॥ अंतरी पेटवू ज्ञानज्योत ॥

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR T.Y.B.Sc.

MATHEMATICS

WITH EFFECT FROM JUNE, 2004

Paper	I	Metric spaces and Lebesgue Integration
Paper	II	Real Analysis
Paper	III	Algebra
Paper	IV	Differential Equations and Dynamics
Paper	V (a)	Numerical Analysis and Operation Research
		OR
	V (b)	Computer programming in C
		OR
	V (c)	Number theory and Combinatorics
Paper	VI (a)	Differential Geometry and Astronomy
		OR
	VI (b)	Mathematical Methods
		OR
	VI (C)	Discrete Mathematics
Paper	VII	Practical Course based on Paper I & II
Paper	VIII	Practical Course based on Paper III & IV
Paper	IX	Practical Course based on Paper V & VI

NOTE:- ~~Two Tutorials and One Seminar Per Course~~

Instruction (1)
Two tutorials and two seminars
shall be conducted per paper,
according to the teaching schedule.

T.Y.B.Sc.
MATHEMATICS - PAPER - I

METRIC SPACES AND LEBESGUE INTEGRATION

1. Sets and Functions (6 Periods, 6 Marks)
   1. Functions and Inverse functions
   2. Real valued function, Characteristic function.
   3. Equivalence and countability.

2. Metric Spaces (12 Periods, 12 Marks)
   1. Metric spaces.
   2. Limits in metric spaces.

3. Continuous Functions on Metric Spaces. (10 Periods, 10 Marks)
   1. Reformulation of definition of continuity in metric space.
   2. Functions continuous on metric space.
   3. Open sets.
   4. Closed sets.
   5. Homeomorphism.

4. Connectedness and Completeness of Metric Space (12 Periods, 10 Marks)
   1. More about open sets.
   2. Connected sets.
   3. Bounded and totally bounded sets.
   4. Complete metric space.
   5. Contraction mapping on metric space

5. Compactness of Metric Space. (12 Periods, 12 Marks)
   1. Compact metric space.
   2. Continuous functions on Compact metric space.
   3. Continuity of the inverse function.
   4. Uniform continuity.

6. Measurable Sets (16 Periods, 16 Marks)
   1. Length of open sets and closed set.
   2. Inner and outer measure of a set.
   3. Measurable sets.
   4. Properties of measurable sets.

7. Measurable Functions (8 Periods, 6 Marks)

1. Real valued measurable functions.
2. Sequence of measurable functions.

8. Lebesgue Integral for Bounded Functions. (10 Periods, 10 Marks)

1. Measurable partition, Refinement. Lower and upper Lebesgue sums, Lower and upper Lebesgue integrals.
2. Existence of Lebesgue integral for bounded functions.
3. Properties of Lebesgue Integral for bounded measurable functions.

9. Lebesgue Integral for Unbounded Functions. (6 Periods, 6 Marks)

1. Truncating function n_f
2. Positive and negative parts of f.
3. Definition and properties of $\int_E$ where f is non-negative valued function in L [a, b] and f is arbitrary measurable function in L [a, b].

10. Some Fundamental Theorems. (12 Periods, 12 Marks)

1. Lebesgue Dominated convergence theorem
2. Fatou's lemma.
3. The metric space L^2 [a, b] : Square integral function. Schwarz's inequality, Minkowski's inequality.
4. The integral on $(-\infty, \infty)$ and in the plane Fubini's theorem (without proof)

Recommended Book :

Method of Real Analysis :By R.R. Goldberg.(Oxford & IBW Publishing Co.)

Chapter I : 1.3, 1.4, 1.5, 1.6 .
Chapter IV : 4.2, 4.3 .
Chapter V : 5.2, 5.3, 5.4, 5.5 .
Chapter VI : 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 .
Chapter XI : 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9 (A,B,C),11.10.

Reference Books :

1. Metriac spaces : By - E.T. Copson. (Cambridge University Press)
2. Mathermatical Analysis : By - S. C. Malik and Savita Arora.
3. Introduction to Real Variable Theory : By – S. C. Saxena and S.M. Shah.
4. Measure and Integration : By – G. De. Barra
5. Measure Theory : By - K. P. Gupta.
6. Lebesgue Measure and Integration : By – P. K. Jain and V. P. Gupta.
7. Measure Theory : By – P. R. Halmos.

T.Y.B.Sc.

MATHEMATICS - PAPER - II

REAL ANALYSIS

1. Riemann Integration (18 Periods, 16 Marks)

   1. Definition of Existence of the integral. The meaning of $\int_a^b f(x)dx$ when $b \leq a$. Inequalities for integrals.
   2. Refinement of partitions.
   3. Darboux's Theorm. (without proof).
   4. Conditions of integrability.
   5. Integrability of the sum and difference of integrable functions. Integrability of the product, quotient and modulus of integrable functions.
   6. The integral as a limit of sums. (Riemann Sums) and the limit of sums as the integral and its applications.
   7. Some integrable functions
   8. Integration and Differentiation (The Primitive).
   9. Fundamental Theorems of integral calculus.

2. Mean Value Theorem of Integral Calculus. (10 Periods, 11 Marks)

   1. First Mean Value Theorem.
   2. The Generalised First Mean Value Theorem.
   3. Abel's Lemma. (without proof)
   4. Second Mean Value Theorem. – Bonnett's form and Karl Weierstrass form.

3. Improper Integrals. (12 Periods, 11 Marks)

   1. Integration of unbounded functions with finite limits of integration.
   2. Comparison Test for convergence at 'a' of $\int_a^b f(x)dx$
   3. Convergence of improper integral. $\int_a^b dx / (x-a)^p$
   4. Cauchy's General Test for convergence at a point 'a' of $\int_a^b f(x)dx$
   5. Absolute convergence of improper integral. $\int_a^b f(x)dx$
   6. Convergence of integral with infinite range of integration.
   7. Comparison test for convergence at ∞.
   8. Convergence of $\int_a^\infty dx / x^p$, $(a>0)$
   9. Cauchy's General Test for convergence at ∞.

10. Absolute convergence of $\int_a^\infty f(x)dx$

11. Test for absolute convergence of $\int_a^\infty f(x)dx$

12. Abel's Test and Dirichlet's Test for convergence $\int_a^\infty f(x)dx$

4. Beta and Gamma Integrals (12 Periods, 12 Marks)

1. Convergence of Beta and Gamma Integrals.
2. Properties of Beta and Gamma functions
3. Relation between Beta and Gamma functions.
4. Duplication formula.
5. Evaluation of integrals using Beta and Gamma integrals.

5. Series of Real Numbers. (8 Periods, 16 Marks)

1. Convergence and divergence
2. Series with non-negative terms.
3. Alternating series
4. Conditional convergence and absolute convergence
5. Rearrangement of series.
6. Test for absolute convergence.
7. Series whose term form non-increasing sequence.
8. Summation by parts.

6. Sequence and Series of Functions (18 Periods, 16 Marks)

1. Pointwise convergence of sequences of functions.
2. Uniform convergence of sequences of functions.
3. Consequences of Uniform convergence.
4. Convergence and uniform convergence of series of functions.
5. Integration and differentiation of series of functions.

7. Fourier Series (16 Periods, 18 Marks)

1. Fourier series and Fourier coefficients.
2. Dirichlet's condition of convergence (Statement only)
3. Fourier series for even and odd function.
4. Sine and Cosine series in half range.

Recommended Book :

1. **Mathematical Analysis :** By S.C. Malik and Savita Arora.
2. **Mathematical Analysis :** By S.K. Chatterjee.
3. **Methods of Analysis :** By P. R. Goldberg.

T.Y.B.Sc.

MATHEMATICS - PAPER - III

ALGEBRA

1. Normal Subgroups (13 Periods, 13 Marks)
   1. Normal Subgroups
   2. Proper and improper Subgroups.
   3. Simple groups.
   4. Commutator Subgroups.
   5. Quotient groups.

2. Permutation and Homomorphism of groups. (13 Periods, 12 Marks)
   1. Definitions, permutation, cycle, transposition.
   2. Permutation as a product of disjoint cycle and transposition.
   3. Even and odd permutations.
   4. Permutation groups, Alternating groups.
   5. Definitions of Homomorphism, Isomorphism and examples.
   6. The fundamental Homomorphism theorem.

3. Rings and Homomorphism of rings. (13 Periods, 13 Marks)
   1. Revision – Definitions-Rings. Integral domain, Field. Division-ring. Divisors of zero and basic properties of rings.
   2. Characteristic of rings.
   3. Sub rings. (Definition and examples)
   4. Ideals, left and right ideals, Principal ideals, maximal ideals, prime ideals.
   5. Simple rings.
   6. Properties of quotient rings.
   7. Field of quotients of an Integral Domain (only application)
   8. Homomorphism of rings- Definition and examples.
   9. Ring of Isomorphism - Definition and examples.
   10. Fundamental theorem of ring homomorphism.

4. Polynomial Rings (13 Periods, 12 Marks)
   1. Definition of Polynomial rings.
   2. Addition and multiplication of two Polynomial.
   3. Degree of Polynomials.
   4. Properties of Polynomial rings.
   5. Division Algorithm (without proof)
   6. Reducible and irreducible Polynomials.
   7. Eisenstein's irreducibility criterion.

5. Vector Spaces. (22 Periods, 20 Marks)

1. Vector Spaces, Subspaces, Examples.
2. Necessary and sufficient condition for a Subspace.
3. Addition, Intersection, Union of Subspace.
4. Quotient space.
5. Linear span and properties.
6. Linear dependence, Linear independence.
7. Basic and dimensions of finite dimensional vector spaces.
8. Co-ordinate of a vector.
9. Existence theorem, Invariant of elements in a basis.
10. Extension theorem
11. Theorem on Basis and Dimensions

6. Linear Transformations (15 Periods, 15 Marks)

1. Range space and Null space of linear transformations.
2. Rank and Nullity Theorem.
3. Vector space $L(V,W)$
4. Algebra of linear transformations and theorems on isomorphism.
5. Invertible linear transformations.
6. Singular and non-singular linear transformations.
7. Representation of Linear transformations by Matrix.

7. Eigen Values and Eigen Vectors (15 Periods, 15 Marks)

1. Matrix polynomial.
2. Characteristic polynomial and minimal polynomial.
3. Eigen Values and Eigen Vectors of Linear transformations.
4. Similarity.
5. Diagonalisation of matrix
6. Cayley – Hamilton theorem.

Recommended Book :

1. **Topics in Algebra :** By- I. N. Herstein.
2. **A First Course in Abstract Algebra:** By- J. B. Fraleigh.
3. **University Algebra.** By- N. S. Gopalkrishanan.
4. **Modern Applied Algebra.** By- Garret Birkhot & Thomos Bartee.
5. **Linear Algebra.** By- Hoffman and Kinze.

T.Y.B.Sc.

MATHEMATICS - PAPER - IV

DIFFRENTIAL EQUATIONS AND DYNAMICS

1. Linear Differential Equations with Constant Coefficients. (18 Periods, 16 Marks)
   1. Complementary functions.
   2. Particular Integral of $F(D)\,y = X$ where $X = e^{ax}$, cosax, or sinax, x^n, $e^{ax}V$, xV, with usual notions.
2. Homogeneous Differential Equations and Reducible to Homogeneous Differential Equations. (6 Periods, 6 Marks)
3. Exact Differential Equations of Higher Order. (10 Periods, 10 Marks)
   1. Exact Differential Equations.
   2. Condition of Exactness.
   3. Integrating Factor.
   4. Exactness of non-linear equation by inspection.
   5. Equations of the form $\frac{d^n y}{dx^n} = f(x)$ and $\frac{d^2 y}{dx^2} = f(y)$
4. Linear Differential Equations of Second Order (18 Periods, 18 Marks)
   1. General form.
   2. Methods of solution by
      a) Change of Dependent variable reduction of order.
      b) Removal of first order derivative.
      Change of Independent variable.
5. Kinematics. (12 Periods, 11 Marks)
   1. Displacement.
   2. Motion in a straight line. Velocity and Acceleration.
   3. Motion in a plain. Velocity and Acceleration.
   4. Radial and Transverse Components of Velocity and Acceleration.
   5. Angular Velocity and Acceleration.
   6. Tangential and Normal components of Velocity and Acceleration.
6. Rectilinear Motion (14 Periods, 11 Marks)
   1. Motion in a straight line with constant acceleration.
   2. Motion of a train between two stations.
   3. Simple Harmonic Motion.

T.Y.B.Sc.

MATHEMATICS - PAPER – V(A)

NUMERICAL ANALYSIS & OPERATIONS RESEARCH

1. Algebraic and Transcendental Equations. (8 Periods, 9 Marks)
   1. Regula- Falsi Methiod (Method of false position).
   2. Newton Raphson Method.
   3. Iteration method $x = \phi(x)$

2. Curve Fittings. (9 Periods, 9 Marks)
   1. Method of least squares.
   2. Fitting of straight line $y = a + bx$
   3. Fitting of curves $xy = K$, $y = ab^x$, $y = ae^{bx}$, $y = ax^b$
   4. Fitting of 2nd degree parabola $y = a+bx+cx^2$

3. Finite Differences and Interpolation. (12 Periods, 9 Marks)
   1. Finite forward and backward differences, forward and backward shift operatrors, μ & δ operators, Inter relation between these operators.
   2. Newton's forward and backward Interpolation formulae.
   3. Lagrange's Interpolation formula for unequally spaces points.

4. Numerical Differentiation (5 Periods, 5 Marks)

   First and Second order derivatives at a given point using
   1. Newton's forward Interpolation formula
   2. Newton's backward Interpolation formula

5. Numerical Integration. (8 Periods, 9Marks)
   1. General quadrature formula for equidistance ordinates
   2. Trapezoidal rule.
   3. Simpson's $\frac{1}{3}$ rule.

6. Solution of ordinary differential equations of first order and first degree. (10 Periods, 9 Marks)
   1. Euler's method and modified Euler's method.
   2. Taylor's series method.
   3. Runge - Kutta's method.

7. Linear programming problem (LPP) (16 Periods, 16 Marks)
   1. Formulation of LPP.
   2. Solution of LPP by graphical method.

3. Solution of LPP by simplex method.
4. Artificial variable Technique.(big M method)
5. Special cases in LPP
   a) Unbounded solution.
   b) Alternate solution.
   c) no solution.
   by graphical as well as. Simplex method.
6. Degeneracy in Simplex method and its resolution.

8. Transportation Problem (TP) (14 Periods, 16 Marks)

1. Formulation of TP; TP as an LPP.
2. Following methods for finding IBFS.
   a) North-west corner rule.
   b) Matrix minima method (least cost method)
   c) Vogel's Approximation method (VAM)
3. Optimality test and optimisation of Solution to TP by U-V method.
4. Following cases in T.P.
   a) Alternate solution.
   b) Maximisation of T.P.
   c) Degeneracy in solving T.P.
   d) Restricted transportation problems

9. Assignment Problem (AP) (10 Periods, 9 Marks)

1. Formulation of Assignment Problem A.P. as a T.P.
2. Hungerian method for solving and A.P.
3. Following cases in A.P.
   a) Alternate solution.
   b) Max. nisation of A.P.
   c) Restricted A.P.

10. Game Theory (12 Periods, 9 Marks)

1. Competition situation and definition of game, Two perosn – Zero sum game.
2. Pure and mixed strategies, value of game.
3. Maximin and minimax principles and saddle point.
4. Analytic solution of 2 x 2 game (without proof)
5. Principle of dominance.
6. Graphical solution of m X 2 and 2 X n games.

Recommended Books :

4. **Introductory Methods of Numerical Analysis :** By S.S. Sastry.
5. **Calculus of finite Difference and Numerical Analysis :** By P.P. Gupta. & G.S. Malik
6. **Operation Research** : By- Kanti Swarup, P.K. Gupta (S.Chand & sons)
7. **Operation Research** : By- V.K. Kapoor (S.Chand & sons)

Reference Books :

1. Numerical methods for scientific and engineering computations. By- M.K. Jain, S.R.K Iyengar & R.K. Jain. (S.Chand & sons)
2. **Operation Research** : By- Gupta & Hira.
3. **Optimisation Method :** By- Mittal

COMPUTER PROGRAMMING IN 'C'

1. Introduction to 'C' (4 Periods, 04 Marks)
   1. Introduction
   2. Methods of writing 'C' program.
   3. Programming style.
   4. Executing a 'C' program..

2. Constant Variable and Data types. (12 Periods, 10 Marks)
   1. Constant.
   2. Variable.
   3. Data type and ranges.
   4. Arithmetic operators.
   5. Logical operators.
   6. Arithmetic expressions.
   7. Comment statement.
   8. Mathematical functions.

3. Input and Output Operators (6 Periods, 6 Marks)
   1. Reading & writing a character.
   2. Input statement.
   3. Output statement.

4. Decision making and Branching (10 Periods, 16 Marks)
   1. Simple 'If' statement.
   2. Compound 'If' statement.
   3. Nested 'If' statement.
   4. 'If-else' Construct statement

5. Decision making and Looping (10 Periods, 16 Marks)
   1. 'for' statement
   2. 'while' statement
   3. 'Do-while' statement
   4. 'brake' statement
   5. 'continue' statement.

6. Case Control (6 Periods, 6 Marks)

1. 'switch' statement
2. 'go to' statement

7. Function Program (7 Periods, 6 Marks)

1. Procedure of writing function program.
2. Types of function program, non-returnable function program, returnable function program, Input / Output argument function program, 'void' function program, recursive function.
3. Function program numerical mathematical technique.

8. Arrays. (15 Periods, 10 Marks)

1. One-dimensional arrays.
2. Two-dimensional arrays.
3. Multi-dimensional arrays.

9. Structure. (15 Periods, 16 Marks)

1. Structure definition
2. Giving value to members
3. Comparison of structure variables
4. Arrays of structure.
5. Arrays within structure.
6. Structure within structure.
7. Structure and function.
8. Unions.
9. Size of structure.

10. File management in 'C' (15 Periods, 18 Marks)

1. Defining and opening a file.
2. Closing a file.
3. Input / output operations on files.
4. Error in opening of files.
5. 'fgets' & 'fput' function.
6. Stdin, Stdout & Stderr file pointer
7. 'exit', 'rewind', 'fread', 'fwrite', 'fseek', 'ftell' function.

Reference Books :

1. **Programming in ANSI 'C'** : By- E. Balagurusamy. (Tata McGraw-Hill Publishibng Company Ltd.)
2. **Let Us 'C'** : By- Yashvant Kanetkar. (BPB Publication).
3. **Programming in 'C' and C++** : By- S. S. Khandare (S.Chand & Co. Ltd)

T.Y.B.Sc.

MATHEMATICS - PAPER – V(C)

NUMBER THEORY AND COMBINATORICS

1. Divisibility of Integers. (20 Periods, 16 Marks)

1. Well ordering principle (Statement only), Principle of mathematical induction (Statement only). Definition of divisibility of integers, Theorems on divisibility (Statement only).
2. Division algorithm Theorem (with proof)
3. Definition : Greatest common divisor, relatively prime number (Co-prime), least common multiple.

Theorem I : Let a and b any two integers. then prove that (a,b) ·[a, b] = ab

Theorem II : Bezout's Theorem (without proof) Euclidean theorem (with proof)

Theorem III : Let m be any integer and a,b any integer at least one of which is non – zero then (ma, mb) = |m| (a, b)

Theorem IV: If d = (a,b) then prove that (a/d, b/d) = 1.

Theorem V: If a|c, b|c and (a,b) = 1 then prove that ab|c, conclusion is false if (a,b) ≠ 1.

4. Definition : Prime and composite number.
   Euclid's Lemma (with proof)
5. 1. Definition : Fermat's number F_n
   Prove that (I) $F_n - 2 = F_0 F_1 ... F_{n-1}$, $n \geq 1$
   (II) Any two Fermat's numbers are relatively prime.
   2. Mersenne Numbers M_n, Mersenne Prime (Definition)
   3. Prove that every integer greater than one can be expressed as a product of primes powers
   4. The fundamental Theorem of Arithmatics (with proof)

2. Congruences : (16 periods 18 marks)

1 Definition a ≡ b (mod n)
Theormes on congruences (Statement only)

2 Fermat, Euler, Wilson Theorem (with proof)
Definition of inverse of a modulo m. Complete residue system (with proof)
Illustrate with examples.

T.Y.B.Sc.

MATHEMATICS - PAPER – VI(A)

DIFFERENTIAL GEOMETRY AND ASTRONOMY

1. Curve in Spaces. (26 Periods, 24 Marks)

   1. Parametric and Vector representation of Curves.
   2. Tangent line, Principal normal and bionormal at a point on a space Curve.
   3. Osculating plane, Normal plane and Rectifying plane at a point on a space curve.
   4. Curvature, Torsion and radius of Curvature.
   5. Serret - frenet Formulae. Expression for Curvature and Torsion .
   6. Helices, Circle of Curvature and Sphere of Curvature.
   7. Properties of Circle of Curvature and Sphere of Curvature. Properties of locus of center of circular and spherical Curvature.
   8. Involutes and Evolutes.
   9. Spherical indicatries.
   10. Bertrand Curves.

2. Developable surfaces (26Periods, 26 Marks)

   1. Parametric representation of surfaces. Tangent plane and normal line at a point on a surface.
   2. Envelope, characteristic and edge of regression to one parameter family of surface.
   3. Envelopes and characteristics to one parameter family of planes and two parameter family of planes.
   4. Developable surfaces. General differential equation of a developable surfaces
   5. Developables associated with a space curve.
   6. Properties of associated developables.

3. Spherical Trigonometry (15Periods,16 Marks)

   1. Angle of intersection of two great circles. Secondaries. Relation between arc of a small circle and arc of a great circle.
   2. Spherical triangle, Polar triangle.
   3. Sine rule, Cosine rule, Cotangent rule, Supplemental Cosine rule, Sine Cosine rule, Sine Cosine tangent of angle and half angle as function of sides and vice versa.

4. Napier's Delambre's Analogies. (7 Periods, 11 Marks)

1. Right angled spherical triangles
2. Napier's rule of circular parts in Right angled spherical triangles.

5. Astronomy (15 Periods, 11 Marks)

1. Cellestial sphere and different systems of Cellestial co-ordinates
2. Rising setting conditions of a star. Motion of Sun.
3. Siderial time.
4. Rate of change of Zenith distance and azimath.

6. Twilight (15 Periods, 12 Marks)

1. Atmospheric refraction. Refraction in Zenith distance.
2. Cassini's hypothesis
3. Differential equation for refraction
4. Simpson's and Braddley's hypothesis.
5. Refraction in any direction. Refraction in right ascersion and declination.

Recommended Book :

1. **Three Dimensional Differential Geometry :** By- Bansilal.(Atmaram & Sons)
2. **Spherical Trigonometry:** By- Tpdhunter (Revised by Gorakh Prasad)
3. **Spherical Astronomy:** By- Gorakh Prasad (Published by Pothishala, Allahabad)

Reference Books :

1. **Spherical Astronomy:** By- Smart W.M (Published by Vikas Publication House Pvt. Ltd. New Dehli)
2. **Theory and Problems Differential Geometry.** By- Martin M. Lipschutz. (Schaum's Series)
3. **Differential Geometry.:** By- Weatherburn.
4. **Differential Geometry.:** By- J. Struik
5. **Differential Geometry.:** By- A. R. Vashishtha and Sharma.
6. **Differential Geometry.:** By- Dr. Mittral Agrawal.

MATHEMATICAL METHODS

1. Laplace Transform. (20 Periods, 22 Marks)

1. Definition of Laplace Transform.
2. Piecewise continuity.
3. Functions of exponential order.
4. Sufficient condition for existence of Laplace Transform.
5. Laplace Transform of some elementary functions
   [$F(t) = 1, t^n, e^{at}$, sin at , cos at sinh at cosh at]
6. Properties of Laplace Transform
   a) Linearily.
   b) First and second translation.(Shifting Theorems)
   c) Change of Scale.
   d) Laplace Transform of derivatives.
   e) Laplace Transform of integrals.
   f) Multiplication by t^n.
   g) Division by t
7. Evaluation of integrals using Laplace Transform

2. Inverse Laplace Transform. (20 Periods, 22 Marks)

1. Definition of Inverse Laplace Transform.
2. Some Inverse Laplace Transform. (Use of tables)
3. Properties of Inverse Laplace Transform.
   a) Linearily.
   b) First and second translation.
   c) Change of Scale.
   d) Inverse Laplace Transform of derivatives.
   e) Inverse Laplace Transform of integrals.
   f) Multiplication by s^n.
   g) Division by s
4. Use of partial fractions.

3. Applications to Differential Equations. (12 Periods, 6 Marks)

1. Ordinary differential equations with constant coefficients.
2. Simultaneous Ordinary differential equations.

4. Ordinary Differential Equations in more than two variables. (15 Periods,16 Marks)

1. Surface and curves in three dimensions.
2. Simultaneous differential equations of first order and first degree in three variables.

3. Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$
4. Orthogonal trajectories of a system of curves on a surface.
5. Pfaffian (Total) differential equations. Theorems.
6. Solution of Pfaffian differential equations in three variables.

5. Partial Differential Equation of first Order (25 Periods, 22 Marks)

1. Partial Differential Equations.
2. Origin of first order Partial Differential Equations.
3. Linear Equations of first order.
4. Integral surface passing through a given curve.
5. Surface orthogonal to given system of surfaces.
6. Compatible system of equations of first order.
7. Charpit's method.
8. Special types of first order equations.
9. Jacobi's method.

6 Partial Differential Equation of Second Order (12Periods, 22Marks)

1. The origin second order equations.
2. Non-linear equation of second order.
   Monge's method of solving $Rr + Ss + Tt = V$

Recommended Book :

1. **Theory and Problems of Laplace Transform:** By- Murray R. Spiegel (Schaum's Outline Series)
2. **Elements of Prtial Differential Equations :** By- Ian Sneddon
   Chapter. I. (Art. 1.1, to 1.6)
   Chapter. II. (Art. 2.1, 2.2, 2.4, 2.5, 2.6, 2.9, 2.10, 2.11, 2.13)
   Chapter. III. (Art. 3.1, 3.11)
3. **Advanced Differential Equations :** By- Raisinghania (S. Chand & Co. New Delhi)

DISCRETE MATHEMATICS

1. Posets. (6 Periods, 6 Marks)

1. Posets and Chain.
2. Diagramatical Representation of poset, Hasse Diagram.
3. Maximal and Minimal Elements of the subset of a Poset Zorne's lemme (statement)
4. Supremum and Infimum of the subset of a Poset
5. Poset Isomorphism
6. Duality Principle.
7. Product of two Posets.

2. Lattices : (10 Periods, 10 Marks)

1. Two definitions of a lattice and Equivalence of two definitions.
2. Modular and Distributive inequalities in a lattice.
3. Sublattice and Semilattice.
4. Complete lattice.

3. Ideals and Homomorphisms : (18 Periods, 16 Marks)

1. Ideals, union and Intersection of Ideals.
2. Prime Ideal.
3. Principal Ideal.
4. Dual Ideal
5. Principal Dual Ideals.
6. complements; relative complements.
7. Pentagonal lattice n_5 .
8. Length and covering conditions; Jordan Dedekind Condition, atom, Dual atoms.
9. Homomorphisms; Join and Meet Homomorphism, embedding mappings.
10. Quotient lattice : Definition and Examples only.

4. Modular and Distributive lattices : (18 Periods, 18 Marks)

1. Modular Lattice.
2. Sublattice of a modular lattice.
3. Homomorphic image of Modular lattice.
4. Product of two modular lattice.
5. Modularity of I (L), (Ideal lattice of L)
6. Complemented and Relatively Complemented lattice.

7. Distribute lattice: Definition and necessary and sufficient condition for a lattice to be distributive.
8. Sublattice of distributive lattice.
9. Homomorphic image of distributive lattices.
10. Product of distributive lattices.
11. Distributivity of I (L) : (Ideal lattice of L) .
12 Boolean lattice

5. Boolean Algebra : (16 Periods, 16 Marks)

1. Boolean Algebra; Definition and Examples.
2. Axioms for Boolean Algebra.
3. Atoms.
4. Symmetric Difference.
5. Boolean Rings.
6. Application of Boolean Algebra to switching Circuits and Simplification of Circuits.

6. Graphs (12 Periods, 10 Marks)

1. Types of Graphs : Simple Graphs, regular graph, complete graphs, Bipartite Graphs, Complete Bipartite Graphs, null graphs.
2. Hand – Shaking lemma.
3. Sub graphs : Sub graphs, spanning Sub graphs.
4. Isomorphisms of two graphs.
5. Matrix Representation of Graphs : Incidence Matrix, Adjacency Matrix.
6. Walk, Paths and Cycles, connected and Disconnected Graphs.
7. Operations on Graphs Union Inter section Ring sum, fusion, Edge & vertex deletion.
8. Eulerian and Hamiltonian Graphs .

7 Trees : (12 Periods, 12 Marks)

1. Definition and Properties of Trees.
2. Binary Tree, Rooted Tree and Spanning Tree.
3. Weighted Graphs : Shortest Spanning Tree.
4. Cut Vertices and Connectivity.
5. Cut Sets, Fundamental Cut Sets Fundamental circuits (Definition and Examples only)

8. Planer Graphs and Colouring: (6 Periods, 6 Marks)

1. Planner Graphs, Euler formula for planar graphs.
2. Geometrical Dual of a planer graph.

3. Colouring : Vertex Colouring, Chromatic number, Chromatic Polynomial & Critical Graphs, Four Colouring Theorem, (statement only)

9. Directed Graphs : (6 Periods, 6 Marks)

1. Diagraphs, Types of diagraphs, Multigraphs and general Diagraphs.
2. Isograph, Isolate vertex transmitter, receiver, carrier.
3. Arborescence and tournament.
4. Indegree, Out degree , Hand Shaking dilemma.

Recommended Books

1. **Lattices and Boolean Algebras** (First –Concepts) by Vijay K. Khanna.
   (Vikas Publishing House, Pvt. Limited) Chap –2, Chap –3, Chap-4.
2. **Boolean Algebra and switching Circuits** by Schaum's out line Series.
3. **Graph Theory by Narsingh Deo with Application to: Engg. & Computer Science** (Prentice Hall of India Pvt. Limited.)
   Chap – I, 1.1, 1.3, 1.4, 1.5.
   Chap – II 2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10.
   Theorems : 2.1, 2.2, 2.3, 2.4, 2.6, 2.8.
   Chap – III 3.1, 3.2, 3.3, 3.4, 3.5, 3.7, 3.8, 3.10.
   Theorems : 3.1 to 3.7, 3.9, 3.11.
   Chap – IV : 4.1, 4.3, 4.4, 4.5.
   Chap V : 5.2, 5.3, 5.6.
   Theorems : 5.1, 5.2, 5.6.
   Chap VIII : 8.1, 8.3.
   Theorems : 8.1, 8.2, 8.3, 8.4, 8.5.
   Chap IX : 9.1, 9.2, 9.4, 9.6.
   Theorems : 9.2

Reference Books :

1. **A First Looks at Graph Theory** by J. Clark & D. A. Holton (Allied Publishers Ltd.)
2. **Basic Graph Theory** by K. R. Parthsarathy (Tata M.C. Graw Hill Publishing Co. Ltd.)
3. **Modern Applied Algebra** by Barnte
4. **Disorete Mathematics** by Schaum Outline Series.

T.Y.B.Sc.
MATHEMATICS - PAPER – VII

PRACTICAL COURSE BASED ON PAPER I & II

T.Y.B.Sc.
MATHEMATICS - PAPER – VIII

PRACTICAL COURSE BASED ON PAPER III & IV

T.Y.B.Sc.
MATHEMATICS - PAPER – IX

PRACTICAL COURSE BASED ON PAPER V & VI