Description of Courses offered by the Department of Mathematics

11031101 Calculus (1) 3 Credit Hours Prerequisite:- No

Functions, transformations, trigonometric functions, their limits, squeeze theorem, continuity, differentiation, its definition, chain rule, implicit differentiation, extrema and critical points, concavity and inflection points, sketching functions, integration, indefinite and definite integration, integration by substitution.

11031102 Calculus (2) 3 Credit Hours 11031101 Pre

Inverse functions; exponential, logarithmic, trigonometric, inverse trigonometric, hyprbolic and inverse hyperbolic functions; their derivatives and integrals, integration methods, improper integrals, applications of integration (areas, volumes, curves lengths and surface areas); introduction to sequences and series.

11031141 Statistics and probability 3 Credit Hours 11031101 Pre

Introduction to statistics, populations and samples, frequency distributions; measures of centrality, dispersion, skewness and kurtosis; correlation & regression; principles of probability, laws of addition and multiplication, total probability rule, Bayes rule, random variables, discrete and continuous probability distributions, binomial distribution, poisson distribution.

11031211 Foundations of mathematics 3 Credit Hours Prerequisite:- No

Logic: axioms, theorems, negation, _; set algebra: union, intersection, symmetric difference, difference, complement; functions: domain, range, one-to-one functions, onto functions, graphs, set relations: equivalence relations & classes, partial ordering relation, total order, number of elements of a set, finite sets, countable sets, uncountable sets.

11031221 Linear Algebra (1) 3 Credit Hours 11031101 Pre

System of linear equations, matrices, matrix algebra, homogeneous and nonhomogeneous systems, Gaussian elimination, elementary matrices, inverse matrix calculation, determinants, Euclidean vector space, linear transformations from $R^n$to $R^m$and properties, general vector space, vector subspace, base, dimension, matrix row space, column space & null space; matrix rank, inner product space, eigenvalues and eigenvectors, matrix diagonalization

11032103 Calculus (3) 3 Credit Hours 11031102 Pre

3 dimensional space, vectors, lines and planes, functions of several variables, partial derivatives and applications, multiple integrals and applications

11032212	**Number theory**	**3 Credit Hours**	**11031211 Pre**

Division algorithm, divisibility, greatest common factor, least common multiple, Diophantine equations, prime numbers and their distribution, fundamental theorem of arithmetic, congruence relations, linear congruence equations, Chinese remainder theorem, divisibility tests, Fermat's little theorem, Wilson's theorem, arithmetic functions, cryptography.

11032164	**Ordinary differential equations**	**3 Credit Hours**	**11031102 Pre**

Classification, solving 1st order, 2nd order and higher order equations, applications in mechanics and physics, Laplace method, power series solution, regular and irregular singular points, linear and nonlinear equations, homogeneous and nonhomogeneous equations

11032242	**Probability theory**	**3 Credit Hours**	**11032103 Pre** **11031141 Pre**

Introduction, samples space, events, probability of an event, probability laws, conditional probability, independent events, Bayes Theorem, probability distribution, discrete and continuous random variables, probability density function, multivariate distributions, marginal distribution, joint distribution, expected value, moments, moment generating function, uniform discrete distribution, binomial distribution, Poisson distribution, normal distribution, functions of random variables

11032222	**Linear algebra (2)**	**3 Credit Hours**	**11031221 Pre**

General vector space, row space, column space, null space, rank and nullity, change of basis, eigenvalues and eigenvectors, similar matrices and diagonalization, orthogonal diagonal matrices, The diagonalization of symmetric matrices, general linear transformations, kernel and range, inverse linear transformations, matrices of general linear transformations, quadratic forms, diagonalization of quadratic forms, classification of quadratic forms, curves and surfaces.

11032261	**Numerical analysis (1)**	**3 Credit Hours**	**11031101 Pre** **11031211 Pre**

Introduction to computational errors and their sources, solutions of nonlinear equations, interpolation theory, curve fitting and differences, function approximation, solution of linear systems by direct and indirect methods

11032131	**Euclidean and non-Euclidean geometry**	**3 Credit Hours**	**None**

Axiomatic systems: consistency, independence and completeness, finite projective geometry, paradoxes of Euclidean geometry, the postulates of connection, distance, angles and angle measurement, congruence postulate, parallel postulate, plane-separation postulate, space-separation theorem, Pasch theorem, similarity, Pythagorean theorem, theorems of Ceva and Menelous, Erdös theorem, circles, circle theorems, cyclic quadrilaterals, Simson line, nine point circle, lines and planes in space

11033104	**Advanced Calculus**	**3 Credit Hours**	**11032103 Pre**

Directional derivative, gradient, divergence, curl, curvilinear coordinates, vector integral calculus, path integral, surface integral, volume integral, Green's theorem, Stoke's theorem, divergence theorem, implicit function theorem, inverse function theorem.

11033265	**Partial differential equations**	**3 Credit Hours**	**11032164 Pre**

Classification, models in physics, heat equation, wave equation, Laplace equation, separation of variables, Sturm-Louisville BVP, Fourier series and integration, Fourier transformation, homogeneous and nonhomogeneous problems, infinite domain problems, BVP on rectangular and circular domains, special functions, Bessel and Legendre functions, BVP on cylindrical and spherical domains.

11032251	**Real analysis (1)**	**3 Credit Hours**	**11031102 Pre** **11031211 Pre**

The completeness property of R. The Archimedes principle in R; limit of a sequence, Cauchy sequences, convergent sequences, monotone sequences, subsequences and limit points, Bolzano--Weierstrass theorem, open sets, bounded sets and compact sets in R. Limits of real valued functions, sequence definition and neighborhood definition of continuity, boundedness of continuous functions on compact intervals, the extreme value theorem, the intermediate value theorem. uniformly continuous functions, the sequential criterion for uniform continuity, the derivative of functions, Rolle's theorem, the mean value theorem. generalized mean value theorem. Taylor's theorem with remainder, l' Hospital's rule.

11033152	**Complex analysis**	**3 Credit Hours**	**11032103 Pre** **11032251 Pre**

The structure of complex numbers, definition, geometric meaning, polar form, Euler's formula, powers and roots of complex numbers, complex plane, complex functions, examples, limits, continuity, derivatives, Cauchy-Reimann equations, analytic functions, definition and properties. Harmonic functions (definition and basic properties). Elementary complex valued functions (exponential, trigonometric, hyperbolic, and logarithmic functions: their definitions and basic properties and inverse functions). Branches of logarithmic functions. Contours and contour integration. The Cauchy-Goursat theorem. Simply and multiply connected regions. The Cauchy integral formula.

11033162	**Numerical analysis (2)**	**3 Credit Hours**	**11032261 Pre**

Numerical integration and differentiation, methods to solve ordinary and partial differential equations, numerical methods to find eigenvalues.

11033243 Mathematical statistics 3 Credit Hours 11032242 Pre

The uniform, gamma exponential, chi-square and beta distributions, the normal approximation to the binomial distribution, distribution function technique, transformation technique (one variable, two variable), moment-generating function technique, the distribution of the mean: finite populations, the t-distribution, the F-distribution, point estimate, unbiased estimate, consistent estimate, sufficient estimate, the method of moments, the method of maximum likelihood, confidence intervals for: means, difference between means, proportions, difference between proportions, variance, ratio of variances, testing of statistical hypothesis, tests concerning means; differences between means, variances, proportions.

11034123 Abstract algebra (1) 3 Credit Hours 11032212 Pre

Groups and subgroups, cyclic groups, permutation groups, isomorphism's of groups, direct product of groups, cosets and Lagrange's theorem, normal subgroups and factor groups, homomorphisms of groups, the first isomorphism theorem, rings, subrings, integral domain, factor ring, and ideals.

11033232 General Topology (1) 3 Credit Hours 11031211 Pre

Topological spaces; open sets; boundary; interior; accumulation points; topologies induced by functions; subspace topology; bases and subbases; finite products; continuous functions; open and closed functions, homeomorphisms; separation axioms, countability axioms; metric spaces, connectedness and continuity.

11033166 Linear programming and applications 3 Credit Hours 11032222 Pre

Foundations of linear programming, the simplex method, the geometry of the simplex method, duality in linear programming, the dual simplex method, sensitivity analysis, introduction to graphs, networks and network flows.

11034163 Mathematical modeling 3 Credit Hours 11032222 Pre

MATLAB software, frontend, variables, data types, single and multidimensional matrices, programming scripts, functions, _, curves, 2d and 3d plots, conditional statements, loop statements, advanced topics in MATLAB.

11033253 Real analysis (2) 3 Credit Hours 11032251 Pre

Functions of bounded variation, total variation, Riemann integral, definition, existence, basic properties, types of Riemann integrable functions (step functions, continuous functions, monotone functions), the mean value theorems for Riemann integral, the fundamental theorem of calculus, the Riemann-Stieltjes integral, definition, basic properties, integration by parts, integrability of continuous functions and monotone functions, the fundamental theorem for Riemann-Stieltjes integral, the mean value theorem, linear transformations on R^n and their matrix representation (fast revision), functions from R^n to R^m (basic setup and examples), derrivatives of vector valued functions of several variables, directional derivatives, point and uniform limits of functions sequences and series, power series

11034224 Abstract algebra (2) 3 Credit Hours 11034123 Pre

Rings, subrings, integral domains, factor rings and ideals, ring homomorphisms, polynomial rings; factorization of polynomials, reducibility and irreducibility tests, divisibility in integral domains, principal ideal domains and unique factorization domains

11034144 Applied statistics 3 Credit Hours 11033243 Pre

sampling distribution, chi-square tests, variation analysis, linear regression, nonparametric tests

11034167 Applied Mathematics 3 Credit Hours 11033265 Pre

Ordinary differential equations review (first order ODEs and higher order ODEs, methods of solution), boundary value problems (Sturm- Liouville Problem), solution of differnetial equations using power series, Frobenius method, Fourier series, Fourier coefficients, convergence of Fourier series, applications, Fourier sine and cosine series , Fourier integrals, solutions of vibrating string equation, Laplace equation and the heat equation using Fourier series

11034291 Graduation project 3 Credit Hours Department approval

The student writes and discuss a research on a topic determined by the supervisor that provides a solution to a real problem, or a service to the community. It is not necessary that the research idea be new.

11033225 Matrix theory 3 Credit Hours 11031221 Pre

Kronecker product of matrices, matrix functions, matrix equations, matrix differential equations, eigenvalues and eigenvectors, the characteristic polynomial, the minimal polynomial, Cayley-Hamilton theorem, canonical forms, Gershgorin's discs, strictly diagonally dominant matrices, Hermitian and unitary matrices, Schur's triangularization theorem, spectral theorem for normal matrices, positive semidefinite matrices, quadratic forms, polar decomposition and singular value decomposition, Moore-Penrose generalized inverse; matrix norms, QR factorization

11033254 Special functions 3 Credit Hours 11032164 Pre

Fobenious method, Frobenious and Laplace transformations, gamma function, beta function, relationship between gamma and beta functions, Bessel function; Legendre, Hermite, Laguerrre, Jacobi and Chebychev Polynomials

11034171 History of mathematics 3 Credit Hours 4th level

Evolution of some mathematical concepts, facts and algorithms in arithmetic, algebra, trigonometry, Euclidean geometry, analytic geometry and calculus through the early civilizations of Egyptians, Babylonians, Greeks, Indians, Chinese, Muslims and Europeans; evolution of solutions of some conjectures and open problems.

11033168 Graph theory 3 Credit Hours 11031211 Pre

Counting methods (inclusion-exclusion principle, recurrence relations) basic concepts in graph theory, vertices, edges, vertex degree, _, directed graphs, undirected graphs, complete graphs, paths, cycles, connected graphs, Euler's and Hamilton's paths, matrix representation of graphs, trees, graph coloring, shortest path algorithm, maximum flow algorithm

11034233 General Topology (2) 3 Credit Hours 11033232 Pre

Separation axioms T2, T3, T4 and some examples and theorems related to them, compact spaces and some related theorems, connected spaces and some related theorems, metric spaces and some related examples and theorems, sequences and their convergence in topological spaces

11034155 Functional analysis 3 Credit Hours 11033253 Pre

Norms on vector spaces, examples of norms, relationship between norms and metrics on vector spaces, sequences in normed spaces, convergence of sequences in normed spaces (strong convergence), complete normed spaces, examples of complete normed spaces, finite dimensional normed spaces, Banach spaces, Hilbert spaces, compactness, Hahn-Banach theorem, finite dimensional normed spaces, compactness of the unit ball in normed spaces, linear operators on Normed spaces. continuous linear operators, bounded linear operators, norms on bounded linear operators