Dr. AMBEDKAR GOVERNMENT ARTS COLLEGE (AUTONOMOUS)
VYASARPADI, CHENNAI – 600 039

MINUTES OF THE MEETING OF BOARD OF STUDIES IN M.Sc. MATHEMATICS

Date of Meeting: 10th June 2019

(a) Resolved that the draft syllabus proposed for M.Sc. (Mathematics) by the Department of Mathematics for the students admitted from the academic year 2019-20 has been discussed and approved.

(b) Resolved that the mandatory areas of the subject recommended by the TANSCHE are incorporated in the syllabus.

(c) Resolved that the draft syllabus would impart an in-depth knowledge and insight to the subject, will offer exposure to job oriented skills and to work on business related problems.

The following members were present in the M.Sc. Board of Studies meeting held on 10th June 2019.

S. No.	Name of the Member	Designation and Institution	Signature
1.	Dr. (Mrs.) A. Sarojini Chairman	Associate Professor and Head, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	10/6/19
2.	Dr. M. Ananthanarayanan University Nominee	Associate Professor, Department of Mathematics, A.M. Jain College, Meenambakkam, Chennai – 114.	10.6.19
3.	Dr. S. J. Venkatesan Subject Expert	Associate Professor, Department of Mathematics, Government Arts College for Men, Nandanam, Chennai – 35.	10.06.19.
4.	Dr. D. Ramamurthy Subject Expert	Assistant Professor and Head, Department of Mathematics, Sir Theagaraya College, Old Washermenpet, Chennai – 600 021.	10/6/19.
5.	Mr. Sridhar Subramaniam Industry Representative	Senior Programmer Analyst, Contec India Private Limited, "Shivam Building", S.No. 257/4B, 200 Feet Radial Road, Chrompet, Chennai – 600 044.	10/6/19
6.	Dr. O.S. Babu Member	Associate Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	10.6.19
7.	Dr. A.R. Ragavan Member	Associate Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	10/6/19
8.	Dr. (Mrs.) J. Desdemona Kirubavathi Member	Associate Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	10.6.19

S. No.	Name of the Member	Designation and Institution	Signature
9.	Dr. S. Karthigeyan Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
10.	Mr. M. K. Purushoth Kumar Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
11.	Mr. K. Thulukkanam Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
12.	Mr. K. Saravanan Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
13.	Mrs. D. Kalpana Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
14.	Dr. G. Palani Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
15.	Dr. (Mrs.) Shirley Gloria D.K. Member	Assistant Professor, PG and Research Department of Mathematics, Dr. Ambedkar Government Arts College (Autonomous), Vyasarpadi, Chennai – 600 0039.	
16.	Mr. Arun Alumnus	Customer Service Representative, Accenture Block B, TECCI Park, 173, Rajiv Gandhi Salai, Sholinganallur, Chennai – 600 119.	

Dr. AMDEDKAR GOVERNMENT ARTS COLLEGE
(AUTONOMOUS)
Post Graduate Courses
M.Sc. Mathematics
Choice Based Credit System

Dr. Ambedkar Government Arts College (Autonomous) offers the Semester System of education with credits for PG courses. Credit simply means the weightage given to what is taught and what is learnt. It is normally related to the number of hours a teacher teaches a particular subject as well as to the number of hours a student spends learning a subject or carrying out an activity. In the semester system of study, every academic year is divided into two semesters. Each semester will have a minimum of 90 working days and each day will have 5 working hours.

Differential weightage is given according to the content and duration of the courses in the curriculum design. Each course is designed variously under lectures / tutorials / laboratory work / seminar / project work / practical training / viva voce, etc to facilitate effective teaching and learning and the credits are assigned accordingly, depending on the content and the specialization.

The minimum credit requirement for a two-year PG course shall be 90.

REGULATIONS

1. Duration

a) There will be two semesters in each academic year. The first academic year shall comprise of the first and second semesters, the second academic year, the third and fourth semesters.

b) The odd semesters shall consist of the period from June to November of each year and the even semesters form December to April of each year.

2. Course of Study

The course of study for Postgraduate Degree courses shall comprise of core courses and electives.

3. System of Credits

Year	No. of Papers		Marks	Credits	
	Core	Elective		Core	Elective
I Year	8	2	1000	32	6
II Year	7	3	1000	28	9
Total	15	5	2000	60	15

Total Credits:

Core + Elective	: 75
EDES (2 x 3)	: 6
Soft Skills (4 x 2)	: 8
Internship	: 2
Total	: 91

4. Passing Minimum

A candidate shall be declared to have passed in each paper/practical of the Main subject of study wherever prescribed if he/she secures NOT LESS THAN 50% of the marks prescribed for the examination. He/She shall be declared to have passed the whole examination, if he/she passes in all papers and practical wherever prescribed, as per the scheme of examination, earning 91 credits.

5. Eligibility for the Award of Degree

Candidates must secure a minimum of 50% of marks in the Semester End Examinations and a minimum of 50% in aggregate marks (Both Semester End and Continuous Assessment taken together). A candidate must secure 6 credits in Extra Disciplinary Elective Subject (EDES), 8 credits in soft skills and 2 credits in internship in addition to 75 credits from core and elective courses to obtain a Postgraduate Degree.

6. Ranking

Candidates who pass all the examinations prescribed for the course in the **FIRST APPEARANCE ALONE** are eligible for **Classification / Ranking / Distinction.**

Distribution of marks for continuous assessment:

Test		Best 1 Out of 2	Assignment / Seminar	Model Exam	Attendance	Total	Reduced to
1	2		1	1			
10	10	10	10	25	5	50	25

Test (Best one out of two) : 10 Marks
Assignment / Seminar : 10 Marks
Model Examination : 25 Marks
Attendance : 5 Marks

End Semester Examination :

Question Paper Pattern:

Section A : (10 out of 12) x 2 = 20 Marks
Section B : (5 out of 8) x 5 = 25 Marks
Section C : (3 out of 5) x 10 = 30 Marks

Total = 75 Marks

Sem. No.	Course	Sub. Code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs.	Marks		Total
							Int.	Ext.	
I	Core		Abstract Algebra	6	4	3	25	75	100
			Real Analysis – I	6	4	3	25	75	100
			Ordinary Differential Equations	6	4	3	25	75	100
			Graph Theory	5	4	3	25	75	100
	Elective I		One from Elective Group	5	3	3	25	75	100
	Soft Skill -1		Employability skills	2	2	3	25	75	100
II	Core		Linear Algebra	6	4	3	25	75	100
			Real Analysis – II	5	4	3	25	75	100
			Partial Differential Equations	5	4	3	25	75	100
			Topology	5	4	3	25	75	100
	Elective II		One from Elective Group	5	3	3	25	75	100
	EDES – I		Mathematics For Competitive Examinations	2	3	3	25	75	100
	Soft Skill -2		Leadership and Communication Skills	2	2	3	25	75	100
			Internship		2	-			
III	Core		Mathematical Methods	6	4	3	25	75	100
			Differential Geometry	5	4	3	25	75	100
			Mathematical Statistics	5	4	3	25	75	100
	Elective III		One from Elective Group	5	3	3	25	75	100
	Elective IV		One from Elective Group	5	3	3	25	75	100
	EDES – II		Applied Statistics	2	3	3	25	75	100
	Soft Skill -3		Managerial Skills	2	2	3	25	75	100
IV	Core		Complex Analysis	6	4	3	25	75	100
			Optimization Techniques	6	4	3	25	75	100
			Functional Analysis	6	4	3	25	75	100
			Mechanics	5	4	3	25	75	100
	Elective V		One from Elective Group	5	3	3	25	75	100
	Soft Skill -4		Personality Development	2	2	3	25	75	100
			Total		91				

Elective Subjects

S. No.	Subjects	Code
1	Number Theory and Cryptography	
2	Difference Equations	
3	Programming in C++ (Theory and Practical)	
4	Numerical Analysis	
5	Formal Languages and Automata Theory	
6	Wavelets	
7	Visual Programming	
8	Tensor Analysis and Theory of Relativity	
9	Resource Management Techniques	
10	Fuzzy sets and their applications	
11	Stochastic Processes	
12	Financial Mathematics	
13	Java Programming	
14	Discrete Mathematics	
15	Fluid Dynamics	

Extra Disciplinary Elective Subjects

S. No.	Subjects	Code
1	Mathematics For Competitive Examinations	
2	Applied Statistics	

SEMESTER-I

- **Abstract Algebra**
- **Real Analysis-I**
- **Ordinary Differential Equations**
- **Graph Theory**
- **Major Elective I: One from Elective Group**
- **Soft Skill-I: Employability skills**

Semester: I
Title: Abstract Algebra
Subject Code:
Credits: 4
Hours: 6

UNIT I: Sylow's Theorem

Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems – double coset – the normalizer of a group.

UNIT II: Finite Abelian Groups

External and Internal direct Products – structure theorem for finite abelian groups – non isomorphic abelian groups.

UNIT III: Splitting Field

Polynomial rings – Polynomials over rational fields – the Eisenstein criterion - extension fields – roots of polynomials – splitting fields.

UNIT IV: Galois Theory

More about roots – simple extension – separable extension – fixed fields – symmetric rational functions – normal extension - Galois group – fundamental theorem of Galois theory.

UNIT V: Solvability by radicals

Solvable group – the commutator sub group – Solvability by radicals - finite fields- Wedderburn Theorem.

Contents and Treatments as in:

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, New York, 1975.

UNIT	Chapter(s)	Sections
I	2	2.11 & 2.12
II	2	2.13 & 2.14
III	3 & 5	3.9, 3.10, 5.1, 5.3
IV	5	5.5 & 5.6
V	5 & 7	5.7, 7.1, 7.2

Reference Books:

1. S. Lang, *"Algebra*", 3rd Edition, Addison-Wesley, Mass, 1993.
2. John B. Fraleigh, *"A First Course in Abstract Algebra",* Addison Wesley, Mass, 1982.
3. M. Artin, *"Algebra",* Prentice-Hall of India, New Delhi, 1991.
4. V. K. Khanna and S.K. Bhambri, *"A Course in Abstract Algebra"*, Vikas Publishing House Pvt Limited, 1993.

Semester: I
Title: Real Analysis-I
Subject Code:
Credits: 4
Hours: 6

UNIT-I : Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation – Total variation on [a, *x*] as a function of *x* - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8
UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula.
Chapter - 7 : Sections 7.1 to 7.10
UNIT-III: Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems. The Riemann-Stieltjes Integral - Intergrals of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals.
Chapter - 7 : 7.11 to 7.18
UNIT-IV : Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.
Chapter - 8 Sec, 8.8, 8.15, 8.17,8.18.
UNIT-V: Sequences of Functions - Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series and functions - Uniform convergence and Riemann - Stieltjes integration – Uniform convergence and differentiation.
Chapter -9 Sec 9.1 to 9.6, 9.8, 9.10.

Contents and Treatment as in:
Tom M.Apostol: Mathematical Analysis, 2nd Edition, Narosa, 1989.
Reference Books:
1. Bartle R. G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik,S.C. and Savita Arora. Mathematical Anslysis, Wiley Eastern Limited. New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964.
6. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.

Semester: I
Title: Ordinary Differential Equations
Subject Code:
Credits: 4
Hours: 6

UNIT-I : Linear equations with constant coefficients: Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian.
Chapter 2: Sections 1 to 5
UNIT-II : Linear equations with constant coefficients(Contd.): Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation.
Chapter 2 : Sections 7 to 11.
UNIT-III : Linear equation with variable coefficients: Initial value problems -Existence and uniqueness theorems – Solutions to solve a non homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients- The Legendre equation.
Chapter : 3 Sections 1 to 8 (Omit section 9)
UNIT-IV : Linear equation with regular singular points: Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel's Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)
UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variables separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)

Contents and Treatment as in;
E.A.Coddington, An introduction to ordinary differential equations (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.

Reference Books:
1. Williams E. Boyce and Richard C. Di Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T.Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001.
6. B.Rai, D.P.Choudhury and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

Semester: I
Title: Graph Theory
Subject Code:
Credits: 4
Hours: 5

UNIT-I : Graphs, subgraphs and Trees : Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut Edges and Bonds – Cut Vertices.
Chapter 1 (Section 1.1 – 1.7)
Chapter 2 (Section 2.1 – 2.3)
UNIT-II : Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.
Chapter 3 (Section 3.1 – 3.2)
Chapter 4 (Section 4.1 – 4.2)
UNIT-III : Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.
Chapter 5 (Section 5.1 – 5.2)
Chapter 6 (Section 6.1 – 6.2)
UNIT-IV : **Independent sets and Cliques, Vertex Colourings** : Independent sets – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.
Chapter 7 (Section 7.1)
Chapter 8 (Section 8.1, 8.2, 8.4)
UNIT-V: Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five- Colour Theorem and the Four-Colour Conjecture (omit Theorem 9.12).
Chapter 9 (Section 9.1 – 9.3, 9.6)

Contents and Treatment as in:
J.A.Bondy and U.S.R. Murty , Graph Theory and Applications , Macmillan, London, 1976.

Reference Books:
1. J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
4. R.J.Wilson and J.J.Watkins, Graphs: An Introductory Approach, John Wiley and Sons, New York, 1989.
5. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
6. 6. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

SEMESTER-II

- **Linear Algebra**
- **Real Analysis-II**
- **Partial Differential Equations**
- **Topology**
- **Major Elective II: One from Elective Group**
- **EDES – I (Mathematics For Competitive Examinations)**
- **Soft Skill-II: Leadership and Communication Skills**

Semester: II
Title: Linear Algebra
Subject Code:
Credits: 4
Hours: 6

UNIT I: Linear transformations

Linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals.

UNIT II: Algebra of polynomials

The algebra of polynomials –Polynomial ideals - The prime factorization of a polynomial - Determinant functions.

UNIT III: Determinants

Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials.

UNIT IV: Diagonalization

Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem.

UNIT V: The Rational and Jordan forms

Cyclic subspaces – Cyclic decompositions theorem (Statement only) – Generalized Cayley – Hamilton theorem - Rational forms – Jordan forms.

REFERENCE BOOKS:

1. Kenneth M Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 2013.

UNIT	Chapter(s)	Sections
I	3	3.1 – 3.5
II	4 & 5	4.1, 4.2, 4.4, 4.5 and 5.1, 5.2
III	5 & 6	5.3, 5.4 and 6.1 – 6.3
IV	6	6.4 – 6.8
V	7	7.1 – 7.3

2. M. Artin, *"Algebra"*, Prentice Hall of India Pvt. Ltd., 2005.
3. S.H. Friedberg, A.J. Insel and L.E Spence, *"Linear Algebra*", 4th Edition, Pritice-Hall of India Pvt. Ltd., 2009.
4. I.N. Herstein, *"Topics in Algebra*", 2nd Edition, Wiley Eastern Ltd, New Delhi, 2013.
5. J.J. Rotman, *"Advanced Modern Algebra*", 2nd Edition, Graduate Studies in Mathematics, Vol. 114, AMS, Providence, Rhode Island, 2010.

G. Strang, *"Introduction to Linear Algebra*", 2ndEdition, Prentice Hall of India Pvt. Ltd, 2013.

Semester: II
Title: Real Analysis-II
Subject Code:
Credits: 4
Hours: 5

UNIT-I : Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Measurable Functions.
Chapter - 2 Sec 2.1, 2.2, 2.4 of de Barra
UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals.
Chapter - 3 Sec 3.1,3.2 and 3.4 of de Barra
UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem.
Chapter 11 : Sections 11.1 to 11.6 of Apostol
UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix – The chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability.
Chapter 12 : Section 12.1 to 12.13 (omit 12.6, 12.10, 12.12) of Apostol
UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem.
Chapter 13 : Sections 13.1 to 13.4 of Apostol

Contents and Treatments as in:

1. G. de Barra, *Measure Theory and Integration*, New Age International, 2003 (for Units I and II)
2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Narosa 1989 (for Units III, IV and V)

Reference Books:

1.Burkill,J.C. *The Lebesgue Integral*, Cambridge University Press, 1951.
2.Munroe,M.E. *Measure and Integration*. Addison-Wesley, Mass.1971.
3.Royden,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988.
4.Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979.
5.Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi, 1991.

Semester: II
Title: Partial Differential Equations
Subject Code:
Credits: 4
Hours: 5

UNIT-I : Partial Differential Equations of First Order: Formation and solution of PDE - Integral surfaces – Cauchy Problem for first order equations- Orthogonal surfaces – Compatible system – Charpit's method. Fundamentals: Classification and canonical forms of PDE.
Chapter 0: 0.4 to 0.8, 0.10 &.11 (omit 0.1,0.2.0.3, .9 and 0.11.1) and Chapter 1: 1.1 to 1.3
UNIT-II : Elliptic Differential Equations: Derivation of Laplace and Poisson equation – BVP – Separation of Variables – Dirichlet's Problem and Neumann Problem for a rectangle – Interior and Exterior Dirichlet's problems for a circle – Interior Neumann problem for a circle – Solution of Laplace equation in Cylindrical and spherical coordinates (Derivations only, omit problems).
Chapter 2: 2.1, 2 2 ,2.5 to 2.12 (omit 2.3, 2.4 and 2.13)
UNIT-III: Parabolic Differential Equations: Occurrence of Diffusion Equation - Boundary conditions - Elementary solution of the diffusion equation - Dirac Delta function - Separation of variables method – Solution of Diffusion Equation in Cylindrical and spherical coordinates (Derivations only, omit problems).
Chapter 3: 3.1 to 3.7
UNIT-IV : Hyperbolic Differential equations: Occurrence of the wave equation - solution of one-dimensional wave equation by canonical reduction – IVP- D'Alembert's solution – Vibrating string – Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems – Uniqueness of the solution for the wave equation.
Chapter 4: 4.1 to 4.11(omit 4.6, 4.7, 4.10)
UNIT-V: Solving PDE using Laplace and Fourier Transforms:. Laplace Transform method: Solution of Diffusion and Wave equation by Laplace Transform. Fourier Transform Method: Finite Fourier sine and cosine transforms – solutions of Diffusion, Wave and Lapalce equations by Fourier Transform Method.
Chapter 6: 6.13.1 and 6.13.2 only (omit (6.14) Chapter 7: 7.10 to 7.13 (omit 7.14)

Contents and Treatments as in:
K. Sankara Rao, *Introduction to Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2005

Reference Books
1. R.C.McOwen, *Partial Differential Equations*, 2nd Edn. Pearson Education, New Delhi, 2005.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd., New Delhi, 2001.

Semester: II
Title: Topology
Subject Code:
Credits: 4
Hours: 5

Unit-I: The definition and some Examples- Elementary concepts - open bases and open sub bases-weak topologies - The function Algebras $\boldsymbol{C}$ (X,R) and $\boldsymbol{C}$ (X,C).
Chapter 3: Sections: 16, 17, 18, 19, 20.
Unit-II: Compactness: Compact Spaces – Products of Spaces – Tychonoffs Theorem and locally compact spaces.
Chapter 4: Sections 21, 22 and 23.
Unit-III: Compactness for metric spaces – Ascoli's Theorem – Separation: T1 – spaces and Hausdorff spaces-Completely Regular spaces and Normal spaces.
Chapter 4: Sections 24 and 25.
Chapter 5: Sections 26 and 27.
Unit –IV Urysohn's Lemma and The Tieze extension theorem – The Urysohn's imbedding Theorem - Connected spaces.
Chapter 5: Sections 28, 29 (Omitted 30).
Chapter 6: Section 31.
Unit-V The Components of a space – Totally disconnected spaces – locally connected spaces.
Approximation: The Weierstrass approximation Theorem.
Chapter 6: Sections 32, 33, 34.
Chapter 7: Sections 35.

Contents and Treatment as in:
Introduction to Topolgy and Modern Analysis by George F. Simmons, International Student Edition.

Reference Books:
1. Munkres J.R. Topology – A first course, Prentice Hall of India, New Delhi, 1994.
2. J. Dugundhi, Topology, Prentice Hall of India, New Delhi, 1975.
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York.

SEMESTER-III

- **Mathematical Methods**
- **Differential Geometry**
- **Mathematical Statistics**
- **Major Elective III: One from Elective Group**
- **Major Elective IV: One from Elective Group**
- **EDES – II (Applied Statistics)**
- **Soft Skill-III: Managerial Skills**

Semester: III
Title: Mathematical Methods
Subject Code:
Credits: 4
Hours: 6

Unit-I

Method of variations with fixed boundaries: Variation and its properties-Euler's Equation-Functional dependence on first and higher order derivatives-functions of several independent variables - Variational problems in parametric form – Some applications –Problems.

Chapter 6 from Elegolts

Unit-II

Variational Problems with moving boundaries: An Elementary problem with moving boundaries-Moving Boundary Problem for a functional of the form $\int_{x_0}^{x_1} F(x, y, z, y', z')dx$ – Extremals with corners – one sided variations – Problems.

Chapter 7 from Elegolts

Unit-III

FOURIER TRANSFORMS: Fourier Transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives - convolution integral – Parseval's Theorem - Solution of Laplace Equations by Fourier transform.

Chapter 7: 7.1 to 7.7 and 7.13 from Sankara Rao

Unit-IV

Integral Equations: Introduction - Integral Equations with Separable Kernels: Reduction to a system of algebraic equations – Fredholm Alternative – An approximate method.

Chapter 1 : Sections 1.1 to 1.7 from Kanwal

Chapter 2 : Sections 2.1 to 2.5 from Kanwal

Unit V

Method of successive approximations: Iterative scheme – Volterra Intergral Equation – Some results about the resolvent kernel.

Chapter 3 : Sections 3.1 to 3.5 from Kanwal

Contents and treatment as in:

For Unit I and Unit II: L.Elegolts, Differential Equations and the Calculus of Variations, MIR Publications, Moscouts 1973.

For Unit III: K. Sankara Rao, *Introduction to Partial Differential Equations*, Prentice-Hall of India Pvt. Ltd., NewDelhi, 2006.

For Unit IV and Unit V: Ram P.Kanwal, *Linear Integral Equations*, Academic Press, New York, 1971.

Semester: III
Title: Differential Geometry
Subject Code:
Credits: 4
Hours: 5

UNIT-I : Space curves: Definition of a space curve – Arc length – tangent, normal and binormal curvature and torsion.
Chapter I : Sections 1 to 5.
UNIT –II: Space curves:
Contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helices.
Chapter I : Sections 6 to 9.
UNIT-III : Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients.-families of curves- Isometric correspondence- Intrinsic properties.
Chapter II: Sections 1 to 9.
UNIT-IV : . Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.
Chapter II: Sections 10 to 18.
UNIT-V : Nonintrinsic properties of a surface: The second fundamental form- Principal curvature – Lines of curvature – Developables – Developables associated with space curves and with curves on surfaces - Minimal surfaces – Ruled surfaces.
Chapter III: Sections 1 to 8.

Contents and Treatment as in:
T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print)

Reference Books:
1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950.
2. A.Pressley, *Elementary Differential Geometry*, Springer International Edition, 2004
3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe *Elementary Topics in Differential Geometry*, Springer International Edition, 2004.

Semester: III
Title: MATHEMATICAL STATISTICS
Subject Code:
Credits: 4
Hours: 5

Unit-I: Probability axioms – Combinatorial formulae – conditional probability – Baye's Theorem – Independent events – Concept of Random Variables – Distribution Function – random variables of discrete and continuous types – functions of random variables – Marginal Distribution – Conditional Distribution – Independent random variables. (Simple problems only)
Chapter 1: Sections 1.3 to 1.7, Chapter 2: Sections 2.1 to 2.4, 2.6 to 2.8.
Unit-II: Parameters of the Distribution of a random variable: Expectation - Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors.
Chapter 3: Sections 3.1 to 3.6
Unit-III: Characteristic functions: Properties of characteristic functions – Characteristic functions and moments – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Probability generating function.(Simple problems only)
Chapter 4: Sections 4.1 to 4.7 (omit 4.3, 4.6)
Unit-IV: Some probability distributions: the Bernoulli scheme – Binomial distribution – Poission scheme – the generalized Binomial distribution – Poisson distribution – Uniform distribution – normal distribution – gamma distribution – Beta distribution.
Chapter 5: Section 5.2 to 5.9 (omit 5.4)
Unit-V: Sample moments and their functions: The notion of a sample – the notion of statistic – distribution of arithmetic mean of independent normally distributed random variables – the chi-square distribution – the distribution of the statistics ($\bar{X}$,S) – student's t-distribution – Fisher's z-distribution.
Chapter 9: Section 9.1 to 9.7

Contents and Treatment as in:

M. Fisz, Probability theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Books for Reference:

1. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
2. Y.S.Chow and H.Teicher, Probability Theory, Springer Verlag. Berlin, 1988 (2^{nd} Edition)
3. V.K.Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
4. S.I.Resnick, A Probability Path, Birhauser, Berlin, 1999.
5. B.R.Bhat, Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

SEMESTER - IV

- **Complex Analysis**
- **Optimization Techniques**
- **Functional Analysis**
- **Mechanics**
- **Major Elective V: One from Elective Group**
- **Soft Skill-IV: Personality Development**

Semester: IV
Title: Complex Analysis
Subject Code:
Credits: 4
Hours: 6

Unit-1: Cauchy's Integral Formula: Definition of analytic function and Introduction to complex integration - The index of a point with respect to a closed curve- The integral formula – Higher derivatives. Local properties of analytical functions: Removable singularities – Taylor's theorem – zeros and poles – The local mapping – The maximum principle.
Chapter4: Sections 2.1 to 2.3
Chapter4: Sections 3.1 to 3.4
Unit – II: The general form of Cauchy's theorem : Chains and Cycles – simple continuity – Homology – The general statement of Cauchy's theorem, proof of Cauchy's theorem, - Calculus of residues : The Residue theorem – The argument principle.
Chapter4: Sections4.1 to 4.5
Chapter4: Sections 5.1to 5.2
Unit-III
Harmonic Functions: Definition of Harmonic function and basic properties – Mean value property – Poisson formula. Harmonic Functions and power series expansions: Schwarz theorem – The reflection principle – weierstrass's theorem – Taylor's series-Laurent series.
Chapter 4: Section 6.1 to 6.5
Chapter 5: Section 1.1 to 1.3
Unit-IV
Partial Fractions and Factorization: Partial fractions – Infinite products – Canonical products-Gamma Function
Chapter 5: Section 2.1 to 2.4
Unit-V
Simply Periodic functions: Representation by Exponentials – The Fourier Developments – Functions of finite order. Doubly Periodic Functions: The Period Module – Unimodular transformations – Canonical basis – General properties of elliptic functions. The Weierstrass theory: The Weierstrass p function – The functions $\zeta(z)$ and $\sigma(z)$ – The differential equation.

Chapter 7: Sections 1.1 to 3.3

Contents and treatments as in:

Lars V.Ahlfors, Complex Analysis (3rd Edition),McGraw Hill Co., New York, 1979.

Reference Books:

1. H.A. Prestly, Introduction to complex analysis, Clarendon Press, Oxford, 1990.
2. J.B.Conway, Functions of one complex variables, springer-verlag, International student edition, Narosa Publishing Co.,

Semester: IV
Title: Optimization Techniques
Subject Code:
Credits: 4
Hours: 6

UNIT-I : Integer Linear Programming: Introduction – Importance of Integer Programming Problem - Gomory's Cutting Plane Method – Branch and Bound Method.
Chapter: 14.
UNIT-II : Goal Programming : Introduction - Concept of Goal Programming – Goal Programming Model formulation – Graphical Solution Method of Goal Programming – Modified Simplex method of Goal Programming.
Chapter: 17.
UNIT-III : Classical Optimization Techniques: Introduction – Unconstrained Optimization – Constrained Multi-variable Optimization with Equality Constraints – Lagrangian Method - Constrained Multi-variable Optimization with inequality Constraints – Kuhn-Tucker conditions.
Non-linear Programming Problem: Introduction – Formulation of NLPP – General NLPP – Graphical solution.
Chapters: 32 and 33.
UNIT-IV: Quadratic Programming: Introduction – Kuhn-Tucker conditions – General Quadratic Programming Problem – Wolfe's Modified simplex method – Beale's Method.
Chapters: 34.
UNIT-V: Dynamic Programming: Introduction – Bellman's Principle of Optimality – Minimum Path problem – Single additive constraint: Multiplicative separable return – Additively separable return – Single multiplicative constraint: Additively separable return.
Chapter: 38.

Contents and Treatments as in:
S.D. Sharma, "Operations Research" 16th Edition, Kedar Nath Ram Nath Publisher, Meerut, 2009.

Reference Books:
1. Hamdy A. Taha, *Operations Research,* (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997.
2. F.S. Hiller & J.Lieberman *Introduction to Operation Research* (7th Edition) Tata- McGraw Hill Company, New Delhi, 2001.
3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979.
4. S.S. Rao - *Optimization Theory and Applications*, Wiley Eastern Ltd. New Delhi. 1990

Semester: IV
Title: Functional Analysis
Subject Code:
Credits: 4
Hours: 6

UNIT-I : Banach Spaces : Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem .
Chapter 9 : Sections 46 to 48.
UNIT-II : The natural embedding of N in N** - Open mapping theorem – conjugate of an operator.
Chapter 9 : Sections 49, 50 and 51
UNIT-III : Hilbert Spaces - Definition and properties – Orthogonal complements – Orthonormal sets.
Chapter 10 : Sections 52, 53 and 54.
UNIT-IV : Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary Operators – Projections.
Chapter 10 : Sections 55 to 59.
UNIT-V: Preliminaries on Banach Algebras **:** Definition and some examples – Regular and singular elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.
Chapter 12 : Sections 64 to 69.

Contents and treatments as in:

G.F.Simmons , Introduction to Topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963.

Reference Books:

1.W.Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi , 1973.
2. G. Bachman & L.Narici, Functional Analysis Academic Press, New York, 1966.
3.C. Goffman and G.Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
4. E. Kreyszig Introductory Functional Analysis with Applications, John wiley & Sons, New York.,1978.
5. M.Thamban Nair, Functional Analysis. A First Course, Prentice Hall of India, New Delhi, 2002.

Semester: IV
Title: Mechanics
Subject Code:
Credits: 4
Hours: 5

UNIT-I: **Mechanical Systems:** The Mechanical system- Generalized coordinates – Constraints - Virtual work - Energy and Momentum.
Chapter 1: Sections 1.1 to 1.5
UNIT-II: **Lagrange's Equations**: Derivation of Lagrange's equations- Examples- Integrals of the Motion.
Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)
UNIT-III: **Hamilton's Equations**: Hamilton's Principle - Hamilton's Equation – Other variational principles.
Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)
UNIT–IV: **Hamilton-Jacobi Theory:** Hamilton's Principle function – Hamilton –Jacobi Equation – Separability.
Chapter 5 : Sections 5.1 to 5.3
UNIT-V: **Canonical Transformation:** Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.
Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)

Contents and Treatments as in:

D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Reference Books:

1. H. Goldstein, Classical Mechanics, (2nd Edition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.L. Synge and B.A. Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co., New York, 1970.

Elective Subjects

Elective
Title: Number Theory and Cryptography
Subject Code:
Credits: 3
Hours: 5

UNIT-I :
Elementary Number Theory: Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring. (Chapter 1)
UNIT-II :
Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES (Chapter 3)
UNIT-III :
Finite Fields, Quadratic Residues and Reciprocity (Chapter 2)
UNIT-IV :
Public Key Cryptography (Chapter 4)
UNIT-V:
Primality , Factoring, Elliptic curves and Elliptic curve crypto systems
(Chapter 5, sections 1,2,3 &5 (omit section 4), Chapter 6, sections 1& 2 only)

Contents and Treatment as in:

Neal Koblitz, *A Course in Number Theory and Cryptography*, Springer-Verlag, New York,1987.

Reference Books:

1. Niven and H.S.Zuckermann, *An Introduction to Theory of Numbers* (Edn. 3), Wiley Eastern Ltd., New Delhi,1976.
2. David M.Burton, *Elementary Number Theory*, Brown Publishers, Iowa,1989.
3. K.Ireland and M.Rosen, *A Classical Introduction to Modern Number Theory*, Springer Verlag, 1972.
4. N.Koblitz, *Algebraic Aspects of Cryptography*, Springer 1998.

Elective
Title: Difference Equations
Subject Code:
Credits: 3
Hours: 5

Unit-I
Difference Calculus: Difference operator-Summation-Generating Functions and approximate summation.
Chapter 2: 2.1-2.3
Unit-II
Linear Difference Equations: First order equations – General Results for Linear Equations-solving Linear equations.
Chapter 3: 3.1to 3.3
Unit-III
Linear Difference Equations(Contd.): Equations with variable coefficients – Nonlinear Equations that can be Linearized.
Chapter 3: 3.5 and 3.6
Unit – IV
Linear Difference Equations: Z transform.
Chapter 3: 3.7
Unit-V
Stability Theory: Initial value problems for linear systems – Stability of linear systems.
Chapter 4: 4.1 and 4.2

Contents and Treatments as in:

W.G.Kelley and A.C.Peterson: Difference equations, An introduction with applications, Second Editions Academic Press, New York, 2001.

Reference Books:

1. S.N.Elaydi, An introduction to Difference Equations, Springer Verlag, New York, 1996.
2. S.Goldberg, Introduction to Difference Equations, Dover Publications, 1986.
3. R.P.Agarwal, Difference Equations and Inequalities, Mercel Dekker, New York, 2000.

Elective
Title: Programming in C++ (Theory and Practicals)
Subject Code:
Credits: 3
Hours: 5

UNIT-I :
Tokens, Expressions and Control Structures – Functions in C++.
Chapters: 3 and 4
UNIT-II :
Classes and Objects – Constructors and Destructors – Operator Overloading and Type conversions.
Chapters : 5, 6 and 7
UNIT-III :
Inheritance – Pointers – Virtual Functions and Polymorphism.
Chapters 8 and 9
UNIT-IV :
Managing Console I/O operations – Working with Files.
Chapters: 10 and11
UNIT-V :
Class templates – Function templates - Exception Handling.
Chapters : 12 and 13

Recommended Text:

E. Balagurusamy, *Object Oriented Programming with* C++, Second edition, Tata McGraw Hill, New Delhi, 2001.

Reference Books:

1.D. Ravichandran, *Programming with* C++, Tata McGraw Hill, New Delhi, 1996
2. Robert Lafore, Programming in C++, Galgotia Publications, New Delhi,

Computer Laboratory Practice Exercises :

Section I : Computer Language Exercises for Programming in C++ :

1. Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.

2. Create a class **FLOAT** that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of **FLOAT**.

3. Write a class called employee that contains a name and an employee number. Include a member function to get data from the user for insertion into object, and another function to display the data. Write a main() program to create an array of employee information and accept information from the user and finally print the information.

4. Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.

5. Write a program to use a common friend function to exchange the private values of two classes.

6. Write a program to include all possible binary operator overloading using friend function.

7. Write a program to read an array of integer numbers and sort it in descending order. Use readdata, putdata, and arraymax as member functions in a class.

8. Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.

9. Write a function that takes two Distance values as arguments and returns the larger one. Include a main() program that accept two Distance values from the user, compare them and displays the larger.

10. Write a program to implement the concept of object as function argument and returning objects.

11. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.

12. Using overloaded constructor in a class write a program to add two complex numbers.

13. Create a class MAT of size(m,n). Define all possible matrix operations for MAT type objects.

14. Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.

Elective
Title: Numerical Analysis
Subject Code:
Credits: 3
Hours: 5

Unit 1: The solution of nonlinear equations f(x)=0 - The solution of linear system AX = B.
Chapter 2: sec 2.1 to 2.4, and 2.6,2.7 (omit 2.5)
Chapter 3: sec 3.3 to 3.7

Unit 2: Interpolation and polynomial approximation - Curve fitting.
Chapter 4: sec 4.1 to 4.4
Chapter 5: sec 5.1 to 5.2

Unit 3: Numerical differentiation - Numerical integration.
Chapter 6: sec 6.1, 6.2
Chapter 7: sec 7.1 to 7.2

Unit 4: Solution of ordinary differential equations
Chapter 9: sec 9.1 to 9.6

Unit 5: Solution of partial differential equations
Chapter 10: sec 10.1 to 10.3

Content and treatment as in:

Numerical Methods for Mathematics, Science and Engineering – John H.Mathews, 2nd edition, Prentice Hall, New Delhi, 2003

Books for reference:

1.Conte S.D and Carl de Boor (1980)- *Elementary Numerical Analysis, An Algorithmic Approach*, Mc.Graw Hill, New York.
2. James B. Scarborough- *Numerical Mathematical Analysis*, Sixth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Devi Prasad, *Numerical Analysis*, Narosa Publications.

Elective
Title: Formal Languages and Automata Theory
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Finite automata, regular expressions and regular grammars Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with moves – Regular expressions – Regular grammars.
Chapter 2. Sections 2.1 to2.5
UNIT-II : Properties of regular sets: The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.
Chapter 3 : Sections 3.1 to 3.4
UNIT-III : Context-free grammars: Motivation and introduction – Context-free grammars – Derivation trees- Simplification of context-free grammars – Chomsky normal form – Greibach normal form.
Chapter 4 : Section 4.1 to 4.6
UNIT-IV : Pushdown automata: Informal description- Definitions-Pushdown automata and context-free languages – Normal forms for deterministic pushdown automat.
Chapter 5 : Sections 5.1 to 5.3
UNIT-V : Properties of context-free languages: The pumping lemma for CFL's – Closure properties for CFL's – Decision algorithms for CFL's.
Chapter 6 : Sections 6.1 to 6.3

Contents and Treatments as in:

John E.Hopcraft and Jeffrey D.Ullman, *Introduction to Automata Theory, Languages and Computation*, Narosa Publishing House, New Delhi, 1987.

Reference Books:

1. A. Salomaa, *Formal Languages*, Academic Press, New York, 1973.
2. John C. Martin, *Introduction to Languages and theory of Computations* (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997.

Elective
Title: Wavelets
Subject Code:
Credits: 3
Hours: 5

UNIT-I : The Discrete Fourier Transforms.
Chapter 2: 2.1 to 2.3
UNIT-II : Wavelets on **Z**n.
Chapter 3: 3.1 to 3.3
UNIT-III : Wavelets on **Z.**
Chapter 4: 4.1 to 4.7
UNIT-IV : Wavelets on **R.**
Chapter 5: 5.1 to 5.5
UNIT-V: Wavelets and Differential Equations.
Chapter 6: 6.1 to 6.3

Contents and Treatments as in:

Michael W.Frazier, *An Introduction to Wavelets through Linear Algebra*, Springer Verlag, Berlin, 1999

Reference Books

1. C.K.Chui, *An Introduction to Wavelets,* Academic Press, 1992
2. E.Hernandez and G.Weiss, *A First Course in Wavelets*, CRC Press, New York,1996
3. D.F.Walnut, *Introduction to Wavelet Analysis*, Birhauser, 2004.

Elective
Title: Visual Programming
Subject Code:
Credits: 3
Hours: 5

Unit-I
Form-variables-data types-string-numbers-Writing simple programs.
Chapter: 3 and 5
Unit-II
The toolbox -Creating controls-name property-command button-access keys-image control text Boxes – labels - message boxes.
Chapter: 4
Unit-III
Displaying information-Determinate loops-indeterminate loops- making Decisions -built in functions-functions and procedures.
Chapter: 6,7,8 and 9
Unit-IV
Lists-arrays-control arrays-combo boxes-Flex grid control.
Chapter: 10 and 11
Unit-V
Projects with multiple forms--Error trapping- Menus-MDI forms.
Chapter: 12 and 14.

Contents and Treatments as in:

Gary Cornell, "Visual Basic 6 from the Ground up", Tata McGraw Hill -1999.

Reference Books:
Noel Jerke, Visual Basic 6(The Complete Reference) Tata McGraw Hill-1999,

Practical: Visual Programming

1. Addition, Subtraction, Multiplication and Division of two numbers.
2. Creating a Multiplication Table using multi-dimensional arrays.
3. Displaying a value of Square Root, Cube Root of a given number using function procedures and sub procedures.
4. Create a Simple calculator to implement command buttons, Text boxes and Lables.
5. Write a program to display the grade and Average mark of a student.
6. Write a program to implement menus and MDI Forms.

Elective
Title: Tensor Analysis and Theory of Relativity
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Tensor Algebra : Systems of Different orders – Summation Convention – Kronecker Symbols - Transformation of coordinates in Sn - Invariants – Covariant and Contravariant vectors - Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors - Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor – Relative Tensor – Cross Product of Vectors.
Chapter I : I.1 – I.3,I.7 and I.8 and Chapter II : II.1 – II.19
UNIT-II : Tensor Calculus : Riemannian Space – Christoffel Symbols and their properties.
Chapter III: III.1 and III.2
UNIT-III : Tensor Calculus(contd) : Covariant Differentiation of Tensors – Riemann–Christoffel Curvature Tensor – Intrinsic Differentiation.
Chapter III: III.3 – III.5
UNIT-IV : Special Theory of Relativity : Galilean Transformations – Maxwell's equations – The ether Theory – The Principle of Relativity.
Relativistic Kinematics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - World line - Example – twin paradox – addition of velocities – Relativistic Doppler effect.
Chapter 7 : Sections 7.1 and 7.2
UNIT-V : Relativistic Dynamics : Momentum – Energy – Momentum energy four vector – Force - Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations. **Accelerated Systems :** Rocket with constant acceleration – example – Rocket with constant thrust.
Chapter 7 : Sections 7.3 and 7.4

Contents and treatments as in:

U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (Unit I, Unit-II, Unit-III)
D.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (Unit-IV & Unit-V)

Reference Books:

1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A.S.Eddington. The Mathematical Theory of Relativitity, Cambridge University Press, 1930.
3. P.G.Bergman, An Introduction to Theory of Relativity, Newyor, 1942.
4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.

Elective
Title: Resource Management Techniques
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Decision Theory **:** Introduction - Types of Decision-Making Environments –Decision Making under Risk – Decision Making Under Uncertainty – Decision Tree Analysis.
Chapter: 22
UNIT-II : Deterministic Inventory Models**:** Introduction – Classification Inventory Models - Inventory Models without shortages: Model I(a), I(b) and I(c) – Inventory models with Shortages: Model II(a), II(b) and II(c).
Chapter: 25
UNIT-III : Deterministic Inventory Models: Deterministic models with Price Breaks – Purchase inventory model: with one price break, with two price breaks and with any number of price breaks. Stochastic Inventory Models: Introduction - Instantaneous stochastic Demand without Setup cost: Model VI(a) and VI(b) – Uniform Demand, No Setup cost Model: Model VII(a), VII(b) – Selective Inventory Management – ABC analysis.
Chapter: 25 and 26
UNIT-IV : Queuing Theory : Introduction - Essential Features of Queuing System – Performance measures of Queuing System – Probability Distributions in Queuing Systems – Classification of Queuing Models – The following models only: Model I, III, IV(a), IV(b).
Chapter: 28
UNIT-V : Simulation**:** Introduction – Types of Simulation – Use of simulation – Limitations of simulation – Phases of Simulation model – Event type simulation – Monte-Carlo simulation – Applications – Scope of simulation.
Chapter: 21

Contents and Treatments as in:

1. S.D. Sharma, "Operations Research" 16th Edition, Kedar Nath Ram Nath Publisher, Meerut, 2009.

Reference Books:

1. Hamdy A. Taha, *Operations Research,* (seventh edition) Prentice – Hall of India Private Limited, New Delhi, 1997.
2. F.S. Hiller and J.Lieberman -,Introduction to Operations Research (7^{th} Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.
3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2^{nd} Edition) Prentice Hall Pvt Ltd., New York, 1979
4. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall ,Linear Programming and Network flow, John Wiley and sons, New York 1990.
5. Gross, D and C.M.Harris, Fundamentals of Queueing Theory, (3rd Edition), Wiley and Sons, New York, 1998.

Elective
Title: Fuzzy sets and their applications
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Fundamental Notions.
Chapter I: Sec. 1 to 8
UNIT-II : Fuzzy Graphs.
Chapter II: Sec. 10 to 17
UNIT-III : Fuzzy Relations.
Chapter II: Sec. 19 to 26
UNIT-IV : Fuzzy Logic.
Chapter III: Sec.31 to 36 and 39
UNIT-V : The Laws of Fuzzy Composition.
Chapter IV: Sec.43 to 49

Contents and treatments as in:

A.Kaufman, *Introduction to the theory of Fuzzy subsets*, Vol.**I,** Academic Press, New York, 1975.

Reference Books:

1. H.J.Zimmermann, *Fuzzy Set Theory and its Applications*, Allied Publishers, Chennai, 1996
2. George J.Klir and Bo Yuan, *Fuzzy sets and Fuzzy Logic-Theory and Applications*, Prentice Hall India, New Delhi, 2001.

Elective
Title: Stochastic Processes
Subject Code:
Credits: 3
Hours: 5

Unit-I Introduction to Stochastic Processes – Specifications of Stochastic Processes – Stationary processes – Martingales.
Chapter 2: Section 2.1 to 2.4
Unit-II Definition of Markov Chain – Higher transition probabilities – classification of states and chains – determination of higher transition probabilities – stability of Markov chain.
Chapter 3: Sections 3.1, 3.2, 3.4 to 3.6
Unit-III Poisson process and related distributions – Generalizations of Poisson process.
Chapter 4: Sections 4.1 to 4.3
Unit-IV Birth and death process – Markov processes with discrete state space – Erlang process.
Chapter 4: Sections 4.4, 4.5, 4.7
Unit-V Renewal process – renewal processes in continuous time – renewal equation and renewal theorems.
Chapter 6: Sections 6.1 to 6.5.

Contents and treatment as in:

J. Medhi, *Stochastic Processes*, 2nd Edition, New Age International (P) Ltd. Publishers.

Reference Books:

1. Cinter E., Introduction to Stochastic Processes, Prentice Hall Inc., New Jersey, 1975.
2. Cox D.R. and H.D. Miller, Theory of Stochastic Processes (3rd Edition), Chapman and Hall, London, 1983.
3. Kannan D., An Introduction to stochastic processes, North Holland, New York, 1979.
4. H.W.Taylor and S.Kannan, An Introduction to Stochastic Modelling (3rd Edition), Academic Press, New York, 1998**.**
5. Sheldon M. Ross, Stochastic Processes, 2nd Edition, Wiley, 1995.
6. S.Karlin and H.M.Taylor, A first course in Stochastic Processes, 2nd Edition, Academic Press, New York, 1975.

Elective
Title: Financial Mathematics
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Single Period Models : Definitions from Finance – Pricing a forward One step Binary Model – a ternary Model – Characterization of no arbitrage – Risk-Neutral Probability Measure.
Chapter 1
UNIT-II : Binomial Trees and Discrete parameter martingales: Multi-period Binary model – American Options – Discrete parameter martingales and Markov processes – Martingale Theorems – Binomial Representation Theorem – Overture to Continuous models.
Chapter 2
UNIT-III : Brownian Motion : Definition of the process – Levy's Construction of Brownian Motion – The Reflection Principle and Scaling – Martingales in Continuous time.
Chapter 3
UNIT-IV : Stochastic Calculus : Stock Prices are not differentiable – Stochastic Integration – Ito's formula – Integration by parts and Stochastic Fubini Theorem– Girsanov Theorem – Brownian Martingale Representation Theorem – Geometric Brownian Motion – The Feynman-Kac Representation.
Chapter 4
UNIT-V : Block-Scholes Model : Basic Block-Scholes Model – Block-Scholes price and hedge for European Options – Foreign Exchange – Dividends – Bonds – Market price of risk.
Chapter 5

Content and treatment as in:

Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Reference Books

1. Martin Boxter and Andrew Rennie, Financial Calculus : An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre , (Translated by Nicolas Rabeau and Farancois Mantion), Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall, 1996.
3. Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.
4. Robert J.Elliott and P.Ekkehard Kopp, Mathematics of Financial Markets, Springer Verlag, New York, 2001 (3rd Printing).

Elective
Title: Java Programming
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Java Tokens – Java statements – Constants – Variables – Data types.
Chapters 3 and 4
UNIT-II : Operators – Expressions – Decision making and Branching.
Chapters 5,6 and 7
UNIT-III :
Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritance.
Chapters 8, 9 and 10
UNIT-IV : Packages Multithreaded Programming – Managing errors and Exceptions.
Chapters: 11, 12 and 13
UNIT-V : Applet Programming – Graphics Programming.
Chapter 14 and 15

Contents and treatments as in:

E. Balagurusamy, *Programming with Java – A primer*, Third Edition. Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.

Reference Books:

1. Mitchell Waite and Robert Lafore, Data Structures and Algorithms in Java, Techmedia (Indian Edition), New Delhi, 1999.
2. Adam Drozdek, Data Structures and Algorithms in Java, (Brown/Cole), Vikas Publishing House, New Delhi, 2001.

Computer Laboratory Exercises:

Section 1. CLASSES,OBJECTS,INHERITANCE,INTERFACE

1. Design a class to represent a bank Account.Include the following members:
Data Members: Methods:
(1) Name of the Depositor (1) To Assign initial values.
(2)Account Number (2) To deposit an amount.
(3)Type of account (3) To withdraw an amount after checking the balance.
(4)Balance (4)To display the name and balance.
Write a Java program for handling 10 customers.

2. Java lacks a complex datatype. Write a complex class that represents a single Complex number and includes methods for all the usual operations, ie: addition, subtraction, multiplication, division.

Section 2 : EXCEPTION HANDLING, MULTITHREADING AND PACKAGES

3. Write a Java program to handle different types of exceptions using try, catch and finally statements

4. Write a Java program to implement the behavior of threads.
(a) To create and run threads.
(b) To suspend and stop threads.
(c) To move a thread from one state to another.
(d) By assigning a prioity for each thread.

5. Create three classes Protection, Derived and SamePackage all in same package. Class Protection is a base class for the class Derived and SamePackage is a seperate class. Class Protection has three variables each of type private,protected and public. Write a program that shows the legal protection modes of all the different variables.

Section 3: APPLET PROGRAMMING

6. Write an applet to draw the following shapes : a) Cone b)Cylinder c)Cube d) Square inside a circle e) Circle inside a square.

7. Creating a Java applet which finds palindromes in sentences. Your applet will have two input controls; One input will be a text field for entering sentences, the other input will be a text field or scroll bar for selecting the minimum length a palindrome to be shown. Your applet will output the first 10 palindromes it finds in the sentence.

8. Write a program which displays a text message coming down the screen by moving left to right and modify the above program instead of text moving from left to right it moves top to bottom.

Section 4 : AWT FORMS DESIGN USING FRAMES

9 Create a frame that contains 3 text fields and four buttons for basic arithmetic operations. You have to enter two numbers in first two text fields. On clicking the respective button that answer should be displayed in the last text filed.

10. Create a frame with check box group containing Rectangle, Circle, Triangle, Square. If the particular value is true then the corresponding shape should be displayed.

Elective
Title: Discrete Mathematics
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Lattices: Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.
Chapter 1: § 1 A and B § 2A and B § 3.
UNIT-II : Applications of Lattices: Switching Circuits: Basic Definitions – Applications.
Chapter 2: § 1 A and B
UNIT-III : Finite Fields
Chapter 3: § 2
UNIT-IV : Polynomials : Irreducible Polynomials over Finite fields – Factorization of Polynomials.
Chapter 3: § 3 and §4.
UNIT-V: Coding Theory : Linear Codes and Cyclic Codes.
Chapter 4 § 1 and 2

Contents and Treatments as in:

Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, Spinger-Verlag, New York, 1984.

Reference Books:

1. A.Gill, *Applied Algebra for Computer Science*, Prentice Hall Inc., New Jersey.
2. J.L.Gersting, *Mathematical Structures for Computer Science*(3rd Edn.), Computer Science Press, New York.
3. S.Wiitala, *Discrete Mathematics- A Unified Approach*, McGraw Hill Book Co.

Elective
Title: Fluid Dynamics
Subject Code:
Credits: 3
Hours: 5

UNIT-I : Kinematics of Fluids in motion. Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equation of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.
Chapter 2. Sec 2.1 to 2.10.
UNIT-II: Equations of motion of a fluid : Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids - Euler's equation of motion - Bernoulli's Equation – Worked examples - Discussion of the case of steady motion under conservative body forces.
Chapter 3. Sec 3.1 to 3.7
UNIT-III : Some three dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axi symmetric flows : Stokes stream function
Chapter 4 Sec 4.1, 4.2, 4.3, 4.5**.**
UNIT-IV : Some two dimensional flows : Meaning of two dimensional flow – Use of Cylindrical polar coordinates - The stream function - The complex potential for two dimensional , irrotational, incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem and some of its applications.
Chapter 5. Sec 5.1 to 5.8 (omit 5.8.2)
UNIT-V Viscous flows: Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid element - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.
Chapter 8. Sec 8.1 to 8.9

Contents and treatments as in:

F. Chorlton, *Text Book of Fluid Dynamics* ,CBS Publications. Delhi ,1985.

Reference Books:

1. R.W.Fox and A.T.McDonald. *Introduction to Fluid Mechanics*, Wiley, 1985.
2. E.Krause, *Fluid Mechanics with Problems and Solutions*, Springer, 2005.
3. B.S.Massey, J.W.Smith and A.J.W.Smith, *Mechanics of Fluids*, Taylor and Francis, New York, 2005.
4. P.Orlandi, *Fluid Flow Phenomena*, Kluwer, New York, 2002.
5. T.Petrila, Basics *of Fluid Mechanics and Introduction to Computational Fluid Dynamics*, Springer, berlin, 2004.

Extra Disciplinary Elective Subjects

Extra Disciplinary Elective Subject:
Title: Mathematics for Competitive Examinations
Subject Code:
Credits: 3
Hours: 2

UNIT I:

Problems of Ages, Surds and indices.

UNIT II:

Profit and Loss, Ratio and Proportions.

UNIT III:

Time and work, Time and distance.

UNIT IV:

Permutations and Combinations.

UNIT V:

Stocks and Shares.

TEXT BOOK :

R.S. Aggarwal, Quantitative Aptitude, S. Chand and Co, Ltd., 2007.

REFERENCE BOOKS:

1. U Mohan Rao,Quantitative Aptitude , Scitech Publication,2010.
2. P.R.Vittal, Business Statistics, Margham Publications, 2007.
3. P.R.Vittal, Allied Mathematics,Margham Publications,2009.

Extra Disciplinary Elective Subject:
Title: Applied Statistics
Subject Code:
Credits: 3
Hours: 2

UNIT I :

Measures of Central Tendency: Mean, Median, Quartiles, Mode – Measures of Dispersion : Standard Deviation, Mean Deviation, Quartile Deviation, Coefficient of Variation.

UNIT II:

Karl Person's Coefficient of Correlation – Spearman's Rank Coefficient of Correlation – Regression lines.

UNIT III:

Testing of Hypothesis – Introduction – Type I error and Type II error – Large Sample tests: Single mean, difference of means, single Proportion and difference of proportions.

UNIT IV:

Small Sample Tests: t – test for single mean, difference of means, paried t – test.

UNIT V:

F – test for difference of variances, chi-square test for independence of attributes.

Text Book:

S. P. Gupta, "Statistical Methods", S.Chand & Co publisher.

Reference Books:

1. Murray R. Spiegel, "Statistics", Schuam's Outline series.
2. Snedecor G.W. and Cochran W.G., "Statistical Methods", Oxford and IBM Academic Press.
3. Croxten F.E. and Cowden O.J., "Applied General Statistics", Prentice Hall.