

B.Sc. Mathematics

PROPOSED COURSE STRUCTURE

To be in force from June 2009.

F.Y.B.Sc. :

Paper 1 Algebra, Trigonometry and Vector Calculus.

Paper 2 Calculus and Differential Equations.

S.Y.B.Sc. :

Paper 3 Advanced Calculus.

Paper 4 Differential Equations.

Paper 5 Linear Algebra (Theory and Practical).

S.Y.B.Sc. : (For students of **Computer Science** as a special subject)

Paper 3 Calculus and Differential Equations.

Paper 4 Discrete Mathematics.

S.Y.B.Sc. : (For students of **Industrial Chemistry** as a special subject)

Paper 3 Calculus and Differential Equations.

Paper 4 FORTRAN 77 and Statistical Methods.

S.Y.B.Sc. : (IDS)

Mathematical Methods.

Group of Symmetries.

T.Y.B.Sc. :

Paper 6 Real Analysis.

Paper 7 Abstract Algebra.

Paper 8 Numerical Analysis (Theory and Practical).

Paper 9 Discrete Mathematics.

T.Y.B.Sc. : (CAN Courses) [Any one from the following]

Number Theory.

Mechanics.

Mathematics in Finance.

Computer Oriented Numerical Methods.

Operation Research.

Mathematical Modelling.

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T.Y.B.Sc.

Mathematics Paper - VI (REAL ANALYSIS)

To be in force from June 2009

[L : 4; P : 0]

Unit 1: Series of real numbers :

Convergence and divergence, Series with non-negative terms, Alternating series, Conditional and absolute convergence, Tests for absolute convergence, Series whose terms form a non-increasing sequence.

Unit 2: Riemann Integration :

Sets of measure zero, Definition of the Riemann Integral, Properties of Riemann Integral, Fundamental theorems of Integral Calculus, Mean-value Theorems of Integral Calculus.

Unit 3: Metric Spaces :

Revision of Limit and Continuity of a function on the real line, Definition & examples of Metric spaces, Limit, Convergence and Cauchy sequence in metric space, Equivalent metrics, Open ball in \mathbb{R}^1 , Open ball in metric space, Functions continuous on metric spaces.

Unit 4: Open, Closed, Connected and Bounded sets :

Open sets, Limit points, Closure of a set, Closed sets, Homeomorphism of metric spaces, Dense set, More about open sets, Connected sets, Bounded sets, Totally bounded sets.

Unit 5: Complete and Compact sets :

Complete metric spaces, Contraction mapping, Application of Picard's fixed point theorem, Compact metric spaces, Open covering, Heine-Borel property, Finite Intersection property.

The course is covered by the following reference books :

1. R.R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi.
2. T.M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983.
4. D. Som Sundaram & B. Chaudhari : A first course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
5. P.K. Jain & S.K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000.
6. Copson : Metric Spaces, Cambridge University Press, 1968.
7. P.K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.

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T.Y.B.Sc.

Mathematics Paper VII (ABSTRACT ALGEBRA) To be in force from June 2009

[L : 4; P : 0]

Unit 1 : Integers and Introduction of Group :

Divisors, Greatest common divisor, Least Common multiple, Prime numbers, Unique factorization theorem, Congruence relation, Equivalence classes, Definition & examples of a group.

Unit 2 : Group Theory :

Properties of group, Subgroups, Lagrange's theorem and its applications, Euler's theorem, Fermat's theorem, A counting principle.

Unit 3: Normal subgroups, Quotient Groups and Homomorphism :

Normal subgroups & Quotient groups, Homomorphisms, Isomorphisms, Automorphisms, Cayley's theorem, Permutation groups, Even & Odd permutations, Alternating group.

Unit 4 : Ring Theory :

Definition & examples of Ring, Integral Domain and Field, Characteristic of an Integral Domain, Homomorphisms and Isomorphisms of Rings.

Unit 5 : Ideals and Euclidean rings :

Ideals & Quotient rings, Maximal Ideal, Principal Ideal. Euclidean rings, Divisibility in Commutative Ring, gcd of two elements in Ring, Units and Associates in Rings, Prime element in a Euclidean Ring.

The course is covered by the following reference books :

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1983.
2. I.H.Sheth : Abstract Algebra, PHI.
3. N.B Gopalkrishnan : University Algebra, Wiley Eastern Ltd.
4. P.R. Bhattacharya, S.K. Jain and S.R. Nagpaul : Basic Abstract Algebra, Cambridge University Press, Indian Edition, 1997.
5. Shantinayakan : Modern Algebra, S. Chand & Co.
6. Serge Lang : Algebra, ed. Addition Wesley, 1993.
7. Surjeet & Kazi Zameeruddin : Modern Algebra, Vikas Publishing House.

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T.Y.B.Sc.

Mathematics Paper - VIII (NUMERICAL ANALYSIS)* (Theory)

To be in force from June 2009

[L : 3; P : 3]

Unit 1: Errors in numerical calculations, Solution of Algebraic & Transcendental Equations :

Numbers and their accuracy, Errors and their analysis, Absolute, Relative and Percentage errors, a general formula, Error in a series approximation, Bisection Method, Convergence of Bisection Method, Iteration method.

Unit 2: Solution of Algebraic & Transcendental Equations and finite differences :

Method of False position, Convergence of False position method, Newton-Raphson Method, Condition of convergence for Newton-Raphson Method. Finite Differences, Forward and backward differences, Central differences, Symbolic relations.

Unit 3: Interpolation :

Newton's forward and backward interpolation formula, Newton divided differences, Interpolation with unequal intervals, Newton divided difference interpolation formula, Lagrange's Interpolation formula.

Unit 4 : Central Difference Interpolation Formulae and Numerical Differentiation :

Gauss' Interpolation formulae, Stirling's formula, Bessel's formula, Numerical Differentiation formulae.

Unit 5: Numerical Integration & Numerical solution of ordinary differential equations :

General quadrature formula, Trapezoidal rule, Simpson's 1/3-rule, Simpson's 3/8-rule, Solution by Taylor's series method, Picard's method of successive approximations, Euler's method, Modified-Euler's method, Runge-Kutta 2nd order methods.

The course is covered by the following reference books :

- 1 . S.S. Sastry : Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 4th Ed.
2. M.K.Jain, Iyenger & Jain : Numerical Methods for Scientific and Engineering Computations, New Age International Ltd.
3. Goel & Mittal : Numerical Analysis, Pragati Prakashan, Meerut.
4. C.E. Froberg : Introduction to Numerical Analysis, Addition Wesley.
5. Kaiser A. Kunz : Numerical Analysis, McGraw Hill Book Co., London.
6. James I. Buchanan & Peter R. Turner : Numerical Methods & Analysis, McGraw Hill Book Co., London.

* Use of Scientific non – Programmable calculator is allowed.

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T.Y.B.Sc.

Mathematics Paper - VIII (Practicals)

[One Practical of 3 periods per batch per week]

1. Errors in a Series Approximations.
2. Solution of Algebraic and Transcendental equations: Bisection Method.
3. Solution of Algebraic and Transcendental equations: False Position Method.
4. Solution of Algebraic and Transcendental equations : Newton-Raphson Method.
5. Solution of Algebraic and Transcendental equations : Iteration method.
6. Numerical solution of the systems of linear equation: Gauss Elimination Method.
7. Numerical solution of the systems of linear equation: Gauss-Jacobi method.
8. Numerical solution of the systems of linear equations: Gauss-Seidal Iteration method.
9. Newton's forward and backward difference Interpolation formulae.
10. Newton's divided difference Interpolation formula.
11. Lagrange's interpolation formula.
12. Numerical Differentiation.
13. Numerical Integration : Trapezoidal rule,
14. Numerical Integration : Simpson's 1/3 rule.
15. Numerical Integration : Simpson's 3/8-rule.
16. Numerical Solution of IVP : Taylor's Series Method.
17. Numerical Solution of IVP : Picard's Approximation Method.
18. Numerical Solution of IVP : Euler's method.
19. Numerical Solution of IVP : Euler's Modified method.
20. Numerical Solution of IVP : Runge-Kutta 2nd order method.

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T.Y.B.Sc.

Mathematics Paper - IX (DISCRETE MATHEMATICS)

To be in force from June 2009

[L : 4; P : 0]

Unit 1 : Posets and Lattices :

Binary relations, Properties of binary relations, Partition, Equivalence relation, Partial ordered relation, Partially ordered sets, Hasse Diagram, Upper bounds, Lower bounds, GLB & LUB of sets, Totally ordered sets, Well ordered sets, Lattices, Properties of lattices, Lattice as an algebraic system, Homomorphism between two lattices.

Unit 2 : Types of Lattices and Boolean Algebra :

Distributive, Complemented and Bounded lattices, Bounds of a lattice, Boolean Algebra as an algebraic system, Boolean expressions (forms), Different representation of Boolean forms, Sum of products canonical form and product of sums canonical forms of Boolean expressions, Value of Boolean expressions, Boolean functions.

Unit 3 : Minimization of Boolean functions and Introduction of Graphs :

Minimization of Boolean functions by Karnaugh Map method and Quine-McCluskey algorithm, AND, OR & NOT gates, Reduction of switching circuit diagram. Graphs, Applications and various type of graphs, Incidence and Degree, Isolated and pendent vertices.

Unit 4 : Euler graphs and Hamiltonian graphs :

Subgraphs, Operations on graphs, Isomorphism between two graphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs, Components of graphs, Euler graphs, Hamiltonian graphs.

Unit 5 : Trees and Planar graphs :

Trees, Properties of trees, Pendent vertices in a tree, Distance between two vertices, Centre, Radius and Diameter of a Tree, Rooted & Binary trees, Spanning Trees, Planar graphs, Kuratowski's two non-planar graphs, Different representation of planar graphs, Regions, Euler's formula.

The course is covered by the following reference books :

1. J.P. Tremblay & R. Manohar : Discrete mathematical Structures with Applications to Computer Science., McGraw Hill Book Co., 1999.
2. Narsingh Deo : Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India Pvt. Ltd., 2000.
3. B. Kolman, R. C. Busby & S. Ross : Discrete Mathematical Structures, Prentice Hall of India Pvt. Ltd., 3rd ed. 2001.
4. R.J. Wilson : Introduction to Graph Theory, Academic Press, New York, 1972.
5. E Harray : Graph Theory, Addison Wesley Pub. Co., 1969.
6. C. Berge : The Theory of Graphs and its Applications, John Wiley & Sons 1962.

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T.Y.B.Sc.

Mathematics (CAN) (NUMBER THEORY)

To be in force from June 2009

[L : 3; P : 0]

Unit 1 : Divisibility Theory in the Integers :

Application of the Division Algorithm, Computation of the Greatest Common Divisor using the Euclidean Algorithm, Relation between Greatest Common Divisor and Least Common Multiple of two integers, Computation of the solutions of linear Diophantine equations in two variables.

Unit 2 : Primes and their Distribution, Basic properties of Congruence :

The Fundamental theorem of Arithmetic [without proof], Pythagorean theorem for the irrationality of $\sqrt{2}$, The Sieve of Eratosthenes, Infinitude of primes, Upper bound for the primes.

Basic properties of congruence, Modular Arithmetic.

Unit 3 : The Theory of Congruence and Fermat's Theorem :

CRS(mod n), Divisibility tests of 9 and 11 and their use to compute missing digits in a calculations, Computation of the solutions of linear congruence $ax \equiv b \pmod{n}$, Chinese Remainder theorem [without proof].

Fermat's little theorem, pseudo-prime, Wilson's theorem.

Unit 4 : Number-Theoretic functions :

Introduction of functions $\tau(n)$, $\sigma(n)$, $\mu(n)$ and $[x]$, Multiplicative nature of these functions, basic properties of these functions, The Mobius Inversion formula [without proof], Use of the $[x]$ to compute exponent of highest powers of p that divides n!.

Unit 5 : Euler's ϕ function and Introduction to Cryptography :

Introduction of Euler's Totient function $\phi(n)$, Multiplicative nature of $\phi(n)$ [Only statement], Euler's Theorem.

Meaning of ciphers, ciphertext, encryption and decryption, Caesar cipher, Use of congruence to encrypt a plaintext message to ciphertext message and vice-versa.

The course is covered by the following reference books :

1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co., N. Delhi, 6th Ed., Reprint, 2006.
2. Neville Robbins : Beginning Number Theory, Narosa Pub. House, N.Delhi, 2nd Ed., 2006.
3. I. Niven, S.Zuckerman & L. Montgomery: An Introduction to Theory of Numbers, John Wiley, 1991.
4. George Andrews : Number Theory, The Hindustan Pub. Corporation, N.Delhi.
5. S.G.Talang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.

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T.Y. B.Sc.

**Mathematics (CAN)
(MECHANICS)**

To be in force from June 2009

[L : 3; P : 0]

Unit 1 :

Methods of plane statics, Triangle of forces, Lamy's theorem, Work and Potential Energy, Forces which do no work, Virtual work, Infinitesimal displacement of a rigid body parallel to a fixed plane, Sufficient condition for the equilibrium of a rigid body moving parallel to a fixed plane, Potential Energy.

Unit 2 :

Mass centre, methods of decomposition and symmetries for finding mass centre of a rigid body. Pappus theorems, Gravitations forces, Laws of friction, Flexible cable, Suspension bridge, Equation of common catenary.

Unit 3 :

Plane Kinematics, Tangential & Normal components of velocity and acceleration, Radial and Transverse components of velocity & acceleration, Hodograph.

Unit 4 :

Methods of plane dynamics, Motion of a particle, Linear and angular momentum of a particle and a system of particles, Principle of Conservation of Energy.

Unit 5 :

Application in plane dynamics, Projectile without resistance, Parabolic trajectory, Limits of range of trajectory, the Harmonic Oscillator, Simple Pendulum, Effect of disturbing force, Damped oscillations, Forced oscillations.

The course is covered by the following reference books :

1. Synge & Griffith: Principles of Mathematics, McGraw Hill Book Co.
2. A.G.Takwal & P.S.Puranil: Introduction to Classical Mechanics, Tata McGraw Hill.
3. A.S.Ramsey : Statics, Cambridge University Press
4. A.S.Ramsey : Dynamics, Cambridge University Press.
5. R.I.Steins : Mechanics, Berncs & Nibwe inc.
6. S.L.Loney, : Statics, Surjeet Prakashan.
7. S.L. Loney : Dynamics, Surjeet Prakashan.

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T.Y. B.Sc.

Mathematics (CAN) (MATHEMATICS IN FINANCE) To be in force from June 2009

[L : 3; P : 0]

Unit 1 : Financial Management :

Its nature and scope, Goals and decision of financial management, Difference between risk speculation and gambling.

Time, Value of money, Interest rate and Discount rate, Present value and Future value for discrete and continuous compounding case, Annuities and its types.

Unit 2 : Numerical Methods and Financial derivatives :

Meaning of return, Return as internal rate of return (IRR), Numerical methods to calculate IRR such as Newton-Raphson method to calculate IRR, Measurement of returns under uncertainty situation.

Bond valuation, Calculation of duration and convexity of bonds.

Financial derivatives, Futures, Forward, Swaps and options, Call & Put options.

Unit 3: Risk Management :

Meaning of Risk, Difference between risk and uncertainty, Types of risks, Management of risks, Calculation of security and portfolio, Risk Return-Markowitz model, Sharpe's single index model, Systematic and Unsystematic risk.

Unit 4 : Mathematics in Insurance :

Mathematics in Insurance, Insurance, fundamentals, Meaning of loss, Changes of loss, peril, hazard and Proximate cause in insurance, Cost and Benefit of insurance to the society, Life insurance and General insurance, Insurable loss exposure and feature of a loss that is ideal for insurance.

Unit 5 : Life insurance Mathematics :

Life insurance Mathematics, Construction of mortality tables and computation of premium of life insurance for fixed duration and for the whole life, Determination of general claims of general insurance using Poisson distribution, Compound aggregate claim model and its properties.

The course is covered by the following reference books :

1. Aswath Damodaran : Corporate Finance-Theory and Practice, John Wiley & Sons.
2. John C. Hull : Options, Futures and other Derivatives, PHI.
3. Sheldon M. Ross : An Intro. to Mathematical Finance, Cambridge Uni. Press.
4. Marl. S. Dorfman : Introduction to Risk Management & Insurance, PHI.
5. C.D.Daykin. T.Pentikainen , M.Pesonen : Practical Risk Theory for Actuaries, C. Hampman & Hall.

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T.Y. B.Sc.

Mathematics (CAN)

(Computer Oriented Numerical Methods)

To be in force from June 2009

[L : 3; P : 0]

Unit 1 :

Digital computer Organization, Flow charts and symbols, More flow charting examples, FORTRAN language, character used in FORTRAN, FORTRAN constants, FORTRAN variable names, Type declaration for integer and real, Arithmetic expression (real and integer expressions), Hierarchy of operations in expressions, Examples of Arithmetic expression, Arithmetic statement, Mode of Arithmetic expression, Special function, examples of use of functions, Program preparation preliminaries, Input-Output statement, Simple FORTRAN program, FORTRAN programming examples.

Unit 2 :

Control statements, Relational operators, Logical IF statement, Arithmetic IF statement, Block IF statement, statement labels, GO TO statement, Example of use of Logical IF statement, Nested logical IF statement, Computed GO TO statement, DO statement, Examples of DO statement, Rules to be followed in utilizing DO loops, Subscripted variables, Subscripted expression, Dimension statement, DO type notation for input / output statement, Format specification and Format specification for a numerical data.

Unit 3 :

Iterative methods : The method of Bisection, The method of False-position, The Newton-Raphson method, The Secant method.

Unit 4 :

Interpolation Methods: The Newton's Forward / Backward / Divided difference Interpolation formulae, Lagrange's interpolation formula.

Unit 5 :

Numerical Integration : Trapezoidal Rule, Simpson's $1/3$ – Rule, Simpson's $3/8$ – Rule.

Numerical solution of Differential Equations : Euler's method, Taylor's series method.

The course is covered by the following reference books :

1. V.Rajaraman : Computer Programming in FORTRAN 77, PHI.
2. V.Rajaraman : Computer Oriented Numerical Methods, PHI.
3. Dhaliwal, Agarwal and Gupta : Programming with FORTRAN 77, Wiley Eastern Ltd.
4. R.S.Salaria : Computer Oriented Numerical Methods, Khanna Book Pub. Co. Ltd.
5. R.Sirkar : FORTRAN based Algorithms, New Central Book Agency, Calcutta.
6. V. Krishnamurthy : FORTRAN based Algorithms, East-West Press, N.Delhi.

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T.Y. B.Sc.

Mathematics (CAN)
(OPERATIONS RESEARCH)

To be in force from June 2009

[L : 3; P : 0]

Unit 1 : Linear Programming Problems(LPP) and Simplex Method :

Model formulation, Basic, Non-basic, Degenerate, Non-degenerate and basic feasible solutions of LPP, Slack & surplus variables, LPP in the standard matrix form, Simplex Method.

Unit 2 : Methods of solving LPP :

Two Phase method, Big-M method, Duality of LPP, The symmetric and non-Symmetric dual problems, Relation between primal & dual problems.

Unit 3 : Transportation and Assignment Problems :

Transportation Problem, Methods for finding initial basic feasible solution, Optimal solution of TP problem by MODI method, Unbalanced Transportation Problem.

Assignment problems, The Hungarian method, Balanced & Unbalance Assignment problems.

Unit 4 : Game Theory :

Competitive games, Two-person Zero-sum game, Maximin and Minimax Principle, Saddle points and the value of the game (based on pure strategies), Mixed strategies, Solution of games with saddle point, Dominance rule, Solution of $m \times 2$ and $2 \times n$ games using graphical method.

Unit 5 : Inventory Models :

Basic definition of parametric association with inventory problems, various costs associated with inventory problems, Inventory models with finite and infinite rate of replenishment with and without shortages.

The course is covered by the following reference books

1. J.K. Sharma : OR Theory & Applications, Mac Milian India Ltd., 1998.
2. Kanti Swaroop, P.K.Gupta & Man Mohan : Operations Research, S. Chand & Sons, New Delhi, 1098.
3. G. Hadley : Linear Programming, Narosa Publishing House, New Delhi, 1995.
4. G. Paria : Linear Programming, Transportation, Assignment, Game, Books & Allied Pvt. Ltd. Calcutta - 9.
5. P.M. Karak: Linear Programming, New Central Book Agency Pvt. Ltd. Calcutta - 9.
6. K.V. Mittal & L.Mohan ; Optimization methods in O.R. and System Analysis, New Age International Publications.
7. Goel & Mittal : O.R., Pragati Prakashan, Meerut.

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T.Y. B.Sc.

Mathematics (CAN)

(MATHEMATICAL MODELLING)

To be in force from June 2009

[L : 3; P : 0]

Unit 1 :

The process of applied Mathematics, Mathematical modelling—an introduction, Basic steps to construct models of real world problems, setting up first order differential equations, Qualitative solution, sketching graphically and interpretation.

Unit 2 :

First order differential equation models: Spread of epidemic disease for susceptible and infectious (SI) model, Susceptible Infectious and Susceptible (SIS) model, Susceptible Infectious with Removable (SIR) model, their solutions with physical interpretation.

New- technological Innovation models for direct contact and mixed contact, their maximum and minimum values and graphs.

Unit 3 :

Network model of LR circuit with constant EMF, Growth and decay of current cases, RL circuit with variable EMF, RC circuit with charging of capacitor and discharging of capacitor with constant EMF, LCR network models, First order differential equations and examples on it.

Unit 4 :

Single species population modes, Population growth–Non age structure model, Smith's model, generalized logistic model, Logistic model for a non-isolated population and expansion.

Unit 5 :

Simple prey–predation model, Basic equation, Trajectory, Stability and equilibrium position, Model for political sciences, Proportional representation, Cumulative voting, Comparison voting, Applications in Ecological and Environmental subject areas, Urban water management.

The course is covered by the following reference books:

1. Models of Applied Mathematics: Springer–Verlag. 1982:
Vol.1: Eds. Martin Braun, C.S.Coleman, D.A.Drew : Diff. Equation Models.
Vol.2: Steven.J.Bram P.D.Strafftn (Eds.) : Political and related models.
Vol.3: W.F.Lucas, F .S.Roberts, R.M.Thrall District and System models.
Vol.4: H.M.Roberts and M. Thompson : Life Science models.
2. A.P.Verma and M.N.Mehta : Mathematics with Applications. Part I and II; Shivam Book Pub.
3. J.N.Kapur : Mathematical Models in Biology and Medicine, Allied E-W Press.

