"கற்றகசடறக்கற்பவைகற்றபின்
நிற்கஅதற்குத்தக"(Fws;. 391)

THIRUVALLUVAR UNIVERSITY

DEPARTMENT OF MATHEMATICS (300)
MASTER OF SCIENCE DEGREECOURSE
M.Sc. MATHEMATICS under CBCS
REGULATIONS& SYLLABUS

With Effect From :2022–2023

Definitions:

Programme : Programme means a course of study leading to the award of a degree in a discipline.

Course : "Course" refers to a paper / practical / subject offered under the degree programme.
Each Course is to be designed variously under lectures / tutorials / laboratory offield work / seminar / practical training / Assignments / Term paper or Report writing etc., to meet effective teaching and learning needs.

i) Core Courses:
"The Core Courses" related to the programme concerned including practicals offered in the programme.

ii) Core Elective Courses:
"TheCore Elective courses" related to the core courses of the programme concerned, offered in the programme.

iii) Open Elective courses :
"The open Elective courses" related to the programme offered to the other University Departments.

iv) Value Added Courses :
"The Value Addedcourses" related to the programme concerned including basic knowledgeof software skills offered in the programme.

A detailed explanation of the above with relevant credits are given under **"Scheme of Examination along with Distribution of Marks and Credits"**

Duration : This means the stipulated years of study to complete a programme as prescribed by the University from time to time. Currently for the postgraduate programme the duration of study is TWO years. These regulations shall apply to the regular course of study in approved institutions of the University.

Credits : The weightage given to each course of study (subject) by the experts of the Board of Studies concerned.

The term 'Credit' refers to the weight age given to a course, usually in relation to the instructional hours assigned to it. For instance, a six-hour course per week is assigned 6/5/4

credits, a five hour course per week is assigned 5/4/3 credits and a four hour course per week is given 4/3/2 credits. However, in no instance the credits of a course can be greater than the hours allotted to it.

The total minimum credits, required for completing a PG program is 96.

Credit System: The course of study under this regulation, where weightage of credits isspread over to different semesters during the period of study and the Cumulative Grade Point Average shall be awarded based on the credits earned by the students. A total of 90 credits are prescribed for the Postgraduate Programme offered in two years.

Choice Based: All Post-Graduate Programmesoffered by the University shall be under Choice Based Credit System.

Choice Based Credit System (CBCS):This is to enhance the quality and mobility of the students within and between the Universities in the country and abroad.

1. Eligibility for Admission to the Course:

A candidate who has passed the B.Sc. Degree Examination in Mathematics of this University or an Examination of any other University with more than one major with Mathematics accepted by the Syndicate as equivalent thereto shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination of this University after a Course of two academic years in the University Department / Colleges affiliated to this University.

No student shall be eligible for admission to a Master's degree programme in any of the faculties unless he/she has successfully completed a three-year undergraduate degree or earned prescribed number of credits for an undergraduate degree through the examinations conducted by a University / autonomous institution or possesses such qualifications recognized by the Thiruvalluvar University as equivalent to an undergraduate degree. Provided that candidates for admission into the specific main subject of study shall also possess **such other qualifying conditions as may be prescribed by the University in the Regulations** governing respective courses of study.

2. Duration of the Course:

The course shall extend over a period of **two years comprising** of four semesters with twosemestersin one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

Each semester has90 working days consists of 5 teaching hours per working day.Thus,each semester has 450 teaching hours and the whole programme has 1800 teaching hours.The odd semesters shall consist of the period from July to November and the evensemesters from December to April.

3. Course of Study:

The course of study for Master'sDegree Course in Mathematics shall consistof Coresubjects, Coreelective subjects ,Core practicals,Open elective subjects, Compulsory subject (Human Rights), Field Project, MOOC online course and a Project in the Fourth semester.

Sl. No	Study Component	Course Title	Ins. Hrs. / Week	Credits	Title of the Paper	Maximum Marks		
						CIA	UNI. EXAM	TOTAL
IYEAR (I SEMESRTER)								
1	CORE	PAPER – 1	6	4	Algebra – I	25	75	100
2	CORE	PAPER – 2	6	4	Real Analysis – I	25	75	100
3	CORE	PAPER – 3	5	4	Ordinary Differential Equations	25	75	100
4	CORE	PAPER – 4	6	4	Mechanics	25	75	100
5	Value Added Course		2	2	Latex	25	75	100
6	CORE-ELECTIVE	PAPER – 1	5	3	**A)** Tensor analysis and Relativity theory **B) Calculus of Variations and Integral** Equations **C)** Difference Equation	25	75	100
7	CORE PRACTICAL	PRACTICAL PAPER -1	4	3	JAVA Programming	25	75	100
Total				**24**	**Total**	**175**	**525**	**700**
I YEAR(II SEMESRTER)								
1	CORE	PAPER-5	5	4	Algebra – II	25	75	100
2	CORE	PAPER-6	5	4	Real Analysis – II	25	75	100
3	CORE	PAPER-7	5	4	Partial Differential Equations	25	75	100
4	CORE	PAPER-8	5	4	Applied Numerical Analysis	25	75	100
5	CORE-ELECTIVE	PAPER-2	5	3	**(A)**Mathematical Methods	25	75	100

					(B) **Cryptography and Data security.** (C)Financial Mathematics			
6	OPEN ELECTIVE (Non Major)	PAPER – 1	3	2	A) Mathematics for Competitive Examinations B) Statistics C) Bio-Mathematics	25	75	100
7	Compulsory Paper		2	2	Human Rights	25	75	100
8	CORE PRACTICAL	PRACTICAL PAPER 2	4	3	C++ Programming	25	75	75
Total				**26**	**Total**	**200**	**600**	**800**
II YEAR(III SEMESTER)								
1	CORE	PAPER-9	6	4	Topology	25	75	100
2	CORE	PAPER-10	6	4	Complex Analysis	25	75	100
3	CORE	PAPER-11	5	4	Graph Theory	25	75	100
4	CORE	PAPER	4	4	**Phython Theory**	25	75	100
5	CORE-ELECTIVE	PAPER-3	5	3	**A.** Mathematical Modelling **B.** Applied Algebra **C. Fluid Dynamics**	25	75	100
6	OPEN ELECTIVE	PAPER – 2	3	2	(A)Numerical Methods (B)Discrete Mathematics (C)Optimization Techniques	25	75	100
7	CORE PRACTICAL	PRACTICAL PAPER 3	4	3	Phython Programming	25	75	100
8	Field work (USRR)		---	2	University Social Responsibility Report	---	---	100
Total				**26**	**Total**	**200**	**600**	**800**
II YEAR(IV SEMESTER)								
1	CORE	PAPER-13	6	4	Functional Analysis	25	75	100
2	CORE	PAPER- 14	6	4	Applied Probability and Statistica	25	75	100

3	CORE-ELECTIVE	PAPER - 4	6	3	**A.** Operations Research **B.** Fuzzy Mathematics **C.Number theory**	25	75	100
4	CORE PRACTICAL	PRACTICAL PAPER- 4	4	3	MATLAB Programming	25	75	100
5	**CORE**	**Project Compulsory**	---	4	Project with viva voce	25(viva)	75 (project)	100
Total			**30**	**20**	**Total**	**125**	**375**	**500**
C0- SCHOLOSTIC COURSES								
	MOOC Online Courses		2	2	**MOOC Online Corses**	25	75	100

4. Distribution of Credit Points and Marks:

The Minimum Credit Requirement for a two-yearMaster's programme shall be **94**(ninety) Credits. The break-up of credits Xor theprogramme is as follows:

(a). Core Courses :56 credits

(b). Core Elective Courses :12 credits

(c). Value added course : 2 credits

(d) Core Practicals :12 credits

(d) Open Elective course :4 credits

(e). Compulsory course :2 credits

(f). Field Work : 2 credits

(g). Soft Skill : 2 credits

(h). Project : 4 credits

Total Credits:**96 credits**

5. Continuous Internal Assessment Test:

The following assessment procedure will be followed for awarding the internal marksin theevaluation of the student's performances. Thebest 2 CIA test marks out of 3 CIA tests marks, will be taken for awarding the internal marks.

(a). CIA Test Marks : 15 marks.

(b).Seminar : 5 marks.
(c).Assignment : 5 marks.

Total : 25 marks

6. Requirement toappear for the examinations

a) A candidate shall be permitted to appear for the university examinations for any semester (theory as well as practical) if

i. He/she secures **not less than 75%** of attendance in theory as well as inpractical's (separate attendance registers shall be maintained for theory and practical) in the number of working days during the semester.

ii. In the case of married woman candidates, the minimum attendance requirement shall be not less than 55% of the total instructional days in theory as well as in practical.

iii. His/her conduct shall be satisfactory. Provided that it shall be open to the Syndicate, or any authority delegated with such powers by the Syndicate, to grant exemption to a candidate who has failed to earn 75% of the attendance in theory as well as in practical, prescribed, for valid reasons, subject to usual conditions.

b) A candidate who has secured **less than 75% but 65%** and above attendance in any semester separately for theory and practical, shall be permitted to take the examination on the recommendations of the Head of the Department to condone the lack of attendance on the payment of prescribed fees to the University, separately for theory and practical.

c) A candidate who has secured **less than 65% but 55%** and above attendance in any semester in theory as well as in practical, has to compensate the shortage in attendance in the subsequent semester (in the next year) besides earning the required percentage of attendance in that semester and appear for both semester papers together at the end of the later semester, on the payment of prescribed fees to the University, separately for theory and practical. However, shortage of attendance in I-semester shall be compensated while studying in III semester, shortage of attendance in II-semester shall be compensated while studying in IV semester, shortage of attendance in III&IV-semesters shall be compensated after rejoining the course in the 3rd year. Also, separate attendance registers shall be maintained in theory as well as practical, for compensating the shortage of attendance. During the hours of compensation of attendance, the candidate shall not be given attendance for the regular semester classes.

d) A candidate who has secured **less than 55%** of attendance in any semester separately for theory and practical shall not be permitted to appear for the regular examinations in that particular semester or in subsequent semesters. He/she has to rejoin/ re-do the semester in which the attendance is less than 55%, on the payment of prescribed fees to the University, separately for theory and practical, after getting prior approval of the University.

e) A candidate who has secured **less than 65%** of attendance in the final semester separately for

theory and practical, has to compensate his/her attendance shortage in a manner as decided by the concerned Head of the department, after getting prior approval of the University. The candidate shall be permitted to rejoin in the 4th semester, after completing his/her regular 2year course.

7. Scheme of Examination:

a. Any theory examination is conducted only for 3 hours irrespective of total marks allotted for the examinations.

b. There shall be theory examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May. However, there shall be practical examinations at the end of even semesters in general, with exceptions in a few courses as prescribed by the Boards of studies, concerned. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May.

c. All candidates admitted in first year, should get registered for the first semester examination, compulsorily. If registration is not possible owing to any reason including shortage of attendance beyond condonation limit, belated joining or on medical grounds, the candidates are permitted to rejoin the course in the next year.

8. Restrictions toappear for the examinations:

Any candidate having arrear paper(s) shall have the option to appear in any arrear paper along with the regular semester papers, in theory as well as in practical, as long as the transitory provision is applicable.

9.Medium ofInstruction and Examinations:

The mediumof instruction for the courses is English only.

10. Question Paper Pattern

The Question Paper Pattern for the University theory examinations is as follows:

Time: 3 Hours Maximum Marks: 75

Part – A (10×2 = 20 marks)
Answer ALL Questions

(Two Questionsfrom each unit)

Part – B (5× 5 = 25 marks)
Answer ALL Questions

(Two Questions from each unit with internal Choice [either or type])

Part – C(3× 10 = 30 marks)
Answer any Three Questions out of Five Questions

(One Question from each unit)

11. Passing Minimum

a). A candidate shall be declared to have passed the whole examination, if the candidate passes in all the theory papers and practical wherever prescribed as per the scheme of examinations by earning 90 credits in Core and Elective courses, including practical.

b). A candidate should get **not less than 50% in the University (external)** Examination, compulsorily, in all papers, including practical.Also the candidate who secures **not less than 5**0% marks in the external as well as internal (CIA) examinations put together in any paper / practical shall be declared to have successfully passed the examination in the subject in theory as well as practical. There shall be no passing minimum for the CIA. The candidate, who absents himself for CIAprogrammes,even after a repeated chance, will be awarded zero mark in the concerned subject (zero to 25 for theory and zero to 40 for practical).

12. Distribution of Marks:

The following are the distribution of marks for external and internal for University (external) examination and continuous internal assessment and passing minimum marks for **theory papers of PG programmes**.

Table – 1(A)

Uni.ExamTotal(ESE)	**Passing Minimum ForUni.Exam**	**CIA Total**	**Passing Minimum For CIA**	**Total Marks Allotted**	**Passing Minimum (Uni.Exam+CIA)**
75	**38**	**25**	**0**	**100**	**50**

The following are the Distribution of marks for the Continuous Internal Assessment in the theory papers of PG Programmes.
Table – 1(B):

S. No.	**Theory**	**Distribution of Marks**	
		Assignments	**Tests**
1.	Assignment - 1 (First 2 Units of the Syllabus)	10	---
2.	Test – 1 (First 2 Units of the Syllabus for 1 hour duration)	---	50
3.	Assignment - 2 (3^{rd}& 4^{th} Units of the Syllabus)	10	---
4.	Test – 2 (First 4 Units of the Syllabus for 2 hours duration)	---	50
5.	Seminar (Entire Syllabus)	10	---
6.	Test – 3 (Entire Syllabus for 3 hours duration)	---	100
Total Marks		**30**	**200**
Marks to be converted to		**5**	**20**
Total Maximum Marks for CIA		**25**	

13. Grading:

Once the marks of the CIA and end-semester examinations for each of the course are available, they shall be added. The mark thus obtained shall then be converted to the relevant letter grade, grade point as per the details given below:

Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	**9.0-10.0**	**O**	Outstanding
80-89	**8.0-8.9**	**D+**	Distinction
75-79	**7.5-7.9**	**D**	
70-74	**7.0-7.4**	**A+**	First Class
60-69	**6.0-6.9**	**A**	
50-59	**5.0-5.9**	**B**	Second Class
00-49	**0.0**	**U**	Re-appear
Absent	**0.0**	**AAA**	ABSENT

C_i = Credits earned for course i in any semester
G_i = Grade Point obtained for course i in any semester
n = refers to the semester in which such course were credited
Grade point average (for a Semester):

Calculation of grade point average semester-wise and part-wise is as follows:

- **GRADE POINT AVERAGE [GPA] =** $\sum_i C_i G_i \; / \; \sum_i C_i$

Sum of the multiplication of grade points by the credits of the courses offered under each part
GPA = ----------
Sum of the credits of the courses under each part in a semester

Calculation of Grade Point Average (CGPA) (for the entire programme):

A candidate who has passed all the examinations prescribed is eligible for the following partwise computed final grades based on the range of CGPA.

CUMULATIVE GRADE POINT AVERAGE [CGPA] = $\sum_n \sum_i C_{ni} G_{ni} \; / \; \sum_n \sum_i C_{ni}$

Sum of the multiplication of grade points by the credits of the entire programme under each part
CGPA = ----------
Sum of the credits of the courses of the entire programme under each part

CGPA	GRADE
9.0 and above but below 10.0	O
8.0 and above but below 9.0	D+
7.5 and above but below 8.0	D
6.5 and above but below 7.5	A+
6.0 and above but below 6.5	A
5.0 and above but below 6.0	B
0.0 and above but below 5.0	U

14. Improvement ofMarks in the subjects already passed:

Candidates desirous of improving the marks awarded in a passed subject in their first attempt shall reappear once within a period of subsequent two semesters by paying the fee prescribed from time to time. The improved marks shall be considered for classification but not for ranking. When there is no improvement, there shall not be any change in the original marks already awarded.If candidate improves his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the Candidate does not show improvement in the marks, his previous marks will be taken into consideration.

❖ No candidate will be allowed to improve marks in the Practical's, Project, Viva-voce and Field work.

15. Classification of Successful candidates:
A candidate who passes all the examinations including practical's securing following CGPA and Grades shall be declared as follows **for Part I or Part II**:

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.0 and above but below 10.0	O	First Class - Outstanding
8.0 and above but below 9.0	D+	First Class with Distinction
7.5 and above but below 8.0	D	
6.5 and above but below 7.5	A+	First Class
6.0 and above but below 6.5	A	
5.0 and above but below 6.0	B	Second Class

a. A candidate who has passed all the examination including practicalin the first appearance within the prescribed duration of the PG programme and secured a CGPA of 9 to 10 and equivalent grade "O" in Core and Elective subjects shall be placed in the category of "**First Class – Outstanding**".

b. A candidate who has passed all the examination including practicalin the first appearance within the prescribed duration of the PG programmes and secured a CGPA of 7.5

to 9 and equivalent grades "D" or "D+" in Core and Elective shall be placed in the category of "**First Class with Distinction**".

c. A candidate who has passed all the examination including practical'sof the PG programme and secured a CGPA of 6 to 7.5 and equivalent grades "A" or "A+" shall be declared to have passed that parts in "**First Class**".

d. A candidate who has passed all the examination including practical of the PG programmes and secured a CGPA of 5.5 to 6 and equivalent grade "B" shall be declared to have passed those parts in "**Second Class**".

16. Conferment of the Degree:

No candidate shall be eligible for conferment of the Degree unless the candidate;

i. Has undergone the prescribed course of study for a period of not less than four semesters in Thiruvalluvarthe University or has been exempted from in the manner prescribed and has passed the examinations as have been prescribed therefor.

ii. Has completed all the components prescribed under core and elective subjects in the CBCS pattern to earn 90 credits.

17. Ranking:

A candidate who qualifies for the PG degree course passing all the examinations in the first attempt, within the minimum period prescribed for the course of study from the date of admission to the course and secures I or II class shall be eligible for ranking. In the case of candidates who pass all the examinations prescribed for the course with a break in the first appearance due to the reasons as furnished in the Regulations 6(a) (iii) supra are eligible for classification / Distinction.

The marks obtained in improvement examinations shall not be taken into consideration for ranking.

18. Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

List of Core Elective Courses

S.No	Title
1	Tensor Analysis and Relativity Theory
2	Calculus of Variations and Integral Equations
3	Difference Equations
4.	Mathematical Methods
5	Crytography and Data security
6	Financial Mathematics
7	Mathematical Modelling
8	Applied Algebra
9	Fluid Dynamics
10	Analytic Number Theory
11	Fuzzy Mathematics
12	Operations Research

List of OpenElective Courses (Non Major)

Sl.No	Title
1	Mathematics for CompetitiveExaminations
2	Statistics
3	Optimization Techniques
4	Numerical Methods
5	Bio-Mathematics
6	Discrete Mathematics

Distribution of Core, Core Elective, Open Elective and Compulsory Subjects

Subject	Papers	Credits	Total Credits	Marks	Total Marks
Core	14	4	56	100	1400
Core Elective	4	3	12	100	400
Value Added Course	1	2	02	100	100
Open Elective	2	2	04	100	200
Core Practical	4	3	12	100	400
Compulsory	1	2	02	100	100
Project	1	4	04	100	100
Soft Skill	1	2	02	100	100
Field Work	1	2	02	100	100
Total	**29**	**---**	**96**	**---**	**2900**

M.Sc First year ISEMESTER

ALGEBRA – I

(CORE PAPER – 1)

Course Objectives:

The main objectives of this course are to:

1. Acquire the basic knowledge in algebraic structures namely group theory and ring theory.
2. Understand how group action is effectively used to study the group structures and their properties.
3. Learn the basic concepts of rings and its structures.

Course Outcome:

At the end of the Course, the Students will able to

CO1 Identify whether the given abstract structure is group or not.

CO2 Apply the concepts of homomorphism and isomorphism for comparing the algebraic features of mathematical systems in groups and rings.

CO3 Define an automorphism of a group, Direct, semi direct Products and abelian groups symmetric group, ring and some special classes of rings like commutative ring, fields.

CO4 Analyze Principal ideal domains , Polynomial rings – Definitions and basic properties.

CO5 Discussed about Euclidean domains, principal ideal domains and unique factorization

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	No	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit I: Introduction to Groups

Dihedral groups–Homomorphisms and Isomorphisms - Group actions – Subgroups - Definition and Examples – Centralizers and Normalizer, Stabilizers and Kernels - Cyclic groups and Cyclic subgroups of a group – Subgroups generated by subsets of a group.

Chapter 1:1.2, 1.6 & 1.7 and Chapter 2: 2.1 - 2.4. (18 Hours)

Unit II: Quotient Groups and Homomorphism's

Definitions and Examples – More on cosets and Lagrange's Theorem – The isomorphismtheorems - Composition series and the Holder program–Transpositions and the Alternating group.

Chapter 3: (18 Hours)

Unit III: Group Actions

Group actions and permutation representations – Groups acting on themselves by left multiplication- Cayley's theorem – Groups acting on themselves by conjugation – The class equation – Automorphisms –The Sylow theorems – The simplicity of An – Direct and semi-direct products and abelian groups - Direct Products – The fundamental theorem of finitely generated abelian groups.

Chapter 4 & Chapter 5: 5.1 - 5.2 (18 Hours)

Unit IV: Introduction to Rings

Basic definitions and examples – Examples - Polynomial rings - Matrix rings and group rings - Ring Homomorphisms and quotient rings – Properties of Ideals - Rings of fractions – The Chinese remainder theorem.

Chapter 7: (18 Hours)

Unit V: Euclidean domains, principal ideal domains and unique factorization domains

Principal ideal domains – Unique factorization domains – Polynomial rings - Definitions and basic properties – Polynomial rings over fields- Polynomial rings that are unique factorization domains – Irreducibility criteria – Polynomial ring over fields.

Chapter 8 & Chapter 9: (18 Hours)

Text Book:

- David S. Dummit and Richard M. Foote, Abstract Algebra (Second Edition), Wiley, 2003.

References:

1. Serge Lang, Algebra, Springer, 2002.
2. I.N. Herstein. Topics in Algebra(II Edition) Wiley Eastern Limited, New Delhi, 1975.
3. M. Artin, Algebra, Prentice Hall of India, 1991.
4. N. Jacobson, Basic Algebra, Vol. I & II, published by Hindustan Publishing Company, New Delhi, 1980.
5. W.H. Freeman, published by Hindustan Publishing Company, New Delhi, 1980.
6. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups (1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
7. Joseph A. Gallian, Contemporary Abstract Algebra, Brooks/Cole Pub Co.,2012

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	M	S	S	S	S	S
CO2	M	S	S	S	S	S	M	S	S	S
CO3	S	S	M	M	S	M	S	S	S	S
CO4	M	S	S	S	M	S	S	S	S	S
CO5	S	M	S	S	S	M	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

REAL ANALYSIS – I

(CORE PAPER – 2**)**

Course Objectives:

Develop the ability to reflect on problems that are quite significant in the field of real analysis. Develop the ability to reflect on problems that are quite significant in the field of real analysis. Ability to consider problems that could be solved by implementing concepts from different areas in mathematics. Ability to identify, formulate, and solve problems. Understanding of professional and ethical responsibilitiesS2-Communicate ideas effectively in graphical, oral, and written media

Course Outcome:

At the end of the Course, the Students will able to

CO1 students will be able to apply limiting properties to describe and prove continuity and differentiability conditions for real and complex functions.

CO2 Have a good understanding of **derivative** securities. Acquire knowledge of how forward contracts, futures contracts, swaps and options work, how they are used and how they are priced. Develop a reasoned argument in handling problemsabout functions, especially those that are of bounded variation

CO3 Be able to describe and explain the fundamental features of a range of key financial **derivative** instruments.

CO4 Learn the theory of Riemann-Stieltjes integrals, to be aquainted with the ideas of the total variation and to be able to deal with functions of bounded variation.

CO5 Knowledge of the implementation of theories in problem solving of Riemann-Stieltjesintegrals . create ability to understand the different math concepts and be able to implement them in our everyday problems.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	No

Unit 1: Limits and Continuity:

Connectedness, Components of a metric space, Arc wise connectedness, Uniform continuity, Uniform continuity and compact sets, Fixed-point theorem for contractions, Discontinuities of real - valued functions, Monotonic functions.

Chapter 4: 4.16 - 4.23 **(18 Hours)**

Unit 2: Derivatives:

Introduction, Definition of derivative, Derivatives and continuity, Algebra of derivatives, The chain rule, One sided derivatives and infinite derivatives, Functions with nonzero derivative, Zero derivatives and local extrema, Rolle's theorem, The Mean Value Theorem for derivatives, Intermediate –value theorem for derivatives, Taylor's formula with remainder.

Chapter 5: 5.1 - 5.12 **(18 Hours)**

Unit 3: Functions of Bounded Variations and Rectifiable Curves:

Introduction, Properties of monotonic functions, Functions of bounded variation, Total variation, Additive property of total variation, Total variation on [a, x] as a function x, Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation.

Chapter 6: 6.1 – 6.8 **(18 Hours)**

Unit 4: 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, Step functions as integrators, Reduction of a Riemann-Stieltjes integral to a finite sum, Euler's summation formula, Monotonically increasing integrators. Upper and lower integrals, Additive and linearity properties of upper and lower integrals, Riemann's condition.

Chapter 7: 7.1 - 7.13 **(18 Hours)**

Unit 5: Riemann – Stieltjes Integral (Continuation)

Comparison theorems, Integrators of bounded variation, Sufficient conditions for existence of Riemann-Stieltjes integrals, Necessary conditions for existence of Riemann-Stieltjes integrals, Mean Value Theorem for conditions for Riemann-Stieltjes integrals, The integral as a function of the interval, Second fundamental theorem of integral calculus, Change of variable in a Riemann integral, Second Mean-Value Theorem for Riemann integrals, Riemann-Stieltjes integrals depending on a parameter, Differentiation under the integral sign, Interchanging the order of integration.

Chapter 7: 7.14 - 7.25 **(18 Hours)**

Text Book:

➢ Tom M. Apostal, "**Mathematical Analysis**", Addison - Wesley Publishing Company, 1974.

References:

1. Walter Rudin, "**Principles of Mathematical Analysis**", Mc Graw Hill Inc, 1964.
2. Anthony W. Knapp, "**Basic Real Analysis"**, Birkhauser, 2005.
3. Wilder, R. L., "**The Foundations of Mathematics"**, second Edition, John Wiley & Sons, New York, 1965.
4. Kenneth A. Ross, "**Elementary Analysis: Theory of Calculus"**, Second edition Springer, 2013.

E-Materials:

https://www.classcentral.com/course/swayam-basic-real-analysis-17525

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	M	M	M	S	S
CO2	M	M	S	S	S	S	S	L	M	M
CO3	S	S	S	S	M	L	S	S	L	L
CO4	S	S	L	S	M	S	S	M	M	M
CO5	M	M	S	S	S	S	M	L	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L-Low

ORDINARY DIFFERENTIAL EQUATIONS

(CORE PAPER – 3**)**

Course Objectives:
The main objectives of this course are to:
1. The main purpose of the course is to introduce students to the theory and methods of ordinary
differential equations
2. Students should be able to implement the methods taught in the course to work associated problems, including proving results of suitable accessibility.
3. Understand the Existence and Uniqueness Theorem and its ramifications.
4. This course is designed to prepare students to solve problems arising from many applications
such as mathematical models of physical or engineering processes.
5. Apply the methods of undetermined coefficients and variation of parameters.

Expected Course Outcomes:
On the successful completion of the course, student will be able to:
CO1 Explore some of the basic theory of linear ODEs, recognize basic types of linear ODEs for which exact solutions may be obtained and to apply the corresponding methods of solution. - K1
CO2 Recognize ODEs and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved in order to solve the problems using multiple approaches. - K3
CO3 Interpret the obtained solutions in terms of the physical quantities involved in the original problem under reference. - K4
CO4 Determine particular solutions to differential equations with given boundary conditions or initial conditions. - K5
CO5 Students are introduced to modern concepts and methodologies in differential equations, with particular emphasis on the methods that can be used to solve largescale problems. K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit:1
Second Order Linear Equations With Constant Coefficients -The second order homogeneous equations – Initial value problems – Linear dependence andindependence - A formula for the Wronskian – The non- homogeneous equation of order two.
Unit:2
nth Order Linear Equations With Constant Coefficients -Homogeneous and non–homogeneous equations of order n – Initial value problems – Annihilator method to solve a non–homogeneous equation – Algebra of constant coefficient operators.
Unit:3
Linear Equations With Variable Coefficients - Initial value problems for the homogeneous equation- Solutions of the homogeneous equation – TheWronskian and linear independence – Reduction of the order of a homogeneous equation -Homogeneous equation with analytic coefficients – The Legendre equation.

Unit:4
Linear Equation With Regular Singular Points- Euler equation - Second order equations with regular singular points – Exceptional cases – Besselequation.
Unit:5 Existence and Uniqueness of Solutions to First Order Equations- Equation with variables separated– Exact equations – The method of successive approximations –The Lipschitz condition –Convergence of the successive approximations.

Text Book(s)
1 "An Introduction to Ordinary Differential Equations" by E.A. Coddington, Prentice Hall of India Ltd., New Delhi, 2009
Unit I : Chapter 2: Sections: 1 - 6. Unit II : Chapter 2: Sections: 7, 8, 10, 11, 12. Unit III : Chapter 3: Sections: 1 – 5, 7, 8. Unit IV : Chapter 4: Sections: 1 - 4, 6 - 8. Unit V : Chapter 5: Sections: 1 - 6.

Reference Books
1 "Ordinary Differential Equation" by S.C. Deo, Y. Lakshminathan and V. Raghavendra: Text
Book of Tata McGraw Hill, New Delhi (Chapters IV, VII and VIII). 1997 (Second edition)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	NO	NO	YES	YES	NO
2	Yes	No	Yes	Yes	Yes	NO
3	NO	YES	YES	NO	YES	NO
4	YES	NO	NO	YES	YES	YES
5	NO	NO	YES	NO	YES	YES

MECHANICS

(CORE PAPER – 4**)**

Course Outcomes:

On the successful completion of the course, student will be able to :

CO1 Understand D'Alembert's Principle and simple application of Lagrangian formulation. - **K2**

CO2 Analyze the Derivation of Lagrange equation from Hamiltons's Principle and modified Hamilton's principle. **K4**

CO3 Distinguish the concept of Hamilton equation of motion and Principle of least action - **K2, K4**

CO4 Obtain canonical equations using different combinations of generating functions and subsequently developing Hamilton Jacobi Method to solve equations of motion- **K1,K5**

CO5 Study the application of theory of canonical transformations to dynamical theory. **K3,K4,K6**

K1 – Remember ; K2 – Understand ; K3– Apply ; K4 –Analyze ; K5 –Evaluate ; K6 –Create

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	No	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit - I: Introductory Concepts

The Mechanical system –Generalized coordinates - Holonomic and non- holonomic systems - constraints – Virtual work – D' Alembert'sprinciple – Energy and Momentum.

Chapter 1:1.1 – 1.5 **(18 Hours)**

Unit - II: Lagrange's Equations

Derivation of Lagrange' sequations – Examples – integralsof motion- cycli c or ignorable coordinates.

Chapter 2:2.1 – 2.3 **(18 Hours)**

Unit - III: Hamilton'sEquations

Hamilton's principle - Hamilton's equations - other variational principle -Principle of Least action.

Chapter 4: 4.1 – 4.3 **(18 Hours)**

Unit - IV: Hamilton –Jacobi Theory
Hamilton principle function - Hamilton–Jacobi equation - Separability.

Chapter 5: 5.1 – 5.3 **(18 Hours)**

Unit - V: Canonical Transformation
Differential forms and generating functions – Special Transformations – Lagrange and Poisson brackets.

Chapter 6: 6.1 – 6.3 **(18 Hours)**

Text Book:

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

References:

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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	L	M	M	M	L	S	S	M	M
CO2	M	L	M	S	M	M	M	M	M	L
CO3	L	M	M	M	L	M	M	M	M	M

CO4	**M**	**L**	**M**	**M**	**M**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**L**	**S**	**M**	**L**	**S**	**S**	**M**	**S**

* PO – Programme Outcome, CO – Course Outcomes

*S-Strong ; M-Medium; L- Low

I-Semester-Value Added Course

LATEX

Pre-requisite: Basic knowledge of programming & Mathematics

Course Objectives:

The main objectives of this course are to:

1. Introduce the Software knowledge in Latex
2. Learn Mathematics structures using Latex
3. Understanding the basic concepts and their properties are important for the development of the present and further courses.

Course Outcome:

On the successful completion of the course, student will be able to:

CO1 Remember to Download and install open source software Latex

CO2 Understanding and formatting Latex

CO3 Illustrate to learn to create Latex file

CO4 Apply and Analyze the Latex commands to large files

CO5 Able to learn mathematics derivations and structures using LATEX

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit:1

Text formatting, TEX and its offspring **(6 Hours)**

Unit:2

What's different in LATEX2ϵ , Distinguishing LATEX2 ϵ, Basic of a LATEX file

(6 Hours)

Unit:3
Commands and Environments-Command names and arguments, Declarations Lengths, special Characters. **(6 Hours)**

Unit:4
Document layout and Organization-Document class, Page style, Parts of the Document
(6 Hours)

Unit:5
Table of Contents, Fine tuning text, Footnotes and marginal notes. **(6 Hours)**

Books for study and References

1. H. Kopka and P.W. Daly , "A guide to LATEX" - third Edition, Addison –Wesley , London 1999.
2. **Stefan Kottwitz**"LaTeX Beginner's Guide: Create High-quality and Professional-looking Texts, Articles, and Books for Business and Science Using LaTeX" Packt Publishing, 2011.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	M	M	S
CO2	S	S	S	M	S	M	S	M	M	M
CO3	S	M	S	M	S	S	S	M	M	L
CO4	S	S	M	M	S	S	S	L	S	S
CO5	S	S	S	S	M	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L

M.Sc First year -I semester

CORE ELECTIVE-Paper- I

A. TENSOR ANALYSIS AND RELATIVITY THEORY

Course Objectives:

- The main purpose of the course is to introduce students to understand the subject of differential geometry, where you talk about manifolds, one difficulty is that the geometry is described by coordinates, but the coordinates do not have meaning. They are allowed to undergo transformation. And in order to handle this kind of situation, an important tool is the so-called tensor analysis, which was new to mathematicians.
- Students should be able to implement the methods taught in the course to work associated problems, including proving results of suitable accessibility in different field..

Course Outcomes :

On successful completion of the course, the students will be able to

CO1 Understand Tesor Algebra terminologies and different orders – Summation convention – Kronecker symbols – Transformation of coordinates in S_n. Invariants – Covariant and Contravariant vectors and arithemetics law related to tensor. **K1,K2**

CO2 Discuss the Riemannian space – Christoffel symbols and their properties. **K4**

CO3 Tensor calculus fundamentals on Covariant differentiation of tensors – Riemann-Christoffel curvature tensor – Intrinsic differentiation are carried out. **K3 ,K5**

CO4 Focus on special theory of relativityconcepts of Laurent's transformation equations, Einstein train – Time dilation – Longitudinal contraction – Invariant interval - Twin paradox. **K2,K5**

CO5 Study the application of theory relativistic dynamics on Momentum-Energy four vector – Force – Conservation of energy – Principle of equivalence – Lagrangian and Hamiltonian formulations- **K3 , K6**

K1 – Remember ; K2 – Understand ; K3– Apply ; K4 –Analyze ; K5 –Evaluate ;

K6 –Create

Unit I: Tensor Algebra

Systems of different orders – Summation convention – Kronecker symbols – Transformation of coordinates in S_n. Invariants – Covariant and Contravariant vectors – Tensors of second order – Mixed tensors – Zero tensors – 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 of tensor – Relative tensor – Cross product of vectors.

Chapter 1: 1.1 – 1.3, 1.7 & 1.8 and **Chapter 2 :** 2.1 – 2.9 of U.C. De, Absos Ali Shaikh &Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004.**(15 Hours)**

Unit II: Tensor Calculus

Riemannian space – Christoffel symbols and their properties.

Chapter 3: 3.1 – 3.2 of U.C. De, Absos Ali Shaikh &Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. **(15 Hours)**

Unit III: Tensor Calculus (Contd …)

Covariant differentiation of tensors – Riemann-Christoffel curvature tensor – Intrinsic differentiation.

Chapter 3: 3.3 – 3.5 of U.C. De, Absos Ali Shaikh &Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. **(15 Hours)**

Unit IV: Special Theory of Relativity

Galilean transformation – Maxwell's equations – The Ether theory – The principle of Relativity.

Relativistic Kinematics: Laurent's 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: 7.1 – 7.2 of D.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. **(15 Hours)**

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:** 7.3 – 7.4 of D.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. **(15 Hours)**

References:

1. J.L.Synge&A.Schild, Tensor Calculus, Toronto, 1949.

2. A.S.Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930.

3. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942.

4. C.E.Weatherburn, Riemannian geometry and The Tensor Calculus, Cambridge, 1938.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	M	L	S	S	M	M
CO2	M	S	M	S	M	M	M	M	M	L
CO3	L	M	M	M	S	M	M	M	M	M
CO4	M	L	M	M	M	M	S	S	S	S
CO5	M	M	L	S	L	L	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

*S-Strong ; M-Medium; L- Low

CORE ELECTIVE-Paper- I

B. Calculus of Variations and Integral Equations

CourseObjectives

1. The aim of the course is to introduce to the students the concept of calculus of variation and its applications.
2. Introduce various types of integral equations and how to solve these equations.

Course Outcome:

At the completion of the Course, the Students will able to

CO1 Students know the concept and properties of variational problems with fixed and moving boundaries, functions of dependent and independent variables and also solve some applications problems in mechanics.

CO2 Able to solve differential equations and integral equation problems. Find the solution of eigen value, eigen functions.

CO3 Implementation of various methods to solve Fredholm Intergral equation.

CO4 Students gain acquire knowledge about Hilbert – Schmidt Theory

CO5 Deriving the complex Hilbert space – Orthogonal system of function and Solutions of Fredholm of Integral equation of first kind

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Variational problems with fixed boundaries

The concept of variation and its properties – Euler's equation – Variational problems for Functionals – Functionals dependent on higher order derivatives – Functions of several independent variables – Some applications to problems of Mechanics.

Chapter 1: 1.1 - 1.7 (Text Book - 1) **(15 Hours)**

Unit II: Variational problems with moving boundaries

Movable boundary for a functional dependent on two functions – one-sided variations – Reflection and Refraction of extremals – Diffraction of light rays.

Chapter 2: 2.1 - 2.5 (Text Book - 1) **(15 Hours)**

Unit III: Integral Equation

Introduction – Types of Kernals – Eign values and Egien functions – connection with differential equations – Solution of an integral equation – Initial value problems – Boundary value problem.

Chapter 1: 1.1 - 1.3 & 1.5 - 1.8 (Text Book - 2) **(15 Hours)**

Unit IV: Solution of Fredholm intergral equation

Second kind with separable kernel – Orthogonality and reality eigen function – Fredholm Integral equation with separable kernel – Solution of Fredholm Integral Equation by successive substitution – Successive approximation – Volterra integral equation – Solution by successive substitution.

Chapter 2: 2.1 - 2.3 and **Chapter 4:** 4.1 - 4.5 (Text Book - 2) **(15 Hours)**

Unit V: Hilbert – Schmidt Theory

Complex Hilbert space – Orthogonal system of function – Gram-Schmitorthognalization process – Hilbert-Schmidt theorems – Solutions of Fredholm of integral equation of first kind.

Chapter 3: 3.1 - 3.4 & 3.8 - 3.9 (Text Book - 2) **(15 Hours)**

Recommended Text Books:

- A.S. Gupta, Calculus of Variations with Application, Prentice Hall of India, New Delhi, 2005.

- Sudir K. Pundir and RimplePundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut, 2005.

Reference Text Books:

- L. Elsgolts, Differential Equations and the Calculus of Variations Mir Publishers, Moscow, 1973.
- Ram P. Kanwal, Linear Integral Equations. Academic Press, New York, 1971.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

I Semester-CORE ELECTIVE-Paper- I

C.DIFFERENCE EQUATIONS

Course Objectives:

- Difference equations usually describe the evolution of certain phenomena over the course of time. The aim of studying this course is.
- To introduce the difference calculus.
- To study linear difference equations and to know how to solve them.
- To know the stability theory for homogeneous linear system of difference equations.
- To study the asymptotic behavior of solutions of homogeneous linear difference equations.

Course Outcome:

After the successful completion of the course, students will be able

CO1 To know the fundamentals of difference calculus, like, the difference operator, the computation of sums, the concept of generating function and the important Euler summation formula.

CO2 To solve linear difference equations using different methods, namely, annihilator method, z-transform method, etc.

CO3 To find the stability results for the linear system using eigen value criteria.

CO4 To find asymptotic analysis of sums, and asymptotic behavior of solutions to linear difference equations by the theorems of Poincare and Perron

CO5 To solve the Three-term Difference Equations – Non-linear Difference Equations – Self-Adjoint second order Equations

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT I: LINEAR DIFFERENCE EQUATIONS OF HIGHER ORDER

Difference Calculus – General Theory – of Linear Difference Equations – Linear Homogeneous Equations with constant coefficients – Linear non-homogeneous Equations – Method of undetermined coefficients, the method of variation of constants – Limiting behavior of solutions.

Chapter 2: Sec 2.1 – 2.5 **(15Hours)**

UNIT II: SYSTEM OF DIFFERENCE EQUATIONS

Autonomous system – The basic theory – The Jordan form – Linear periodic system.

Chapter 3: Sec 3.1 – 3.4 **(15 Hours)**

UNIT III: THE Z-TRANSFORM METHOD

Definition, Example and properties of Z-transform – The inverse Z-transform and solution of Difference Equations: Power series method, partial fraction method, the inverse integral method – Volterra Difference Equations of Convolution types – Volterra systems.

Chapter 5: Sec 5.1 – 5.5 (Except 5.4) **(15Hours)**

UNIT IV: ASYMPTOTIC BEHAVIOR OF DIFFERENCE EQUATIONS

Tools and Approximations – Poincare's Theorem – Second order Difference Equations – Asymptotic diagonal systems – Higher order Difference Equations.

Chapter 8: Sec 8.2 – 8.5 **(15 Hours)**

UNIT V: OSCILLATION THEORY

Three-term Difference Equations – Non-linear Difference Equations – Self-Adjoint second order Equations.

Chapter 7: Sec 7.1 – 7.3 **(15 Hours)**

Recommended Text:

➢ SaberN.Elaydi, An Introduction to Difference Equations, Springer Verlag, New York, 1996.

Reference Books:

1. R.P. Agarwal., Difference Equations and Inequalities, Marcel Dekker, 1999.
2. S.Goldberg, Introduction to Difference Equations, Dover Publications, 1986.

3. V.LakshmiKantham and Trigiante, Theory of Difference Equations, Academic Press, New York, 1988.

4. Peterson, A Difference Equations, An Introduction with Applications, Academic Press, New York, 1991.

2. COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	M	L	S	S	M	M
CO2	M	S	M	S	M	M	M	M	M	L
CO3	L	M	M	M	S	M	M	M	M	M
CO4	M	L	M	M	M	M	S	S	S	S
CO5	M	M	L	S	L	L	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

*S-Strong ; M-Medium; L- Low

I SEMESTER-CORE PRACTICAL

JAVA PROGRAMMING (Practical paper- 1)

The main objectives of this course are to:

3. The main objective of JAVA Programming Lab is to provide the students a strong foundation on programming concepts and its applications through hands-on training.
4. To practice the Basic concepts, Branching and Looping Statements and Strings in programming

5. To implement and gain knowledge in Arrays, functions, Structures, Pointers and File handling

Course Outcomes:
CO1: Understand the basic concepts of Java Programming with emphasis on ethics and principles of professional coding
CO2: Demonstrate the creation of objects, classes and methods and the concepts of constructor, methods overloading, Arrays, branching and looping
CO3: Create data files and Design a page using AWT controls and Mouse Events in Java programming Implement the concepts of code reusability and debugging.
CO4: Develop applications using Strings, Interfaces and Packages and applets.
CO5: Construct Java programs using Multithreaded Programming and Exception Handling.

1. Write a Java Applications to extract a portion of a character string and print the extracted string.

2. Write a Java Program to implement the concept of multiple inheritance using Interfaces.

3. Write a Java Program to create an Exception called payout-of-bounds and throw the exception.

4. Write a Java Program to implement the concept of multithreading with the use of any three multiplication tables and assign three different priorities to them.

5. Write a Java Program to draw several shapes in the created windows.

6. Write a Java Program to create a frame with four text fields name, street, city and pin code with suitable tables. Also add a button called my details. When the button is clicked its corresponding values are to be appeared in the text fields.

7. Write a Java Program to demonstrate the Multiple Selection List-box.

8. Write a Java Program to create a frame with three text fields for name, age and qualification and a text field for multiple line for address

9. Write a Java Program to create Menu Bars and pull down menus.

10. Write a Java Program to create frames which respond to the mouse clicks. For each events with mouse such as mouse up, mouse down, etc.,
Text books:

M.Sc., First Year - SEMESTER - II

ALGEBRA – II
(CORE PAPER – 5**)**

Course Objectives:

The main objectives of this course are to:

1. Facilitate the basic concepts of vector spaces and matrix of a linear transformation.
2. Enable students to learn rational canonical form and Jordan canonical form in detail.
3. Introduce the concept of finite fields and Galois theory

Course Outcome:

At the end of the Course, the Students will able to

CO1 Define the Matrix of a linear transformation and Dual vector spaces.

CO2 Comparison between Rational Canonical Form and Jordan Canonical Form, Field extensions and Algebraic Extensions.

CO3 Define Splitting fields, Algebraic closures and Cyclotomic polynomials.

CO4 Analyze the fundamental theorem of Galois theory.

CO5 Related definitions and fundamental theorem of Galois theory and Finite Fields.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	No	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit I: Vector Spaces

Definitions and basic theory – The Matrix of a linear transformation – Dual vector spaces – Determinants. **(18 Hours)**

Chapter 11:11.1 - 11.4

Unit II: Module over Principal Ideal Domain

Basic definitions and examples – The Basic Theory –The Rational Canonical Form –The Jordan Canonical Form. **(18 Hours)**

Chapter 10: 10.1 &Chapter 12: 12.1 - 12.3

Unit III: Field theory

Basic Theory of field extensions – Algebraic Extensions. **(18 Hours)**

Chapter 13: 13.1 - 13.2

Unit IV: Field Theory (Cont…)

Splitting fields and Algebraic closures – Separable and inseparable extensions - Cyclotomic polynomials and extensions. **(18 Hours)**

Chapter 13: 13.4 - 13.6

Unit V: Galois Theory

Basic definitions – The fundamental theorem of Galois theory – Finite Fields. **(18 Hours)**

Chapter 14: 14.1 - 14.3

Text Book : David S. Dummit and Richard M. Foote, Abstract Algebra (Second Edition), Wiley, 2003.

References:

1. Serge Lang,Algebra, Springer, 2002.
2. I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.
3. M.Artin, Algebra, Prentice Hall of India, 1991.
4. N.Jacobson, Basic Algebra,Vol. I & II W.H.Freeman; also published by Hindustan Publishing Company, New Delhi, 1980.
5. I.S.Luther and I.B.S.Passi, Algebra,Vol. I - Groups (1996); Vol. II *Rings,* Narosa Publishing House , New Delhi, 1999.
6. Joseph A. Gallian, Contemporary Abstract Algebra, Brooks / Cole Pub Co.,2012.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	S	S	S	M	S
CO2	M	S	S	S	S	S	S	S	S	S
CO3	M	S	S	M	S	M	M	S	S	S
CO4	M	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	M	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes ,S – Strong, M – Medium, L – Low

REAL ANALYSIS – II

(CORE PAPER – 6**)**

CourseObjectives

- ✓ To introduce the concepts Double sequences, Double series and Multiplication of series
- ✓ To enable the students to know about Uniform convergence and Riemann-Stieltje's integration.

Course Outcome:

At the end of the Course, the Students will able to

CO1 Define Double sequences, Double series and Multiplication of series.

CO2 Distinguish Point-wise convergence of sequences of functionandUniform convergence of infinite series of functions.

CO3 Analyze Non-uniformly convergent sequences that can be integrated term by term,Sufficient conditions for uniform convergence of a series.

CO4 An application tocomplex-valued functions.

CO5 Apply Functions with non-zero Jacobian determinant.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Infinite series and Infinite products

Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesarosummability - Infinite products.

Chapter 8: 8.20 – 8.26 **(18 Hours)**

Unit 2: Sequence of Functions

Point-wise 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 of functions.

Chapter 9: 9.1 – 9.6 **(18 Hours)**

Unit 3: Sequence of Functions [Continued]

Uniform convergence and Riemann-Stieltje's integration – Non-uniformly convergent sequences that can be integrated term by term - Uniform convergence and differentiation - Sufficient conditions for uniform convergence of a series - Uniform convergence and double sequences - Mean convergence.

Chapter 9: 9.8 – 9.13 **(18 Hours)**

Unit 4: Multi-Variable Differential Calculus

Introduction - The differential derivative - Directional derivatives and continuity – The total derivative - The total derivative expressed in terms of partial derivatives - An application to

complex-valued functions - The matrix of a linear function - The Jacobian matrix - The chain rule.

Chapter 12: 12.1 – 12.9 **(18 Hours)**

Unit 5: Implicit functions and Extremum problems

Introduction - Functions with non-zero Jacobian determinant - The inverse function theorem - The implicit function theorem.

Chapter 13: 13.1 – 13.4 **(18 Hours)**

Recommended Text Book:

- Tom M. Apostal, "**Mathematical Analysis**" Addison-Wesley Publishing Company, 1974.

References:

1. Walter Rudin, "**Principles of Mathematical Analysis**", McGraw HillInc, 1964.

2. Anthony W. Knapp, "**Basic Real Analysis"**, Birkhauser, 2005.

3. Dieudome, J., "**Foundations of Modern Analysis"**, Academic press, Inc, Newyork, 1960.

E-Materials: https://www.classcentral.com/course/swayam-basic-real-analysis-17525

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	M	M	M	S	S
CO2	M	M	S	S	S	S	S	M	M	M
CO3	S	S	S	S	M	L	S	S	M	M
CO4	S	S	M	S	M	S	S	M	M	M
CO5	M	M	S	S	S	S	M	L	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L

PARTIAL DIFFERENTIAL EQUATIONS
(CORE PAPER – 7**)**

Course Objectives

1. Learn the elementary concepts and basic ideas involved in partial differential equations.
2. Develop the mathematical skills to solve problems involving partial differential equations rather than general theory.
3. Understand the partial differential equations as models of various physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer and electrostatics.

Course Outcome:
On successful completion of the course, the students will be able to

CO1 Extract information from partial differential equations to interpret the reality.

CO2 Know the various types of methods and their limitations to solve the partial differential equations.

CO3 Identify the physical situations and real world problems to formulate mathematical models using partial differential equations.

CO4 Apply the acquired knowledge to select the most appropriate method to solve the particular partial differential equations.

CO5 To understand Formation and solution of one-dimensional & two dimensional wave equation - canonical reduction – IVP and BVP.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT - I: PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER

Formation and solution of PDE- Integral surfaces - Cauchy Problem order equation - Orthogonal surfaces - First order non-linear - Characteristics - Compatible system –Charpit's method.

Chapter 0: 0.4 to 0.11 (omit 0.1, 0.2, 0.3 and 0.11.1) **(18 Hours)**

UNIT - II: FUNDAMENTALS

Introduction - Classification of Second order PDE - Canonical forms – Adjoint operators - Riemann's method.

Chapter 1: 1.1 to 1.5 **(18 Hours)**

UNIT - III: ELLIPTIC DIFFERENTIAL EQUATIONS

Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet's Problem and Newmann Problem for a rectangle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.

Chapter 2: 2.1, 2.2, 2.5 to 2.7, 2.10 to 2.13(omit 2.3, 2.4, 2.8 and 2.9) **(18 Hours)**

UNIT - IV: PARABOLIC DIFFERENTIAL EQUATIONS

Formation and solution of Diffusion equation – Dirac - Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.

Chapter 3: 3.1 to 3.7 and 3.9. (omit 3.8) **(18 Hours)**

UNIT - V: HYPERBOLIC DIFFERENTIAL EQUATIONS

Formation and solution of one-dimensional wave equation - canonical reduction – IVP - D'Alembert's solution - IVP and BVP for two-dimensional wave equation - Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems - Uniqueness of the solution for the wave equation - Duhamel's Principle - Examples.

Chapter 4: 4.1 to 4.12 (omit 4.5, 4.6 & 4.10) **(18 Hours)**

Recommended Text:

- K. Sankar Rao, *Introduction to Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2005

Reference Books:

1. R.C.McOwen, *Partial Differential Equations*, 2ndEdn. Pearson Eduction, 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*

ValueProblems, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations,*S.Chand& Company Ltd., New Delhi, 2001.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**		**S**	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

APPLIED NUMERICAL ANALYSIS
(CORE PAPER – 8**)**

Course Objectives

The objectives of the course is to

1. To study the algebraic system of equations and how to solve them by using various method
2. Evaluate the polynomial equations using interpolation methods.
3. Study the Newton's Gauss forward and backward formulae.
4. Know the numerical solution of first order ordinary differential equations.
5. Learn the classification of PDE and solving them.

Course Outcomes

After successful completion on the course the student will be able to

1 Solve simultaneous linear equations by using Gauss elimination method, matrix inversion method, Gauss-Jordan Method, Gauss – Seidal method

2 Apply finite difference to evaluate polynomial using interpolation for equal and unequal intervals

3 Compute derivative of a function at the point in the given interval by using Newton's and Gauss forward and backward differences formulae

4 Utilize General Quadrature formula, Trapezoidal rule, Simpson's rule, Weddle's Rule in integration and find the numerical solution of the first order ordinary differential equations

5 Analyzing the Difference Quotients - classification of PDE - Schmidt explicit formula – Crank-Nicolson method - Hyperbolic equations - Solution of two dimensional heat

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1:Algebra and transcendental system of equations 18 hours

General iterative method - Bisection method - Secant method – Newton - Raphson method - solution of system of equations - Gaussian elimination method - Gauss Jordan method - LU decomposition method - Rate of convergence Gauss - seidel method - Eigen value of a Matrix -Power method - Jacobi method**.**

Text Book 1: Chapter 2: 2.3 - 2.4 & 2.10 - 2.11

Unit–2: Interpolation 18 hours

Interpolation with equal intervals - Newton's forward and backward formula - Central difference interpolation formula - Gauss forward and backward formula - Sterling's formula - Bessel's formula - Interpolation with unequal intervals - Lagrange's interpolation and inverse interpolation formula - Newton's divided difference formula - Interpolation with cubic spline.
Text Book 1: Chapter 3: 3.2 - 3.4 & 3.7 and **Chapter 4:** 4.1.

Unit–3: Numerical Differentiation and Integration 18 hours

Numerical differentiation - Formulae for derivatives - Maxima and minima of a tabulated function - Numerical Integration - Trapezoidal rule - Simpson's $^{1}/_{3^{rd}}$ and $^{3}/_{8^{th}}$ rules - Romberg's method -Applications.
Text Book 1: Chapter 5: 5.2, 5.4& 5.6 - 5.7

Unit-4: Ordinary Differential Equations 18 hours

First order equations - System of equations and higher order equations - Taylor series method -Euler method - Modified and Improved Euler's method - Runge kutta methods - Fourth order Runge kutta method - Multi step methods: Adams - Bash forth and Milne's methods - Linear two point Boundary value problems: The shooting method.

Text Book 1: Chapter 6: 6.2 - 6.4 & 6.6 - 6.7.

Unit-5: Partial Differential Equations 18 hours

Difference Quotients - classification of partial differential equations - Elliptic equation - Laplace equation by Liebmann's iteration process - Poisson's equations - Parabolic equations - Schmidt explicit formula – Crank-Nicolson method - Hyperbolic equations - Solution of two dimensional heat equations.
Text Book 2: Chapter 12: 12.1 -12.7, 12.8.2 & 12.9

Prescribed Books

1. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical methods for Scientific and Engineering, New Age International Ltd., 5th Edition (2010).
2. B.S.Grewal, J.S.Grewal, Numerical methods in Engineering and Science, Khanna Publishers, New Delhi, 1999.

Reference Books:

1. S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India Pvt.Ltd., New Delhi (2003).
2. M.K.Venkatraman, Numerical methods in Science and technology, National Publishers Company, 1992.
3. P.Kandasamy, K.Thilagavathy and K.Gunavathy, Numerical methods, S.Chand and Company, New Delhi, 2003.

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

6. Having the capacity to solve the algebraic system of equations by Gauss elimination method, Gauss Jordan method, Jacobi and Seidal method.
7. Evaluate the polynomial equations by using interpolation for equal and unequal intervals.
8. Able to solve various method like trapezoidal rule, simpson's rule and Romberg method.
9. Solve the ODE by using taylor series, Runge-kutta, Fourth order Runge Kutta method.
10. Learn the concepts of two dimensional heat equations and able to solve them.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	S	M	S
CO2	S	S	S	S	M	M	S	S	M	S
CO3	S	S	S	S	S	S	M	S	S	M
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	M	S	S	M	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, Low

II SEMESTER-Core Elective Paper II

A. MATHEMATICAL METHODS

Pre-requisite

- **The goal of the course is to understand the students the concept of mathematics applied in real life scenario.**
- **Introduce Special functions, Integral transforms and problem solving in differential equations.**

Course Objectives:

The main objectives of this course is to:

1. Generating the special functions of polynomials and series
2. Introduce fundamentals of infinite and finite Integral transforms and applying differential equation and integral equation.
3. Use in special functions, Integral transforms and differential equations as tools for problem solving

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

CO1 Understand to Generating the special functions such as Legendre functions and Bessel's functions, basic properties, solving in differential equations

CO2 Understand to solve the boundary value problems in such as a two and three dimension heat flow by using Fourier series

CO3 Acquire a basic knowledge in Fourier transform of properties, Derivatives and its application of Differential Equations

CO4 Acquire a basic knowledge in Laplace transform of properties, Derivatives and its application of Differential Equations

CO5 Apply the acquired knowledge in solving applied problems

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Legendre Differential Equation and Legendre Functions

Generating functions of Legendre polynomial – Rodrigue's Formula for Legendre Polynomials – Orthogonal Properties of Legendre's Polynomials – Recurrence Formulae for $P_n(x)$ – Expansion of Arbitary Functions in Series of Legendre polynomial.

Chapter:7.12 – 7.16 & 7.20 **(15 hours)**

Unit II: Bessel's Differentiation Equation; Bessel's Functions of first kind and Second Kind

Limiting values of $J_n(x)$ and $Y_n(x)$ –Differential Equations Reducible to Bessel's Equation-Bessel's Functions of third kind; Hankel Functions-Recurrence formulae for $J_n(x)$ – Generating Function for $J_n(x)$ –Jacobi Series- Bessel's Integrals-Orthonormality of Bessel's Functions.

Chapter:7.22 – 7.30 **(15 hours)**

Unit III : Fourier Equation of Heat Flow

Solution of Heat Flow Equation: Method of Separation of Variables-Linear Flow in Semi – infinite solid- Variable Linear Flow in an Infinite Bar-Two-Dimensional Heat Flow-Three Dimensional Heat Flow- Heat Flow in Circular Plate(Use of Cylindrical coordinates)

Chapter: 9.7-9.13 **(15 hours)**

Unit IV : Fourier Transform

Properties of Fourier Transform- Fourier Transform of a Derivative- Fourier sine and cosine Transforms of Derivatives- Fourier Transform of Functions of Two or Three Variables-Finite Fourier Transforms –Simple Applications of Fourier Transforms

Chapter: 10.2-10.8 **(15 hours)**

Unit V: Laplace Transforms

Properties of Laplace Transforms –Laplace Transform of the Derivative of a Function-Laplace Transform of Integral- Laplace Transform of Periodic functions- Laplace Transform of Some Special Functions- Inverse Laplace Transform – Properties of Inverse Laplace Transform - Evaluations of Inverse Laplace Transforms by Convolution Theorem- Method of Partial Fractions - Differential Equations - Applications of Laplace Transform

Chapter: 10.9-10.15, 10.17 & 10.19-10.22 **(15 hours)**

Recommended Text: SATYA PRAKASH, Mathematical Physics with Classical Mechanics, Sultan Chand & Sons, Educational Publishers, New Delhi, sixth revised 2012.

References :

1. Advanced Engineering & Sciences M.K.Venkataraman, The National Publishing Co.

2. F.B.Hildebrand. (1977) *Advanced Calculus for Applications.* Prentice Hall. New Jersey.

3. Engineering Mathematics Series, Veerarajan. T, Tata Mcgraw Hill Publication

4. Advanced Engineering Mathematics, Erwin Kreyszing, fifth edition, Wiley Eastern pubishers, 1985.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**		**S**	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

II SEMESTER- CORE ELECTIVE PAPER-II

B.CRYPTOGRAPHY AND DATA SECURITY

The main objectives of this course are to:
1. To introduce students to some of the basic ideas of number theory, and to use this as a context inwhich to discuss the development of mathematics through examples, conjectures, theorems,
proofs and applications.
2. Illustrate different methods of proof in the context of elementary number theory, and will apply some basic techniques of number theory to cryptography.
3. To explore the working principles and utilities of various cryptographic algorithms including
secret key cryptography, hashes and message digests, and public key algorithms.
4. To introduce classical encryption techniques and concepts of modular arithmetic and number
theory. Expected Course Outcomes:

Course Outcomes:
On the successful completion of the course, student will be able to:
CO1 Identify and apply various properties of and relating to the integers including the Well Ordering Principle, primes, unique factorization, the division algorithm, and greatest common divisors.-- K1 & K2
CO2 Understand the concept of congruence and use various results related to congruencies including the Chinese Remainder Theorem. --K2 & K3
CO3 Identify and Understand how number theory is related to and used in Cryptography - K2 & K4
CO4 Acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.-- K4
CO5 Understand how to deploy encryption techniques to secure data in transit across data networks --K5 & K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit 1: Time estimates for doing arithmetic – Divisibility and the Euclidean algorithm – Congruences**(15hours)**

Unit 2: Some applications to factoring – Quadratic residues and reciprocity.(**15 hours**)

Unit 3: Some simple cryptosystems – Enciphering matrices..(**15 hours**)

Unit 4: The idea of public key cryptography – RSA – Discrete log – Knapsack – Zero-Knowledge protocols and oblivious transfer..(**15 hours**)

Unit 5: Pseudo primes – The rho method – Fermat factorization and factor bases – The continued fraction method – The quadratic sieve method. .
(**15 hours)**

Text Book: Neal Koblitz, "A Course in Number Theory and Cryptography"- Second Edition, Springer Publishers.

Unit 1: Chapter 1 sections 1,2 and 3, Unit 2: Chapter 1 section 4 and chapter 2 section 2

Unit 3: Chapter 3, Unit 4: Chapter 4 except section 5, Unit 5: Chapter 5

Reference Books

1. A.Menezes, P. van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC press, 1996.
2. Douglas R. Stinson "Cryptography theory and practice" Second Edition, Chapman and Hall / CRC.

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	NO	NO	YES	YES	NO
2	Yes	No	Yes	Yes	Yes	NO
3	NO	YES	YES	NO	YES	NO
4	YES	NO	NO	YES	YES	YES
5	NO	NO	YES	NO	YES	YES

II SEMESTER-CORE ELECTIVE PAPER-II

C.FINANCIAL MATHEMATICS

Course Objectives: After completing the course students will understand the mathematical foundations of quantitative finance. Understand the standard and advanced quantitative methodologies and techniques of importance to a range of careers in investment banks and other financial institutions.Appreciation of emerging theory and techniques in the area of financial mathematic

Course Outcome :
At the end of the Course, the Students will able to

CO1 Create and evaluate potential models for the price of shares.Construct, evaluate and analyze models for investments and securities.

CO2 Student can familiarize on computation of the present value and the accumulated value of a stream of equal or unequal payments using different kinds of interest rate.

CO3 Application of Capital investment and discount cash flow techniques are able to understand using compound interest function., Equation of value, Repayment by regular installments of interest and capital, discounted cash flow techniques.

CO4 Understand the investments and risk characteristics of the following types: Simple Compound interest problems. Design, build, investigate and evaluate forward contract using arbitrage-free pricing methods.

CO5 : Develop connections within branches of Financial Mathematics and between Probability and other disciplines like Reliability theory – Life time distributions – Hazard rate survival function.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit I: Generalized Cash Flow model for financial transaction, making allowance for the probability of payment, Time value of money using concepts of compound interest and discounting, Interest rates or discount rates in terms of different time periods. **(15 Hours)**

Unit II: Calculation of the present value and the accumulated value of a stream of equal or unequal payments using specified rates of interest and the net present value at a real rate of interest, assuming a constant rate of inflation. **(15 Hours)**

Unit III: Use of compound interest function, Equation of value, Repayment by regular installments of interest and capital, discounted cash flow techniques. **(15 Hours)**

Unit IV: The investments and risk characteristics of the following types: Simple compound interest problems. The delivery price and the value of the forward contract using arbitrage free pricing methods. **(15 Hours)**

Unit V: Basics of Reliability theory – Life time distributions – Hazard rate survival function – Exponential, Wei-bull-Gamma, Life Time Distributions. **(15 Hours)**

Recommended Text Book:

Suresh Chandra (1998), Introductory Financial Mathematics, Narosa Publishers, New Delhi. (for unit 1 - 4).

S.K. Sinha (1979), Reliability and Life – Testing, Wiley Eastern, New Delhi.(for unit-5).

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

II SEMESTER-OPEN ELECTIVE (Non Major)-Paper-I

(A) Mathematics for Competitive Examinations

Course Objectives:

The main objectives of this course are to:

1. Know the fundamental concepts in mathematics
2. Equip the students to solve problemsusing shortcut methods in quantitative aptitude.
3. Prepare the students for competitive exams.

Course Outcome: At the end of the Course, the Students will able to

CO1 Solve the problems on Ages – Percentage .
CO2 Gain knowledge in Profit and Loss – Ratio and Proportion related problems.
CO3 Provides the capability to solve the work and distance problems.
CO4 Calculating the simple Interest and compound interest.
CO5 Understand the principles of stocks and shares.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	No	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit I: Problems on Ages – Percentage – **(6 hours**).

Unit II: Profit and Loss – Ratio and Proportion – **(6 hours).**

Unit III: Time and Work – Time Distance – **(6 hours).**

Unit IV: Simple Interest- Compound Interest – (**6 hours**).

Unit V: Stocks and Shares – Bankers' Discount – (**6 hours**).

Text Book: Quantitative Aptitude by Dr.R.S. Aggarwal (Edition 2017), S. Chand Publishing, Section I: Chapter – 8, 11,12,13,17,18,22,23, 29 and 33.

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	S	S	M	S	S	S
CO2	M	M	S	S	M	M	M	S	S	M
CO3	S	S	M	S	S	S	S	M	S	S
CO4	S	M	M	S	M	M	S	M	S	M
CO5	S	S	S	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

II SEMESTER-OPEN ELECTIVE (Non Major)-Paper-I

(B).STATISTICS

Course Objectives

The objectives of the course is to

1, To introduce Collection and Bar diagrams.
2.To understand the measure of central tendencies.
3.To make the students familiar in Quartile deviation and mean deviation.
4.To understand the correlation and its types.
5.To introduce the Regression lines and its equations.

Course Outcomes

After successful completion on the course the student will be able to

6 Students understand the types of data. Collection, compilation, classification and tabulation of data. Also representation of data on diagrammatical and graphical are discussed Assess the existence and uniqueness of solutions and derive necessary and sufficient optimality conditions for a given optimization problem

7 Analysis of data among the measurements of central tendencies properties and simple problems are practiced Study the concepts of game theory and saddle point, domaince by graphical method

8 Analysis of data among the measurements of dispersion or variations properties and simple problems are practiced

9 To understand the knowledge and application of bivariate data using correlation analysis. Different kinds of correlation, it's properties and worked out real life problems

0 In Regression analysis to understand the types of regression lines, equations, partial and multiple regression with practical examples.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1: **6 hours**

Collection, classification and tabulation of data, graphical and diagrammatic representation of data – Bar diagrams

Unit–2: **6 hours**

Measures of central tendency – Mean, Median and Mode : Discrete series and Continuous series.

Unit–3: **6 hours**

Measures of dispersion – Range, Quartile deviation, Standard deviation and variance.

Unit-4: **6 hours**

Correlation – Introduction, scatter diagram, properties and Karl Pearson's coefficient of correlation.

Unit-5: **6 hours**

Regression types and method of analysis, Regression line, Regression equations.

Prescribed Books

1. S.C.Guptaand V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 1994.

Reference Books:

1. Freund J.E. (2001); Mathematical Statistics, Prentice Hall of India
2. Goon, A.M., Gupta M.K., Dos Gupta, B, (1991), Fundamentals of Statistics, Vol, I, World Press, Calcutta

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

6 Able to convert the tabulations of data.
7 Learnt the Mean, Median and Mode
8 Able to solve the Quartile Deviation
9 Know to solve the Linear and Non linear Correlation.
10 Learn the concepts of Regression line.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	M	S	S	M	S	S	S	M	M

CO3	**M**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**M**	**S**

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

II SEMESTER-OPEN ELECTIVE (Non Major)-Paper-I

C.BIO-MATHEMATICS

Course Objectives	This course gives an introduction to mathematical modelling for biological systems. Introduce the Epidemicamodels, models for bio fluid and blood flood and diffusion reactions.

Course Outcome:
At the completion of the Course, the Students will able to

CO1	Students understand the terminologies of single species non-age structured population models. Applying Logistic Modelswith Time- Age-scale population models- Continuous and -Time Discrete.
CO2	Understand the Epidemic models for deterministic models without removal and with removal and immigration. Also ,how to control of an epidemic are reviewed.
CO3	Emphasize on models for blood flow related to understand some basic concepts for fluid dynamics - about blood, cardiovascular system and blood flows. Application of steady non-Newtonian fluid flow in circular tubes, , blood flow through artery with mild stones are discussed.
CO4	Student can able to understand role mathematical models of flows for other Bio-fluids related to peristaltic flow in tubes and channels, models for gas exchange and air flow in lungs, Two-dimensional flow in renal tubule, lubrication of Human joints.
CO5	Role of diffusion and diffusion-Reaction Models for Artificial Kidney (Hemodialyser) – Oxygen Diffusion through Living Tissues are able to understand.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Single species Non-age structured population Models: Single. Logistic Models- Logistic Models with TimeDelay effects- Discrete-Time. Discrete-Age-scale population models- Continuous-Time Discrete. Age scale population Models. **(6 Hours)**

Chapter: 3.1 - 3.2

UNIT II : Discrete-Time. Discrete-Age-scale population models- Continuous-Time Discrete. Age scale population Models.

Chapter : 4.1 and 4.2

Unit III : Epidemic models: Deterministic models without removal, general deterministic model with removal,.

Chapter: 8.1 -and 8.2**(6 Hours)**

Unit IV: Models for Blood Flow: Some basic concepts for fluid dynamics, basic concepts about blood, cardiovascular system and blood flows, steady non-Newtonian fluid flow in circular tubes, Newtonian pulsatile flows in rigid and elastic tubes,

Chapter: 11.1 – 11.4 **(6 Hours)**

UnitV: Models of flows for other Bio-fluids:

Peristaltic flow in tubes and channels, models for gas exchange and air flow in lungs, Two-dimensional flow in renal tubule (**6 Hours)**.

Chapter: 12.1 – 12.3

Text Book:

- Mathematical Modelling in Biology Medicine: J.N. Kapoor

References:

(1) Mathematical Modelling: J.N. Kapoor.

(2) Mathematical Biology: J.D. Murty.

(3) Ecology and Resource Management: K.E.F. Watt

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes* S – Strong, M – Medium, L – Low

II Semester-HUMAN RIGHTS

(COMPULSORY PAPER)

Course Objectives:

The main objectives of this course are to:

1. Know the human values and rights pertaining to the contemporary economic situation.
2. Aware of International Human Rights.
3. Identify issues relating to Human Rights.

Course Outcome:

At the end of the Course, the Students will able to

CO1 Explain the Human Values and rights pertaining to contemporary economic Situations.

CO2 Gain knowledge and awareness about Human rights and its Right Perspective

CO3 Provides the capability to identify issues relating to Human Rights

CO4 Develops investigative and analytical skills relating to Human Rights.

CO5 Understand the principles and institutions of International Human Rights.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	No	Yes	No	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	No	Yes	No	No
5	Yes	Yes	Yes	No	No	No

Unit I:

Definition of Human Rights – Nature, Content, Legitimacy and Priority – Theories on Human Rights – Historical Development of Human Rights – **(6 hours).**

Unit II:

International Human Rights – Prescription and Enforcement upto World War II – Human Rights and the U.N.O. – Universal Declaration of Human Rights – International Covenant on Civil and Political Rights – International Covenant on Economic, Social and Cultural Rights and Optional Protocol – **(6 hours).**

Unit III:

Human Rights Declarations – U.N. Human Rights Declarations – U.N. Human Commissioner – (6 hours).

Unit IV:

Amnesty International – Human Rights and Helsinki Process – Reginal Developments – European Human Rights System – African Human Rights System – International Human Rights in Domestic Courts – (**6 hours).**

Unit V:

Contemporary Issues on Human Rights: Children's Rights – Women's – Dalit's Rights – Bonded Labour and Wages – Refugees – Capital Punishment - Fundamental Rights in the Indian Constitution- Directive Principles of State Policy – Fundamental Duties – National Human Rights Commission – **(6 hours).**

References :

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982.
3. Mausice Cranston – What is Human Rights.
4. Desai, A.R. - Violation of Democratic Rights in India.
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.
7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha&K.Cheous [Ed] - International Encyclopedia of Peace, Security Social Justice and Human Rights [Vols 1-7].
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay.
2. Human Rights Today, Columbia University.
3. International Instruments of Human Rights, UN Publication.
4. Human Rights Quarterly, John Hopkins University, U.S.A.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	S	S	S	M	S	S	S
CO2	M	L	S	S	M	L	M	S	S	M
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	M	M	S	L	M	L	M	S	M
CO5	S	M	S	M	S	M	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

II SEMESTER-CORE PRACTICAL

C++ PROGRAMMING(PRACTICAL-2)

The main objectives of this course are to:
1. Impart knowledge of object oriented programming concepts and implement them in C++
2. Enable to differentiate procedure oriented and object-oriented concepts.
3. Equip with the knowledge of concept of Inheritance so that learner understands the need of inheritance.
4. Explain the importance of data hiding in object oriented programming
Course Outcomes:

CO1: Define the different programming paradigm such as procedure oriented and object oriented programming methodology and conceptualize elements of OO methodology

CO2:Illustrate and model real world objects and map it into programming objects for a legacy system.
CO3: Identify the concepts of inheritance and its types and develop applications using overloading features.

CO4: Discover the usage of pointers with classes.

CO5:Explain the usage of Files, templates and understand the importance of exception Handling

1. Write a C++ Program to create a class to implement the data structure STACK. Write a constructor to initialize the TOP of the STACK. Write a member function PUSH() to insert an element and member function POP() to delete an element check for overflow and underflow conditions..

2. Write a C++ Program to create a class ARITHMETIC which consists of a FLOAT and an INTEGER variable. Write member functions ADD (), SUB(), MUL(), DIV() to perform addition, subtraction, multiplication, division respectively. Write a member function to get and display values.

3. Write a C++ Program to read an integer number and find the sum of all the digits until it reduces to a single digit using constructors, destructors and inline member functions.

4. Write a C++ Program to create a class FLOAT that contains one float data member. Overload all the four Arithmetic operators so that they operate on the object FLOAT

5. Write a C++ Program to create a class STRING. Write a Member Function to initialize, get and display stings. Overload the operators ++ and == to concatenate two Strings and to compare two strings respectively.

6. Write a C++ Program to create class, which consists of EMPLOYEE Detail like E_Number, E_Name, Department, Basic, Salary, Grade. Write a member function to get and display them.

Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade.

7. Write a C++ Program to create a class SHAPE which consists of two VIRTUAL FUNCTIONS Calculate_Area() and Calculate_Perimeter() to calculate area and perimeter of various figures. Derive three classes SQUARE, RECTANGLE, TRIANGE from class Shape and Calculate Area and Perimeter of each class separately and display the result.

8. Write a C++ Program to create two classes each class consists of two private variables, a integer and a float variable. Write member functions to get and display them. Write a FRIEND Function common to both classes, which takes the object of above two classes as arguments and the integer and float values of both objects separately and display the result.

9. Write a C++ Program using Function Overloading to read two Matrices of different Data Types such as integers and floating point numbers. Find out the sum of the above two matrices separately and display the sum of these arrays individually.

10. Write a C++ Program to check whether the given string is a palindrome or not using Pointers

11. Write a C++ Program to create a File and to display the contents of that file with line numbers.

12. Write a C++ Program to merge two files into a single file.

Text Books:
Ashok N Kamthane, Object-Oriented Programming with Ansi And Turbo C++, Pearson Education, 2003.
E. Balagurusamy, Object-Oriented Programming with C++, TMH, 1998

M.Sc., Second Year- SEMESTER III

TOPOLOGY

(CORE PAPER – 9**)**

Course Objectives:

To provide knowledge on point set topology, topological space, Quotient spaces, product spaces and metric spaces sequences, continuity of functions connectedness and compactness, homotopy and covering spaces.

Course Outcome:

On successful completion of the course, the students will be able to

CO1 Define and illustrate the concept of topological spaces and continuous functions.

CO2 Prove a selection of theorems concerning topological space, continuous functions, product topologies, and quotient topologies.

CO3 Define and illustrate the concept of product of topologies

CO4 Illustrate the concepts of the separation axioms.

CO5 Define connectedness and compactness, and prove a selection of related theorems, and describe different examples distinguishing general, geometric, and algebraic topology.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Topological Spaces

Topological Spaces - Examples– Basis for a topology–Sub-basis– closed sets –interior – closure - boundary – Limitpoints – Hausdorff spaces–Subspace topology – The product topology on X× Y - Projections.

Chapter 2: Section: 12 - 17 **(18 Hours)**

Unit II: Continuous Functions

Continuous functions–Examples–Homeomorphisms –topological property – pasting lemma –the product topology– Box topology - Comparison of the product topology and the box topology –the metric topology – Sequence Lemma –Uniform Limittheorem.

Chapter 2: Section: 18 - 21 **(18 Hours)**

Unit III: Connected Spaces

Connected Spaces–connected subspace of the real line – Linear continuum –Intermediate
Theorem – components and Local connectedness– Totally disconnected spaces.

Chapter 3: Section: 23 - 25 **(18 Hours)**

Unit IV: Compact Spaces

Compact Spaces - Compact subspace of the real line – The Lebesque number lemma –Uniform continuitytheorem–Limit point compactness–Local compactness– one point compactification.

Chapter 3: Section: 26 - 29 **(18 Hours)**

Unit V: Countability and Separation Axioms

First countable and second countable spaces – separation axioms– regular and completely regular spaces– Normal and completely Normal spaces–Urysohn's lemma–Urysohn's metrization theorem –Tietze Extension theorem.

Chapter 4: Section: 30 - 35 **(18 Hours)**

Text Book:

James R. Munkres, "Topology", 2nd Edition, Prentice Hall of India Pvt.Ltd., (Third Indian Reprint).

References :

1. J.Dugundji, Topology, Prentice Hall of India, New Delhi,1975.

2. George F.Simmons, Introduction to Topologyand Modern Analysis, McGraw Hill International Edition, New York, 1963.

3. J.L.Kelly, General Topology, Van Nostrand , Reinhold co., New York.

4. K.D.Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

5. C.Wayne Patty, Foundations of Topology, (Student Edition), Jones & Bartlett India Pvt.Ltd., New Delhi.

6. Colin Adams, Robert Franzosa, Introduction to Topology Pure and Applied, Pearson Education, Indian Edition,2009.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	M	S	S	S	M	M
CO2	M	S	M	S	M	M	M	M	M	S
CO3	S	M	M	M	S	M	M	M	M	M
CO4	M	S	M	M	M	M	S	S	S	S

CO5	**M**	**M**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**S**

* PO – Programme Outcome, CO – Course Outcomes

*S-Strong ; M-Medium; L- Low

COMPLEX ANALYSIS

(CORE PAPER – 10)

Course Objectives:

- To lay the foundation for this subject, to develop clear thinking and analyzing capacity for further study.
- Cauchy's Theorem guaranteeing that certain integrals along closed paths are zero. This striking result leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.
- Important results are the Mean Value Theorem, leading to the representation of some functions as power series (the Taylor series), and the Fundamental Theorem of Calculus which establishes the relationship between differentiation and integration.

Course Outcome:

On successful completion of the course, the students will be able to

CO1 Analyze limits and continuity for complex functions as well as consequences of continuity.

CO2 Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.

CO3 Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem

CO4 Represent functions as Taylor, power and Laurent series, classify singularities and poles,
find residues and evaluate complex integrals using the residue theorem.

CO5 Discuss Harmonic Functions, basic properties – and deriving the theorems Schwarz's aWeierstrass's, Taylor's series and Laurent series

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	No

Unit I: Complex Functions

Spherical representation of complex numbers - Analytic functions - Limits and continuity - Analytic Functions - Polynomials - Rational functions - Elementary Theory of Power series - Sequences - Series - Uniform Convergence - Power series - Abel's limit functions - Exponential and Trigonometric functions - Periodicity - The Logarithm.

Chapter 1: 1.2 & 1.4 and**Chapter 2:** 2.1 – 2.3 **(18 Hours)**

Unit II: Analytical functions as mappings

Conformality - Arcs and closed curves - Analytic functions in Regions - Conformal mapping - Length and area - Linear transformations - Linear group - Cross ratio - symmetry - Oriented Circles - Families of circles - Elementary conformal mappings - Use of level curves - Survey of Elementary mappings - Elementary Riemann surfaces.

Chapter 3: 3.2 – 3.4 **(18 Hours)**

Unit III: Complex Integration

Fundamental Theorems - Line Integrals – Rectifiable Arcs- Line Integrals as Arcs- Cauchy's Theorem for a rectangle and in a disk- Cauchy's Integral Formula – Index of point with respect to a closed curve – The Integral formula – Higher order derivatives – Local properties

of analytic functions – Taylor's Theorem – Zeros and Poles – Local mapping – Maximum Principle.

Chapter 4: 4.1 – 4.3 **(18 Hours)**

Unit IV: Complex Integration (Contd…)

The General form of Cauchy's Theorem - Chains and Cycles – Simple connectivity – Homology – General statement of Cauchy's theorem – Proof of Cauchy's theorem – Locally exact differentials - Multiply connected regions – Calculus of residues – Residue Theorem – Argument Principle – Evaluation of definite Integrals.

Chapter 4: 4.4 – 4.5 **(18 Hours)**

Unit V: Harmonic functions and Power Series expansions

Harmonic Functions – Definition and basic properties – Mean-value Property – Poisson's formula – Schwarz's Theorem – Reflection Principle – Weierstrass's theorem – Taylor's series- Laurent series.

Chapter 4: 4.6 and **Chapter 5:** 5.1 **(18 Hours)**

Text Book:

- Complex Analysis"by L.V. Ahlfors, Third Edition, McGraw Hill, New York, 1979.

References:

1. J.B. Conway, Functions of One Complex Variable, Narosa Publication House, New Delhi, 1980.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publication House, New Delhi 2004.
3. S. Lang, Complex Analysis, Addison - Wesley Mass, 1977.
4. R.V.Churchill&J.W.Brown , ComplexVariables&Applications,Mc.GrawHill,1990.

E-Materials:

https://nptel.ac.in/courses/111/103/111103070/
https://www.freebookcentre.net/maths-books-download/Complex-Analysis-by-NPTEL.ht
https://swayam.gov.in/nd1_noc20_ma50

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	M	M	S	L	M
CO2	M	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	L	M	S	M	M	S
CO4	S	S	M	S	M	S	S	M	S	S
CO5	M	L	S	S	S	S	M	S	S	L

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L

GRAPH THEORY

(CORE PAPER - 11)

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the fundamental concepts of graph theory
2. Understand the applications of graph theory in day to day life.
3. Equip the students on how to solve the graph theory problems

Course Outcome:

At the end of the Course, the Students will able to

CO1 Recognize the characteristics of graph.

CO2 Convert the graph into matrix form and explain operations on graphs.

CO3 Analyze special graphs like Eulerian graphs and Hamiltonian graphs with examples.

CO4 Describe planar graphs and identify the chromatic number of the graph..

CO5 Discuss the different types of graphs and five color theorem and, four color conjecture -

Non Hamiltonian planar graphs.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	Yes
2	Yes	Yes	Yes	No	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes

Unit I: Graphs and Sub-graphs

Graphs and simple graphs - Graph isomorphism-Incidence and adjacency matrices – Sub-graphs - Vertex degrees - Path and Connection cycles – Applications: The shortest path problem – Trees: Trees - Cut edges and bonds - Cut vertices-Cayley's formula.

Chapter 1 (Except 1.9) and**Chapter 2** (Except 2.5) **(18 Hours)**

Unit II: Connectivity

Connectivity – Blocks - Euler tours and Hamilton cycles: Euler tours – Hamilton cycles – Applications: The Chinese postman problem.

Chapter 3 (Except 3.3) and**Chapter 4** (Except 4.4) **(18 Hours)**

Unit III: Matchings

Matchings- Matching and coverings in bipartite graphs-Perfect matchings –. Edge colorings: Edge chromatic number - Vizing's theorem- Applications: The timetabling problem.

Chapter 5: (Except 5.5) and **Chapter 6** **(18 Hours)**

Unit IV: Independent sets and Cliques

Independent sets-Ramsey's theorem-Turan's theorem-Vertex colorings: Chromatic number-Brook's theorem – Hajo's conjecture-Chromatic polynomials-Girth and chromatic number.

Chapter 7:(Except 7.4 - 7.5) and **Chapter 8** (Except 8.6) **(18 Hours)**

Unit V: Planar graphs

Plane and planar graphs -Dual graphs-Euler's formula- Bridges - Kuratowski's Theorem (statement only) – The Five color theorem and The Four color conjecture - Non Hamiltonian planar graphs.

Chapter 9 (Except 9.8) **(18 Hours)**

Text Book:

- J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

References:

- R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
- J.Clark and D.A.Holton, A First look at Graph Theory,Allied Publishers, New Delhi, 1995.
- Douglas B.West, Introduction to Graph Theory, Pearson, 2000.
- Gary Chartrand, Introduction to Graph Theory, Tata McGraw-Hill Education, 2006.
- A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	S	M	S
CO2	S	M	M	S	S	S	M	M	S	S
CO3	S	M	S	S	S	S	S	M	S	M
CO4	S	S	M	S	S	S	M	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

PYTHON THEORY

(CORE PAPER-12)

Course Objectives:

The main objectives of this course are to:

1. To introduce the fundamentals of Python Programming.
2. To teach about the concept of Functions in Python.
3. To impart the knowledge of Lists, Tuples, Files and Directories.
4. To learn about dictionaries in python.
5. To explores the object-oriented programming, Graphical programming aspects of python with help of built in modules.

Course Outcomes:

CO1: Understanding the concepts of Input / Output operations in file.

CO2: Remembering the concept of operators, data types, looping statements in Python programming.

CO3: Applying the concept of functions and exception handling.

CO4: Analyzing the structures of list, tuples and maintaining dictionaries.

Demonstrate significant experience with python program development environment.

Unit 1- BASICS : Python Variables – Executing Python from the Command Line – Editing Python Files – Python Reserved Words – Basic Syntax-Comments -Standard Data Types – Relational Operators – Logical Operators -– Bit Wise Operators – Simple Input and Output (**18hours)**

Unit 2: **CONTROL STATEMENTS**

CONTROL STATEMENTS: Control Flow and Syntax – Indenting – if Statement – statements and expressions- string operations- Boolean Expressions –while Loop – break and continue – for Loop. LISTS: List-list slices – list methods – list loop – mutability – aliasing – cloning lists - list parameters. TUPLES: Tuple assignment, tuple as return value –Sets – Dictionaries**18hours)**

Unit:3 FUNCTIONS

FUNCTIONS: Definition – Passing parameters to a Function – Built-in functions- Variable Number of Arguments – Scope – Type conversion-Type coercion-Passing Functions to a Function – Mapping Functions in a Dictionary – Lambda – Modules – Standard Modules – sys – math – time – dir – help Function.

Unit:4 ERROR HANDLING

ERROR HANDLING: Run Time Errors – Exception Model – Exception Hierarchy – Handling Multiple Exceptions – Data Streams – Access Modes Writing – Data to a File Reading – Data From a File – Additional File Methods – Using Pipes as Data Streams – Handling IO Exceptions – Working with Directories.

Unit:5 OBJECT ORIENTED FEATURES

OBJECT ORIENTED FEATURES: Classes Principles of Object Orientation – Creating Classes – Instance Methods – File Organization – Special Methods – Class Variables – Inheritance – Polymorphism – Type Identification – Simple Character Matches – Special Characters – Character Classes – Quantifiers – Dot Character – Greedy Matches – Grouping – Matching at Beginning or End – Match Objects – Substituting – Splitting a String – Compiling Regular Expressions.

Text Books:

Martin C. Brown, PYTHON: The Complete Reference‖, McGraw-Hill, 2001

E. Balagurusamy (2017), "Problem Solving and Python Programming", McGraw-Hill, First Edition

Reference Books

Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016

Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011

Wesley J Chun, ―Core Python Applications Programming‖, Prentice Hall, 2012

I

II SEMESTER-CORE ELECTIVE – Paper-III

A.MATHEMATICAL MODELLING

Course Objectives:

1. To enable the students to acquire the knowledge of Mathematics in different field.

2. To make the students understand various mathematical models using ODE , bio-fluid dynamics.

Course Outcome :
At the end of the Course, the Students will able to

CO1 To understand mathematical modeling through system of ordinary differential equations in population dynamics, epidemics using first order.

+

CO2 Emphasize on models for blood flow related to understand some basic concepts for fluid dynamics - about blood, cardiovascular system and blood flows. Application of steady non-Newtonian fluid flow in circular tubes, , blood flow through artery with mild stones are discussed.

CO3 Student can able to understand role mathematical models of flows for other Bio-fluids related to peristaltic flow in tubes and channels, models for gas exchange and air flow in lungs, Two-dimensional flow in renal tubule, lubrication of Human joints.

CO4 Role of diffusion and diffusion-Reaction Models for Artificial Kidney (Hemodialyser) – Oxygen Diffusion through Living Tissues are able to understand.

CO5 Student can able to develop Mathematical Modelling through Calculus of Variations and Dynamic Programming using optimization principles and techniques –

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Mathematical modeling through system of ordinary differential equations of the first order: Mathematical modeling in population dynamics, Mathematical modeling of epidemics through system of ordinary differential equations of first order- **(15 Hours)**

Chapter 3: 3.1 - 3.2 & 3.5 of J.N. Kapoor, Mathematical Modelling, Wiley Eastern Limited, Reprint- 2000.

Unit II: Mathematical Models for Blood flows: Some basic concepts of Fluid Dynamics- Basic concepts about blood, cardiovascular system and Blood flows- Steady Non-Newtonian fluid flows in circular tubes- Newtonian pulsatile flows in rigid and elastic tubes- **(15 Hours)**

Chapter 11: 11.1 - 11.4 of J.N. Kapoor, Mathematical Models in Biology and Medicine, Affiliated East – West Press Private limited, Reprint – 2010.

Unit III: Mathematical Models of flows for other Bio-fluids: Peristaltic flows in tubes and channels- Models for gas exchange and airflow in lungs – Two-dimensional flow in renal tube. **(15 Hours)**

Chapter 12: 12.1 - 12.4 of J.N. Kapoor, Mathematical Models in Biology and Medicine, Affiliated East – West Press Private limited, Reprint – 2010.

Unit IV: Diffusion and Diffusion – Reaction Models: The Diffusion equation – Diffusion in Artificial Kidney (Hemodialyser) – Oxygen diffusion through living tissues –

(15 Hours)

Chapter 13: 13.1 - 13.3 of J.N. Kapoor, Mathematical Models in Biology and Medicine, Affiliated East – West Press Private limited, Reprint – 2010.

Unit V: Mathematical Modelling through Calculus of Variations and Dynamic Programming: Optimization principles and techniques – – **(15 Hours)**

Chapter 9: 9.1 - 9.3 of J.N. Kapoor, Mathematical Modelling, Wiley Eastern Limited, Reprint- 2000.

Recommended Text Book:

J.N. Kapoor, Mathematical Modelling, Wiley Eastern Limited, Reprint- 2000.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

III SEMESER- CORE ELECTIVE – Paper-III

B.APPLIED ALGEBRA

Course Objectives:

The main objectives of this course are to:

1. Facilitate the basic concepts of Boolean Algebras- Switches and Logic Gates
2. Enable students to learn design of experiments, algebraic cryptography.
3. Equip the students to solve the problems in applied algebra.

Course Outcome:

At the end of the Course, the Students will able to

CO1 Introducing the Laws of Boolean Algebra- Polynomials and Functions. Gate Networks-
Simplification of Circuits- Designing Circuits- Bridge Circuits.

CO2 Understand the area of design of experiments and formulating and construction of

matrix of a BIBD from Difference Sets.

CO3 Student able to know the field of algebraic cryptography for this to understand Algebraic Enciphering Algorithms and Classical Cryptosystems -Block Ciphers and Advanced Encryption Standard- Public-Key Cryptosystems.

CO4 Understand the application of Coding Theory using Error-Correcting Codes and various coding such as Linear Codes, Cyclic Codes and BCH Codes.

CO5 Understand the field of Symmetry Groups and Color Patterns.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	No	Yes	Yes

Unit I: Boolean Algebras and Switching Circuits

Boolean Algebras- Switches and Logic Gates- Laws of Boolean Algebra- Boolean Polynomials and Boolean Functions- Switching Circuits and Gate Networks- Simplification of Circuits- Designing Circuits- Bridge Circuits.

Chapter 1: 1.1 - 1.8 **(15 Hours)**

Unit II: Balanced Incomplete Block Designs

Basic Definitions and Results - Incidence Matrix of a BIBD-Construction of BIBDs from Difference Sets- Construction of BIBDs Using Quadratic Residues - Difference SetFamilies- Construction of BIBDs from Finite Fields- Construction of BIBDs from Nearrings- Planar Nearrings- Finite Integral Planar Nearrings and BIBDs - Finite Fields and Planar Nearrings.

Chapter 2: 2.1 – 2.10 **(15 Hours)**

Unit III: Algebraic Cryptography

Substitution Ciphers - Algebraic Enciphering Algorithms and Classical Cryptosystems - Block Ciphers and Advanced Encryption Standard- Public-Key Cryptosystems.

Chapter 3: 3.1 – 3.4 **(18 Hours)**

Unit IV: Coding Theory

Introduction to Error-Correcting Codes- Linear Codes- Cyclic Codes- BCH Codes.

Chapter 4: 4.1 - 4.4 **(15 Hours)**

Unit V: Symmetry Groups and Color Patterns

Permutation Groups- Groups of Symmetries- Colorings and Patterns- Action of a Group on a Set- Burnside Theorem and Color Patterns.

Chapter 5: 5.1 – 5.5 **(15 Hours)**

Text Book:

- S. R. Nagpaul, S. K. Jain-Topics in Applied Abstract Algebra-American Mathematical Society (2004)

References:

1. R.E. Klima,N.Sigmon, E. Stitzinger-Application of Abstract Algebra with MAPLE-CRC Press(1999).
2. Rudolf Lidl, Gunter Pilz – Applied Abstract Algebra-Springer (1997).
3. M.R. Adhikari, A.Adhikari- Basic modern Algebra with Applications-Springer(2014).
4. T.W.Judson –Abstract Algebra Theory and Applications (1997).
5. D.Joyner,R.Kreminski, J.Turisco -Applied Abstract Algebra(2003).

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	M	S	S	S
CO2	M	M	S	S	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	M	M	S	M	S	M	M	S	M
CO5	S	S	S	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

III SEMESTER-CORE ELECTIVE – Paper-III

C. FLUID DYNAMICS

Course Objectives The aim of the course is to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.

Course Outcome:
At the completion of the Course, the Students will able to

CO1 Students know what are Real fluids and ideal fluids, flows and solved problems regarding this.

CO2 Solved some problems and derivations about equation of motion of fluid

and learn some naming theorems.

CO3 Students got some knowledge about some three dimensional and two dimensional flows.

CO4 To understand the geometrical knowledge of two dimensional flows – use of cylindrical polar coordinates and complex velocity potential for standard two dimensional flows – the Milne-Thomson circle theorem with examples.

CO5 Analyze the Stress components and relation between Cartesian components of stress, translation motion of a fluid element – the rate of strain quadric. Navier –Stokes equations of motion of a viscous fluid.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Kinematics of fluids in motion:

Real fluids and ideal fluids - velocity of a fluid at a point - stream lines and path lines - steady and unsteady flows - the velocity potential - the vorticity vector - local and particle rates of change - the equation of continuity - worked examples.

Chapter 2 : 2.1 – 2.8 (**15 Hours)**

Unit II: Equation of motion of fluid:

Pressure at a point in 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.

Chapter 3 : 3.1 – 3.6 **(15 Hours**)

Unit III: Some three dimensional flows:

Introduction – sources – sinks and doublets – Axis symmetric flow – Stokes stream function.

Chapter 4 : 4.1– 4.2 & 4.5 **(15 Hours**)

Unit IV: Some two dimensional flows:

Meaning of two dimensional flows – use of cylindrical polar coordinates – the stream function – the potential for two dimensional – irrotational – incompressible flows – complex velocity potential for standard two dimensional flows – the Milne-Thomson circle theorem with examples.

Chapter 5 : 5.1 – 5.5 & 5.8 **(15 Hours)**

Unit V : Viscous Flows : Stress components in real fluids – relation between Cartesian components of stress – translation motion of a 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 co-efficient of viscosity and laminar flow– the Navier –Stokes equations of motion of a viscous fluid.
Chapter 8 : 8.1 –8.7 and 8.9 (**15 Hours**)

Text Book:

1. **F. Chorlton, Text book of Fluid Dynamics, CBS Publication, New Delhi, 1985.**
2. M.K.Venkataraman, Advanced Engineering & Sciences, The National Publishing Co.

References:

1. G.K.Batchelor, An Introduction of Fluid Mechanics, Foundation Books, New Delhi,1993.

2. A.R.Paterson, A First Course in Fluid Dynamics, Cambridge University Press, New York, 1987.

3. R.K.Rathy, An Introduction to Fluid Dynamics, IBH Publishing Company, New Delhi,1976.

4. R.Von Mises, O.Friedrichs, Fluid Dynamics, Springer International Student Edition,Narosa Publishing House, New Delhi.

5. S.W.Yuan, Foundation of Fluid Mechanics, Prentice Hall Private Ltd, New Delhi, 1976.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

III SEMESTER- CORE PRACTICAL

PYTHON PROGRMMING (Practical paper-3)

Course Objectives:

The main objectives of this course are to:

1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples
2. To understand and write simple Python programs
3. To Understand the OOPS concepts of Python
4. To develop web applications using Python

Expected Course Outcomes:
Able to write programs in Python using OOPS concepts
To understand the concepts of File operations and Modules in Python
Implementation of lists, dictionaries, sets and tuples as programs
To develop web applications using Python

LIST OF PROGRAMS **75 hours**

Implement the following in Python:
1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms.

Total Lecture hours **75 hours**

Text Books

1 Bill Lubanovic, "Introducing Python", O'Reilly, First Edition-Second Release, 2014.

2 Mark Lutz, "Learning Python", O'Reilly, Fifth Edition, 2013.

Reference Books

David M. Beazley,"Python Essential Reference", Developer's Library, Fourth Edition,2009.

2 SheetalTaneja,Naveen Kumar, "Python Programming-A Modular Approach",PearsonPublications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	M	M	S	M	M
CO2	M	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	M	S	L	M	S
CO4	S	S	L	S	M	S	S	M	S	S
CO5	M	M	S	S	S	S	L	S	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L-Low

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III Semester-OPEN ELECTIVE-Non Major-Paper-II

A. NUMERICAL METHODS

Course Objectives

The objectives of the course is to

1. To study the bisection and method of successive approximation.
2. Evaluate the polynomial equations using interpolation methods.
3. Study the simultaneous linear algebraic equations.
4. Know the numerical solution of first order ordinary differential equations.
5. Introduce the trapezoidal and Simpsons rule.

Course Outcomes

After successful completion on the course the student will be able to

CO1 Apply numerical methods to obtain approximate solutions to mathematical problems

CO2 Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations

CO3 Work numerically on the ordinary differential equations using different methods through the theory of finite differences

CO4 Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations

CO5 Improve and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No

4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1: Solution Of Numerical Algebraic And Transcendental Equations

The Bisection Method – Method of Successive approximations -Regula –falsiMethod.(**6 hours**)

Unit–2: Interpolation

Newton's Raphson Method - Convergence of Newton's Method and rate of Convergence. **(6 hours)**

Unit–3: Solution of Simultaneous Linear Algebraic Equations

Gauss elimination method-Gauss Jordan method – Jacobi Iterative method - Gauss Seidal method - Comparison of Gauss elimination and Gauss Seidal Iteration Method. (**6 hours)**

Unit-4: Numerical Solution of Ordinary Differential Equations

Introduction-Power series approximations-Pointwise methods-Solution by Taylor series method for simultaneous first order differential equations (**6 hours)**

Unit-5: Numerical Integration

Introduction-Trapezoidal rule-Simpson's one-third rule- Simpson's three-eighths rule (**6 hours).**

Prescribed Books

3. P. Kandasamy, K.Thilagavathy, K.Gunavathi, Numerical Methods, S. Chand & Company Ltd., New Delhi, 2003.

4. S.C.Gupta and P.C.Raymond, Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000.

Reference Books:

4. M.K.Venkataraman, Numerical Methods in Science and Engineering, The National publishing company, Fifth Edition, 1999.
5. S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1998.

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

1. Having the capacity to solve bisection method.
2.Evaluate the convergence of newton's method.
3.Able to solve Gauss elimination, Jordan, Jacobi and Seidal method.
4.Solve the ODE by using taylor series method.
5.Learn the trapezoidal rule, Simpsons rule methods.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

III Semester-OPEN ELECTIVE- Non Major-Paper-II

B. DISCRETE MATHEMATICS

Course Objectives:

To develop logical thinking and its application to computer science (to emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument). The subject enhances one's ability to reason and ability to present a coherent and mathematically accurate argument. About 40% of the course time will be spent on logic and proofs and remaining 60% of the course time will be devoted to functions, relations, etc

Course Outcome:

Upon completion of this course, the student will be able to:

CO1 Construct mathematical arguments using logical connectives and quantifiers.

CO2 validate the correctness of an argument using statement and predicate calculus.

CO3 Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.

CO4 learn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation..

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit I: Mathematical Logic: Statement and notations, Connectives, Statement formulas and truth table, Conditional and bi-conditional statements, Tautology and contradiction, Equivalence of formulas, Tautological implications. (**6 hours)**

Unit II: Theory of Inference: Validity using truth table, Rules of inference, Consistency of premises and indirect method of proof, Predicates, Statement function, Variables, Quantifiers, Free and bound variables, Universe of discourse, Inference of the predicate calculus. (6 hours)

Unit III: Relation: Review of binary relations, equivalence relations, Compatibility relation, Composition of binary relations, Composition of binary relations and transitive closure, Partial ordering and partial ordered set.**(6 hours)**

Unit IV: Function: Review of functions and their enumeration, Pigeonhole principle. **Recurrence Relation:** Iteration, Sequence and discrete functions, Recurrence relations, Generating function. (**6 hours)**

Unit V: Lattice and Boolean Algebra: Lattice and algebraic system, Basic properties of algebraic systems, Special types of lattices, Distributed, Complemented lattices, Boolean algebra, Boolean expressions, Normal form of Boolean expressions, Boolean function and its applications to logic GATES. (**6 hours)**

Reference Books :

1. **J. P. Trembley** and **Manohar,** Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co. 1997.

2. Kenneth, H. Rosen, Discrete Mathematics and its Applications, WCB / McGraw Hill.

3.Liu, C.L., Elements of Discrete Mathematics, McGraw Hill , New York, (1978)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S		S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	M	S	S

* PO – Programme Outcome, CO – Course Outcome* S – Strong, M – Medium, L – Lo

III Semester -OPEN ELECTIVE- Non Major-Paper-II

C. OPTIMIZATION TECHNIQUES

Course Objectives

The objectives of the course is to

1. To introduce the methods of optimization techniques.

2. To understand the theory of optimization techniques for solving various types of optimization problems.

3. To provide with basic skills and knowledge of optimization techniques and their applications.

4. To make the students familiar in solving techniques, analysing the results and propose recommendations to the decision-making processes.

5. To analyze the Network Diagramming.

Course Outcomes

After successful completion on the course the student will be able to

CO1 Formulate a real-world problem as linear programming and queuing models
CO2 Assess the existence and uniqueness of solutions and derive necessary and sufficient optimality conditions for a given optimization problem
CO3 Understand the mathematical tools that are needed to solve optimization problems
CO4 Study the concepts of game theory and saddle point, domaince by graphical method
CO5 Analyze the Network project and diagram

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1: **6 hours**

Linear programming: Formulation – graphical solution. Simplex method. Assignment problem: Mathematical Formulation. Comparison with Transportation Model.Hungarian Method. Unbalanced Assignment problems

Chapter 6 & 8

Unit–2: **6 hours**

Transportation problem: Mathematical Formulation. Basic Feasible solution. North WestCorner rule, Least Cost Method, Vogel's approximation. Optimal Solution.

Chapter 9

Unit–3: **6 hours**

Sequencing problem: n jobs on 2 machines – n jobs on 3 machines – two jobs on m

machines – n jobs on m machines.

Chapter 10

Unit-4: **6 hours**

Game theory : Two-person Zero-sum game with saddle point – without saddle point – dominance – solving 2 x n or m x 2 game by graphical method.

Chapter 12 S

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Unit-5: **6 hours**

Network: Project Network diagram – CPM and PERT computations.

Chapter 13

Prescribed Books

Operations Research, by R.K.Gupta , Krishna Prakashan India (p),Meerut Publications

Reference Books:

1. Gauss S.I. Linear programming , McGraw-Hill Book Company.
2. Gupta P.K. and Hira D.S., Problems in Operations Research , S.Chand& Co.

3. Kanti Swaroop, Gupta P.K and Manmohan , Problems in Operations Research,
4. Sultan Chand & Sons
5. Ravindran A., Phillips D.T. and Solberg J.J., Operations Research, John wiley& Sons.
6. Taha H.A. Operation Research, Macmillan pub. Company, New York.
7. Linear Programming, Transporation, Assignment Game by Dr.Paria, Books and

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

1.Able to convert the real word problems as linear programming.
2.Learnt the theory of optimization techniques and solve them.
3.Able to solve the sequencing problem.
4.Know to solve the dominance and graphical method .
5.Learn the concepts of network diagram.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	M	M	S	S
CO2	S	S	M	S	M	S	S	S	M	S
CO3	S	S	S	S	S	M	M	S	M	S
CO4	S	M	M	S	M	S	M	M	S	S
CO5	S	M	M	S	S	M	S	S	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

III Semester-Core Practicalpaper

PYTHON PROGRMMING (Practical paper-3)

Course Objectives:

The main objectives of this course are to:

1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples
2. To understand and write simple Python programs
3. To Understand the OOPS concepts of Python
4. To develop web applications using Python

Expected Course Outcomes:

Able to write programs in Python using OOPS concepts
To understand the concepts of File operations and Modules in Python
Implementation of lists, dictionaries, sets and tuples as programs
To develop web applications using Python

LIST OF PROGRAMS **75 hours**

Implement the following in Python:

1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms.

Total Lecture hours	**75 hours**
Text Books	
1	Bill Lubanovic, "Introducing Python", O'Reilly, First Edition-Second Release, 2014.
2	Mark Lutz, "Learning Python", O'Reilly, Fifth Edition, 2013.

Reference Books

David M. Beazley,"Python Essential Reference", Developer's Library, Fourth Edition,2009.

2	SheetalTaneja,Naveen Kumar, "Python Programming-A Modular Approach",PearsonPublications.

M.Sc. II Year (SEMESTER IV)

FUNCTIONAL ANALYSIS
(CORE PAPER – 13)

Course Objectives:

1.This course introduces functional analysis and operator theoretic concepts. This area combines ideas from linear algebra and analysis in order to handle infinite-dimensional vector spaces and linear mappings thereof.

2.This course provides an introduction to the basic concepts which are crucial in the modern study of partial differential equations, Fourier analysis, quantum mechanics, applied probability and many other fields.

Course Outcome:

On successful completion of the course, the students will be able to

CO1 Appreciate how ideas from different areas of mathematics combine to produce new tools that are more powerful than would otherwise be possible. **K1, K6**

CO2 Understand how functiona l analysis underpins modern analysis. **K2, K4**

CO3 Develop their mathematical intuition and problem-solving capabilities. **-K5, K6**

CO4 Learn advanced analysis in terms of Sobolev spaces, Besov spaces, Orlicz spaces and other distributional spaces. K5K6

CO5 Definition and examples of Banach Algebras – To understand the Regular and simple elements, radical and semi-simplicity- **K2,K4**

K1 – Remember ; K2 – Understand ; K3– Apply ; K4 –Analyze ; K5 –Evaluate ; K6 –Create

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT I: BANACH SPACES

Banach spaces - Definition and examples - Continuous Linear Transformations – Hahn Banach Theorem.

Chapter 9: Sections 46 to 48 **(18 Hours)**

UNIT II: BANACH SPACES AND HILBERT SPACES

The natural embedding of N in N** - Open mapping theorem - Conjugate of an operator – Hilbert space - Definition and properties.

Chapter 9: Sections 49 to 51; **Chapter 10:** Sections 52. **(18 Hours)**

UNIT III: HILBERT SPACE

Orthogonal complements - Orthonormal sets - Conjugate space H* - Adjoint of an operator.

Chapter 10: Sections 53 to 56. **(18 Hours)**

UNIT IV: OPERATIONS ON HILBERT SPACES

Self-adjoint operator - Normal and Unitary Operators – Projections.

Chapter 12: Sections 57 to 59. **(18 Hours)**

UNIT V: BANACH ALGEBRAS

Banach Algebras - Definition and examples - Regular and simgle elements - Topological divisors of zero - spectrum - the formula for the spectral radius - the radical and semi-simplicity.

Chapter 12: Sections 64 to 69. **(18 Hours)**

Recommended Text:

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. H.C. Goffman and G. Fedrick, *First Course in Functional Analysis,* Prentice Hall of India, New Delhi, 1987.
3. Bela Bollobas, *Linear Analysis an introductory course,* Cambridge Mathematical Text books, Cambridge University Press, 1990.
4. D. Somasundaram, *Functional Analysis,* S. Viswanathan Pvt. Ltd., Chennai, 1994.
5. G. Bachman &L.Narici, *Functional Analysis* Academic Press, New York, 1966.
6. E. Kreyszig*Introductory Functional Analysis with Applications*, John wiley& Sons, New York.,1978. Co.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	S	M	M	S
CO2	S	M	S	S	M	S	M	S	S	M
CO3	M	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	M
CO5	S	S	S	M	S	S	S	S	L	S

*S-Strong ; M-Medium; L- Low

APPLIED PROPBABILITY AND STATISTICS
(CORE PAPER – 14**)**

Course Objectives:
1. To enable the students to acquire the knowledge of statistics
2. To make the students understand various characteristics of discrete and continuous statistical distributions with mathematical techniques

Course Outcome :
At the end of the Course, the Students will able to

CO1 Describe the concepts of Random variables and Distribution Function with examples.

CO2 Evaluate Binomial, Poisson distributions, Regression and Correlation distributions .

CO3 Analyze student's t-test, F-test and Chi-square test.

CO4 Analyze Randomized Block Design (RBD) and Latin Square Design (LSD).

CO5 Basic concept-Reliabilities of series.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	No

Unit I: RANDOM VARIABLES. (18 Hours)
Random variables - the concept of a random variable - distribution and density functions - random variables of the discrete and continuous type - joint distribution and joint density functions - marginal distribution - conditional distribution - co-variance – correlation - mathematical expectation - Moment generating function - characteristic function.

Chapter 1&2 (1.1 – 1.7, 2.1 – 2.9):M.Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.

Unit II: SOME PROBABILITY DISTRIBUTIONS. (18 Hours)
Binomial and Poisson distributions - Normal distribution - Gamma and Exponential distribution -Weibull distribution - Regression and Correlation - Partial and Multiple Correlation - Multiple regression.

Chapter – 4 (4.1 - 4.7):M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.

Unit III: TESTING OF HYPOTHESIS. (18 Hours)
Estimation and procedure of testing of hypothesis - Large sample tests - Small sample tests - student's t-test - F-test - Chi-square test - Testing of mean, variance and proportions - independence of attributes and goodness of fit.

Chapter 4 & Chapter 5 of M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.

Unit IV: DESIGN OF EXPERIMENTS. (18 Hours)
Analysis of variance - One way and two way classifications - completely Random Design (CRD) - Randomized Block Design (RBD) - Latin Square Design (LSD).

Chapter 10: Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

Unit V: RELIABILITY (18 Hours)
Basic concept-Reliabilities of series and parallel systems-System Reliability-Hazard function-Reliability and Availability-Maintainability.

Chapter 15 & 16 (15.1 - 15.2, 16.1 - 16.5) Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

Text Books:

- R.E.Walpole, R.H.Mayers, S.L.Mayers and K.Ye, Probability and Statistics for engineers and scientists, 7th Edition, Pearson Education (2003).

- Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

Reference:

1. J.L.Devore, Probability and Statistics, 5th Edition, Thomson (2000).
2. R.A.Johnson, Miller & Freund's Probability and Statistics for Engineers, Seventh edition, Pearson Education, New Delhi (2008).
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th Edition, 2003.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	S	M	S
CO2	S	M	M	S	S	S	M	M	S	S
CO3	S	M	S	S	S	S	S	M	S	M
CO4	S	S	M	S	S	S	M	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

IV Semester-CORE ELECTIVE – Paper-4

A. OPERATIONS RESEARCH

Course Objectives:

The main objectives of this course are to:

1. Study the network problems, inventory models, linear programming problems, queuing models and replacement models in the real life situations.
2. Equip the students to formulate and solve the problems.
3.

Course Outcome:

At the end of the Course, the Students will able to

CO1 Discuss Basic Concepts Convex sets, Linear Programming Problem
CO2 Solve the Network problems by using CPM and PERT methods
CO3 Identify EOQ of inventory models and when to replace an item in the replacement problems
CO4 Compute the steady state probabilities for various queuing models.
CO5 Describe the Individual replacement and Group replacement.

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	No	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	No	Yes	Yes

UNIT I: LINEAR PROGRAMMING PROBLEM

Linear Programming Basic Concepts - Convex sets, Linear Programming Problem (LPP). Examples of LPP. Huperplane, Open and closed half - spaces. Feasible, basic feasible and optimal solutions. Extreme point and graphical method.

Chapter: Appendix – $A_1 – A_7$ **(15 hours)**

UNIT II: PROJECT NETWORK SCHEDULING BY PERT AND CPM

Basic differences between PERT and CPM - Steps in PERT / CPM Techniques - PERT / CPM Network components and Precedence Relationships - Critical Path Analysis - Probability in PERT Analysis - Project Time - Cost Trade Off - Updating the Project.

Chapter - 13: 13.2, 13.4, 13.5, 13.7, 13.8. **(15 hours)**

UNIT III: INVENTORY CONTROL MODELS

Meaning of Inventory Control - Functional classification - Advantage of Carrying Inventory - Features of Inventory System - Inventory Model building - Deterministic Inventory Models with or without shortage - Probabilistic Inventory models with or without shortage.

Chapter - 14: 14.2 – 14.6 **(15 hours)**

UNIT IV: QUEUEING MODELS

Essential features of Queueing System - Operating Characteristic of Queueing System - Probabilistic Distribution in Queueing Systems - Classification of Queueing Models - Solution of Queueing Models - Probability Distribution of Arrivals and Departures.

Chapter - 16: 16.2 – 16.7 with Appendix 16.A. **(15 hours)**

UNIT V: REPLACEMENT AND MAINTENANCE MODELS

Replacement models - Items that deteriorate with time - When money value changes - Item that fail completely - Individual replacement and Group replacement.

Chapter - 17: 17.1 – 17.4 **(15 hours)**

Recommended Text:

- J.K.Sharma, Operations Research Theory and Applications, 3rd Edition (2007), Macmillan India Ltd.

Reference Books:

1. Kanti Swarup, Gupta P.K., and Manmohan, (2008), Operations Research, S. Chand & sons.

2. HamdyA.Taha, Operations Research (6th Edition), Prentice Hall of India Private Limited, New Delhi.

3. S.D.Sharma, Operations Research, Kedamanth Ramnath & Co., 2006.

4. F.S.Hillier and J.Lieberman, Introduction to Operations Research (8th Edition), Tata McGraw Hill Publishing Company, New Delhi, 2006.

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	S	S	M	S	S	S
CO2	M	M	S	S	M	S	M	S	S	M
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	M	S	M	M	M	M	S	M
CO5	S	S	S	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

IV Semester-Core Elective paper-4

B.FUZZY MATHEMATICS

Course Objectives

Familiarize the students with the fundamentals of fuzzy sets, operations on these sets and concept of membership function. Familiar with fuzzy relations and the properties of these relations .To know the concept of a fuzzy number and how it is defined. Become aware of the use of fuzzy inference systems in the design of intelligent systems

Course Outcome:

At the completion of the Course, the Students will able to

CO1 Understand the concepts of Fuzzy sets and its types – Characteristics – Significance of the paradigm shift.- K1

CO2 Be able to distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.K2

CO3 To know Fuzzy intersection – t-norms, fuzzy unions – t-conorms. Combinations of operations – Aggregation operations.K2,K3

CO4 Apply the concept of a fuzzy number and apply in real world problems K3

CO5 Student practice to construct various methods of fuzzy sets using sample

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

data.K6

K2 – Understand ; K3– Apply ; K4 –Analyze ; K5 –Evaluate ; K6 –Create

Unit I: Fuzzy Sets

Fuzzy sets – Basic types – basic concepts – Characteristics – Significance of the paradigm shift – Additional properties of α–cuts.

Chapter 1: 1.3 - 1.5 and **Chapter 2:** 2.1 **(15 Hours)**

Unit II: Fuzzy sets versus CRISP sets

Representation of fuzzy sets – Extension principle of fuzzy sets – Operation on fuzzy sets – Types of operation – Fuzzy Complements.

Chapter 2: 2.2 - 2.3 and **Chapter 3:** 3.1 - 3.2 **(15 Hours)**

Unit III: Operations on Fuzzy sets

Fuzzy intersection – t-norms, fuzzy unions – t-conorms – Combinations of operations – Aggregation operations.

Chapter 3: 3.3 - 3.6 **(15 Hours)**

Unit IV: Fuzzy Arithmetic

Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Lattice of fuzzy numbers.

Chapter 4: 4.1 - 4.4 **(15 Hours)**

Unit V: Constructing Fuzzy Sets

Methods of construction on overview – direct methods with one expert – direct method with multiple experts – indirect method with multiple experts and one expert – Construction from sample data.

Chapter 10: 10.1 - 10.7 **(15 Hours)**

Text Book:

- G.J Kilr and Bo Yuan, Fuzzy sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India Ltd, New Delhi, 2005.

References:

1. H.J Zimmemann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
2. A.Kaufman, Introduction to the Theory of fuzzy subsets, Academic press, New York, 1975.
3. V.Novak, Fuzzy Sets and Their Applications, Adam Hilger, Bristol, 1969.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	L	M	M	M	L	S	S	M	M
CO2	M	L	M	S	M	M	M	M	M	L

CO3	**L**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**
CO4	**M**	**L**	**M**	**M**	**M**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**L**	**S**	**M**	**L**	**S**	**S**	**M**	**S**

* PO – Programme Outcome, CO – Course Outcomes

*S-Strong ; M-Medium; L- Low

IV Semester-Core Elective paper-4

C.Analytic Number Theory

Course Objectives:
Analyze how analytical methods can be used to tackle problems in number theory. Famous examples include Prime Number Theorem about the asymptotic density of prime and Dtichlet theorem about prime numbers in arithmetic progressions

Course outcomes:

CO1: Know the definition and properties of Dirichlet product the Möbius inversion formula, the greatest integer function, Euler's phi-function.

CO2: Analyze how analytical methods can be used to tackle problems in number theory. Famous examples include Prime Number Theorem about the asymptotic density of prime and Dtichlet theorem about prime numbers in arithmetic progressions.

CO3:. Analyze the interrelationships between various arithmetical functions

CO4: Understand some elementary identities involving μ(n) and Л(n). This will be used in studying the distribution of primes.

CO5: Apply multiplicative functions to deal with Dirichet series as functions of a complex variable.

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	M	M	S	M	M
CO2	M	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	M	S	L	M	S
CO4	S	S	L	S	M	S	S	M	S	S
CO5	M	M	S	S	S	S	L	S	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L-Low

UNIT I: The Fundamental Theorem of Arithmetic

Divisibility – greatest common divisor – prime numbers – the fundamental theorem of arithmetic – the series of reciprocals of the primes – the euclidean algorithm – the gcd of more than two numbers. **(15 hours**)

UNIT II: Arithmetic functions and Dirichlet Multiplication

The Möbius function μ(n) – the Eulertotientfunctionφ(n) – a relation connecting φandμ - a product formula for φ(n) – the Dirichlet product of arithmetical functions – Dirichlet inverse and the Möbius inversion formula – the Mangoldt function Λ(n).(**15 hours)**

UNIT III: Multiplicative functions

Multiplicative functions – multiplicative functions and Dirichlet multiplication – the inverse of a completely multiplicative function – Liouville's function – the divisor functions – generalized convolutions. (**15 hours)**

UNIT IV: Averages of Arithmetical Functions

Asymptotic equality of functions – Euler's summation formula – some elementary asymptotic formula – the average order of d(n) – average order of the divisor functions the average order of φ(n) – the average order of μ(n) and of Λ(n). **(15 hours**)

UNIT V: Distribution of Prime Numbers

The partial sums of a Dirichlet product – applications to μ(n) and Λ(n) - Chebyshev's functions ψ(x) and I(x) – relations connecting I(x)and π(x).Some equivalent forms of the prime number theorem, inequalities for Λ(n) and pn. (**15 hours)**

TEXT BOOK:

Tom M. Apostol*,"Introduction to Analytic Number Theory",* Springer, International Student Edition, 2013. Unit 1, Unit2: Ch 2.1-2.8, Unit 3: Ch 2.9 -2.14, Unit 4: 3.1 -3.10, Unit 5: 4.1 – 4.5

Reference Books

1. **R.G. Ayoub**, "*An Introduction to the Analytic Theory of Numbers*", Mathematical Survays, No.10, Providence, R.I, AMS Publications, 1963.

2. **K. Chandrasekharan**, *"Introduction to Analytic Number Theory",*Springer Verlag, 1968.

3. **D.T. Newman,** "*Analytic Number Theory*" GTM Vol 177, Correeted Edition, Springer, 2000.

4. **HengHuat Chan,** "*Analytic Number Theory for undergraduate*" World Scientific, 2009.

IV Semester-CORE PRACTICAL

MATLABPROGRAMMING(Practical paper-4)

Pre-requisite: Basic knowledge of programming & Mathematics

CourseObjectives:

Themainobjectivesofthiscourseareto:

1. providetowritebasicMatlabcode,mainlyfor numericalcomputing.
2. trainingthedifferentplotsliketwo-dimensionalplotsandthree-dimensionalplots.
3. toenhancetheprogrammingskillswiththehelpofMATLABanditsfeatureswhichallowtolearnandap plyspecializedtechnologies.

CourseOutcomes:

Onthe successfulcompletionofthecourse,studentwillbe able to:

1 writeMATLABcodingrelatedtofindaddition,Multiplicationand determinantsofmatrices
2 learnuseoffor-loopand thewhile-loop inMATLABcoding
3 writeMATLABcodingformathematicalfunctions
4 effectivecomputabilityofnumericalcomputing suchasMATLAB
5 WriteMATLABcodingfor drawthegraphoffunctions

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes	Yes

4	Yes	Yes	Yes	Yes	Yes	Yes

CourseContent (40hours)	
Plottingafunction.	
Polarplot.	
Additionoftwomatrices.	
Findingthedeterminantofamatrix.	
FindingEigenvaluesandEigenvectorsofamatrix.	
Straightlinefit.	
Exponentialcurvefitting.	
Solvingafirst-orderlinearODE.	
Solvingasecond-ordernonlinearODE.	
Solvingnonlinearalgebraequations.	

5	Yes	Yes	Yes	No	Yes	Yes

E-Materials:	
1	https://nptel.ac.in/courses/103/106/103106118/
2	https://swayam.gov.in/nd1_noc20_ma40/preview

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	M	M	S	S	M
CO2	M	M	S	S	S	S	S	S	M	S
CO3	S	S	S	S	L	M	S	M	L	M
CO4	S	S	L	S	M	S	S	S	M	S
CO5	M	M	S	S	S	S	M	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L-Low

CORE: PROJECT COMPULSORY

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