B.Sc. in Mathematics

Study Plan

▪ University Compulsory Courses — 16 C.H

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▪ University Elective Courses — 9 C.H

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▪ Faculty Compulsory Courses — 19 C.H

Line No.	Code	Course	
901010	MATH101	CALCULUS(I)	3
901020	MATH102	CALCULUS (2)	3
901310	MATH131	ELEMENTS OF STATISTICS	3
921010	PHY101	GENERAL PHYSICS (1)	3
921020	PHY102	GENERAL PHYSICS (2)	3
921072	PHY107B	GENERAL PHYSICS (LAB)	1
1721150	CS115	C++ PROGRAMMING .	3

▪ Department Compulsory Courses — 74 C.H

Line No.	Code	Course	
901400	MATH140	ELEMENTS OF LINEAR ALGEBRA	3
902010	MATH201	INTERMEDIATE ANALYSIS	3
902030	MATH203	ORDINARY DIFFERENTIAL EQUATIONS	3
902301	MATH230A	PROBABILITY THEORY	3
902400	MATH240	LINEAR ALGEBRA	3
902450	MATH245	SET THEORY AND LOGIC	3
902520	MATH252	MATHEMATICAL METHODS 1	3
902611	MATH261A	EUCLIDEAN & NON-EUCLIDEAN GEOMETRY	3
903011	MATH301A	ADVANCED CALCULUS	3
903050	MATH305	INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS	3
903071	MATH307A	REAL ANALYSIS (1)	3
903081	MATH308A	COMPLEX ANALYSIS	3
903211	MATH321A	NUMERICAL ANALYSIS (1)	3
903300	MATH330	MATHEMATICAL STATISTICS	3
903311	MATH331A	STATISTICAL METHODS(1)	3
903420	MATH342	ABSTRACT ALGEBRA (1)	3
903620	MATH362	TOPOLOGY (1)	3
903711	MATH371A	LINEAR PROGRAMMING AND APPLICATIONS	3
903950	MATH395	MATHEMATICAL COMPUTER APPLICATIONS	2
904070	MATH407	REAL ANALYSIS (2)	3
904211	MATH421A	NUMERICAL ANALYSIS (2)	3
904420	MATH442	ABSTRACT ALGEBRA (2)	3
904700	MATH470	PROBABILISTIC MODEIS IN OPERATIONS RESEARCH	3
904750	MATH475	ELEMENTS OF OPTIMIZATION THEORY.	3
904921	MATH492A	RESEARCH IN APPLIED MATHEMATICS	1
904931	MATH493A	METHODS OF TEACHING MATHEMATICS	2

▪ Department Elective Courses — 12 C.H

Line No.	Code	Course	
903320	MATH332	SAMPLING TECHNIQUES	3
903390	MATH339	TIME SERIES	3
903450	MATH345	NUMBER THEORY	3
903500	MATH350	MATHEMATICAL MODELS	3
903521	MATH352A	MATHEMATICAL METHODS (2)	3
903930	MATH393	HISTORY OF MATHEMATICS	3
904230	MATH423	APPROXIMATION THEORY.	3
904311	MATH431A	STATISTICAL METHODS	3
904450	MATH445	APPLIED LINEAR ALGEBRA	3
904540	MATH454	MODELING AND SIMULATION	3
904621	MATH462A	TOPOLOGY (2)	3
904910	MATH491	SPECIAL TOPICS IN APPLIED MATHEMATICS.	3
1732110	CS211	DATA STRUCURE AND SYSTEMS	3
1732150	CS215	SELECTED PROGRAMMING LANGUAGE	3
1732820	CS282	COMPUTAION THEORY	3
1732840	CS284	COMPUTER ALGORITHMS	3
1733120	CS312	OBJECT ORIENTED PROGRAMMING	3
1733170	CS317	FUNDAMENTALS OF PROGRAMMING LANGUAGES	3
1734100	CS410	VISUAL PROGRAMMING LANGUAGES	3
1743100	CIs310	SOFTWARE ENGINEERING	3
1743400	CIs340	WEB APPLICATION DEVELOPMENT	3
1743401	CIs340	WEB APPLICATION DEVELOPMENT (LAB)	0
1743820	CIs382	FUNDEMENTALS OF MULTIMEDIA	3

TOTAL — 130 C.H

**** For prerequisite & equivalent courses see the Courses' Description.***

B.Sc. in Mathematics

Courses' Description

Math 101 Calculus I 3 C.H
Limits and continuity and their applications:, chain rule, Implicit differentiation, related rates, increase decrease, concavity. Extrema. Newton's method, Roll's theorem, Mean-Value Theorem, definite and indefinite integrations, fundamental theorem of calculus, Area and volume, inverse functions, Exponential and logarithmic functions with their derivatives . conic sections.

Math 102 Calculus II 3 C.H
Inverse trigonometric and hyperbolic functions. Techniques of integration, by parts, trigonometric integrals, trigonometric substitutions, partial fractions, quadratic expressions, general substitutions.Numerical integration(Sympson's rule). Improper integrals. Infinite series, convergence and divergence, convergence tests, Maclaurin and Taylor seies. Polar coordinates: definition, arc length , area, conic sections.

Math 102A Calculus (For Bio. Sci. Students) 3 C.H
Introduction, Exponential and logarithmic functions, trigonometric functions, techniques of integration, definite integral and its application. Introduction to differential equations. *(Prereq. Math. 101)*

Math 131 Elements of Statistics 3 C.H
Presentation and description of statistical data. Probability: concept of probability, probability rules. Random variables and probability distributions, expectation, Binomial distribution, Poisson distribution, Normal distribution. Sampling distributions, t-distribution, CLT. Estimation, point and interval estimation for normal population mean and the difference of two population means. Testing hypotheses, the z-test, the t-test, testing the difference between two means (small and large sample sizes). Correlation and simple linear regression, residuals analysis, interval estimation of regression parameters.

Math 140 Elements of Linear Algebra (1) 3 C.H
Matrices, basic algebraic operations, reduced forms, rank and inverse solutions of systems of linear equations. Determinants and their properties. Vector spaces, subspaces, intersection and sum of subspaces, linear independence, spanning set, bases and dimension, line transformations and matrices of linear transformations, eigenvalues and eigenvectors. *(Prereq. Math 101)*

Math 141 Liner Algebra 3 C.H
Complex numbers, vector spaces and subspaces, linear independence. Matrices, determinants, solution of linear equation, eigenvalues and eigenvectors. Software to solve linear equations and to find eigenvalues and eigenvectors. *(Prereq. Math 101)*

Math 201 Intermediate Analysis 3 C.H
Quadratic surfaces, vectors, lines, planes, vector valued functions. Functions of several variables, partial differentiation. Multiple and triple integration, applications, line integral, surface integral. Vector fields, Green's Theorem, Gauss Theorem, and Stokes Theorem. (*Prereq. Math 102)*

Math 203 Ordinary Differential Equations 3 C.H
Introductions, classification, first order differential equations, applications. Differential equations of higher order and their solutions. Applications, solutions by series near ordinary points, Solving IVPS using Laplace transform. linear systems of differential equations. *(Prereq. Math.102)*

Math 230 Probability Theory 3 C.H
Definition and axioms of probability, some probability theorems, conditional probability and independence. Random variables, probability distributions, expectation, some discrete and continuous distributions,. Joint distributions, marginal and conditional distributions, distributions of functions of random variables: the cumulative distribution function method, moment generating function method, Jacobian method, sampling distributions, limiting distributions. *(Prereq. Math 131+ Math 201)*

Math 233 Probability 3 C.H
(For Computer Science Students)
Introduction to probability, rules of probability, counting techniques, permutations and combinations, probability using counting techniques, random variables, some discrete and continuous distributions. expectation, moment generating function, distributions of functions of random variables, generating random numbers from uniform distribution, generating random numbers from nonuniform distributions, using the generated random numbers on some simulation methods. *(Prereq. Math 131+ Math 102)*

Math 235 Probability and Statistics 3 C.H
(For Engineering Students)
Descriptive statistics, Probability; axioms of probability, rules of probability, conditional probability, independence. Discrete and continuous random variables, expectation, probability distributions. Sampling distributions; t and Chi square and F distributions, CLT. Point estimation: for mean and variance, the difference between two means and the ratio of two variances, testing hypotheses for small, large and dependant samples, correlation, simple linear and multiple regression. Goodness of fit tests. *(Prereq. NONE)*

Math 240 Linear Algebra 3 C.H
Diagonalization of linear transformations. Invariant subspaces and the Cayley Hamilton Theorem, Inner product spaces, positive def. Matrices, Hessian matrix, Quadratic forms, Jordan form. (*Prereq. Math.140)*

Math 241 Discrete Mathematics 3 C.H
Introduction to discrete mathematical structures that form the basis for computing. Sets, functions and sequences. Propositional calculus, formal proofs, quantifiers, predicted calculus, mathematical induction. Matrices, groups, semigroups, homomorphism and isomorphism. Relations, partitions, equivalence relations, trees, directed and undirected graphs. *(Prereq. Math 102)*

Math 245 Set Theory and Logic 3 C.H
Logic: propositional calculus, quantifiers, postulates and theorems of Boolean Algebra. Set theory: functions and relations, order relations, partial order, maximal element, total order, chains, equivalence relation, equivalence classes, maximal principle, cardinal number, ordinal numbers, well order, the Zorn's lemma, axiom of choice. *(Prereq. Math 102)*

Math 252 Mathematical Methods (1) 3 C.H
Laplace transforms: definition, properties, inverse Laplace transform, solving IVP's, Laplace transforms and special functions, convolution, impulses and the Dirac Delta functions. Special functions: Gamma, Beta, Error,

trigonometric series, periodic extension and convergence, Fourier series, convergence of fourier series, Integration and differentiation of Fourier series, conditions for the uniform of a Fourier series. Fourier transform, integral Fourier transform. Fourier sine and cosine transforms, applications to Fourier transform *(Prereq. Math 201+Math 203)*

Math 261 Euclidean and Non-Euclidean Geometry 3 C.H

Mathematical axiomatic structure, history of Eucledis geometry and its defects. Hilbrert's axioms for Euclidean geometry, Non Euclidean geometry: history and axioms with special study of hyperbolic geometry. *(Prereq. Math 245)*

Math 301 Advanced Calculus

Vector Calculus: Vector fields, line integral, Green's theorem, surface integral, Stokes' theorem, divergence (Gauss) theorem. Coordinate systems of R^3. The Jacobian , Topology of R^n: Open sets, closed sets, cluster points, boundedness, Bolzano – Weierstrass theorem, compactness, Heine-Borel theorem. Connectedness. Sequences of Real Numbers: Sequences and their limits, limit theorems, monotone sequences, subsequences and the Bolzano-Weierstrass theorem, Cauchy sequences, properly divergent sequences.Series of Real Numbers: Convergence, tests of convergence, power series, Taylor series, Abel's theorem. Sequences and Series of Several Variables: Convergence, tests of convergence, double series.

Math 305 Introduction to Partial Differential Equations 3 C.H

First order equations and their solutions, second order equations and classification into canonical forms (parabolic, elliptic, and hyperbolic), characteristics. Solution of second order equations using differential operators. Fourier series. Solution of BVP in rectangular coordinates using separation of variables. *(Prereq. Math 252)*

Math 307 Real Analysis (1) 3 C.H

Limits: Limits of functions, limits of functions and sequences, algebra of limits, limits of monotone functions, limits at infinity and infinite limits. Continuous Functions: Continuous functions, algebra of continuous functions, continuous functions on intervals, uniform continuity, monotone and inverse functions. Differentiation: The derivative of a function, algebra of derivatives, the Mean Value Theorem, L'Hospitals rule and the inverse function theorem, Taylor's Theorem. The Riemann Integral: Riemann integral, classes of Riemann integrable functions, the Fundamental Theorem of Calculus, algebra of integrable functions, derivatives of integrals, mean-value theorem and change of variable theorem. Approximate integration.

Math 308 Complex Analysis 3 C.H

The Complex numbers system, polar representation and complex root analytic functions, power series, mobius transformation, conformal mapping. Complex integration, power series representation of analytic functions, residues, Cauchy's Theorem, application to integration simple closed curves, Cauchy's integral formula, Morera's Theorem, singularities, classification and remainder. *(Prereq. Math 201)*

Math 321 Numerical Analysis (1) 3 C.H

Introduction to computational errors and their sources, solutions of non- linear equations, interpolation theory, curve fitting and differences, approximation of functions, solution of linear systems by direct and indirect methods. *(Prereq. CS113)*

Math 330 Mathematical Statistics 3 C.H

The concept of statistical inference, estimation, point estimation, methods of estimation; moments, MLE, least squares estimates, properties of estimators, unbiased estimators, sufficient statistics, complete statistics, Fisher information criteria, Rao-Cramer inequality, exponential family distributions, interval estimation, testing of hypotheses, the Neyman-Pearson lemma, uniformly most powerful tests, likelihood ratio tests. *(Prereq. Math 230)*

Math 331 Statistical Methods (1) 3 C.H

Simple linear regression: estimation and inference, prediction, residual analysis, multiple regression, estimation and statistical inference, criteria for choosing best model. The concept and applications of experimental design, randomized designs. *(Prereq. Math 330*)

Math 332 Sampling Techniques 3 C.H

Elements of the sampling problem, simple random sampling, stratified sampling, ratio estimation, regression and difference, systematic sampling, cluster sampling. Estimating the populations size. *(Prereq. Math 230*)

Math 339 Time Series Analysis 3 C.H

Introduction to time series analysis. Some descriptive techniques to analyze time series components, autocorrelation function, probability models of time series, (ARMA) models, estimation and model identification, prediction, spectral analysis, bivariate processes. *(Prereq. Math 230)*

Math 342 Abstract Algebra 1 3 C.H

Group theory, basic structure of groups, subgroups and cyclic subgroups, normal subgroups, quotients groups, homomorphism, automorphisms, Cayley's Theorem, permutation groups, Sylow's Theorem. External and internal direct products. Cosets and Lagrange's Theorem. *(Prereq. Math 245)*

Math 345 Number Theory 3 C.H

Natural numbers: properties, classifications, congruence, residue classes, Euler's Theorem, Ferma Theorem, quadratic residues, Diophautine equations, numerical functions. *(Prereq. Math 245)*

Math 350 Mathematical Models 3 C.H

This course investigates the process of translating real world problems into mathematical models. *(Prereq. Math230+Math 252)*

Math 352 Mathematical Methods (2) 3 C .H

Series solutions near regular singular points, legendre and associated Legendre functions, Frobenius method and its extension, Bessel functions, representation of functions using orthogonal systems, expansions in terms of Bessel functions, orthogonal polynomials. Systems of DE's. Basic concepts and theory, homogeneous linear systems with constant coefficients, phase plane, critical points, stability, phase plane methods for nonlinear systems, non homogeneous linear systems. *(Prereq. Math 252)*

Math 362 Topology (1) 3 C.H

An Introduction to the basic ideas and methods of point set topology. Topological spaces: definition, basis, subbases, product spaces, continuous functions, separation axioms: Housedorf, regular and normal

spaces, compactness, connectedness, first and second countable spaces, metric space. (*Prereq. Math 245)*

Math 371 Linear Programming 3 C.H
Linear programming problem formulation. Simplex method including Big-M, two-phase, revised and dual simplex. Theory of linear programming, duality and postoptimality analysis, transportation, goal programming, networks analysis. *(Prereq. Math.240)*

Math 393 History of Mathematics 3 C.H
Study of the historic development of mathematics through different epochs and civilizations: Egyptians, Babylonian, Greek, Indian, Chinese, and Islamic. More attention is paid to concept development and to Islamic mathematics.

Math 395 Computer Mathematical Applications 2C.H
Several mathematical Sofware and applied in different mathematical areas like calculus , numerical analysis, differential equations, (*Prereq. Instructor consent)*

Math 407 Real Analysis (2) 3 C.H
Sequences and Series of Functions: Poitwise and uniform convergence, interchange of limits, uniform convergence of power series, the exponential function, the logarithmic and trigonometric functions.Differentiation in R^n: The derivative of functions from R^m to R^n, the Jacobian, chain rule, Mean Value Theorem, interchange of the order of differentiation, higher derivatives, Taylor's Theorem. Mapping Theorems and Implicit Functions: Injective mapping theorem, surjective mapping theorem, open mapping theorem, inverse function theorem, implicit function theorem. Extremum Problems: Relative extrema, second derivative test, extremum problems with constraints, Lagrange's theorem (of multipliers), inequality constraints. Integration in R^n: Content of a set, Riemann sums and the integral, Cauchy criterion, properties of the integral, integrability theorem, sets with content, the content function, properties of the integral, the mean value theorem for integrals, iterated integral, Fubbini's theorem.

Math 421 Numerical Analysis (2) 3 C.H
Numerical integration and differentiation, different numerical methods for the solution of ODE's and PDE's, numerical methods for finding the eigenvalues. *(Prereq. Math 321)*

Math 423 Approximation Theory 3 C.H
Normal liner space, General existence and uniqueness of approximations. Uniform approximation: Weierstrass approximation theorems. Algebraic polynomial of best approximation. Tchebysheff's approximations. Jackson's theorems. Bernsteins theorems. Approximations by means of Foruier series. *(Prereq. Math.307+Math 321*)

Math 431 Statistical Methods (2) 3 C.H
Completely randomized block design. Incomplete randomized block design. Latin squares design. Factorial designs. Nested designs. Nonparametic tests. *(Prereq. Math 331)*

Math 442 Abstract Algebra (2) 3 C.H
Rings, integral domains and fields, some non-commutative examples. The field of quotients of an integral domain, quotient rings and ideals. Prime and maximal ideals, homomorphisms, rings of polynomials. Division algorithm, ideal structure and unique factorization in the ring of polynomials over a field and the ring of Gaussian integers, field extensions. Algebraic elements and their irreducible polynomials. *(Prereq. Math 342)*

Math 445 Applied Linear Algebra 3 C.H
QR factorization, Householder and given rotations. Least squares solutions and singular value decomposition. Classical Jacobian method, Cyclic Jacobian method, fast given, QR and QZ methods. Steepest descent, conjugate gradient iterations, Chebysheve iterations GRMRES methods. Lanczos iterative schemes. *(Prereq. Math 321)*

Math 454 Modeling and Simulation 3 C.H
The fundamental systems concept and modeling methodology. Input analysis: collecting data, hypothesizing a distribution, estimation of parameters, goodness of fit. Random numbers generation. Transient and steady state simulation. Simulation software, selected application. *(Prereq. Math 230)*

Math 462 Topology (2) 3 C.H
Local bases and first countable spaces. Sequences in topological spaces. second countable spaces. Separable spaces. Components and pathwise components in Rn, countably compact spaces, locally compact spaces metric spaces, metric topologies, equivalent metrics, continuity and uniform continuity of functions on metric spaces, compactness of metric spaces hompoopy. *(Prereq. Math 362)*

Math 470 Probabilistic Models in Operations Research 3 C.H
Markov Chains, Queuing theory and its application, inventory theory, Markovian decisions processes and applications, Simulation. *(Prereq. Math 230+Math 371)*

Math 471 Elements of Stochastic Processes 3 C.H
Stochastic modeling, Markov Chains, some special Markov Chain models, the long run behavior of Markov Chains. Poisson processes. Some continuous time Markov Chains (pure birth and death processes). simple queuing systems. *(Prereq. Math 230)*

Math 475 Elements of Optimization Theory 3 C.H
Optimization fundamentals, unconstrained optimization, constrained optimization and Lagrange multipliers, some nonlinear programming algorithms. *(Prereq. Math 371)*

Math 476 Elements of Queuing Theory 3 C.H
Elements of queuing systems, single server queues, multiserver queues, applications. *(Perq. Math 230*)

Math 491 Special Topics in Applied Mathematics 3 C.H
The contents of this course is a topic in applied mathematics which is not covered by the courses offered in the department*. (Prereq. Dept. approval)*

Math 492 Research in Applied Mathematics (1 cred.)
independent research project with faculty supervision worked by the students. *(Prereq. Dept. approval)*

Math 493 Methods of Teaching Mathematics 3 C.H
The student is taught an introduction in methods of teaching in general and how to teach mathematics subjects in particular. The student should apply his knowledge once or twice for first year students under the supervision of the instructor. (*Prereq. 4th year level*)