

Minor Courses of Mathematics for all University Students.

Math-700 Mathematics for Postgraduate Students 4(4-0)

Basic set theory: sets, subsets, power set, algebra of sets, Venn diagram, intervals and related word problems; Sequence and series; A.P., G. P., H. P., nth term, sum of 1st n terms, means and applications. Binomial theorem, binomial series and its simple application. Matrices; algebra of matrices, determinants, inverse of a matrix; trigonometry: trigonometric identities, inverse trigonometric functions, finding heights, distances and widths using trigonometry and area of a triangle. Calculus and Analytic Geometry: division of a line segment, equation of a straight line and other standard curves, relations and functions, limit, continuity, differentiation, differentials; anti-derivation by standard results by substitution and by parts.

Books recommended:

1. Thomas, G.B. and R.L. Finney. 2002. 9th edition. Calculus and Analytical Geometry. Roohani Ar Press Islamabad.
2. Yusuf, S. M. and M. Amin. 2002. Mathematical Methods. Iimi Kitab Khana Kabir Street Urdu Bazaar, Lahore.
3. Yusuf, S. M. and M. Amin 2000. Calculus with Analytic Geometry. Iimi Kitab Khana, Kabir Street, Urdu Bazaar, Lahore.

Math-701 Introduction to Matrices and Numerical Analysis 3(3-0)

Matrices, vectors and their products (review), matrices as linear transformations, Rank of a matrix, linear independence and the four fundamental subspaces of a matrix, orthogonality and isometrics, the QR decomposition, eigenvalues and the spectral decomposition of symmetric matrices, the singular value decomposition and its applications, the conditioning of a matrix, least squares problems, algorithms for solving systems of linear equations and least squares problems, Iterative methods for solving linear systems and the methods of conjugate gradients. Solution of equation in one variable, applications: multivariate linear regression and principal component analysis, interpolation and polynomial approximation and approximation theory, Numerical solution of differential and difference equations.

Books Recommended:

1. Faires, B. 2009. Numerical Analysis. 7th edition Amazon Publishers.
2. Kreyzig, E. 2008. Advanced Engineering Mathematics. 7th edition. National Book Foundation Islamabad.
3. Strang G. Introduction to Linear Algebra, Ed. 4, Wellesley-Cambridge Press.
4. Trefethen L. N. and D. Bau, III, Numerical Linear Algebra, SIAM

Math-702 Mathematics for Economists 3(3-0)

Introduction, Applications of mathematics in economics, One variable calculus: relations, functions, polynomials, graphs, slope, limit and continuity, differentiation and extreme values. Linear algebra: modeling to linear equations, matrices, determinants, Euclidean space, linear independence and applications of system of linear equations. Calculus of several variables: limits and open sets, the chain

rule, directional derivatives, gradients, higher order derivatives. Optimization: quadratic forms and definite matrices, 2nd order conditions and convexity, unconstrained optimization, constrained optimization, homogenous and homothetic functions, concave and quasi-concave functions.

Books Recommended:

1. Chiang A. C. and K. Wainwright, 2005. Fundamental method of mathematical economics, 3rd edition. McGraw Hill.
2. Simon C. P., and L. Blume, 1994. Mathematics for Economists, Viva-Norton
3. Jacques, I. 2006 Mathematics for Economics and Business. Prentice Hall

Math-703 Operations Research 3(3-0)

Overview of operations research, linear programming: graphical method, Simplex method, Duality and sensitivity analysis ; transportation problem and its variants, network models: minimal spanning tree, shortest route problem and maximal flow problem; decision analysis and games, queuing systems and Markovian decision analysis.

Books Recommended:

1. Render, B., R., M. S. Jr. and M.E. Hanna 2005. Quantitative Analysis for Management, 8th edition, Prentice Hall of India, New Delhi
2. Taha, H. A. 2010. Operations Research: An Introduction. 9th edition. Prentice Hall.
3. Hiller, F. 2009. Introduction to Operations Research. 9th edition, McGraw Hill Science.

Math-704 Mathematics for Chemistry 3(3-0)

Basic set theory; limit and continuity, differentiation of algebraic, exponential and logarithmic functions, integration of algebraic, exponential and logarithmic function by different methods, modeling and solutions of differential equations and definite integration, partial fractions, application of derivative; extreme value of function and its variants, partial derivative with constrained variables, extreme values and saddle points, Langranges multipliers.

Books Recommended:

1. Kreyzig, E. 2009. Advanced Engineering Mathematics. 8th edition. John Wiley, New York.
2. Yusuf, S. M. and M. Amin 2002. Mathematical Method, Ilmi Kitab Khana, Kabir Stree Urdu Bazaar, Lahore.
3. Yusuf, S. M. and M. Amin 2000. Calculus with Analytic Geometry, Ilmi Kitab Khana, Kabir Street Urdu Bazaar, Lahore.

Math-705 Mathematical Statistics 3(3-0)

Interpretation of Probability, Experiments and events, Definition of probability. Definition of conditional probability. Bay's theorem. Random variables and discrete distributions. Functions of random variables. Continues distributions. Probability function and probability density function. Bivariate distributions. Marginal distributions. Some special Discrete and continuous probability distributions. Kolmogorov- Smirnov tests. The Wilcoxon Signed-ranks tests. The Wilcoxon-Mann-Whitney Ranks tests. Introduction to Bayesian statistics, Fundamentals of Bayesian Inference; Likelihood and prior, Bayes theorem Informative priors, conjugate priors, objective priors, Prior information, assigning prior distributions to parameters: Prior distributions, Methods of elicitation of

prior distributions, Posterior distributions: The posterior means, medians (Bayes estimators under loss functions) and variances of univariate and bivariate posterior distributions, Non informative priors: Methods of elicitation of non-informative priors, Bayesian Hypotheses Testing: Bayesian inference for discrete probability models. Bayesian inference for continuous probability models.

Books Recommended:

1. Berger, J. O. 1985. Statistical Decision Theory and Bayesian analysis, 2nd edition New York, Springer-Verlag.
2. Bernardo, J. M. and A. F. M. Smith. 1994. Bayesian Theory, John Wiley, New York.
3. Hogg, R. V, E.A. Tains and J.M Rao. 2005. Probability and Statistical Inference, 7th edition. Pearson Education New Delhi, India
4. Rohatgi, V. K. 2009. An Introduction to Probability and Statistics, 2nd edition John Wiley & Sons.
5. Lee, P. M. 1991. Bayesian Statistics. An Introduction, Oxford University Press, New York.

Math-706 Mathematical Physics-1 3(300)

Series solutions of differential equations of special functions: power series method, Legendre,s equation, Bessel,s equation, Sturm-Liouville problems and orthogonal eigen function expansions. Laplace transform,,: Laplace transform, inverse Laplace transform, transforms of derivatrives and intergrals differential equations, intergal equations and partial function. Linear algebra and vector calculus: linear independence, vector space, Gauss Jordon elimination, Gauss Elimination, inner product space and linear transformtrions. Matrix eigenvalue problems: eigen values, eigen vectors, application of eigen value problems, basis of eigen vectors and diagonalization. Vector differential calculus: vector algevrta in 2-space and 3-space, vectir product, vector and scalar functions and fields, derivatrives, curves, tangents, are lengthrh, velocity and acceleratrion, gradient of a scalar field, divergence of a vector field and curl of a vector field. Vector intergral calculus, integral theorems: line integral, green, theorm in a plane, surfaces for surface intergrals, duble intergrals, surface intergrals, triple integrals, divergence theorm of gauss and stokes,s theorem of Gauss and stokes's theorm.

Books recommended:

1. Kreyszig, E. 2009. Advanced Engineering Mathematics, 8th edition. John Wiley and sons, New York.
2. Axler, S. 1997. Linear Algebra Done Right, 2nd edition. Springer.
3. Thoms, G.B. and R.L. Finney. 2002. Calculus and Analytical Geometry, 9th edition. Roohani Press Islamabad.
4. Hassani, S. 1999. Mathematical Physics . 1st edition, springer.

Math-707 Mathematical Physics-II 3(3-0)

Fourier series integrals and transforms: periodic functions, trigonometric series, Fourier series, complex Fourier series, approximation by trigonometric polynomials, Fourier integrals and Fourier transforms. Partial different squations: basic concepts, modeling, wave equation, separation of variables, use of Fourier series, heat equation, Laplacian in polar coordinates, Laplace's equation in cylindrical and spherical coordinates and solution by Laplace transforms. Complex analysis: complex numbers and functor's comples plane, polar form, analytic funcdction, Cauchy Riemann's equations, Laplace's equation, geometry of analytic functions, trigonometric and hyperbolic functions. Complex integration:

line integral in complex plane, Cauchy's integral theorem and formula, and derivatives of analytic functions. Power series, Taylor series, Maclaurin series, Laurent series, Residue integration method and complex analysis applied to potential theory.

Books recommended:

Axler, S. 1997. Linear Algebra Done Right. 2nd edition. Springer.

Hassani, S. 1999. Mathematical Physics. 1st edition, Springer.

Kreyszig, E. 2009. Advanced Engineering Mathematics, 8th edition. John Wiley and sons, New York.

Thomas, G.B. and R. L. Finney. 2002. Calculus and Analytical Geometry, 9th edition. Roohani Press Islamabad.

Math-708 Introduction to Measure Theory 3(3-0)

Measurability: σ -algebra, real valued functions. Measure: measure space, signed measure and completion. Integral: non negative functions and the monotonic convergence theorem. Integrability integrable functions, three fundamental properties and the dominated convergence theorem. Spaces L^p : normed spaces, the space L^p and L^∞ and completeness, the Radon-Nikodym theorem and the Lebesgue decomposition theorem. Extension outer measure, Carathéodory and Hahn extensions and Lebesgue measure. Product: product measure, sections and the Fubini theorem.

Books recommended:

1. Athreys, K.B. and S. N. Lahiri. 2006. Measure Theory and Probability Theory. Springer.
2. Capinski, M. and E. Kopp. 2004. Measure, integral and Probability, 2nd edition. Springer.
3. Chaudhry, B and S. Nanda. 1991. Functional Analysis with Applications. Wiley Eastern Limited, New Delhi.
4. Khan, A. and A. Rahim. 1993. Introduction to Lebesgue Measure. LLmi Kitab ?Khana Lahore.
5. Kubrusly, C. S. 2007. Measure Theory: A First Course. Elsevier Inc. 30 Corporate Drive, Suite 400, Burlington, USA.
6. Wang, Z, and J.J. Klir, 2008. Generalized Measure Theory. Springer.

Math-709 Introduction to Information Technology and Data Analysis 3(1-2)

Theory:

Overview of basic computer concepts. Brief history of development of computers, Classification of computers on the basis of size, power and logic used in construction. Hardware: Input hardware, Output hardware, Processing hardware, storage hardware, communication hardware, Software; Application software, system software. Communication and Connectivity.

Practical:

Working with operating system; Windows (Most Recent Version). Use of Internet. Development of Excel Sheets for statistical data analysis. Data Analysis by using Analysis ToolPack in Excel. Introduction to Minitab, data manipulation in Minitab, Programming in Minitab, Construction of Macros in Minitab. Introduction to SPSS data manipulation in SPSS.

Books recommended:

1. Huizingh, E. 2007. Applied Statistics with SPSS. SAGE Publications Ltd.
2. Nebebe, F. M. Nebebe and L. Mimenault. 1990. Statistics with Minitab. Pearson Custom Publishing. N. Y.

3. Shelly, G.B. M.E. Vermaat and J.J Quasney. 2009. Discovering Computers 2010. Living in a Digital World. Cengage Learning, N.Y