace transform, First shifting theorem, Existence of Laplace transform, and Transforms of derivatives. |
| 13 | To determine the Laplace transform of a given function. |
| 14 | Apply the idea of Laplace Transform I finding the solution of ordinary differential equation & initial value problem. |
| 15 | Deal with the Laplace transform of the integral of a function, Convolution and Integral equations. |

FIFTH SEMESTER

MM5CRT01: MATHEMATICAL ANALYSIS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Describe the real line as a complete ordered field. |
| 2 | Apply the ideas of finite and infinite sets and the properties of real numbers. |
| 3 | Understand the convergence of sequences |
| 4 | Produce various proofs of results that arise in the context of real analysis. |
| 5 | Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and calculate limits. |
| 6 | Analyse mathematical series and their convergence |
| 7 | Use the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series. |
| 8 | Solve various problems related to series using various tests. |
| 9 | Describe the limit of sequence and functions. |
| 10 | Apply theorems for finding the limit of functions. |

MM5CRT02 : DIFFERENTIAL EQUATIONS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Explain the concepts of nature and methods of getting solutions of linear and separable equations |
| 2 | Solve exact equations and homogeneous differential equations |
| 3 | Familiarize the orthogonal trajectory of the system of curves on a given surface. |
| 4 | Calculate integrating factors of DE and Solve using Reduction of order. |
| 5 | Determine the solutions of second order linear differential equations with constant coefficients. |
| 6 | Determine the solutions of Higher order linear differential equations using method of undetermined coefficients and Variation of parameters. |
| 7 | Solve Higher order linear equations |
| 8 | Familiarize the method of power series solutions. |
| 9 | Understand ordinary points, Singular points and regular singular points. |

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| 10 | Solve the problems involving ordinary points, Singular points and regular singular points. |
| 11 | Determine the solutions first order partial differential equations using different methods |
| 12 | Calculate the solution of the differential equation in Lagrangrs form |
| | MM5CRT03 : ABSTRACT ALGEBRA |
| CO NO | EXPECTED COURSE OUT COME |
| 1 | Describe, analyse and demonstrate the abstract concept groups, abelian groups, subgroups, cyclic groups, cosets, normal subgroups, permutation groups, factor groups. |
| 2 | Analyse consequences of Lagrange's theorem. |
| 3 | To analyse the concepts of homomorphism of groups and factor groups using theorems and examples. |
| 4 | Explain isomorphism and automorphism of groups. |
| 5 | Describe and analyse, rings, commutative rings, fields, ideals, quotient rings etc. |
| 6 | To explain the concepts of ideals and factor rings from the concepts of normal subgroups and factor groups: |
| 7 | To analyse the concepts of homomorphism of ring and factor ring using theorems and examples |
| 8 | The fundamental concept of zero divisors , integral domains . |
| | MM5CRT04 : HUMAN RIGHTS AND MATHEMATICS FOR ENVIORNMENTAL STUDIES |
| CO NO | EXPECTED COURSE OUT COME |
| 1 | Know about the multidisciplinary nature of environmental studies, natural resources, and ecosystems. |
| 2 | Get awareness about biodiversity and its conservation, environmental pollution and social issues. |
| 3 | Make their own decisions about complex environmental issues. |
| 4 | Develop and enhance their critical and creative thinking skills. |
| 5 | Understand how their decisions and actions affect the environment. |
| 6 | Encourage character building, and develop positive attitudes and values for a sustainable environment. |
| 7 | Develop the sense of awareness about the environment and its various problems and realize the inter-relationship between man and environment for protecting the nature and natural resources. |
| 8 | Establish the connection of mathematics with nature and real life through Fibonacci numbers and golden ratio. |
| 9 | Praise the beauty of mathematics and generate interest in learning mathematics. |

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| 10 | Acquire basic knowledge about various human rights. |
| | MM5GET02 : APPLICABLE MATHEMATICS(OPEN COURSE) |
| CO NO | EXPECTED COURSE OUT COME |
| 1 | Enhance their arithmetic and problem solving skills. |
| 2 | Attain the competency to perform well in competitive exams. |
| 3 | Develop their critical thinking and logical ability. |
| 4 | Find the application of mathematical concepts in the real world. |
| 5 | Understand the basic operations of Mathematics and apply shortcut methods for solving problems. |
| 6 | Communicate mathematical knowledge and understanding. |
| 7 | Distinguish between ratio and proportion and their application in real life. |
| 8 | Deal with problems related to HCF, LCM, profit and loss, percentage etc.. |
| 9 | Perform abstract mathematical reasoning. |
| 10 | Come across the concept of permutations and combinations and their application problems. |
| 11 | Realise the presence of trigonometry and quadratic equations in real life through different examples and problems. |
| 12 | To describe the definitions of trigonometric ratios. |
| 13 | Conceive the idea of simple and compound interest and problems related to it. |
| 14 | Deal with problems related to time, work, wage, distance etc.. |
| 15 | Learn about the exponential and logarithmic series. |
| 16 | Carry out problems related to elementary mensuration, elementary algebra. |
| 17 | Understand the method of factorising simple quadratic and cubic polynomials. |
| 18 | Get an introduction to differential calculus. |
| 19 | Acquire the basic ideas of derivatives, standard results and various rules for finding the derivatives of functions. |
| 20 | Generate interest in mathematics. |

SIXTH SEMESTER

MM6CRT01 : REAL ANALYSIS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Outline the concept of continuous function, monotone function, and inverse function. |
| 2 | Identify Continuity and Discontinuity of various functions in different contexts. |
| 3 | Distinguish between uniform continuity and continuity. |
| 4 | Attain the competency in solving the problems related to continuity. |
| 5 | Comprehend the definition of differentiability. |
| 6 | Establish a relation between continuity and differentiability. |
| 7 | Come across different theorems related to differentiability and apply them. |
| 8 | Conceive the idea of Mean Value theorem, L hospitals rule and Taylor's theorem and problems related to it. |
| 9 | Gain the knowledge of Reimann Integral and Reimann Integrable functions. |
| 10 | Get familiarised with the Fundamental Theorem of Calculus. |
| 11 | Understand and distinguish between the idea of pointwise and uniform convergence. |
| 12 | Solve problems on point-wise and uniform convergence, interchange of limits, and series of functions. |

MM6CRT02 : GRAPH THEORY AND METRIC SPACES

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Develop the basic concepts of graph theory |
| 2 | Describe the Matrix representation of graphs |
| 3 | Discover trees, spanning trees and its properties |
| 4 | Identify bridges, cut vertices and properties |
| 5 | Explain Euler graphs, Hamiltonian graphs, and their applications |
| 6 | Interpret the basic concepts of metric space |

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| 7 | Develop the ideas of open set, closed set, and Cantor set. |
| 8 | Solve problems related to convergence, completeness |
| 9 | Establish the properties of continuous mapping. |

MM6CRT03 : COMPLEX ANALYSIS

| CO NO | EXPECTED COURSE OUT COME |
|-------|---|
| 1 | Remember complex numbers and its algebraic properties. |
| 2 | Ability to analyse and work with analytic functions. |
| 3 | Know and apply Cauchy – Reiman equation in various contexts. |
| 4 | Develop concept about sufficient condition for differentiability. |
| 5 | Describe various functions like Elementary functions, Exponential functions, logarithmic functions, trigonometric and hyperbolic functions. |
| 6 | Understanding of harmonic functions and their relevance in various contexts. |
| 7 | Comprehension of key theorems and their application in contour integration. |
| 8 | Understanding when a complex function is differentiable at a point. |
| 9 | Recognizing the distinction between simply and multiply connected domains. |
| 10 | Explore the implications of Liouville’s theorem. |
| 11 | Acquire the theory and application of the power series expansion of analytic functions. |
| 12 | Proficiency in representing functions as power series including Taylor series. |
| 13 | Recognition and classification of singularities. |
| 14 | Apply residue theorem for the evaluation of improper integrals. |

MM6CRT04 : LINEAR ALGEBRA

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | To learn matrix and it’s properties, system of equations which has wide variety of applications in various science subjects . |

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| 2 | Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion. |
| 3 | Identify invertible matrices, left and right inverse of matrix, orthogonal matrices. |
| 4 | Demonstrate understanding of the concepts of vector space, subspace and linear independence, span, and basis. |
| 5 | Explain the concept of dimension of a vector space |
| 6 | CO6: Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism. |
| 7 | CO7: Decide whether a linear transformation is one-to-one or onto and how these questions are related to matrices. |
| 8 | CO8: Compute with the characteristic polynomial, eigenvectors, eigenvalues and Eigen spaces, as well as the geometric and the algebraic multiplicities of an eigen value and apply the basic diagonalization result. |
| | MM6CBT01 : OPERATIONS RESEARCH (Elective) |
| CO NO | EXPECTED COURSE OUT COME |
| 1 | Understand the new term LPP |
| 2 | Familiarize General Mathematical Model of LPP and solution by graphical method |
| 3 | Calculate the solution of LPP using Simplex method and BIG M method |
| 4 | Convert a Primal LPP into dual LPP in standard form |
| 5 | Understand theorems and principles in Duality |
| 6 | Understand Transportation Problem and its initial solutions using various methods |
| 7 | Calculate Transportation problems using MODI method and its variations. |
| 8 | Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method |
| 9 | Identify Principle behind theory of games. |
| 10 | Familiarize the concept of Games with and without saddle points and rule of dominance |

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| 11 | Solve Games using Arithmetic and Matrix method |
| 12 | Calculate Value of games using Graphical and Linear programming method. |

MATHEMATICS (COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)

FIRST SEMESTER

MM1CMT01: PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICAL METHODS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Acquire the concept of partial derivatives. |
| 2 | Develop the ability to analyse and differentiate functions with multiple variables using chain rule. |
| 3 | Find out rank of matrix using elementary transformations. |
| 4 | Learn to solve systems of linear equations using matrix method. |
| 5 | Understand eigenvalues and eigen vectors of a matrix |
| 6 | Apply Cayley – Hamilton theorem for finding the inverse of the matrix. |
| 7 | To compute summation of infinite series using C+ iS method |
| 8 | Understand the idea about circular and hyperbolic functions. |
| 9 | Enhance problem solving skill by applying the expansion technique to simplify and analyse complex trigonometric expressions. |
| 10 | Develop strong problem skills by learning various techniques to approximate solutions. |
| 11 | Acquire methods for finding roots of equations using bisection method, method of false position, iteration method and Newton – Raphson method. |
| SECOND SEMESTER | |
| MM2CMT01 : INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS | |
| CO NO | EXPECTED COURSE OUT COME |

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| 1 | Explore the vast area of integral and differential calculus. |
| 2 | Apply integration to find volume, arc length, area of the surface of revolution. |
| 3 | Find out volumes using cross sections and cylindrical shells. |
| 4 | Comprehend the idea of multiple integrals and its applications. |
| 5 | Use multiple integrals to find volume of a solid and area of bounded regions. |
| 6 | Understand the concept of ordinary differential equations and partial differential equations. |
| 7 | Attain the competency in solving ordinary differential equation using different methods. |
| 8 | Understand the concept of exact differential equations, variable separable equations, linear equations, homogeneous equations, Bernoulli's equations. |
| 9 | Develop the ability in solving partial differential equations. |
| 10 | Know about the origin of first order and second order partial differential equations. |
| 11 | Apply the concept of Lagrange's method of solving a partial differential equation. |

THIRD SEMESTER

MM3CMT01: VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA

| CO NO | EXPECTED COURSE OUT COME |
|-------|---|
| 1 | Get a review of vectors. |
| 2 | Analyse vector functions to find derivatives, tangent lines, integrals, arc length, and curvature and normal vectors of a curve. |
| 3 | Get familiar with the idea of directional derivatives and gradient vectors and apply the concept in solving problems. |
| 4 | Comprehend the idea of vector integration. |
| 5 | Apply Green's theorem, Stoke's theorem, Divergence theorem in solving problems. |
| 6 | To illustrate the idea about conic sections, polar coordinates and conics in polar coordinates. |
| 7 | Describe, analyze and demonstrate the abstract concept groups, abelian groups, subgroups, cyclic groups, cosets, normal subgroups, permutation groups, factor groups. |
| 8 | Assess properties implied by the definitions of groups, cyclic groups, subgroups |
| 9 | Use the concepts of homomorphism for groups . |

FOURTH SEMESTER

MM4CMT01: FOURIER SERIES, LAPLACE TRANSFORM AND COMPLEX ANALYSIS

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Learn to represent periodic functions as infinite series |
| 2 | Solve problems involving Fourier series. |
| 3 | Apply power series method for solving differential equations. |
| 4 | Solve problems involving Laplace transforms. |
| 5 | Acquire skills in finding the inverse Laplace transform. |
| 6 | Understand the concept of analytic functions and elementary functions. |
| 7 | Learn and apply Cauchy's theorem in various problems. |
| 8 | Develop proficiency in evaluating complex line integrals. |
| 9 | Apply Cauchy's integral formula to evaluate complex integrals. |
| 10 | Find out derivatives of analytic functions. |

MATHEMATICS (COMPLEMENTARY COURSE TO B.Sc. STATISTICS)

FIRST SEMESTER

DIFFERENTIAL CALCULUS, LOGIC AND BOOLEAN ALGEBRA

| CO NO | EXPECTED COURSE OUT COME |
|--------------|---|
| 1 | Explain the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point. |
| 2 | Compare and contrast the ideas of continuity and differentiability. |
| 3 | Find the derivative of trigonometric functions. |
| 4 | State the chain rule for the composition of two functions. |
| 5 | Apply the chain rule together with the power rule. |

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| 6 | Apply the chain rule and the product/quotient rules correctly in combination when both are necessary |
| 7 | Recognize the chain rule for a composition of three or more functions |
| 8 | Conceive the idea of Rolle's theorem, Mean Value theorem and problems related to it. |
| 9 | Find out absolute extrema, critical points |
| 10 | Calculate the partial derivatives of a function of two variables. |
| 11 | Calculate the partial derivatives of a function of more than two variables. |
| 12 | Determine the higher-order derivatives of a function of two variables. |
| 13 | To explain the concepts of mathematical logic methods. |
| 14 | Define proposition and argument. |
| 15 | Explain propositional connectives. |
| 16 | Explain and exemplify truth value status of a proposition. |
| 17 | Explain and exemplify validity of an argument, tautology, contradiction |
| 18 | Construct truth table of a proposition. |
| 19 | Learn about Boolean algebra and logic gates and switching circuits. |

SECOND SEMESTER

MM2CMT05: INTEGRAL CALCULUS AND TRIGONOMETRY

| CO NO | EXPECTED COURSE OUT COME |
|-------|--|
| 1 | Acquire idea about definite integrals. |
| 2 | Understand the fundamental theorem of calculus and substitution rules. |
| 3 | Find out the volumes using slicing and rotation about an axis. |
| 4 | Applying integration in specific contexts like finding the length of the plane curve and area of surface revolution. |
| 5 | Acquire idea about basic integration. |
| 6 | Develop skills doing integration by parts. |

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| 7 | Simply integrals of rational functions. |
| 8 | Master techniques for integrating various trigonometric functions. |
| 9 | Apply Demoiver's theorem in solving problems. |
| 10 | Understand the idea about circular and hyperbolic functions |
| 11 | To compute summation of infinite series using C+ iS method |

THIRD SEMESTER

MM3CMT05 : VECTOR CALCULUS, DIFFERENTIAL EQUATIONS LAPLACE TRANSFORM

| CO NO | EXPECTED COURSE OUT COME |
|-------|---|
| 1 | Get an introduction to vector algebra. |
| 2 | Recall their knowledge about vector and scalar functions. |
| 3 | Learn about the components of a vector, vector addition and scalar multiplication. |
| 4 | Comprehend the idea of inner product (dot product), vector product (cross product), scalar triple product and its properties. |
| 5 | Apply the concept of inner product (dot product), vector product (cross product) and scalar triple product in solving problems. |
| 6 | Get into the area of vector calculus. |
| 7 | Know about the parametric representation of curves. |
| 8 | Do problems on tangents and arc lengths. |
| 9 | Understand the definition of gradient, directional derivative, divergence and curl and apply the concept in solving different problems. |
| 10 | Get an introduction to Differential Equations. |
| 11 | Find out solutions of First order differential equations using various methods. |
| 12 | Understand the concept of ordinary differential equations and partial differential equations. |
| 13 | Understand the concept of exact differential equations, variable separable equations, linear equations, homogeneous equations, bernoulli's equations. |
| 14 | Attain the skill of forming partial differential equation. |
| 15 | Develop the ability in solving partial differential equations. |

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| 16 | Develop the competency in applying Lagrange's method in solving a partial differential equation. |
| 17 | Get an introduction to Laplace transform and linearity property. |
| 18 | Comprehend the concept of shifting theorem and inverse laplace transform. |
| 19 | Analyse and apply laplace transform in solving problems. |

FOURTH SEMESTER

MM4CMT05: LINEAR ALGEBRA, THEORY OF EQUATIONS, NUMERICAL METHODS AND SPECIAL FUNCTIONS.

| CO NO | EXPECTED COURSE OUT COME |
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| 1 | Find out rank of matrix using elementary transformations. |
| 2 | Learn to solve systems of linear equations using matrix method. |
| 3 | Understand eigenvalues and eigen vectors of a matrix |
| 4 | Apply Cayley – Hamilton theorem for finding the inverse of the matrix. |
| 5 | Apply matrix method for finding linear independence and dependence of vectors. |
| 6 | Understand the idea about fundamental theorem of algebra |
| 7 | Explore relationship between roots and coefficients. |
| 8 | Develop strong problem skills by learning various techniques to approximate solutions. |
| 9 | Acquire methods for finding roots of equations using bisection method, method of false position, iteration method and Newton – Raphson method |
| 10 | Develop deep understanding about Beta and Gamma functions. |
| 11 | Knowing and applying the relationship between Beta and Gamma functions |

