

Gautam Buddha University
School of Vocational Studies and Applied Sciences
Mathematics Courses

Department of Applied Mathematics
B.Tech.+M.Tech./MBA
(Engineering/ICT/Biotechnology/Food Processing and Technology)

Session 2013-2014

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MA 101 (Engineering Mathematics-I)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

BASIC ANALYSIS

Real number system: Algebraic and Order properties of R , Archimedean property, Completeness axiom, Density of rational numbers in R . Sequence and series, Limit, Continuity and differentiability of a function of single variable, Successive differentiation, Leibnitz theorem. Rolle's Theorem, Mean value theorems, Taylor and Maclaurin's series.

Unit II

MULTIVARIABLE CALCULUS

Limits, Continuity and differentiability in higher dimensions, Partial differentiation, Chain rule, Jacobian, Directional Derivatives and Gradient Vectors, Extreme values and Saddle points, Lagrange's multiplier method. Taylor's series for a function of several variables.

Unit III

CURVE TRACING

Curve Tracing in Cartesian Coordinates and Polar Coordinate systems, Area and Length in Polar Coordinates.

Unit IV

MULTIPLE INTEGRAL

Double Integral, triple integral, Fubini's Theorem, Change of order for double integral, Change of variables (*double integral: polar form, triple integral: Cylindrical and Spherical form*).

Unit V

FUNDAMENTAL THEOREMS OF VECTOR CALCULUS

Line integral, surface area and surface integral, Green's Theorem, Vector fields, Divergence and curl of vector fields. Stokes' Theorem and Gauss divergence theorems.

Textbook Thomas Calculus , 11th Edition, Pearson Education Asia, 2009.

Books

- [1] R. K. Jain and S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publications.
- [2] E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 2005.
- [3] P. V. O'Neil, *Advanced Engineering Mathematics*, Thomson (Cengage) Learning, 2007.
- [4] J. Stewart, *Calculus*, Cengage Learning, Sixth Edition.
- [5] R. G. Bartle and D.R.Sherbert, *Introduction to real analysis*, Wiley India Pvt. Ltd.

MA 102 (Engineering Mathematics-II)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Matrices, Algebra of Matrices, Elementary row and column operations and reduced echelon forms, Normal Form, Rank of a matrix, Consistency of linear system of equations and their solutions.

Unit II

Finite dimensional vector spaces over reals, Subspace, Linear Dependence and Independence of vectors, Basis, Dimension. Characteristic equation and characteristic polynomial, eigenvalues and eigenvectors, Cayley-Hamilton theorem, diagonalisation.

Unit III

Algebra of Complex numbers, Polar form of complex numbers, Functions of complex variables, Limit, Continuity and Differentiability of Complex functions.

Unit IV

Analytic function, C-R equation, Harmonic functions, Line Integral in complex form, Cauchy's integral theorem, Morera's Theorem, Cauchy's integral formula: Cauchy's Integral formula for derivatives of analytic functions, Liouville's theorem, Fundamental Theorem of algebra.

Unit V

Taylor's and Laurent's Series, Singularities, Zeros and Poles, Residue, Residue theorem, Evaluation of real integrals, Conformal mapping.

Textbook E. Kreyszig, *Advanced Engineering Mathematics*. John Wiley and Sons, 2005.

Books

- [1] R. K. Jain and S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publications.
- [2] J. W. Brown, R. V. Churchill, *Complex Variables and Applications*, McGraw-Hill Higher Education; 8 edition, 2008.

MA 103 (Mathematics-I)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Sets and their representations, operations on sets, Cartesian product of sets, relations, functions, algebraic and transcendental function, Principle of Mathematical induction, Solution of quadratic equations. Permutation and Combination, Binomial Theorem.

Unit II

Straight Lines, slope of a line and angle between two lines, various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point forms, intercepts form and normal form, general equation of a line, distance of a point from a line. Introductory idea of Ellipse, Circle, parabola and Hyperbola.

Unit III

Trigonometric functions, positive and negative angles, Measuring angle in radians & in degree and conversion from one measure to another. Definition of trigonometric with the help of unit circle. Trigonometric identities. Complex numbers, algebraic properties of complex numbers, Argand plane and polar representation of complex numbers, Fundamental theorem of algebra.

Unit IV

Vectors and scalars, magnitude and direction of a vector, direction cosines (and ratios) of vectors, Types of vectors, position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar product of vectors, projection of a vector on a line, vector product of vectors.

Unit V

Matrices and determinants: definition of a matrix, various types of matrices, addition, subtraction, multiplication of matrices, inverse of matrix, determinant of matrices, expansion of determinant, properties of determinants, solution of linear system of equations, Cramer rule.

Textbook *Mathematics Part I and Part II - Textbook for Class XI and XII*, NCERT.

Books

- [1] H. S. Hall and S.R. Knight, *Higher Algebra*. Arihant, 2010.
- [2] J. Stewart, *Calculus*, Cengage Learning, Sixth Edition.

MA 104 (Mathematics-II)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Limit, continuity and differentiability of functions, Derivatives of elementary functions, rules of differentiation, Derivatives of polynomial and trigonometric functions, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function, logarithmic differentiation. Derivative of functions expressed in parametric forms, successive differentiation

Unit II

Successive differentiation, Leibnitz Theorem, Partial differentiation, Euler Theorem, Taylors series (Single Variable), Maxima and Minima (Single Variables),

Unit III

Integration as inverse process of differentiation, Integration of elementary functions, integration by substitution, by partial fractions and by parts, Fundamental theorem of calculus, Basic properties of definite integrals and evaluation of definite integrals, definite integral as limit of sum, Application to areas and curves

Unit IV

Definition of ordinary differential equations, order and degree, general and particular solutions of a differential equation, Formation of differential equation, solution of differential equations of first order and first degree: solution by method of separation of variables, homogeneous differential equations, linear differential equations, exact differential equations, Solution of second order differential equations with constant coefficients.

Unit V

Introduction to mathematical modeling, modeling of Simple elementary biological system, population growth model, exponential models, logarithmic models

Textbook *Mathematics Part I and Part II - Textbook for Class XI and XII*, NCERT.

Books

- [1] G. B. Thomas and R. L. Finney, *Calculus and Analytical Geometry*, Pearson Education.
- [2] J. N. Kapoor, *Mathematical Modeling*, New Age International.
- [3] J. Stewart, *Calculus*, Cengage Learning, Sixth Edition.

MA 201 (Engineering Mathematics-III)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Definition of differential equation (linear/nonlinear) with examples, order and degree of the differential equation, types of solutions of differential equations, methods of solution, variables separable method, exact differential equations, integrating factors of first order differential equation of the type $M(x, y)dx + N(x, y)dy = 0$, Bernoulli equations, Riccati differential equation, Picard's existence and uniqueness theorem for $dy/dx = f(x, y)$ (without proof)

Unit II

Linear differential equations of nth order with constant coefficients, solutions of homogeneous and non-homogeneous linear differential equations, complementary functions and particular integrals, Operator Method, simultaneous linear differential equations, Euler -Cauchy linear differential equations, method of variation of parameters, applications to engineering problems (Motion of a particle in resisting medium, simple harmonic motion, electric circuit problem).

Unit III

Existence theorem for Laplace transform, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac delta function, Laplace transform of periodic functions, Convolution theorem, Application to solve linear and simultaneous differential equations.

Unit IV

Periodic functions, Trigonometric series, Fourier series of period 2π , Euler's formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine Fourier series,

Unit V

PDEs and its Applications: Linear partial differential equations with constant coefficients. Classifications of 2^{nd} order PDE. Method of separation of variables for solving partial differential equations, Its applications to solve Heat conduction equation, Wave equation, steady state heat equation (Laplace equation) through Fourier series.

Textbook R. K. Jain and S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publications.

Books

- [1] G. F. Simmons, *Differential Equations*. Tata Mc Graw-Hill Publishing Company Ltd., 1981.
- [2] E. Kreyszig, *Advanced Engineering Mathematics*. John Wiley and Sons, 2005.
- [3] W. E. Boyce and R.C. DiPrima, *Elementary differential equations and Boundary Value Problems*. John Wiley and Sons, 8th Edition, 2010.

MA 202 (Numerical and Statistical Analysis)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Zeros of transcendental and polynomials, Bisection method, Regular-falsi method and Newton-Raphson method, Secant Method, Rate of convergence of above methods, Error Analysis.

Unit II

Interpolation, Finite differences, difference tables, Newton's forward and backward interpolation, Divided differences, Lagrange's and Newton's divided difference formula for unequal intervals. Numerical differentiation, Numerical integration, Newton-Cote quadrature formula, Trapezoidal, Simpson's one third and three-eighth rules.

Unit III

Solution of system of linear equations, Gauss-Seidal method, Gauss-Jordan Method, Crout method, Jacobi Iteration method. Numerical Solutions of Ordinary Differential Equations and Partial Differential Equations: Picard's Method, Euler's Method, Modified Euler's Method, Runge-Kutta method. Numerical solutions of parabolic and elliptic partial differential equations, Introduction to finite element method.

Unit IV

Probability, Conditional Probability, Bayes' Theorem, Random variable, Probability distributions, Mean and Variance of the distribution, Probability density function, Binomial distributions, Poisson distributions and Normal distributions.

Unit V

Mathematical Expectations, Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Regression analysis: Linear, Nonlinear and multiple. Random sampling, Sample mean, Sample variance, Estimation of parameters, Maximum likelihood method, Confidence intervals, Testing of Hypotheses: in the case of normal distributions, Goodness of Fit, Chi-square test, t-test, Analysis of variance.

Textbook E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 2005.

Books

- [1] R. S. Gupta, *Elements of Numerical Analysis*, Macmillan, 2009
- [2] C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis* 7th Edit., Addison-Wesley, Boston, 2003.
- [3] R. A. Johnson, *Miller & Freund's Probability and Statistics for Engineerings* Pearson, 2001
- [4] S. M. Ross, *Introduction to Probability and Statistics for Engineers & Scientists* Elsevier, Academic press, 2004.

MA 203 (Quantative Techniques in Biotechnology)

Credit (L-T-P) : 4 (3- 1- 0)

Unit I

Frequency Distribution, Graphic representation of a frequency distribution, Measures of Central tendency, Moments, moment generating functions, Central Moments, Non- Central Moments, Measures of Dispersion, Measures of Skewness, Measures of Kurtosis

Unit II

Curve fitting, Method of Least squares, Fitting of Straight lines, Polynomials, Exponential Curves, Linear Correlation, Correlation Coefficient, Properties of Correlation Coefficient, Rank Correlation Coefficient, Regression Analysis: Linear & Non linear. Time series and forecasting.

Unit III

Introduction, Experiments, Outcomes, Events, Definition of Probability, Conditional Probability, Independent Events, Total Probability, Bayes' Theorem.

Unit IV

Random Variable, Discrete Random Variable, Probability Function, Continuous Random Variable, Probability Density Function, Discrete Distributions, Continuous Distributions, Mathematical Expectation, properties of Expectation, Two Dimensional Random Variables, Joint Probability Density Functions, Marginal Probability Distribution, Conditional Probability Distribution.

Unit V

Binomial Distribution, Poisson Distribution, Normal Distribution Sampling theory, Tests of significations, Chi-square test, t-test, Analysis of variance (one way), Statistical quality control methods, Control charts, R, p, np, and c charts.

Textbook J. N. Kapoor, Mathematical Statistics, S. Chand Publication, 2004.

Books

- [1] V. K Rohatgi, *An Introduction to Probability Theory and Mathematical Statistics*, John Wiely & Sons 1976.
- [2] Marylees Miller, John E. Freund, Irwin Miller, *Mathematical Statistics: With Applications*, Prentice Hall 2003.
- [3] Gupta, S.C. and Kapoor, V.K. (2007): *Fundamentals of Mathematical Statistics*, 11th Edn.,(Reprint), Sultan Chand and Sons.
- [4] S. M. Ross, *Introduction to Probability and Statistics for Engineers & Scientists* Elsevier, Academic press, 2004.