

LAHORE GARRISON UNIVERSITY, LAHORE



Scheme of Studies

BS Honors in Mathematics

8 Semesters / 4 Year Degree Program

Department of Mathematics

**Course descriptions for Bachelors of Science in Mathematics
Lahore Garrison University, Lahore**

Courses	Credits	Description	Reading List
Calculus – I	4	The Real Number System, Axioms, Existence of Irrational Numbers, The Real Line Inequalities, Functions Limits of Functions, Continuity, Derivability, Derivatives of Trigonometric, Inverse Trigonometric, Logarithmic, Exponential, Hyperbolic, Inverse Hyperbolic, Implicit Functions, Higher Derivates, Leibniz Theorem, Application, Rolle’s Theorem, Mean Value Theorem, Maclurin’s and Taylor’s Expansion series with the application, Cauchy’s Mean Value Theorem, Increasing and Decreasing Functions, Anti-Derivates, Integration by Substitution, Integration by Parts, Integration of Rational, Irrational, Trigonometric Functions, The Definite Integrals, and their Properties, Improper Integrals, Reduction Formulas	George B. Thomas, Calculus and Analytic Geometry. Dr. S. M. Yousaf and Muhammad Amin Ch, Calculus with Analytic Geometry Ilmi Kitab Khana Urdu Bazar Lahore.
Linear Algebra	4	Review of elementary concepts of Vector spaces. Linear dependence and independence of vectors. Vector spaces and subspaces. Quotient spaces. Direct sum of spaces. Linear transformation. Rank and Nullity of linear transformations. Algebra of linear transformations and representation of linear transformations as matrices. Change of bases. Inner product spaces. Vector and linear combination. Vector space. Subspace. Basis. Span. Orthogonality. Linear independence. Linear transformation. Eigenvalues. Eigenvectors.	S. Lang, Linear Algebra, Addison-Wesley K.H. Dar, First Step to Abstract Algebra, (2nd Edition 1998). Feroze Sons Pvt
Discrete Mathematics	3	logic and mathematical proof, set theory, relations, functions, matrices	Notes

		and systems of linear equations, Boolean algebras, sequences.	
Statistics – I	3	Introduction, descriptive statistics, basic concepts of probability, correlation, and linear regression, Meanings of Statistics, Main branches of Statistics, Meanings of Descriptive and Inferential Statistics, Population and Sample, Types of Variables, Description of data by frequency Tables and Graphs. Stem and Leaf display and Box Plots. Measures of central tendency: Arithmetic Mean, Mode, Median. Measures of Dispersion. Absolute and Relative Measures, Range, Variance, Standard Deviation. Properties of Variance and Standard Deviation with Proofs.	Chaudhry, S.M and Kamal, S. (2002). Introduction to Statistical Theory. Ilmi Kitab Khana, Urdu Bazar, Lahore.
English – I	3	Grammar, Letters, Parts of speech, Essay Writing etc.	High School English Grammar and Composition Book by H. Martin and P. C. Wren
Islamic Studies	2	Islamic Studies	--
Real Analysis - I	3	Algebraic and ordered properties of Real Numbers, Absolute values, Inequalities (Cauchy's, Minkowski's, Bernoulli's) Properties and concepts of supremum and infimum, Ordered sets, Fields, Field of Real, The extended real number system, Euclidean spaces, Sequences, Subsequences, Cauchy sequence, Series of Numbers and their convergence. The Comparison, Root, Ratio, and Integral tests. Absolute and Conditional convergence of infinite series. Limits and Continuity. Properties of continuous functions. Types of discontinuities. Differentiable functions. Mean-value theorems, Continuity of derivatives. Partial Derivatives and Differentiability. Derivative and differentials of Composite functions. The Directional Derivative, the	Kaplan W. Advance Calculus 1984 Addison-Wesley publishing Company

		Laplacian in polar cylindrical and Spherical coordinates.	
Physics – I	3	Kinematics, Two Dimensional kinematics, Laws of Motions, Further applications of Newton’s laws, Linear momentum and Collisions. Wave motion and Sound with Beats, Doppler Effect and its application, Bernoulli’s Equations, Applications, of Bernoulli’s Equation, Work-Energy Theorem, Radio waves, Microwaves, Principal of Laser, Characteristics, and use of laser, Principals and working of fiber optic, Advantages and Disadvantages, Computer Networks and Fiber Optic	Physics by R.H.K, 4th Edition
Accounting	3	Introduction to Accounting, Assets, Liabilities, Equity, Revenue, Income, Mortgage, Expenses, Credit, debit, balance sheet, ledgers.	Notes
Introduction to Computer	3	Computer Hardware, System Software, Windows, MS Office, Network and Security.	Notes
English – II	3	English Course	Notes
Pakistan Studies	2	Study of Pakistan	---
Set Theory	3	Equivalent sets, Countable and uncountable sets, The concept of cardinal number, Addition, and multiplication of cardinals, Cartesian products as sets of function, Addition, and multiplication of ordinals. Partially ordered sets axiom of choice, statement of the lemma.	Patrick Suppes, Axiomatic Set Theory, Dover Publications, Inc., New York.
Calculus - II	3	Tangents and Normal, Polar Coordinates Conic in Polar Coordinates, Relationship between Rectangular and polar system. Tangents and Normal in Cartesian and polar Coordinates, Parametric representation of Curve. Asymptotes (Rectangular and polar Curves) Maxima, Minima, , Lengths of Arcs, Intrinsic Equations, Curvature, Circle of Curvature, Distance of a point. Form a line, Equations for planes. The	George B. Thomas, Calculus And Analytic Geometry S.M. Yusuf and M. Amin, Calculus with Analytic Geometry, Ilmi Kitab Khana Urdu Bazar Lahore.

		angle between two planes. Shortest Distance between Two Straight Lines. Functions of Several Variables, Partial Derivatives. Homogeneous Functions, Differentials, tangent Plane, and the Normal Line. Extrema of Functions of two Variables. Double Integrals, Triple integrals Area and volume by double integrals, Volume and Area of Surface of Revaluation.	
Physics – II	3	Coulomb’s law. The electric field with different charges. Electric flux. Gauss’s law and its applications. Magnetic field. Magnetic flux. Faraday’s law and its applications. Ampere’s circuit law and its applications. Electromagnetic inductions. Motional electromotive force. Self-inductance with solenoid . R-l and R-C series circuit. Electromagnetic oscillators. (A-C and D-C) the voltage applied to “inductors and capacitors) Phaser concept. A sinusoidal voltage is applied to an (L-R, R-C, R-l-C) series circuit. Frequency response of (R-L-C) series circuits. Semiconductors with (P-Type and N-Type) material. Pn-Junction. Resistance. Capacitance. Inductance. Diodes. Rectifiers. Multi-vibrators. Logic-gates. Generators. Motors. Transformers.	Physics by R.H.K, 4th Edition and Notes
Software Package	3	Matrix Laboratory (MATLAB)	MATLAB Programming for Engineers Book by Stephen J. Chapman
English – III	3	English Course	Notes
Calculus - III	4	Scalars and vectors. Representation of Vectors. Types of vectors. Addition & Subtraction of Vectors. Properties of vector addition. Multiplication of a Vector by a Scalar. The unit vectors i, j, and k. Vector or Cross Product of two Vectors. Vectors Area of a Triangle. Product of three Vectors. Geometrical Interpretation of Scalar	Zill D G, Cullen M.R. Differential Equations with Boundary-Value Problems (3rd Edition), 1997, PWS Publishing Co. Muhammad Amin,

		Triple Product, Condition for four points to be Coplanar. Vector Triple Product, Scalar, and vector Products of Four Vectors. Scalar point function, Vector point function, Continuous Function, Differentiation of Vector Function. Geometrical Meaning of dr/dt . Derivative of a vector function in terms of its components. Integration of Vector Functions. Partial Derivatives and Differentials. Directional Derivatives.	Mathematical Methods, 2007, Ilmi Kitab Khana Lahore.
Algebra - I	3	Groups and subgroups. relations. Cyclic group, Cosets and Lagrange's theorem. Normalizers and centralizers. Center of a group. Subgroups. Factor groups, Isomorphism theorems, and automorphisms. Commutators. Permutation groups and Cayley's theorem, Introduction to Rings, Types of Rings, Integral domains. Field and its characteristics.	I.N., Herstein, Topics in Algebra, Addison-Wesley. J.B, Fraleigh, Abstract Algebra. Addison-Wesley. K.H. Dar, First Step to Abstract Algebra, (2nd edition 1998). Feroz Sons, 1998.
Affine and Euclidean Geometry	3	Linear and Affine subspace, Inner product and Euclidean Geometry, Classical Theorems in Affine Geometry, Menelaus, Ceva and Desargues Theorems, Orthogonal Transformation.	Notes
Scientific Computer Language	3	Dev-C++	Practical
Arabic (Language)	3	Arabic Course	---
Topology	3	The definition of metric and metric space, examples, balls, diameters, open & closed ball, open set & close-set. interior points and interior of a set, exterior points and exterior of a set, closure of a subset, limit points, neighborhood points, boundary points, sequences, and their convergence complete space, function as relations, topological spaces; subspaces and relative topology, open sets, closed sets, neighborhood, interior, exterior boundary and limit points, base and	G.F. Simon, Introduction to Topology and Modern Analysis, 1963, McGraw Hill Book Company, New York. A, Majeed, Elements of Topology and Functional Analysis, Ilmi Kitab Khana Lahore

		sub base.	
Differential Geometry	3	Curvature, Centre, Radius of Curvature, Formula for Radius of Curvature, Centre of Curvature, Curvature and Radius of Curvature in Polar Form, Tangent line, Normal line, Equation of tangent of a point, Normal plane, Equation of Normal plane, Oscillating plane or plane of Curvature, Torsion, Equation of the Centre of Curvature	R. Millman, and G. Parker. Elements of differential Geometry Prentice Hall Inc. And Notes
Algebra - II	3	Review of elementary concepts of vector spaces. Linear dependence and independence of vectors. Vector spaces and subspaces. Quotient spaces. Direct sum of spaces. Linear transformation. Rank and Nullity of linear transformations. Algebra of linear transformations and representation of linear transformations as matrices. Change of bases. Eigenvectors, eigenvalues. Diagonalization of Matrices. Inner product spaces.	S. Lang, Linear Algebra, Addison-Wesley. K.R. Hoffman, and Kunze, R., Linear Algebra Prentice –Hall.
Ordinary Differential Equation	3	Differential equations, Ordinary Differential equations, Partial Differential equations, General Solutions, Particular Solutions, Singular Solutions, Formations of differentials equations, First-order differentials equations, Initial Conditions, Boundary Conditions, Differential equations first order first degree, Differential equations first order the highest degree	Prof. Dr. Nawazish Ali Shah, Ordinary Differential quations, for Scientists and Erngineers.
Optimization Theory	3	Formal definition, Status of Optimization, Flow chart of Modeling process, Requirement of Optimization Algorithm, Types of Optimization, Constraints, Convex Function, Convex Optimization Problem, Matrix form of equations, Unconstraint Optimization problems, Newton Raphson Method (For	Gotfried B.S and Weisman, J. Introduction to Optimization Theory (Prentice-Inc. New Jersey,1973).

		unconstraint's Optimization), Lagrange Multiplier Method, Single Constraint, Multiple Constraints, Newton Raphson's Method of constraint optimization.	
Introduction To Economics	3	Economics Course	---
Classical Mechanics	3	Friction, Virtual Work, Kinematics, Rectilinear Motion, Motion of a Projectile, Orbital Motion, Composition of Forces, Centres of Mass and Gravity,	K .L. Mir, Theoretical Mechanics Ilmi Kitab Khan
Partial Differential Equation	3	Basic Concepts and Definitions, Formation and Classification of partial differential equations (PDEs). Partial differential equations of the first order. Nonlinear PDEs of the first order. Applications of first-order PDEs. Partial differential equations of second order: Mathematical formation of heat, Laplace and wave equations. Classification of second-order PDEs. Boundary and initial conditions. Characteristics. Method of Characteristics. Methods of separation of variables. Laplace, Fourier, and Henkel transform for the solution of PDEs and their application to boundary value problems.	Prof. Dr. Nawazish Ali Shah, Partial Differential quations, for Scientists and Erngineers.
Complex Analysis	3	Analytic functions, Cauchy-Riemann equations. Power series, Radius of convergence. Cauchy's theorem. Cauchy's integral formula and related theorems. Contour integration. Taylor's and Laurent's series. Analytic continuation. Residues, Residue theorem. Fundamental Theorem of Algebra. Application of calculus of residues to infinite products.	Notes

Real Analysis - II	3	<p>Functions of bounded variations. Point-wise and uniform convergence of sequences and series of functions, Uniform convergence, and continuity. Uniform Convergence and differentiation, Uniform Convergence and integration. Convergence of improper integrals. Implicit functions, Jacobians, Functional dependence. Maxima and minima of functions of two variables. Method of Lagrange Multipliers.</p>	Kaplan W. Advance Calculus (3rd edition) 1984 Addison-Wesley publishing Company
Mathematical Methods	3	<p>Laplace Transform, Linearity Property, First Shifting property, Second Shifting property, Inverse Laplace transform, Convolution for Laplace transformation, Convolution Theorem, Fourier Transform, Fourier Transform of Gaussian function, Attenuation property, Fourier Transformation derivatives of a function, Fourier Sine and Cosine Transform, Fourier Sine and Cosine, Transform of derivatives, Convolution form Fourier Transform</p>	S.M. Yousaf and M. Amin, Mathematical Methods, Ilmi Kitab Khana latest edition Urdu Bazar Lahore
Functional Analysis	3	<p>Metric Spaces Definition & examples, Open and closed sets, Convergences, Cauchy sequence and examples, completeness of a metric space, completeness proofs. Definition and examples of Normed spaces. Banach spaces. Convergence in Normed space. Basis of Normed Space. Convex sets. Quotient spaces. Equivalent Norms. Compact Normed space. Characterization of Banach spaces. Linear operators. Bounded linear operators, Various characterizations of bounded (continuous) Linear operators. The space of all bounded linear operators. Linear Functional and their examples. Dual Space and Reflexive space. Inner product spaces and their examples, The Cauchy-</p>	A. Majeed, Elements of Topology and Functional Analysis Ilmi Kitab Khana Lahore.

		Schwarz inequality. Polarization Identity. Hilbert spaces, Bessel's inequality. Gram-Schmidt orthogonalization process. Minimizing Vector. Direct Sum of spaces. The Riesz representation theorem. Annihilators and Orthogonal complements. Direct Decomposition.	
Numerical Analysis	4	Introduction, Study of various iterative methods to solve nonlinear equations, convergence and stability of bisection, false position, secant, Newton-Raphson and fixed-point methods, iterative methods, (Jacobi, Gauss-Seidel) and their convergence analysis, Trapezoidal Rule Simpson's Rules, Euler's Method, Improved Euler's Methods. Midpoint Formula.	Shan and Kuo, Computer Applications of Numerical Methods (Addison – Wesley) National Book Foundation, (1972), Islamabad
Number Theory	3	Divisibility, Division algorithm or Euclid theorem, Application of division algorithm, Mathematical induction, Greatest common divisor, Linear combination, Relatively prime, Alternative definition of G.C.D, Least common multiple, Alternative definition of L.C.M	Number Theory by Z.R. Bhatti
Graph Theory	3	Basic graph theoretical concepts: paths and cycles, connectivity, trees, spanning subgraphs, bipartite graphs, Hamiltonian and Euler cycles. Algorithms for shortest path and spanning trees. Matching theory. Planar graphs. Colouring, Flows in networks, the max-flow min-cut theorem. Random graphs.	Notes
Fuzzy Logic And Its Applications	3	Fuzzy sets with examples. Intersection, union, etc. of fuzzy sets. Cross product with examples. Level set, core, superset, etc. Properties of fuzzy sets. Fuzzy implication. Fuzzy relation. Composition. Max-min composition. Min-max	Notes

		composition	
Analytical Dynamics	3	Lagrange's equations, generalized coordinates, symmetries and conservation laws, variational methods, Hamilton's equations, phase space and Liouville's theorem, oscillations, rotation of rigid bodies.	Notes
Operations Research	3	Introduction, Brief History, Optimization Techniques. Transportation Problem. Simplex Method, The M-Method, and the Two-phase Technique for starting Optimization. Critical Path Method (CPM), Program Evaluation and Review Technique (PERT). methods include North –West Corner method. Least –cost method and Vogel's approximation. The Assignment model. Application to Networks. Shortest- Route Algorithm for acyclic and cyclic networks. Maximal-flow problems.	C. M Harvey, Operation Research, North Holland, New Delhi
Probability Theory	3	Interpretations of Probability. Experiments and events, Definition of probability, Finite sample spaces. Counting methods. The probability of a union of events. Independent events. Definition of conditional probability. Random variables. Continuous distributions. Probability function and probability density function. Variance, Moments. The mean and the median. Covariance and correlation.	I Introduction to Statistical Theory Part-1 and Part 2 by Prof. Sher Muhammad Chaudhary and Dr. Shahid Kamal.
Integral Equation	3	Integral Equations. Formulation and classification of integral equations.	Notes
Project	3	Topic "On The Solutions Of First And Second Order Non Linear Initial Value Problems"	---