

SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

BOARD OF STUDIES IN MATHEMATICS

Syllabus for T.Y.B.Sc (2013 Course)

Subject: MATHEMATICS

(With effect from June 2015)

Introduction:

University of Pune has decided to change the syllabi of various faculties from June, 2013. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects Board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of T.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

- i) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerable power of mathematical ideas and tools and know how to use them by modeling ,solving and interpreting.
- ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
- iii) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .
- iv) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

- (i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays ,state important facts resulting from their studies.
- (ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
- (iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
- (iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Eligibility: S.Y.B.Sc.(With Mathematics)or T.Y.B.Sc Computer Science as per University rules.

Structure of the course:

Semester- III		Semester- IV	
MT 331 :	Metric Spaces	MT 341:	Complex Analysis
MT 332 :	Real Analysis-I	MT 342:	Real Analysis-II
MT 333 :	Problem Course on MT 331 and MT 332	MT 343:	Problem Course on MT 341 and MT 342
MT 334 :	Group Theory	MT 344:	Ring Theory
MT 335 :	Ordinary Differential Equations	MT 345:	Partial Differential Equations
MT 336 :	Problem Course on MT 334 and MT 334	MT 346:	Problem Course on MT 344 and MT 345
Select Any Two out of six courses		Select Any Two out of six courses	
MT 337:A.	Operations Research	MT 347: A	Optimization Techniques
MT 337:B.	Dynamical System	MT 347:B	Differential Geometry
MT 337: C	C- Programming I	MT 347 :C	C- Programming II
MT 337:D.	Lattice Theory	MT 347: D	Graph theory
MT 337: E	Financial Mathematics	MT 347: E	Lebesgue Integration
MT 337:F	Number Theory	MT 347: F	Computational Geometry
MT 338:	Practical based on papers selected from 337 A to 337 F	MT 348 :	Practical based on papers selected from 347 A to 347 F

Note.

1.Papers MT 331 to MT 336 are compulsory , a student can opt any two papers from MT337 A to MT 337 F in first semester.

2.Papers MT 341 to MT 346 are compulsory , a student can opt any two papers from MT347 A to MT 347 F in second semester.

3.For MT 331 to MT 337 and MT 341 to MT 347 each course is of 50 marks (40 marks theory and 10 marks internal examination).

4.Papers MT 338 and MT 348 are practicals and each course is of 50 marks (32 marks theory, 8 marks oral and 10 marks internal examination).

Medium of Instruction: English

Examination:

A) Pattern of examination: Semester wise.

B) Standard of passing : 20 Marks out of 50 marks for each papers. (But for passing a student should obtain minimum 16 marks out of 40 in the theory and oral examination and overall total marks for theory, oral and internal should be minimum 20).

C)Pattern of question papers: For MT 331 to MT 337 and MT 341 to MT 347.

Q1. Attempt any 05 out of 07 questions each of 02 marks. [10Marks]

Q2. Attempt any 02 out of 03 questions each of 05 marks. [10 Marks].

Q.3. Attempt any 02 out of 03 questions each of 05 marks. [10 Marks].

Q.4. Attempt any 01 out of 02 questions each of 10 marks. [10 Marks].

D) External Students: Not allowed.

E) Verification / Reevaluation: Allowed for Theory papers only.

F) Qualifications for Teacher: M.Sc. Mathematics (with NET /SET as per existing rules)

Equivalence of Previous syllabus along with new syllabus:

Semester III		Semester IV	
New Course	Old Course	New Course	OldCourse
MT 331 : Metric Spaces	MT 341: Metric Spaces	MT 341: Complex Analysis	MT 342: Complex Analysis
MT 332: Real Analysis-I	MT 331 : Set Theory and Logic	MT 342: Real Analysis-II	MT 332: Real Analysis
MT 333 : Problem Course on MT 331 and MT 332	MT 343: Problem Course on MT 341 and MT 342	MT 343: Problem Course on MT 341 and MT 342	MT 333 : Problem Course on MT 331 and MT 332
MT 334 : Group Theory	MT 334 : Group Theory	MT 344: Ring Theory	MT 344: Ring Theory
MT 335 : Ordinary Differential Equations	MT 335 : Ordinary Differential Equations	MT 345: Partial Differential Equations	MT 345: Partial Differential Equations
MT 336 : Problem Course on MT 334 and MT 334	MT 336 : Problem Course on MT 334 and MT 334	MT 346: Problem Course on MT 344 and MT 345	MT 346: Problem Course on MT 344 and MT 345
MT 337 A. Operations Research	MT 337 A. Operations Research	MT 347 A : Optimization Techniques	MT 347 A Optimization Techniques
MT 337 B. Dynamical System	MT 347 D : Dynamics	MT 347 B : Differential Geometry	MT 337 D: Differential Geometry
MT 337 C. C- Programming I	MT 337 C. C- Programming I	MT 347 C: C- Programming II	MT 347 C C- Programming II
MT 337 D: Lattice Theory	MT 337 B: Lattice Theory	MT 347D. Graph theory	MT 337 E : Combinatorics
MT 337 E. Financial Mathematics	MT 347 B : Improper Integrals and Laplace Transforms	MT 347 E: Lebesgue Integration	MT 347 E: Lebesgue Integration
MT 337 F. Number Theory	MT 337 F: Number Theory	MT 347F : Computational Geometry	MT 347 F: Computational Geometry
MT 338: Practical based on papers selected from 337 A to 337 F	MT 338: Practical based on papers selected from 337 A to 337 F	MT 348 : Practical based on papers selected from 347 A to 347 F	MT 348 : Practical based on papers selected from 347 A to 347 F

Details of Syllabus:
Semester III

MT 331: Metric Spaces

- 1. Introductory Concepts** [14 Lectures]
Definition and examples of metric spaces, open spheres and closed spheres, neighborhoods, open sets, equivalent Metrics, interior points, closed sets, limit points and isolated points, closure of a set, boundary points, distance between sets and diameter of a set, subspace of a metric space, product metric spaces.
- 2. Completeness** [8 Lectures]
Convergent sequences, Cauchy sequences, complete spaces, dense sets and nowhere dense sets (only definition)
- 3. Continuous Functions:** [6 Lectures]
Definition and characterizations, extension theorem, uniform continuity, homeomorphism
- 4. Compactness** [14 Lectures]
Compact spaces, sequential compactness, equivalence of compactness and sequential compactness, compactness and finite intersection property, continuous functions and compact spaces.
- 5. Connectedness** [6 Lectures]
Separated sets, disconnected and connected sets.

Text Book:

Metric Spaces (second Edition), Pawan K. Jain,
Khalil Ahmad, Narosa Publishing House. Sections: 2.1 to 2.13, 3.1 to 3.5,
4.1 to 4.4, 5.1 to 5.6, 6.1, 6.2.

Reference Books:

1. Topology of Metric Spaces, S. Kumaresan, Narosa Publishing House
2. First Course in Metric Spaces, B. K. Tyagi, Cambridge University Press
3. Metric Spaces, Satish Shirali, H. Vasudeva, Springer
4. Principles of Mathematical Analysis, W. Rudin

MT 332: Real Analysis -I

1. Sets and functions: [12 Lectures]

Operations on sets, Functions, Real-valued functions, Equivalence countability, Real numbers, Cantor set, Least upper bounds

2. Sequences of Real Numbers: [18 Lectures]

Definition of sequence and subsequence, Limit of a sequence, Convergent sequences, Monotone sequences, Divergent sequences, Limit superior, Limit inferior, Cauchy sequences.

3. Series of Real numbers: [18 Lectures]

Convergent and divergent series, series with non-negative terms, alternating series, Conditional and Absolute convergence, Rearrangement of series, Tests of absolute convergence, series whose terms form a non-increasing sequence, The class l^2 .

Text book:

R. R. Goldberg, Methods of real analysis, Oxford & I. B. H. Publications, 1970.
Ch. 1, Art 1.1 to 1.7; Ch. 2, Art 2.1 to 2.10; Ch. 3, Art 3.1 to 3.7 and 3.10

Reference Books:

1. Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015.
2. D. Somasundaram, B. Choudhary - A first course in Mathematical Analysis, Narosa Publishing House, 1997.
3. Robert, G. Bartle, Donald Sherbert - Introduction to real analysis, Third edition, John Wiley and Sons.
4. Shantinarayan and Mittal - A course of Mathematical Analysis, Revised edition, S. Chand and Co.(2002).
5. S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publications, third Edition,(2008).

MT 334: Group Theory

- 1. Groups:** [8 lectures]
Binary Operations, Isomorphic Binary Structures, Groups.
- 2. Subgroups:** [8 lectures]
Subgroups, Cyclic Groups.
- 3. Permutations:** [16 lectures]
Cosets, Direct Product: Groups of Permutations, Orbits, Cycles, Alternating Groups, Cosets and the Theorem of Lagrange, Direct Products.
- 4. Homomorphisms and Factor Groups:** [16 lectures]
Homomorphisms, Factor Groups, Factor Group Computations and Simple Groups.

Text book:

John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson.
[Articles: Section 2 to Section 6, Section 8 to Section 10, Section 11(only Direct Product), Section 13, Section 14, Section 15]

Reference Books:

1. M. Artin, Algebra, Prentice Hall of India, New Delhi, 1994.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, Second Ed., Foundation Books, New Delhi, 1995.
3. I.N. Herstein, Topics in Algebra, John Wiley and Sons.
4. N.S. Gopalakrishnan, University Algebra, Second Edition, New Age International, New Delhi, 1986.
5. Joseph. A. Gallian, Contemporary Abstract Algebra,(4th Edition), Narosa Publishing House.
6. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag, London, 1998.
7. I.N. Herstein, Abstract Algebra.

MT 335: Ordinary Differential Equations

1. Linear Differential Equations with constant coefficients: [12 lectures]

The auxiliary equations. Distinct roots, repeated roots, Complex roots, particular solution. The operator $1/f(D)$ and its evaluation for the functions x^m , e^{ax} , $e^{ax}v$ & xv and the operator $1/(D^2 + a^2)$ acting on $\sin ax$ and $\cos ax$ with proofs.

2. Non-Homogeneous Differential Equations: [14 lectures]

Method of undetermined coefficients, Method of variation of parameters, Method of reduction of order, The use of a known solution to find another.

3. Power series solutions: [12 lectures]

Introduction and review of power series, Linear equations and power series, Convergence of power series, Ordinary points and regular singular points.

4. System of First-Order Equations: [10 lectures]

Introductory remarks, linear systems, homogeneous linear systems with constant Coefficients, Distinct roots, repeated roots, Complex roots.

Text Books:

Elementary Differential Equations, Rainville and Bedient, Macmillan Publication .

Reference Books:

1. Ordinary and Partial Differential Equation, by M.D.Raisinghania, S.Chand and Company LTD, 2009
2. Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGraw-Hill.
3. W.R. Derrick and S.I. Grossman, A First Course in Differential Equations with applications. CBS Publishers and distributors, Delhi-110 032. Third Edition.
4. Shanti Narayan, Integral Calculus, S. Chand and Company.
5. Daniel Murray, Introductory Course in Differential Equations, Orient Longman

MT 337 A: Operations Research

1. Modeling with Linear Programming: [8 lectures]

Two variable LP Model, Graphical LP solution, Selected LP Applications, Graphical Sensitivity analysis.

2. The Simplex Method: [16 lectures]

LP Model in equation form, Transition from graphical to algebraic solutions, the simplex method, Artificial starting solutions.

3. Duality: [6 lectures]

Definition of the dual problem, Primal dual relationship.

4. Transportation Model: [12 Lectures]

Definition of the Transportation model. The Transportation algorithm.

5. The Assignment Model: [06 Lectures]

The Hungarian method, Simplex explanation of the Hungarian method.

Text Book:

Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.

Ch.2: 2.1,2.2,2.3(2.3.4, 2.3.5, 2.3.6). **Ch.3:** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 (3.6.1).

Ch.4: 4.1, 4.2. **Ch.5:** 5.1,5.3 (5.3.1, 5.3.2, 5.3.3), 5.4(5.4.1, 5.4.2).

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operation Research (Eighth Edition) Tata McGraw Hill.

2. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmilan India Ltd.

3. Hira and Gupta, Operation Research.

MT 337 B: DYNAMICAL SYSTEMS

1. Planar Linear Systems

[12 Lectures]

System of first order differential equations, Autonomous system, equilibrium points, Conversion of second order differential equation into a system of differential equations. Preliminaries from Linear Algebra Review of Linear dependence and basis in \mathbb{R}^2 , Writing planar system in matrix form, Eigenvalues and eigenvectors Examples, Solving a linear system, Linearity Principle and examples.

2. Phase Portraits for Planar Systems

[12 Lectures]

Cases of real distinct eigenvalues Concept of Saddle, Source and Sink types of equilibrium points. Complex eigenvalues. Examples to show center, spiral sink and spiral source Repeated Eigenvalues and changing coordinates Examples by diagonalising the matrix.

3. Classification of Planar System and Higher Dimensional Linear Algebra

[12 Lectures]

Review of Linear Algebra, eigenvalues and eigenvectors, properties of determinants, Complex eigenvalues, repeated eigenvalues, Review of Basis and Subspaces, Generosity

4. The exponential of a matrix

[12 Lectures]

Solving a system of first order differential equations by using exponential of a matrix.

Textbook:

Differential Equations, Dynamical Systems and Introduction to Chaos by Morris Hirsch, S. Smale and Devaney, Academic Press, 2004 Elsevier. (Indian Edition)
Section 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.4

Reference Book: Differential Equations, Dynamical System and Linear Algebra by Morris Hirsch and Stephen Smale, Academic Press, 1974, Elsevier

MT 337 C: C Programming-I

1. Introductory Concepts: [2 Lectures]

Introduction to computer. Computer Characteristics. Types of Programming Languages. Introduction to C.

2. C Fundamentals: [4 Lectures]

The character set. Identifier and keywords. Data types. Constants. Variables and arrays. Declarations. Expressions. Statements. Symbolic constants.

3. Operators and Expressions: [6 Lectures]

Arithmetic operators. Unary operators. Relational and Logical operators. Assignment operators. Conditional Operator. Library functions.

4. Data Input and Outputs: [8 Lectures]

Preliminaries. Single character input-getchar() function. Single character output-putchar() function. Writing output data-printf function. Formatted input-output. Get and put functions.

5. Preparing and Running a Program: [2 Lectures]

Planning and writing a C Program. Compiling and Executing the Program.

6. Control Statements: [8 Lectures]

Preliminaries. The while statement. The do-while statement. The for statement. Nested loops. The if-else statement. The switch statement. The break statement. The continue statement. The comma operator.

7. Functions: [8 Lectures]

A brief overview. Defining a function. Accessing a function. Passing arguments to a function. Specifying argument data types. Function prototypes ,Recursion.

8. Arrays: [10 Lectures]

Defining an array. Processing an array. Passing arrays to a function. Multidimensional arrays. Arrays and strings.

Text Book:

Programming with C. By Byron S. Gottfried. Schaum's Outline series.
Chapters:1,2,3,4,5,6,7,9.

Reference Book: The C Programming Language. By Brian W. Kernighan, Dennis M. Ritchie.

MT 337 D: Lattice Theory

1. Ordered Sets

[12 lectures]

- a. Ordered sets.
- b. Examples from social science and computer science.
- c. Diagrams : the art of drawing ordered sets.
- d. Constructing and de-constructing ordered sets.
- e. Down-sets and up-sets.
- f. Maps between ordered sets.

2. Lattices and Complete Lattices

[18 lectures]

- a. Lattice as ordered sets.
- b. Lattices as algebraic structures.
- c. sublattices, products and homomorphisms.
- d. Ideals and Filters.
- e. Complete lattices and Intersection-structures.
- f. Chain conditions and completeness.
- g. Join-irreducible elements.

3. Modular, distributive and Boolean Lattices

[18 lectures]

- a. Lattices satisfying additional identities.
- b. The characterization Theorems of Modular and Distributive lattices.
- c. Boolean lattices and Boolean algebras.
- d. Boolean terms and disjunctive normal form.

Test-book:

B.V. Davey and H.A. Priestley : Introduction to Lattices and Order, Cambridge University Press, Second edition, 2002. (**Chapters 1,2 and 4**).

Reference Book :

S. Greitzer, General Lattice Theory, Academic Press.

MT 337 (E): Financial Mathematics

- 1. Mathematical models in economics** [06 Lectures]
Introduction, a model of the market, market equilibrium and excise tax.
- 2. The elements of finance and the cobweb model:** [10 Lectures]
Interest and capital growth, income generation, the interval of compounding, stability of market equilibrium, the general linear case and economic interpretation.
- 3. Introduction to optimization:** [8 Lectures]
Profit maximization, critical points, optimization in an interval and infinite intervals.
- 4. The derivative in economics:** [12 Lectures]
Elasticity of demand, profit maximization again, competition versus monopoly, the efficient small firm, startup and breakeven points.
- 5. Linear equations :** [4 Lectures]
Making money with matrices, a two-industry 'economy', arbitrage portfolios and state prices, IS-LM analysis.
- 6. The input-output model:** [8 Lectures]
An economy with many industries and the technology matrix.

Text Book

Martin Anthony and Norman Biggs, Mathematics for Economics and Finance Methods and Modelling, Cambridge University Press, Reprint 2012.

Reference Book

Edward T. Dowling , Mathematical Economics, Second Edition, Schaum's Outline Series, McGraw Hill International Edition.

MT 337 F: Number Theory

1. Divisibility :

[8 Lectures]

Divisibility in integers, Division Algorithm, GCD, LCM, Fundamental theorem of Arithmetic, Infinitude of primes, Mersene Numbers and Fermat Numbers.

2. Congruences

[12 Lectures]

Properties of Congruences, Residue classes, complete and reduced residue system, their properties, Fermat's theorem. Euler's theorem, Wilson's theorem, $x^2 \equiv -1 \pmod{p}$ has a solution if and only if $p = 2$ or $p \equiv 1 \pmod{4}$, where p is a prime. Linear Congruences of degree 1, Chinese remainder theorem.

3. Greatest integer function:

[10 Lectures]

Arithmetic functions Euler's function, the number of divisors $d(n)$, sum of divisors $\sigma(n)$, $\omega(n)$ and $\Omega(n)$. Multiplicative functions, Möbius function, Möbius inversion formula.

4. Quadratic Reciprocity:

[10 Lectures]

Quadratic residues, Legendre's symbol. Its properties, Law of quadratic reciprocity.

5. Diophantine Equations :

[8 Lectures]

Diophantine Equations $ax + by = c$ and Pythagorean triplets.

Text Book:

1. I. Niven, H. Zuckerman and H.L. Montgomery, An Introduction to Theory of Numbers, 5th Edition, John Wiley and Sons.
(§1.1- §1.3, §2.1- §2.3, §3.1- §3.3, §4.1 -§4.3, §5.1 and §5.3.)

Reference Book:

1. David M. Burton, Elementary Number Theory (Second Ed.), Universal Book Stall, New Delhi, 1991.

Semester IV

MT 341: Complex Analysis

1. Complex Numbers

[6 Lectures]

Sums and products, Basic algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential Form, Products and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Examples, Regions in the complex plane.

2. Analytic functions

[12 Lectures]

Functions of Complex Variables, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulas, Cauchy-Riemann Equations, Sufficient Conditions for differentiability, Polar coordinates, Analytic functions, Harmonic functions.

3. Elementary Functions

[7 Lectures]

The Exponential functions, The Logarithmic function, Branches and derivatives of logarithms, Some identities involving logarithms, Complex exponents, Trigonometric functions, Hyperbolic functions.

4. Integrals

[12 Lectures]

Derivatives of functions, Definite integrals of functions, Contours, Contour integral, Examples, Upper bounds for Moduli of contour integrals, Anti-derivatives, Examples, Cauchy-Goursat's Theorem (without proof), Simply and multiply Connected domains. Cauchy integral formula, Derivatives of analytic functions. Liouville's Theorem and Fundamental Theorem of Algebra.

5. Series

[5 Lectures]

Convergence of sequences and series, Taylor's series, Laurent series (without proof), examples.

6. Residues and Poles

[6 Lectures]

Isolated singular points, Residues, Cauchy residue theorem, residue at infinity, types of isolated singular points, residues at poles, zeros of analytic functions, zeros and poles.

Text Book:

J.W. Brown and R.V. Churchill, Complex Variables and Applications, International Student Edition, 2009. (Eighth Edition).

Chapter 1 : §1 to §11. Chapter 2: §12, §15 to §26. Chapter 3 : §29 to §35. Chapter 4 : §37 to §46 and §48 to §53. Chapter 5: §55 to §60 and §62. Chapter 6: §68 to §76.

Reference Books:

1. S. Ponnusamy, Complex Analysis, Second Edition (Narosa).
2. S. Lang, Complex Analysis, (Springer Verlag).
3. A.R. Shastri, An Introduction to Complex Analysis, (MacMillan).

MT 342: Real Analysis-II

1. Riemann Integral:

[16 Lectures]

Sets of measure zero, Definition and existence of Riemann integral, properties of Riemann integral, Fundamental theorem of integral calculus, mean value theorems of integral calculus.

2. Improper Integrals:

[16 Lectures]

Definition of improper integral of first kind, comparison test, test, absolute and conditional convergence, integral test for convergence of series, definition of improper integral of second kind, Cauchy principal value.

3. Sequences and series of functions:

[16 Lectures]

Point wise and uniform convergence of sequences of functions, consequences of uniform convergence, convergence and uniform convergence of series of functions, integration and differentiation of series of functions.

Text Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and I. B. H. Publication Co., 1970 Ch. 7, Art. 7.1 to 7.4 and 7.8 Ch. 9, Art 9.1 to 9.5
2. First course in mathematical analysis, D somsundaram, B Chuadhari, Narosa Publishing house 2009. Ch. 8, Art 8.5

Reference Books:

1. Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015.
2. Robert, G. Bartle, Donald Sherbert - Introduction to real analysis, Third edition, John Wiley and Sons.
3. Shantinarayan and Mittal - A course of Mathematical Analysis, Revised edition, S. Chand and Co.(2002).
4. S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publications,Third Edition,(2008).

MT 344: Ring Theory

1. Rings and Fields:

[16 Lectures]

Rings and Fields, Integral Domains, The Fields of Quotients of an Integral Domain, Rings of Polynomials, Factorization of Polynomials over a Field.

2. Ideals and Factor Rings:

[16 Lectures]

Homomorphisms and Factor Rings, Prime and Maximal Ideals.

3. Factorization:

[16 Lectures]

Unique Factorization Domains , Euclidean Domain Euclidean Domains, Gaussian Integers and Multiplicative Norms

Text Book:

John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson.

Articles: Section 18 to Section 23, Section 26, Section 27, Section 45, Section 46, Section 47.

Reference Books:

1. Joseph, A. Gallian, Contemporary Abstract Algebra,(4th Edition), Narosa Publishing House.
2. I.N. Herstein. Abstract Algebra, (3rd Edition), Prentice Hall of India, 1996.
3. N.S. Gopalkrishnan, University of Algebra, Wiley Eastern 1986.
4. C. Musili, Rings and Modules, Narosa Publishing House, 1992.

MT 345: Partial Differential Equations

1. Ordinary Differential Equations in More Than Two Variables [22 Lectures]

- (a) Surface and Curves in Three Dimensions
- (b) Simultaneous Differential Equations of the First Order and the First Degree in Three Variables.
- (c) Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$
- (d) Orthogonal Trajectories of a System of curves on a Surface.
- (e) Pfaffian Differential Forms and Equations.
- (f) Solution of Pfaffian Differential Equations in Three Variables

2. First Order Partial Differential Equations: [26 lectures]

- (a) Genesis of First Order Partial Differential Equations.
- (b) Classification of Integrals.
- (c) Linear Equations of the First Order.
- (d) Pfaffian Differential Equations.
- (e) Compatible Systems.
- (f) Charpit's Method.
- (g) Jacobi's Method.
- (h) Integral Surfaces through a given curve.
- (i) Quasi-Linear Equations.

Text Books:

1. Ian Sneddon, Element of Partial Differential Equations, McGraw-Hill Book Company, McGraw-Hill Book Company. Chapter 1: §1 to §6.
2. T. Amaranath, An Elementary Course in Partial Differential Equations, Narosa Publishing, House 2nd Edition, 2003 (Reprint, 2006). Chapter 1: §1 to §10.

Reference Books:

1. Frank Ayres Jr., Differential Equations, McGraw-Hill Book Company, SI Edition (International Edition, 1972)
2. Ravi P. Agarwal and Donal O'Regan, Ordinary and Partial Differential Equations, Springer, First Edition (2009).
3. W.E. Williams, Partial Differential Equations, Clarendon Press, Oxford,(1980).
4. K. Sankara Rao, Introduction to Partial Differential Equations, Third Edition, PHI.

MT 347 A: Optimization Techniques

1. Network Models [12 Lectures]

CPM and PERT, Network representation, Critical Path Computations, Construction of the time schedule, Linear programming formulation of CPM, PERT calculations.

2. Decision Analysis and Games [12 Lectures]

Decision under uncertainty, Game theory, Some basic terminologies, Optimal solution of two person zero sum game, Solution of mixed strategy games, graphical solution of games, linear programming solution of games.

3. Replacement and Maintenance Models [8 Lectures]

Introduction, Types of failure, Replacement of items whose efficiency deteriorates with time.

4. Sequencing Problems [6 Lectures]

Introduction, Notation, terminology and assumptions, processing n jobs through two machines, processing n jobs through three machines.

5. Classical Optimization Theory [10 Lectures]

Unconstrained problems, Necessary and sufficient conditions, Newton Raphson method, Constrained problems, Equality constraints (Lagrangian Method Only).

Text Book:

1. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi. Ch.6: 6.5 (6.5.1 to 6.5.5).

Ch.13: 13.3, 13.4(13.4.1,13.4.2,13.4.3). Ch.18: 18.1(18.1.1, 18.1.2), 18.2 (18.2.1).

2. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmilan India Ltd. Ch.17: 17.1,17.2, 17.3.

Ch.20: 20.1, 20.2, 20.3, 20.4.

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operation Research (Eighth Edition) Tata McGraw Hill.

2. Hira and Gupta, Operation Research.

MT 347 B: Differential Geometry

1. Curves in the plane and in space. [4 Lectures]
2. How much does a curve? [8 Lectures]
3. Global Properties of curves. [8 Lectures]
4. Surfaces in three dimensions. [8 Lectures]
5. The first fundamental form. [10 Lectures]
6. Curvature of surfaces. [10 Lectures]

Text Book : Andrew Pressley : Elementary Differential Geometry, Springer International Edition, Indian Reprint 2004. Chapters : 1 to 6.

Reference Book : John A. Thorpe : Differential Geometry, Springer International Edition, Indian Reprint 2004

MT 347 C: C programming II

1. Program Structures: [4 Lectures]

Storage classes. Automatic variables. External variables, Static variables.

2. Pointers: [12 Lectures]

Fundamentals. Pointer declarations. Passing pointer to a function. Pointer and one dimensional arrays. Dynamic memory allocation. Operations on pointers. Pointers and multidimensional arrays. Array of pointers. Pointer to function. Passing functions to other functions. More about pointer declarations.

3. Structures and Unions: [12 Lectures]

Defining a structure. Processing a structure. Userdefined data types (typedef). Structures and pointers. Passing structure to a function. Self-referential structures, Unions.

4. Data Files: [10 Lectures]

Opening and closing a data file. Creating a data file. Processing a data file. Unformatted data files. 5. Low-Level Programming: Bitwise operators. Register variables. Enumerations. Macros. Command line arguments. The C processor.

Text Book: Programming with C. By Byron S. Gottfried. Schaum's Outline series. Chapters:8,10,11,12,13,14.

Reference Book: The C Programming Language. By Brian W. Kernighan, Dennis M. Ritchie.

MT 347 D: Graph Theory

1. An Introduction to Graphs

[18 Lectures]

The definition of a Graph, Graphs and Models, More Definitions, Vertex Degree, Sub graphs, Paths and Cycles, The Matrix Representation of Graphs, Fusion

2. Trees and Connectivity

[14 Lectures]

Definition and Simple Properties, Bridges, Spanning Trees, Connector Problems, Shortest Path Problems, Cut Vertices and Connectivity.

3. Euler Tours and Hamiltonian Cycles

[8 Lectures]

Euler Tours, The Chinese Postman Problem, Hamiltonian Graphs, The Travelling Salesman Problem.

4. Directed Graphs

[8 Lectures]

Definitions, In degree and Out degree, Tournaments, Traffic Flow.

Text Book

A First Look at Graph Theory, John Clark and Derek Allan Holton, Allied Publishers Ltd.(1991), Chapter No. 1,2,3 and 7.

Reference Books

1. Introduction to Graph Theory, R. J. Wilson, Pearson(2003)
2. Graph Theory, Hararay, Narosa Publishers, New Delhi(1989)
3. Graph Theory, Narsing Deo, Prentice Hall of India Pvt. Ltd.(1987)
4. Basic Graph Theory, K. R. Parthasarathy, TataMcGraw Hill Publisher Co. Ltd.

MT 347 E: Lebesgue Integration

1. Measurable Sets [12 Lectures]

- (i) Length of open sets and closed sets.
- (ii) Inner and outer measure.
- (iii) Measurable sets.
- (iv) Properties of measurable sets.

2. Measurable Functions [12 Lectures]

3. The Lebesgue integrals [16 Lectures]

- (i) Definition and example of the Lebesgue integrals for bounded functions.
- (ii) Properties of Lebesgue integrals for bounded measurable functions.
- (iii) The Lebesgue integral for unbounded functions.
- (iv) Some fundamental theorems.

4. Fourier Series [8 Lectures]

- (i) Definition and examples of Fourier Series.
- (ii) Formulation of convergence problems.

Text-Book:

Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970).

(Chapter No. 11, 11.1 to 11.8, 12.1, 12.2. Theorem No. 11.1B and 11.1C, 11.8D Statements only).

Reference Books:

1. Tom Apostol, Advanced Calculus, 2nd Edition, Prentice Hall of India, (1994).
2. D. Somasundaram and B. Choudhari, A first course in Mathematical Analysis, Narosa Publishing House, (1997).
3. R.G. Bartle and D.R. Scherbert, Introduction to real analysis 2nd Edition, John Wiley, (1992).
4. Inder K. Rana, Measure and Integratio

MT 347 F: Computational Geometry

1. Two dimensional Transformations

[12 Lectures]

Introduction, Representation of Points, Transformations and Matrices, Transformation of Points, Transformation of Straight Lines, Midpoint Transformation, Transformation of Parallel Lines, Transformation of Intersecting Lines, Rotation, Reflection, Scaling, Combined Transformations, Transformation of the Unit Square, Solid Body Transformation, Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Reflection Through an Arbitrary Line, Projection - A Geometric Interpretation of Homogeneous Coordinates, Overall Scaling, Points at Infinity.

2. Three Dimensional Transformations:

[12 Lectures]

Three Dimensional Scaling and Shearing, Three Dimensional Rotation. Three Dimensional Reflection. Three Dimensional Translation. Multiple Transformations, Rotations about an Axis Parallel to a coordinate axis, Rotation about an Arbitrary Axis in Space, Reflection Through an Arbitrary Plane. Affine and Perspective Geometry, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformations. Techniques for generating perspective views, Vanishing points.

3. Plane Curves

[12 Lectures]

Curve representation, non-parametric curves, parametric curves, parametric representation of a circle, parametric representation of an Ellipse, parametric representation of a parabola, parametric representation of a Hyperbola.

4. Space Curves Beizer curves:

[12 Lectures]

Introduction, definition, properties (without proofs), curve fitting (up to $n = 3$), equation of the curve in matrix form (up to $n = 3$).

Text-Book:

D.F. Rogers, J. Alan Adams, Mathematical Elements of Computer Graphics, Second Edition, McGraw-Hill Publishing Company.

(§2.2 to 2.20, 3.1 to 3.15, 3.17, 4.1 to 4.8, 5.8)

Modalities For Conducting The Practical and The Practical Examination:

Special Instruction: Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed.

- 1) There will be one 3 hour practical session for each batch of 12 students per week
- 2) A question bank consisting at least 60 questions in all for each semester, distributed in two sections: 30 questions each of optional Paper I and optional Paper II will be the course work for this paper. A question bank will be prepared by the individual subject teacher based on pattern of questions provided by university. The question bank of each year should be preserved by the subject teachers, which can be reviewed by the L.I.C. members visiting college.
- 3) University will conduct the Practical Examination each semester twice a year. The practical examination will consist of written examination of 32 marks and oral examination of 08 marks.
- 4) The practical exam will be of the duration of 3 hours.

5) The pattern of question paper for MT 338 and MT348 (Mathematics Practical)

Q1.A) Attempt any 01 out of 02 questions each of 08marks.(Based on optional Paper I) [08 Marks]

B) Attempt any 02 out of 03 questions each of 04 marks.(Based on optional Paper I) [08Marks]

Q2.A) Attempt any 01 out of 02 questions each of 08 marks.(Based on optional PaperII)[08Marks]

B) Attempt any 02 out of 03 questions each of 04 marks.(Based on optional PaperII)[08Marks]

N.B. For C-Programming a separate slip containing programmes for 16 marks.

- 6) Each student will maintain a journal to be provided by the college.
- 7) The internal 10 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practicals.
- 8) It is recommended that concept may be illustrated using computer software and graphing calculators wherever possible.
- 9) Trips/Study tours may be arranged at places having important mathematical institutes or historical places.

