PROGRAMME OUTCOMES, PROGRAMME SPECIFIC OUTCOMES AND COURSEOUTCOMES OF B.SC.IN MATHEMATICS:

Programme Outcomes:

PO1 Students will acquire the basic subject Knowledge required for higher studies.

PO2 Students will be able to Communicate effectively by oral, written, computational and graphic means.

PO3 This programme will help students in improving their employability for positions in the Education, Banking, Insurance, Investment Sectors and other public and private organizations.

Programme Specific Outcomes:

After the completion of the B.Sc. Math (H) Programme, a student shall be able to-

PSO1 Communicate mathematics effectively by oral, written, computational and graphic means.

PSO2 Create mathematical ideas from basic axioms.

PSO3 Gauge the hypothesis, theories, techniques and proofs provisionally.

PSO4 Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and synthesis.

PSO5 Identify applications of mathematics in other disciplines.

PSO6 Learn to apply the knowledge of Mathematics to solve the real life problems.

PSO7 Feel the necessity of exploring the opportunities for enhancement of career prospects in different fields through mathematical knowledge.

PSO8 Appreciate the requirement of lifelong learning through continued education and research

Course Outcomes:

MAT-HC-1016 (Calculus):

This course will enable the students to:

CO1 Learn first and second derivative tests for relative extremum and apply the knowledge in problems inbusiness, economics and life sciences.

CO2 Sketch curves in a plane using its mathematical properties in different coordinate systems.

CO3 Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.

CO4 Understand the calculus of vector functions and its use to develop the basic principles of planetary motion.

MAT-HC-1026:Algebra

This course will enable the students to:

CO1 Employ De Moivre's theorem in a number of applications to solve numerical problems.

CO2 Learn about equivalent classes and cardinality of a set.

CO3 Use modular arithmetic and basic properties of congruences.

CO4 Recognize consistent and inconsistent systems of linear equations by the row echelon form of theaugmented matrix.

CO5 Learn about the solution sets of linear systems using matrix method and Cramer's rule

MAT-HG-1016/ MAT-RC-1016:Calculus

The students who take this course will be able to:

CO1 Understand continuity and differentiability in terms of limits.

CO2 Describe asymptotic behavior in terms of limits involving infinity.

CO3 Use derivatives to explore the behavior of a given function, locating and classifying its extrema, andgraphing the function.

CO4 Understand the importance of mean value theorems.

MAT-HG-1026: Analytic Geometry

This course will enable the students to:

CO1 Transform coordinate systems, conic sections

CO2 Learn polar equation of a conic, tangent, normal and related properties

CO3 Have a rigorous understanding of the concept of three dimensional coordinate systems

CO4 Understand geometrical properties of dot product, cross product of vectors

MAT-HC-2016: Real Analysis

This course will enable the students to:

CO1 Understand many properties of the real line *R*, including completeness and Archimedean properties.

CO2 Learn to define sequences in terms of functions from *N* to a subset of *R*.

CO3 Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limitsuperior, limit inferior, and the limit of a bounded sequence.

CO4 Apply the ratio, root, alternating series and limit comparison tests for convergence and absoluteconvergence of an infinite series of real numbers.

MAT-HC-2026: Differential Equations(including practical)

The course will enable the students to:

CO1 Learn basics of differential equations and mathematical modeling.

CO2 Formulate differential equations for various mathematical models.

CO3 Solve first order non-linear differential equations and linear differential equations of higher order usingvarious techniques.

CO4 Apply these techniques to solve and analyze various mathematical models.

MAT-HG-2016/MAT-RC-2016: Algebra

This course will enable the students to:

CO1 Learn how to solve the cubic and biquadratic equations, also learn about symmetric functions of the roots forcubic and biquadratic

CO2 Employ De Moivre's theorem in a number of applications to solve numerical problems.

CO3 Recognize consistent and inconsistent systems of linear equations by the row echelon form of theaugmented matrix. Finding inverse of a matrix with the help of

Cayley-Hamilton theorem

CO4 Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutationgroups, ring etc.

CO5 Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space

MAT-HG-2026: Discrete Mathematics

After the course, the student will be able to:

CO1 Understand the notion of ordered sets and maps between ordered sets.

CO2 Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.

CO3 Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuitsand their applications.

MAT-HC-3016: Theory of Real Functions

This course will enable the students to:

CO1 Have a rigorous understanding of the concept of limit of a function.

CO2 Learn about continuity and uniform continuity of functions defined on intervals.

CO3 Understand geometrical properties of continuous functions on closed and bounded intervals.

CO4 Learn extensively about the concept of differentiability using limits, leading to a better understanding forapplications.

CO5 Know about applications of mean value theorems and Taylor's theorem

MAT-HC-3026: Group Theory - I

The course will enable the students to:

CO1 Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutationgroups, etc.

CO2 Link the fundamental concepts of groups and symmetrical figures.

CO3 Analyze the subgroups of cyclic groups and classify subgroups of cyclic groups.

CO4 Explain the significance of the notion of cosets, normal subgroups and factor groups.

CO5 Learn about Lagrange's theorem and Fermat's Little theorem.

CO6 Know about group homomorphisms and group isomorphisms.

MAT-HC-3036: Analytical Geometry

This course will enable the students to:

CO1 Learn conic sections and transform co-ordinate systems

CO2 Learn polar equation of a conic, tangent, normal and properties

CO3 Have a rigorous understanding of the concept of three dimensional coordinates systems

SKILL ENHANCEMENT COURSESEC-1

MAT-SE-3014: Computer Algebra Systems and Related Software

This course will enable the students to:

CO1 Use of softwares; Mathematica/MATLAB/Maxima/Maple etc. as a calculator, for plotting functions andanimations

CO2 Use of CAS for various applications of matrices such as solving system of equations and finding eigenvaluesand eigenvectors.

CO3 Understand the use of the statistical software **R** as calculator and learn to read and get data into **R.**

CO4 Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationshipbetween data.

CO5 Analyze, test, and interpret technical arguments on the basis of geometry

MAT-HG-3016/MAT-RC-3016: Differential Equations

The course will enable the students to:

CO1 Learn basics of differential equations and mathematical modelling.

CO2 Solve first order non-linear differential equations and linear differential equations of higher order usingvarious techniques.

MAT-HG-3026: Linear Programming

This course will enable the students to:

CO1 Learn about the graphical solution of linear programming problem with two variables.

CO2 Learn about the relation between basic feasible solutions and extreme points.

CO3 Understand the theory of the simplex method used to solve linear programming problems.

CO4 Learn about two-phase and big-M methods to deal with problems involving artificial variables.

CO5 Learn about the relationships between the primal and dual problems.

CO6 Solve transportation and assignment problems.

CO7 Apply linear programming method to solve two-person zero-sum game problems.

MAT-HC-4016: Multivariate Calculus

This course will enable the students to:

CO1 Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.

CO2 Understand the maximization and minimization of multivariable functions subject to the given constraints

CO3 Learn about inter-relationship amongst the line integral, double and triple integral formulations.

CO4 Familiarize with Green's, Stokes' and Gauss divergence theorems

MAT-HC-4026: Numerical Methods (including practical)

The course will enable the students to:

CO1 Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of asystem of linear equations, up to a certain given level of precision.

CO2 Know about methods to solve system of linear equations, such as False position method, Fixed pointiteration method, Newton’s method, Secant method and LU decomposition.

CO3 Interpolation techniques to compute the values for a tabulated function at points not in the table.

CO4 Applications of numerical differentiation and integration to convert differential equations into differenceequations for numerical solutions.

MAT-HC-4036: Ring Theory

On completion of this course, the student will be able to:

- CO1 Appreciate the significance of unique factorization in rings and integral domains.
- CO2 Learn about the fundamental concept of rings, integral domains and fields.
- CO3 Know about ring homomorphism and isomorphism theorems of rings.
- CO4 Learn about the polynomial rings over commutative rings, integral domains, Euclidean domains, and UFD

SKILL ENHANCEMENT COURSESEC-2

MAT-SE-4024: LaTeX and HTML (practical)
After studying this course the student will be able to:

- CO1 Create and typeset a LaTeX document.
- CO2 Typeset a mathematical document using LaTex.
- CO3 Learn about pictures and graphics in LaTex.
- CO4 Create beamer presentations.
- CO5 Create web page using HTML

MAT-HG-4016/ MAT-RC-4016: Real Analysis

This course will enable the students to:

- CO1 Understand many properties of the real line R, including completeness and Archimedean properties.
- CO2 Learn to define sequences in terms of functions from R to a subset of R.
- CO3 Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limitsuperior, limit inferior, and the limit of a bounded sequence.
- CO4 Apply the ratio, root, alternating series and limit comparison tests for convergence and absoluteconvergence of an infinite series of real numbers.

MAT-HG-4026: Numerical Analysis

The course will enable the students to:

- CO1 Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of asystem of linear equations, up to a certain given level of precision.
- CO2 Know about iterative and non-iterative methods to solve system of linear equations
- CO3 Know interpolation techniques to compute the values for a tabulated function at points not in the table.
- CO4 Integrate a definite integral that cannot be done analytically
- CO5 Find numerical differentiation of functional values
- CO6 Solve differential equations that cannot be solved by analytical methods

MAT-HC-5016: Riemann Integration and Metric spaces

The course will enable the students to:

- CO1 Learn about some of the classes and properties of Riemann integrable functions, and the applications of theFundamental theorems of integration.
- CO2 Know about improper integrals including, beta and gamma functions.
- CO3 Learn various natural and abstract formulations of distance on the sets of usual or

unusual entities. Becomeaware one such formulations leading to metric spaces.

CO4 Analyse how a theory advances from a particular frame to a general frame.

CO5 Appreciate the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc.in an abstract setting.

CO6 Know about Banach fixed point theorem, whose far-reaching consequences have resulted into anindependent branch of study in analysis, known as fixed point theory.

CO7 Learn about the two important topological properties, namely connectedness and compactness of metricspaces.

MAT-HC-5026: Linear Algebra

The course will enable the students to:

CO1 Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space.

CO2 Basic concepts of linear transformations, dimension theorem, matrix representation of a lineartransformation, and the change of coordinate matrix.

CO3 Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometricand the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.

CO4 Compute inner products and determine orthogonality on vector spaces, including Gram−Schmidtorthogonalization to obtain orthonormal basis.

CO5 Find the adjoint, normal, unitary and orthogonal operators.

MAT-HE-5026: Mechanics

The course will enable the students to:

CO1 Know about the concepts in statics such as moments, couples, equilibrium in both two and three dimensions.

CO2 Understand the theory behind friction and center of gravity.

CO3 Know about conservation of mechanical energy and work-energy equations.

CO4 Learn about translational and rotational motion of rigid bodies.

MAT-HE-5046: Linear Programming

This course will enable the students to:

CO1 Learn about the graphical solution of linear programming problem with two variables.

CO2 Learn about the relation between basic feasible solutions and extreme points.

CO3 Understand the theory of the simplex method used to solve linear programming problems.

CO4 Learn about two-phase and big-M methods to deal with problems involving artificial variables.

CO5 Learn about the relationships between the primal and dual problems.

CO6 Solve transportation and assignment problems.

CO7 Apply linear programming method to solve two-person zero-sum game problems.

MAT-HC-6016: Complex Analysis (including practical)

Completion of the course will enable the students to:

CO1 Learn the significance of differentiability of complex functions leading to the understanding ofCauchy−Riemann equations.

CO2 Learn some elementary functions and can evaluate the contour integrals.

CO3 Understand the role of Cauchy−Goursat theorem and the Cauchy integral formula.

CO4 Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, findresidues and apply Cauchy Residue theorem to evaluate integrals.

MAT-HC-6026: Partial Differential Equations (including practical)

The course will enable the students to:

CO1 Formulate, classify and transform first order PDEs into canonical form.

CO2 Learn about method of characteristics and separation of variables to solve first order PDE's.

CO3 Classify and solve second order linear PDEs.

CO4 Learn about Cauchy problem for second order PDE and homogeneous as well as nonhomogeneous waveequations.

CO5 Apply the method of separation of variables for solving second order PDEs.

MAT-HE-6036: Mathematical Modelling (including practical)

The course will enable the students to:

CO1 Know about power series solution of a differential equation and learn about Legendre's and Bessel'sequations.

CO2 Use of Laplace transform and inverse transform for solving initial value problems.

CO3 Learn about various models such as Monte Carlo simulation models, queuing models, and linearprogramming models.

MAT-HE-6056: Rigid Dynamics

The course will enable the students to:

CO1 Know how to find the moments and products of inertia.

CO2 Learn about the motion of the centre of inertia

CO3 Learn about the D'Alembert's principle and Lagrange's equations

CO4 Learn about motion of a body in two dimension

MAT-HE-6066: Group Theory II

The course shall enable students to:

CO1 Learn about automorphisms for constructing new groups from the given group.

CO2 Learn about the fact that external direct product applies to data security and electric circuits.

CO3 Understand fundamental theorem of finite abelian groups.

CO4 Be familiar with group actions and conjugacy in S_n.

CO5 Understand Sylow theorems and their applications in checking non-simplicity.

PROGRAMME OUTCOMES, PROGRAMME SPECIFIC OUTCOMES AND COURSE OUTCOMES OF M.SC. IN MATHEMATICS:

PROGRAMME OUTCOMES:

After completion of M.Sc. in Mathematics students will:

PO1 Get idea about both the Pure and Applied branches of Mathematics.

PO2 Be able to apply for Ph.D.

PO3 Will be able to find out or analyze scientific reasoning for various things

PROGRAMME SPECIFIC OUTCOMES:

PSO1 This Programme will assist students in preparing for competitive exams e.g. NET, GATE, etc.

PSO2 It will help in understanding of number theory in details which can be used in modern online cryptographic technologies.

PSO3 This Programme will also guide to develop problem solving skills, thinking, creativity through assignments, project work etc.

Course Outcomes:

MAT 101 – Algebra

CO1 Based on the UGC Syllabus the paper 1016 (Algebra) for 1st semester is prepared in a logical andsystematic and simple way so that the students can compare the studies of different algebraic systems called groups, rings, fields and vector spaces.

CO2 The students can justify the concept of relations, mappings and composition in the study of algebraic systems called groups and rings. The concept of groups and rings play a significant rolein the development of geometry and number theory in recent times.

CO3 The syllabus contains a detailed study of field extension and its application to geometry, so that the students are able to solve some antique unsolved problems of geometry by the theory of field extension.

CO4 The students are able to explain that the study of vector spaces is nothing but the generalization ofthe analytical geometry and mechanics.

MAT-102 Differential Equations

Students will have knowledge:

CO1 To identify and know the methods of finding solutions of differential equations in explicit form

CO2 To Explain and able to apply whether a differential equation has a unique solution or not

CO3 In dealing with solution in series, great prominence has been found to the method of Frobenius

CO4 To handle partial differential equations with different methods mainly Charpit's and the Jacobi's method

CO5 The subject Partial Differential equations have wide range of applications in engineering and technological sciences. Using Partial Differential equations, students

can solve wave equations, heat equations, Laplace equations etc.

CO6 Laplace equation that can be solved by Partial Differential Equation is used in real life situations such as electrostatics, gravitation, steady state flow of inviscid fluids, steady state heat conduction etc.

CO7 Using Partial Differential Equations students can formulate other mathematical applications such as semiconductor modelling, mathematical models in biology, astrophysics etc.

CO8 The students can apply Partial Differential Equations in medical sciences such as Kidney dialysis, blood circulation systems etc.

MAT 103- Mechanics

Students will have knowledge:

CO1 To differentiate the properties of motion in various coordinate systems viz. cylindrical,spherical,conical surfaces.

CO2 To apply various tools of vector algebra as well as vector calculus, calculus of variationsto discuss the motion of rigid bodies under certain constraints.

CO3 To handle various physical laws of motion viz. Carnot's theorem, Kelvin's theorem,Hamiltonian's principle etc with mathematical tools.

CO4 To construct mathematical models viz. rigid body to describe motions under certainconstraints or no constraints which are able to analyse the physical scenario.

CO5 To understand Tensors. They will be able to derive transformation laws of covariant tensors, contravariant tensors and mixed tensors and to find their ranks.

CO6 To perform algebraic operations on tensors, to obtain covariant derivatives of varioustensors and to express Laplacian in tensor form.

CO7 To identify that application of tensors is invaluable to most of the branches of Mathematics, Engineering and Theoretical Physics such Mechanics, Elasticity, Electrodynamics, Relativity etc.

MAT-104: Real Analysis

After completing this course, the student will

CO1 Understand how Lebesgue measure on R is defined, how measures may be used to construct integrals, know the basic convergence theorems for the Lebesgue integral, the relation between series and the Hilbert space of square integrable functions.

CO2 Have familiarity with common examples and counterexamples, knowledge of the content of the major theorems, understanding of the ideas in their proofs, and ability to make direct applicationof those results to related problems.

CO3 Get the knowledge in sequences of functions and their uniform convergence and get the idea about how to find out the region of convergence of power series.

CO4 Develop the core skills of the subject and research skills in this areas.

MAT 105- Tensor Analysis

Students will have knowledge:

CO1 To differentiate the properties of motion in various coordinate systems viz. cylindrical,spherical,conical surfaces.

CO2 To apply various tools of vector algebra as well as vector calculus, calculus of

variationsto discuss the motion of rigid bodies under certain constraints.

CO3 To handle various physical laws of motion viz. Carnot's theorem, Kelvin's theorem,Hamiltonian's principle etc with mathematical tools.\

CO4 To construct mathematical models viz. rigid body to describe motions under certainconstraints or no constraints which are able to analyse the physical scenario.

CO5 To understand Tensors. They will be able to derive transformation laws of covariant tensors, contravariant tensors and mixed tensors and to find their ranks.

CO6 To perform algebraic operations on tensors, to obtain covariant derivatives of varioustensors and to express Laplacian in tensor form.

CO7 To identify that application of tensors is invaluable to most of the branches of Mathematics, Engineering and Theoretical Physics such Mechanics, Elasticity, Electrodynamics, Relativity etc.

MAT-106 Fundamental of Mathematics

Students will have knowledge:

CO1 To learn the interdisciplinary nature of various of branches of mathematics.

CO2 To learn the origin of mathematics and its gradual development.

CO3 To do research in mathematics on the fundamental topics.

MAT 201 – Complex **Analysis**

CO1 It is common to encounter an integral that seems impossible to evaluate but with the knowledge ofResidue theorem and its consequences students can make it possible.

CO2 Holonomic functions have the property that they can be uniquely analytically continued to (almost) the entire complex plane. Using the analytic continuation students can understand the behavior of a function at much larger scale by just knowing how the function behaves at a teenie-weenie open discin the complex plane. This section has a tremendous use in physics and engineering.

CO3 Power series expansions are largely used in every branch of physics. An important application ofpower series in the field of engineering is spectrum analysis. Power series is used extensively youhave to solve complicated differential equations. Students having knowledge of power series can solve many complicated equations arising in physics, finance and engineering.

CO4 Conformal mapping is an important technique used in complex analysis and has many applications indifferent physical situations. If the physical problem can be represented by complex functions but the geometric structure becomes inconvenient then by appropriate mapping it can be converted to a problem of convenient geometry. With the help of conformal mapping students can solve boundary value problems that arise in heat conduction, electrostatic potential and fluid flow.

MAT- 202 Continuum Mechanics

CO1 The objective of this course is to explain the fundamental concept of the principles of classicalcontinuum physics as applied to elasticity and fluid mechanics.

CO2 The students can acquire the idea of constitutive equations of material behaviour.

CO3 The students can identify specific branches of continuum mechanics such as hydrodynamics,viscous flow and classical elasticity.

CO4 Using the theory of Cartesian tensors and matrices the students can realize the physical stress components, deformation, emphasizing force balance and constitutive models with applications indifferent branches of engineering and technology.

MAT 203 Functional Analysis

Students will have knowledge:

CO1 To identify normed linear spaces and Banach spaces and can provide and construct examples of these spaces. They will be familiar with different types of convergence of series in normed linear spaces and various types of subsets like absorbing, balanced, convex sets, convex hull, linear hullof a subset etc. They can be able to classify finite dimensional spaces and can provide different characteristics of such spaces.

CO2 To explain the fundamental theorems on normed linear spaces, Hahn-Banach theorem, separationtheorem and can give their different applications. They will be familiar with dual spaces of different normed linear spaces and can explain the concepts of reflexivity, separability, weak and weak topology.

CO3 To identify inner product spaces, Hilbert spaces and can provide examples of such spaces. They can classify different types of operators like normal, unitary, self adjoint, positive, compact operators with examples and characteristics. They will also be able to explain the underlying ideaof fixed point theorem, extreme points and Krein Milman theorem.

MAT 204 – General Topology

Students will have knowledge:

CO1 To identify topological spaces and will be familiar with different types of subsets like open sets, closed sets, neighbourhoods, interior, boundary, derived sets, etc ., together with the ideas of bases, subbases, relative topology, continuous functions and homeomorphisms. They can be ableto classify different spaces like first countable, second countable, separable spaces and give the characterization of these spaces using some important results like Urysohn's lemma , Tietze extension theorem.

CO2 To use the idea of compactness and connectedness and give their different characterizations.

CO3 To explain the product topology and its relationship with compactness, connectedness, countability, etc. They can also provide examples of metrizable spaces, and can explain the relationship between embedding and metrization.

MAT-205 Mathematical Methods

CO1 The main objective of introducing this paper in the PG syllabus is that number theory is extensively used in the financial and defence sector of a country whereas Graph theory

serves as an Mathematical model in any system involving a binary relation. Both Number and Graph Theory are used in computer application.

CO2 Students can use the concept of primitive roots and indices for solvability of congruence of higherorder. The students can explain the quadratic reciprocity law using Legendere's and Jacobi's symbol.

CO3 Students can explain Fibonacci numbers and related identities. Students can also explain partitionfunctions, its graphical representations and generative functions.

CO4 The students acquire basic knowledge of graphs to model some practical situation by using graphs.

CO5 Students can analyze their social networks using graph theory and able to view social network.

CO6 Students are able to use a combination of theoretical knowledge and independent thinking in creative investigation of questions in graph theory.

MAT-206 Mathematics Education

After completing the course, the students will:

CO1 Learn the Nature, Philosophy and Foundation of Mathematics

CO2 Learn Mathematics as a subject in social and political context and History of Mathematics and its symbolization.

CO3 Learn the relation of Mathematics and Logics.

MAT-301 Fuzzy Set Theory

After completing this course, the students will:

CO1 Be able to distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function, able to draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristicand membership functions respectively. Become aware of the use of fuzzy inference systems in the design of intelligent or humanistic systems.

CO2 Be able to become aware of the application of fuzzy inference in the area of control. Have acquired the ability of thinking differently and have become capable, when necessary, to apply a new thinking methodology to real life problems including engineering ones.

CO3 Acquire necessary knowledge of important parts of fuzzy set theory, which will enable them to createeffective mathematical models of technical phenomena and processes with uncertain information, and carry them out on PC by means of adequate implementations.

CO4 Be presenting a more logical approach to complicated dynamical behavior and exposing the students to the current trends in system theory and applications.

MAT-302 Graph Theory

CO1 The students acquire basic knowledge of graphs to model some practical situation by usinggraphs.

CO2 Students can analyze their social networks using graph theory and able to view social network.

CO3 Students are able to use a combination of theoretical knowledge and independent thinking increative investigation of questions in graph theory.

MAT-303 Number theory

CO1 The main objective of introducing this paper in the PG syllabus is that number theory is extensively used in the financial and defence sector of a country whereas Graph theory serves as an Mathematical model in any system involving a binary relation. Both Number and Graph Theory are used in computer application.

CO2 Students can use the concept of primitive roots and indices for solvability of congruence of higherorder. The students can explain the quadratic reciprocity law using Legendere's and Jacobi's symbol.

CO3 Students can explain Fibonacci numbers and related identities. Students can also explain partitionfunctions, its graphical representations and generative functions.

MAT-304 Numerical Analysis

CO1 The student learn to solve any algebraic equations when no analytical method is applicable.

CO2 Students can find the approximate solutions of boundary value problems by using numericaltechnique.

CO3 Students can identify different types of approximation functions such as trigonometric functions,exponential functions etc.

CO4 Students are now able to apply the numerical technique in physical and engineering problems.

MAT-305 Special Theory of Relativity

Students will have knowledge:

CO1 To find difference between classical relativity and Einstein's relativity. They will know thepostulates of special theory of relativity, Lorentz transformations.To use addition law of velocities and its interpretation. They will learn the fact that a clock attached to any moving system runs at different rhythm from a stationary clock; and a measuringrod attached to any moving system changes its length according to the velocity of the system.

CO2 To explain the variation of mass with velocity, the equivalence of mass and energy and thetransformations of mass, momentum and energy.

CO3 To identify Minkowski's space, unification of space and time etc.

CO4 To study the transformation of charge and current density and the invariance of Maxwell'selectromagnetic equations.

MAT-306 Dissertation

Students will have an idea:

CO1 How to do research in mathematics

CO2 How to do literature survey

CO3 How to write a thesis in Mathematics.

MAT-401 Advanced Topology

Students will have knowledge:

CO1 To explain the concepts of fundamental group, homotopy of maps.

CO2 To calculate fundamental group using Van Kampen's theorem, fixed point theorem.

CO3 To explain covering spaces, unique path lifting theorem, homotopy theorems, special cases of many folds and topological groups. Singular homotopy, relation between fundamental group and first homology.

CO4 To calculate homology of S^n and to explain application spheres and vector fields.

MAT-401 Fluid Dynamics

Studying fluid Dynamics, students will acquire knowledge of many features. A few of them are as follows:

CO1 Students will come across many laws of Physics in Mathematical form. For instance, law ofconservation of mass in terms of Equation of continuity; law of conservation of momentum in terms of Equation of motion; law of conservation of energy in terms of Energy equation etc.

CO2 Students will acquire knowledge in controlling the viscous drag which is a very essential part in Aeronautical Engineering. For instance, in manufacturing the wings of the aircrafts, Aeronautical Engineers keep in mind the fact that viscous drag on the wings is least. If the drag forces are controlled properly then the impact of collision of the wings with air gets reduced which in turnhelps the aircrafts to avoid unwanted accident to a marginal extent.

CO3 Further in manufacturing the wings, it is also kept in mind that the buoyancy force can be applied properly during the period of flying so that the aircrafts float at reasonable heights. This phenomenonis also associated with the principle of fluid dynamics.

CO4 In studying this subject, students will encounter with different types of complicated linear and non- linear differential equations and so the students are to acquire knowledge of solving such type of equations.

MAT-402: Advanced Functional Analysis

After completing this course, the student will have the:

CO1 Facility with the main, big theorems of functional analysis, the notion of C*-algebra and variousexamples of C*-algebras, and their basic properties.

CO2 The notion of C*-algebra, Gelfand transform, commutative C*-algebras, positive and

unitaryelements, weak topology and density.

CO3 Representations of C*-algebras - the GNS-construction, algebras of compact operators.

CO4 Develop the core skills of the subject and research skills in this areas and its applications to differentbranches of social sciences and applied sciences.

MAT-402: Dynamical Systems

CO1 Dynamical systems and Fractal Geometry is an interdisciplinary topic which became popular in late 1970s. Mainly stability aspect of nonlinear systems are discussed with taking tools from topology, functional analysis, linear algebra, differential equation, computer etc. With the introduction of this paper, the students has got acquaintance with many interesting and challenging real life problems including bio-science which are dealtwith many geometrical and other tools.

CO2 This course will enable the students to pursue for research in many application oriented fields like bio-science.

CO3 This topic got a tremendous boost after the arrival of powerful computers as the computeris an indispensable tool for research in this topic. As a result the students have come to know how computers can be used to solve many challenging problems of real life.

CO4 The course has introduced the students to an entirely new kind of geometry known as Fractal Geometry which is entirely different from Euclidean Geometry.

MAT-403 Operations Research

CO1 The subject operation Research originated during World War II where Mathematical techniques were used to tackle the problem of maximum utilization of limited military resources.

CO2 Students studying this subject learn the technique of maximizing the profit and minimizing the cost.

CO3 If a student with some knowledge on Operations Research goes to start an industry, he will be able to select the place for distribution of products so that total cost of transportation is minimum and to select the best advertising media with respect to time, cost etc.

CO4 If a student with knowledge of OR becomes a personal manager, he will be able to appoint the most suitable persons on minimum salary, determine the best age of retirement and to select the number of persons to be appointed.

CO5 If a student with knowledge on OR goes to involve himself in agriculture, he will be able to solve the problem of optimum allocation of land in various crops in accordance with climatic conditions and the problem of optimum distribution of water from various resources like canal for irrigation purposes.

MAT-404 Advanced Numerical Analysis

CO1 Practical classes on the numerical methods learnt in the paper Numerical Analysis (1056)

CO2 Enabling for writing C programming and finding complete solutions bindependently.

CO3	Enabling all to develop an computation skill through C programming and any software likeMathematica/Matlab

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