

COURSE OUTCOMES OF VARIOUS COURSES IN B.A./B.SC. MATHEMATICS HONOURS PROGRAMME

Honours Core Course (14 nos)
Skill Enhancement Course (SEC) (2 nos)
Discipline Specific Elective (DSE) (4 nos)

SEMESTER WISE PLACEMENT OF THE COURSES

Semester I - Core Courses

MAT-HC-1016: Calculus (including practical),
MAT-HC-1026: Algebra

Semester II – Core Courses

MAT-HC-2016: Real Analysis,
MAT-HC-2026: Differential Equations(including practical)

Semester III – Core Courses

MAT-HC-3016: Theory of Real Functions,
MAT-HC-3026: Group Theory-I,
MAT-HC-3036: Analytical Geometry

Skill Enhancement Courses (Any one of the following two)

MAT-SE-3014: Computer Algebra Systems and Related Software
MAT-SE-3024: Combinatorics and Graph Theory

Semester IV - Core Courses

MAT-HC-4016: Multivariate Calculus,
MAT-HC-4026: Numerical Methods (including practical)
MAT-HC-4036: Ring Theory

Skill Enhancement Courses (Any one of the following two)

MAT-SE-4014: R Programming
MAT-SE-4024: LaTeX and HTML

Semester V - Core Courses

MAT-HC-5016: Riemann Integration and Metric spaces
MAT-HC-5026: Linear Algebra

Discipline Specific Elective Courses (any Two from the following courses)

MAT-HE-5016: Number Theory
MAT-HE-5026: Mechanics
MAT-HE-5036: Probability and Statistics
MAT-HE-5046: Linear Programming
MAT-HE-5056: Spherical Trigonometry and Astronomy
MAT-HE-5066: Programming in C (including practical)

Semester VI - Core Courses

MAT-HC-6016: Complex Analysis ,
MAT-HC-6026: Partial Differential Equations (including practical)

Discipline Specific Elective Courses (any Two from the following courses)

MAT-HE-6016: Boolean Algebra and Automata Theory
MAT-HE-6026: Bio-Mathematics
MAT-HE-6036: Mathematical Modelling (including practical)
MAT-HE-6046: Hydromechanics
MAT-HE-6066: Group Theory II
MAT-HE-6076: Mathematical Finance

CORE COURSES

1. MAT-HC-1016: Calculus (including practical)

Total marks: 100 (Theory: 60, Practical 20, Internal Assessment: 20)

Lectures 2 Practical, Credits 6 (4+2) *Each unit carry equal credit*

Course Objectives: The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real world problems. Also, computer lab will help to have a deep conceptual understanding of the above tools in true sense.

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

- i) Learn first and second derivative tests for relative extremum and apply the knowledge in problems in business, economics and life sciences.
- ii) Sketch curves in a plane using its mathematical properties in different coordinate systems.
- iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.
- iv) Understand the calculus of vector functions and its use to develop the basic principles of planetary motion.

2. MAT-HC-1026: Algebra

Total marks: 100 (Theory: 80 Internal Assessment: 20)

Per week: 5 Lectures 1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: The primary objective of this course is to introduce the basic tools of set theory, functions, induction principle, theory of equations, complex numbers, number theory, matrices and determinant to understand their connection with the real-world problems.

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

- i) Employ De Moivre's theorem in a number of applications to solve numerical problems.
- ii) Learn about equivalent classes and cardinality of a set.
- iii) Use modular arithmetic and basic properties of congruences.
- iv) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix.
- v) Learn about the solution sets of linear systems using matrix method and Cramer's rule

3. MAT-HC-2016: Real Analysis

Total marks: 100 (Theory: 80 Internal Assessment: 20)

Per week: 5 Lectures 1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: The course will develop a deep and rigorous understanding of real line $\mathbb{R}$ and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers. These concepts have wide range of applications in real life scenario.

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

- i) Understand many properties of the real line $\mathbb{R}$, including completeness and Archimedean properties.
- ii) Learn to define sequences in terms of functions from $\mathbb{N}$ to a subset of $\mathbb{R}$.
- iii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

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

Total Marks: 100: (Theory 60, Practical 20, Internal assessment 20)

Per week: 4 Lectures 2 Practical, Credits 6 (4+2) *Each unit carry equal credit*

Course Objectives: The main objective of this course is to introduce the students to the exciting world of differential equations, mathematical modeling and their applications.

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

- i) Learn basics of differential equations and mathematical modeling.
- ii) Formulate differential equations for various mathematical models.
- iii) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
- iv) Apply these techniques to solve and analyze various mathematical models.

5. MAT-HC-3016: Theory of Real Functions

Total Marks: 100(Theory 80 Internal assessment 20)

Per week: 5 Lectures 1 Tutorial, Credits,*Each unit carry equal credit*

Course Objectives: It is a basic course on the study of real valued functions that would develop an analytical ability to have a more matured perspective of the key concepts of calculus, namely; limits, continuity, differentiability and their applications

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

- i) Have a rigorous understanding of the concept of limit of a function.
- ii) Learn about continuity and uniform continuity of functions defined on intervals.
- iii) Understand geometrical properties of continuous functions on closed and bounded intervals.
- iv) Learn extensively about the concept of differentiability using limits, leading to a better understanding for applications.
- v) Know about applications of mean value theorems and Taylor's theorem

6. MAT-HC-3026: Group Theory - I

Total Marks: 100 (Theory 80 Internal assessment 20)

Per week 5 Lectures 1 Tutorial Credits,*Each unit carry equal credit*

Course Objectives: The objective of the course is to introduce the fundamental theory of groups and their homomorphisms. Symmetric groups and group of symmetries are also studied in detail. Fermat's Little theorem is studied as a consequence of the Lagrange's theorem on finite groups.

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

- i) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc.
- ii) Link the fundamental concepts of groups and symmetrical figures.
- iii) Analyze the subgroups of cyclic groups and classify subgroups of cyclic groups.
- iv) Explain the significance of the notion of cosets, normal subgroups and factor groups.
- v) Learn about Lagrange's theorem and Fermat's Little theorem.
- vi) Know about group homomorphisms and group isomorphisms.

7. MAT-HC-3036: Analytical Geometry

Total Marks: 100: (Theory 80, Internal assessment 20)

Per week: 5 Lectures 1 Tutorial Credits 6,*Each unit carry equal credit*

Course Objectives: The primary objective of this course is to introduce the basic tools of two dimensional coordinates systems, general conics, and three dimensional coordinate systems.

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

- i) Learn conic sections and transform co-ordinate systems
- ii) Learn polar equation of a conic, tangent, normal and properties
- iii) Have a rigorous understanding of the concept of three dimensional coordinates systems

8. MAT-HC-4016: Multivariate Calculus

Total Marks: 100 (Theory80, Internal assessment 20)

Per week: 5 lectures 1 Tutorial, Credits 6,*Each unit carry equal credit*

Course Objectives: To understand the extension of the studies of single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding. This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

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

- i) Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.
- ii) Understand the maximization and minimization of multivariable functions subject to the given constraints
- iii) Learn about inter-relationship amongst the line integral, double and triple integral formulations.
- iv) Familiarize with Green's, Stokes' and Gauss divergence theorems

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

Total marks: 100: (Theory: 60, Practical 20, Internal Assessment: 20)

Per week: 4 Lectures, 2 Practical, Credits 6(4+2), *Each unit carry equal credit*

Course Objectives: To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations and to find the approximate solutions of system of linear equations and ordinary differential equations. Also, use of Computer Algebra System (CAS) by which the numerical problems can be solved both numerically and analytically, and to enhance the problem solving skills.

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

- i) Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision.
- ii) Know about methods to solve system of linear equations, such as False position method, Fixed point iteration method, Newton's method, Secant method and LU decomposition.
- iii) Interpolation techniques to compute the values for a tabulated function at points not in the table.
- iv) Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.

10. MAT-HC-4036: Ring Theory

Total Marks: 100: (Theory 80 Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: The objective of this course is to introduce the fundamental theory of rings and their corresponding homomorphisms. Also introduces the basic concepts of ring of polynomials and irreducibility tests for polynomials over ring of integers.

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

- i) Appreciate the significance of unique factorization in rings and integral domains.
- ii) Learn about the fundamental concept of rings, integral domains and fields.
- iii) Know about ring homomorphism and isomorphism theorems of rings.
- iv) Learn about the polynomial rings over commutative rings, integral domains, Euclidean domains, and UFD

11. MAT-HC-5016: Riemann Integration and Metric spaces

Total Marks: 100: (Theory 80, Internal assessment 20)

Per week: 5 Lectures 1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: To understand the integration of bounded functions on a closed and bounded interval and its extension to the cases where either the interval of integration is infinite, or the integrand has infinite limits at a finite number of points on the interval of integration. Up to this stage, students do study the concepts of analysis which evidently rely on the notion of distance. In this course, the objective is to develop the usual idea of distance into an abstract form on any set of objects, maintaining its inherent characteristics, and the resulting consequences.

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

- i) Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Fundamental theorems of integration.
- ii) Know about improper integrals including, beta and gamma functions.
- iii) Learn various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces.
- iv) Analyse how a theory advances from a particular frame to a general frame.
- v) Appreciate the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc. in an abstract setting.
- vi) Know about Banach fixed point theorem, whose far-reaching consequences have resulted into an independent branch of study in analysis, known as fixed point theory.
- vii) Learn about the two important topological properties, namely connectedness and compactness of metric spaces.

12. MAT-HC-5026: Linear Algebra

Total Marks: 100: (Theory 80 Internal Assessment: 20)

Per week: 5 Lectures 1 Tutorial. Credits 6, *Each unit carry equal credit*

Course Objectives: The objective of this course is to introduce the fundamental theory of vector spaces, also emphasizes the application of techniques using the adjoint of a linear operator and their properties to least squares approximation and minimal solutions to systems of linear equations.

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

- i) Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space.
- ii) Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix.
- iii) Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.
- iv) Compute inner products and determine orthogonality on vector spaces, including Gram–Schmidt orthogonalization to obtain orthonormal basis.
- v) Find the adjoint, normal, unitary and orthogonal operators.

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

Total marks: 100: (Theory: 60, Practical 20, Internal Assessment: 20)

Per week: 4 Lectures, Practical 2, Credits 6(4+2) *Each unit carry equal credit*

Course Objectives: This course aims to introduce the basic ideas of analysis for complex functions with visualization through relevant practicals. Emphasis has been given on Cauchy's theorems, series expansions and calculation of residues.

Course Learning Outcomes: Completion of the course will enable the students to:

- i) Learn the significance of differentiability of complex functions leading to the understanding of Cauchy–Riemann equations.
- ii) Learn some elementary functions and can evaluate the contour integrals.
- iii) Understand the role of Cauchy–Goursat theorem and the Cauchy integral formula.
- iv) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

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

Total marks: 100: (Theory: 60, Practical 20, Internal Assessment: 20)

Per week: 4 Lectures, 2 Practical, Credits 6(4+2), *Each unit carry equal credit*

Course Objectives: The main objectives of this course are to teach students to form and solve partial differential equations and use them in solving some physical problems.

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

- i) Formulate, classify and transform first order PDEs into canonical form.
- ii) Learn about method of characteristics and separation of variables to solve first order PDE's.
- iii) Classify and solve second order linear PDEs.
- iv) Learn about Cauchy problem for second order PDE and homogeneous as well as nonhomogeneous wave equations.
- v) Apply the method of separation of variables for solving second order PDEs.

Discipline Specific Elective Courses **(any four courses in semester V and VI _ two in each semester)**

1. MAT-HE-5016: Number Theory

Total Marks: 100 (Theory 80 Internal assessment 20)

Per week: 5 lectures 1 Tutorial Credits 6, *Each unit carry equal credit*

Course Objectives: In number theory there are challenging open problems which are comprehensible at undergraduate level, this course is intended to build a micro aptitude of understanding aesthetic aspect of mathematical instructions and gear young minds to ponder upon such problems.

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

- i) Learn about some fascinating discoveries related to the properties of prime numbers, and some of the open problems in number theory, viz., Goldbach conjecture etc.
- ii) Know about number theoretic functions and modular arithmetic.
- iii) Solve linear, quadratic and system of linear congruence equations.

2. MAT-HE-5026: Mechanics

Total Marks: 100: (Theory 80, Internal assessment 20)

Per week: 5 Lectures 1 Tutorial, Credits 6(5+1) *Each unit carry equal credit*

Course Objectives: The course aims at understanding the various concepts of physical quantities and the related effects on different bodies using mathematical techniques. It emphasizes knowledge building for applying mathematics in physical world.

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

- i) Know about the concepts in statics such as moments, couples, equilibrium in both two and three dimensions.
- ii) Understand the theory behind friction and center of gravity.
- iii) Know about conservation of mechanical energy and work-energy equations.
- iv) Learn about translational and rotational motion of rigid bodies.

3. MAT-HE-5036: Probability and Statistics

Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial, **Credits 6**, *Each unit carry equal credit*

Course Objectives: To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness. The course intends to render the students to several examples and exercises that blend their everyday experiences with their scientific interests.

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

- i) Learn about probability density and moment generating functions.
- ii) Know about various univariate distributions such as Bernoulli, Binomial, Poisson, gamma and exponential distributions.
- iii) Learn about distributions to study the joint behavior of two random variables.
- iv) Measure the scale of association between two variables, and to establish a formulation helping to predict one variable in terms of the other, i.e., correlation and linear regression.
- v) Understand central limit theorem, which helps to understand the remarkable fact that: the empirical frequencies of so many natural populations, exhibit a bell-shaped curve, i.e., a normal distribution

4. MAT-HE-5046: Linear Programming

Total Marks: 100 (Theory: 80 Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial Credits: 6, *Each unit carry equal credit*

Course Objectives: This course develops the ideas underlying the Simplex Method for Linear Programming Problem, as an important branch of Operations Research. The course covers Linear programming with applications to transportation, assignment and game problem. Such problems arise in manufacturing resource planning and financial sectors.

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

- i) Learn about the graphical solution of linear programming problem with two variables.
- ii) Learn about the relation between basic feasible solutions and extreme points.

- iii) Understand the theory of the simplex method used to solve linear programming problems.
- iv) Learn about two-phase and big-M methods to deal with problems involving artificial variables.
- v) Learn about the relationships between the primal and dual problems.
- vi) Solve transportation and assignment problems.
- vii) Apply linear programming method to solve two-person zero-sum game problems.

5. MAT-HE-5056: Spherical Trigonometry and Astronomy

Total Marks: 100 (Theory 80, Internal Assessment 20)

Per week: 5 Lecture Tutorial 1, Credits 6, *Each unit carry equal credit*

Course Objectives: This main objective of this course is to provide the spherical triangles, Napier's rule of circular parts and Planetary motion

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

- i) Learn about the properties of spherical and polar triangles
- ii) know about fundamental formulae of spherical triangles
- iii) learn about the celestial sphere, circumpolar star, rate of change of zenith distance and azimuth
- iv) learn about Kepler's law of planetary motion, Cassini's hypothesis, differential equation for fraction

6. MAT-HE-5066: Programming in C (including practical)

Total Marks: 100 (Theory 60, Practical 20, Internal Assessment 20)

Per week: 4 Lectures 2 Tutorial, Credits 6(4+2) *Each unit carry equal credit*

Course Objectives: This course introduces C programming in the idiom and context of mathematics and imparts a starting orientation using available mathematical libraries, and their applications.

Course Learning Outcomes: After completion of this paper, student will be able to:

- i) Understand and apply the programming concepts of C which is important to mathematical investigation and problem solving.
- ii) Learn about structured data-types in C and learn about applications in factorization of an integer and understanding Cartesian geometry and Pythagorean triples.
- iii) Use of containers and templates in various applications in algebra.
- iv) Use mathematical libraries for computational objectives.
- v) Represent the outputs of programs visually in terms of well formatted text and plots.

7. MAT-HE-6016: Boolean Algebra and Automata Theory

Total Marks: 100 (Theory 80 Internal Assessment 20)

Per week 5 Lectures, Tutorial 1, Credits 6, *Each unit carry equal credit*

Course Objectives: This course aims to introduce the basic ideas and properties of ordered sets, Lattices, Boolean algebra and automata theory.

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

- i) Learn about the order isomorphism, Hasse diagrams, building new ordered set.
- ii) Learn about the algebraic structure lattices, properties of modular and distributive lattices.
- iii) Get ideas about the Boolean algebra, Switching circuits and applications of switching circuits.
- iv) Appreciate the theory of automata and its applications

8. MAT-HE-6026: Bio-Mathematics

Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial Credits: 6, *Each unit carry equal credit*

Course Objectives: The focus of the course is on scientific study of normal functions related to living systems. The emphasis is on exposure to nonlinear differential equations with examples such as heartbeat, chemical reactions and nerve impulse transmission. The basic concepts of the probability to understand molecular evolution and genetics have also been applied.

Course Learning outcomes: Apropos conclusion of the course will empower the student to:

- i) Learn the development, analysis and interpretation of bio mathematical models such as population growth, cell division, and predator-prey models.
- ii) Learn about the mathematics behind heartbeat model and nerve impulse transmission model.
- iii) Appreciate the theory of bifurcation and chaos.
- iv) Learn to apply the basic concepts of probability to molecular evolution and genetics.

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

Total Marks: 100 (Theory: 60, Practical 20, Internal Assessment: 20)

Per week: 4 Lectures, 2 practical Credits: 6 (4+2) *Each unit carry equal credit*

Course Objectives: The main objective of this course is to teach students how to model physical problems using differential equations and solve them. Also, the use of Computer Algebra Systems (CAS) by which the listed problems can be solved both numerically and analytically.

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

- i) Know about power series solution of a differential equation and learn about Legendre's and Bessel's equations.
- ii) Use of Laplace transform and inverse transform for solving initial value problems.
- iii) Learn about various models such as Monte Carlo simulation models, queuing models, and linear programming models.

10. MAT-HE-6046: Hydromechanics

Total Marks: 100: (Theory 80 Internal assessment: 20)

Per week: 5 Lectures, 1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: The main objectives of this course are to teach students about fluid pressure on plane surfaces, curved surfaces and Gas law. Also, introduces velocity of a fluid at a point, Eulerian and Lagrangian method, velocity potential and acceleration of a fluid at a point.

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

- i) Know about Pressure equation, rotating fluids.
- ii) Learn about Fluid pressure on plane surfaces, resultant pressure on curved surfaces, Gas law, mixture of gases
- iii) Learn about the Eulerian and Lagrangian method.
- iv) Learn about equation of continuity, examples, acceleration of a fluid at a point

11. MAT-HE-6056: Rigid Dynamics

Total Marks 100(Theory80 Internal assessment20)

Per week: 5 Lectures1 Tutorial, Credits 6, *Each unit carry equal credit*

Course Objectives: The main objectives of this course is to introduce moments and products of inertia, theorem of six constants, D'Alembert's principle, Motion of a body in two dimension and Lagrange's equations.

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

- i) Know how to find the moments and products of inertia.
- ii) Learn about the motion of the centre of inertia
- iii) Learn about the D'Alembert's principle and Lagrange's equations
- iv) Learn about motion of a body in two dimension

12. MAT-HE-6066: Group Theory II

Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial, Credits: 6, *Each unit carry equal credit*

Course Objectives: The course will develop an indepth understanding of one of the most important branch of the abstract algebra with applications to practical real-world problems. Classification of all finite abelian groups (up to isomorphism) can be done.

Course Learning Outcomes: The course shall enable students to:

- i) Learn about automorphisms for constructing new groups from the given group.
- ii) Learn about the fact that external direct product applies to data security and electric circuits.
- iii) Understand fundamental theorem of finite abelian groups.
- iv) Be familiar with group actions and conjugacy in S_n .
- v) Understand Sylow theorems and their applications in checking non-simplicity.

13. MAT-HE-6076: Mathematical Finance

Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial Credits: 6, *Each unit carry equal credit*

Course Objectives: This course is an introduction to the application of mathematics in financial world, that enables the student to understand some computational and quantitative techniques required for working in the financial markets and actuarial mathematics.

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

- i) Know the basics of financial markets and derivatives including options and futures.
- ii) Learn about pricing and hedging of options, as well as interest rate swaps.
- iii) Learn about no-arbitrage pricing concept and types of options.
- iv) Learn stochastic analysis (Ito formula, Ito integration) and the Black–Scholes model.
- v) Understand the concepts of trading strategies and valuation of currency swaps.

Skill Enhancement Courses

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

Total marks: 100 (Theory 60, Internal assessment 20, Practical 20)

Per week; 2 Lectures 2 Practical, Credits 4(2+2) *Each unit carry equal credit.*

Course Objectives: This course aims at familiarizing students with the usage of mathematical softwares (/Mathematica/MATLAB/Maxima/Maple) and the statistical software **R**. The basic emphasis is on plotting and working with matrices using CAS. Data entry and summary commands will be studied in **R**. Graphical representation of data shall also be explored.

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

- i) Use of softwares; Mathematica/MATLAB/Maxima/Maple etc. as a calculator, for plotting functions and animations
- ii) Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.
- iii) Understand the use of the statistical software **R** as calculator and learn to read and get data into **R**.
- iv) Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationship between data.
- v) Analyze, test, and interpret technical arguments on the basis of geometry

2. MAT-SE-3024: Combinatorics and Graph Theory

Total marks: 100(Theory 80, Internal Assessment 20)

Per week: 4 Lectures, Credits 4, *Each unit carry equal credit.*

Course Objectives: This course aims to provide the basic tools of counting principles, pigeonhole principle. Also introduce the basic concepts of graphs, Eulerian and Hamiltonian graphs, and applications to dominoes, Diagram tracing puzzles, Knight's tour problem and Gray codes.

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

- i) Learn about the counting principles, permutations and combinations, Pigeonhole principle
- ii) Understand the basics of graph theory and learn about social networks, Eulerian and Hamiltonian graphs, diagram tracing puzzles and Knight's tour problem.

3. MAT-SE-4014: R Programming

Total marks: 100 (Theory 60, Internal assessment 20, Practical 20)

Per week: 2 Lectures 2 Practical, Credits 4(2+2)

Course Objectives: The purpose of this course is to help using **R**, a powerful free software program for doing statistical computing and graphics. It can be used for exploring and plotting data, as well as performing statistical tests.

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

- i) Become familiar with **R** syntax and to use **R** as a calculator.
- ii) Understand the concepts of objects, vectors and data types.

- iii) Know about summary commands and summary table in **R**.
- iv) Visualize distribution of data in **R** and learn about normality test.
- v) Plot various graphs and charts using **R**.

4. MAT-SE-4024: LaTeX and HTML (practical)

Total marks: 100 (Theory 60, Internal assessment 20, Practical 20)

Per week: 2 Lectures 2 Practical, Credits 4(2+2)

Course Objectives: The purpose of this course is to acquaint students with the latest typesetting skills, which shall enable them to prepare high quality typesetting, beamer presentation and webpages

Course Learning Outcomes: After studying this course the student will be able to:

- i) Create and typeset a LaTeX document.
- ii) Typeset a mathematical document using LaTeX.
- iii) Learn about pictures and graphics in LaTeX.
- iv) Create beamer presentations.
- v) Create web page using HTML.