MMA23501T	ABSTRACT ALGEBRA	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Groups and Rings

Course Objectives:

- To give students idea of Automorphism and Polynomial rings.
- To provide 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.

Course Outcome:

After successful completion of the course, the students will be able to
CO1: describe the direct product and sums of groups, solvable groups
CO2: categories polynomials of different degree and understand the concept of rings of polynomials.
CO 3: understand the concepts of ED, UFD and PID and their properties.
CO4: describe extension of fields, algebraic and transcendental elements, Galois Theory.

Module1:Direct Product and Solvable Groups	**15 Hours**

Direct product and Direct sums of Groups. Decomposable groups. Normal and Subnormal series of groups, composition series, Jordan Holder theorem, solvable groups.

Module2:Polynomial Ring	**12 Hours**

A brief review of polynomial rings over a field; reducible and irreducible polynomials, Gauss' theorem for reducibility of $f(x)$ in Z[x]; Eisenstein's criterion for irreducibility of $f(x)$Z [x] over Q, roots of polynomials; finite fields.

Module3: Factorization Theory in Integral Domains	**15 Hours**

Divisibility in commutative rings, Principal Ideal Domain, Unique Factorization Domain, Euclidean Domain and their properties.

Module4:Field Extension and Galois Theory	**18 Hours**

Sub Fields and Prime Fields. Extensions of fields. Algebraic and Transcendental elements, Algebraic Extensions of Splitting field perfect Fields, Finite field (Moore's theorem etc.), Construction by ruler and compass, elements of Galois theory**.**

Total Lecture hours	**60 hours**

Text Book(s)

1. Herstein, N. Topics in Algebra, John Wiley& Sons, 1975.
2. Singh, S. and Zameruddin, Q. Modern Algebra, Vikash Publishing House, 2006.

ReferenceBooks

1. Gallian J. A., Contemporary Abstract Algebra (8th Edition), Cengage Learning India Pvt. Ltd. Delhi, Fourth impression, (2015)
2. Fraleigh John B., A First Course in Abstract Algebra, 7th Edition, (2001)

MMA23502T	MECHANICS AND TENSOR	L	T	P	C
		3	1	0	4

Pre-requisite: B. Sc. Statics, Dynamics or equivalent

Course Objectives:

- To understand the basic concept of planetary motion
- To identify problems in rigid body dynamics.
- To learn generalized coordinate systems
- To introduce the principles of tensor analysis

Course Outcome:

After successful completion of the course, the students will be able to

CO 1: identify and describe Kepler's laws of planetary motion.

CO 2: formulate and solve problems in rigid body dynamics

CO 3: derive the equations of motion for the system, which determine how the coordinates change as functions of time.

CO 4: understand the concept of tensor analysis in solving physical problems

Module 1: Central Forces and Planetary motion — **12 Hours**

Motion of a particle under a central force, Apses and apsidal angles, Kepler's laws of planetary motion, Newton's universal law of gravitation, Motion in an inverse square field, Velocity and acceleration in cylindrical and spherical polar coordinate systems

Module 2: Motion of Rigid Bodies — **12 Hours**

General motion of a rigid body: screw motion, Instantaneous axis of rotation Moments and products of inertia, Theorems of parallel and perpendicular axes, Principal axes, Kinetic energy about a fixed point, Momental ellipsoid-equimomental systems, Coplanar distributions, Euler's dynamical equation for the motion about a fixed point, Motion under no external forces

Module 3: Lagrange's Equations — **10 Hours**

Generalized coordinates: Lagrange's equations for a holonomic system, Case of conservative forces and theory of small oscillations

Module 4: Hamiltonian Theory — **10 Hours**

Hamiltonian methods, Hamilton's equations, Variational method, Hamilton's and principle of least action

Module 5: Tensor — **16 Hours**

Transformation of coordinates, Contravariant vectors, Scalar invariants, Covariant vectors, Tensor of any order, Addition and multiplication of tensors, Quotient Law, Riemannian space, Fundamental tensors, Metric tensor, Christoffel symbols, Transformation laws and their properties, Covariant derivative, Gradient, Divergence, Curl of a vector, Riemann Chritoffel tensor, Curvature tensor, Ricci Tensor, Scalar Curvature, Einstein tensor

Total Lecture hours — **60 Hours**

Text Book(s)	
1.	Chrolton. F., Textbook of Dynamics, CBS Publishers & Distributors (Indian edition), Delhi (1985)
2.	Eisenhart, L. P., Riemannian Geometry (Ebook), Princeton University Press, USA (1966)
Reference Books	
1.	Loney, S. L., An Elementary Treatise on the Dynamics of a Particle and Rigid Bodies (Ebook), Cambridge University Press (2016)
2.	Weatherburn, C. E., An Introduction to Riemannian Geometry and the Tensor Calculus, Cambridge University Press (1938)
3.	Smith, Mathew S., Principles and Applications of Tensor Analysis (Ebook), W. Sons (1963)

MMA23503T	REAL ANALYSIS	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Single and Multivariable Calculus

Course Objectives:

- To demonstrate students how to perform integration in terms of Reimann Stieltjes.
- To explain sequences of functions and their uniform convergence and get the ideaabout how to find out the region of convergence of power series.
- To understand and apply the functions of several variables.
- To understand how Lebesgue measure on R is defined and how measures may be used to construct integrals.

Course Outcome:

After successful completion of the course, the students will be able to

CO 1: measure the Reimann – Steieltjes integrability of a bounded function.

CO 2: understand the difference between pointwise and uniform convergence of sequence and series of functions.

CO3: understand the functions of several variables and use of Implicit function theorem and Stoke's theorem.

CO4: understand Lebesgue measure on R and its use to construct integrals along with basic convergence theorems for the Lebesgue integral.

Module 1: Reimann – Stieltjes Integral — **15Hours**

Definition and existence of Reimann- Stieltjes Integral, Linearity Properties of Reimann- Stieltjes Integral, Reimann- Stieltjes Integral as the limit of sums, integration and differentiation, Fundamental theorem of calculus, Integration of vector valued functions.

Module2:Uniform Convergence — **20Hours**

Uniform convergence of sequence of functions at an interval, Cauchy's criterion, Test for uniform convergence, properties of uniformly convergent sequences and series of functions, results related to uniform convergence with continuity, integration and differentiation,Weirstrass's approximation theorem, Power series, radius of convergence, Abel's and Tauber's theorem, Fundamental properties.

Module3: Functions of several variables — **10Hours**

Functions of several variables, Linear transformation, Derivative in an open subset of R^n, Inverse function theorem, Implicit function theorem, Jacobians, Extremum problems with constants, Lagrange's multiplier method, Differentiation of integrals, Stoke's Theorem.

Module4: Lebesgue Measure — **15Hours**

Lebesgue outer measure, Measurable sets and properties, Borel sets and their measurability, Characterization of measurable sets, non-measurable sets, Measurable functions and their properties, Operations of measurable functions, Sets of measure zero, Sequence of measurable functions, Convergence in measure.

Total Lecture hours — **60hours**

Text Book(s)

1. Bartle R. G., Sherbert Donald R., Introduction to Real Analysis, John Wiley &Sons, Inc. NewYork (2000)
2. Malik, S.C. and Arora S.. Mathematical Analysis, New Age International Private Limited,2017.
3. Royden H.L., Real Analysis, Prentice Hall of India, 2011
4. Jain P.K. and Gupta V.P., Lebesgue Measure and Integration, Anshan Ltd., 2012

Reference Books

1. Rudin W., Principles of Mathematical Analysis, McGraw-Hill Education, 1976
2. Goldberg R.R., Methods of Real Analysis, Oxford and IBH Publishing, 2012.Pradesh (1955)

MMA23504T	ORDINARY DIFFERENTIAL EQUATION	L	T	P	C
		4	0	0	4

Pre-requisite: B. Sc. Differential Equations

Course Objectives:

- To evaluate first order differential equations and show existence and uniqueness of solutions
- To solve second order and higher order linear differential equations
- To solve second order differential equations using series
- To learn and implement systematic approaches for solving boundary-value problems

Course Outcome:

After successful completion of the course, the students will be able to

CO1: demonstrate solutions of first order and first degree differential equations
CO2: apply different methods to find the complete solution of a non-homogeneous differential equation.
CO 3: explain different types of differential equations and their solutions.
CO 4: apply the method of separation of variables to solve a boundary value problem of the Sturm-Liouville type.

Module 1: Equations of First Order and First Degree — **15 Hours**

Differential equations and their classification, Nature of solutions and application, Initial value problems, Boundary value problems, Existence and Uniqueness problem, Picard existence and uniqueness theorem, Simultaneous differential equations, Total differential equations.

Module 2: Equations of Higher Order — **15 Hours**

Second order linear differential equations, General solution of higher order ODE with constant coefficients, Linear equations with variable coefficients, Solution of the homogeneous equation, Wronskian and linear independence, Reduction of order of a homogeneous equation, Non homogeneous equation.

Module 3: Power series solutions — **15 Hours**

Solution of homogeneous equations with analytic coefficients, Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties

Module 4: Boundary Value Problems for Second Order Equations — **15 Hours**

Ordinary Differential Equations of the Strum-Liouville type and their properties, Application to Boundary Value Problems, Eigen values and Eigen functions, Orthogonality of characteristic function. Expansion theorem, Green's function for Ordinary Differential Equations, Application to Boundary Value Problems.

Total Lecture hours — **60 Hours**

Text Book(s)

1. Ross S. L., Differential Equations, John Willey and Sons, Inc. (1984)
2. Simmons, G.F., Differential Equations with Applications and Historical Notes (Ebook), CRC Press, London (2017)
3. Agarwal Ravi P., O' Regan D., Ordinary and Partial Differential Equations (Ebook), Springer (2009)

Reference Books	
1.	Ahmad S., Ambrosetti A., A Textbook on Ordinary Differential Equations (Ebook, 2nd Edition), Springer (2015)
2.	Tenenbaum M., Pollard H., Ordinary Differential Equations (Ebook), Dover Publications, Inc. (1963)

MMA23505P	ODE LAB (MATLAB)	L	T	P	C
		1	0	2	2

Pre-requisite: Basic computer knowledge

Course Objectives:

- To impart the knowledge to the students with MATLAB software.
- To enhance programming knowledge in Research and Development.

Course Outcome:

After successful completion of the course, the students will be able to

CO 1: use basic commands of MATLAB

CO 2: understand the basics functions of MATLAB

CO 3: plot the 2D, 3D figures for functions and solutions of differential equations

Module 1: Introduction to MATLAB	**10 Hours**

Components of a computer, Working with numbers, Machine code, Software hierarchy, Introduction to MATLAB window, A first Program, Expressions, Constants, Variables and assignment statements, Arrays, Matrix operation (addition, multiplication, inverse, transpose).

Module 2: Graph Plots	**10 Hours**

Plotting of graphs: functions, polynomials, parametric curves, surfaces of revolution, conics in Cartesian and polar coordinates, Plotting of first and second order solution family of differential equations

Module 3: Essential Ordinary Differential Equations	**20 Hours**

Solution of some simple ODEs, Plotting of second order solution family of differential equation, Plotting of third order solution family of differential equation, Second order linear homogeneous ODE with constant coefficients

Module 4: IVPs and BVPs	**20 Hours**

Numerical methods for IVPs, Solution of homogeneous equations, Solution of some BVPs

Total Lecture + Practical Hours	**60 Hours**

Text Book(s)

1.	https://www.mathworks.com/moler/chapters.html

MMA23230T	BASIC STATISTICS	L	T	P	C
		3	0	0	3

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

- To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness.
- To render the students to several examples and exercises those blend their everyday experiences with their scientific interests.

Course Outcome:

After successful completion of the course, the students will be able to

CO 1: learn about probability and moment generating functions.

CO 2: know about various distributions such as Binomial, Poisson and Normal distributions.

CO 3: 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.

Module 1: Introduction to Probability	**10 Hours**

Random experiment, Sample space, Events, Definition of probability and examples, Addition law of probability, Conditional probability, Baye's Theorem

Module 2: Random Variable	**10 Hours**

Random Variable, Probability distribution: Discrete and Continuous, Mean and Variance of probability distribution, Binomial distribution, Poisson's and Normal distribution

Module 3: Introduction to Statistics	**10 Hours**

Measures of central Tendency, Measures of dispersion, Moments and moment generating function, Skewness and Kurtosis

Module 4: Bivariate Data	**15 Hours**

Bivariate data: Definition, Scatter diagram, Simple and multiple correlation, Rank correlation, Simple linear Regression, Lines of regression, Principle of least squares and fitting of straight lines.

Total Lecture hours	**45 hours**

Text Book(s)

1. Hogg R. V., McKean J.W., & Craig A. T., Introduction to Mathematical Statistics (7th ed.). Pearson Education, Inc., (2013).
2. Miller I. & Miller M., John E. F., Mathematical Statistics with Applications (8th ed.), Pearson. Dorling Kindersley (India), (2014).
3. Ross S. M. Introduction to Probability Models (11th ed.). Elsevier Inc., (2014).

Reference Books

1. Mood, A. M., Graybill, F. A. & Boes, D. C., Introduction to the Theory of Statistics (3rd ed.). McGraw-Hill Education Pvt. Ltd. Indian Edition (2017)