VIVEKANANDHA
COLLEGE OF ARTS AND SCIENCES FOR WOMEN
[AUTONOMOUS]

SPONSORED BY: ANGAMMAL EDUCATIONAL TRUST.
An ISO 9001: 2015 Certified Institution
Affiliated to Periyar University, Approved by AICTE and
Re-Accredited with 'A+' Grade by NAAC
Recognized under section 2(f) and 12(B) of UGC Act, 1956

Elayampalayam – 637 205.Tiruchengode,Namakkal Dt., TamilNadu

A U T O N O M O U S

DEPARTMENT OF MATHEMATICS

M.Sc., Mathematics

SYLLABUS & REGULATIONS

FOR THE STUDENTS ADMITTED FROM
2023- 2024 ONWARDS

ACADEMIC YEAR: 2024-2025

VIVEKANANDHA EDUCATIONAL INSTITUTIONS

Angammal Educational Trust

Elayampalayam,Trichengode(T.k),Namakkal(Dt)

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN

[Autonomous]

ELAYAMPALAYAM, TIRUCHENGODE

M.Sc. MATHEMATICS - REGULATIONS

(Students admitted from 2023-2024 Onwards)

Under TANSCHE Syllabus

I. SCOPE OF THE COURSE

M.Sc. (Mathematics) is a high profile postgraduate program aimed to create enhanced competence of career positioning tied up with opportunity to become a skilled Mathematician. The program expects a serious commitment of the student to take up challenging study schedules and assignments. The course involves a blend of theoretical education and practical training which run concurrently for a period of two years and equips a student with knowledge, ability, skills and other qualities required for a professional Mathematician.

The uniqueness of the program is its content and topic coverage, the teaching methodology and the faculty. The syllabus has been designed at a level equal to that of professional courses. The teaching methodologies include classroom lectures, industrial visits, orientation, internship, case study and research work. Focus is also on developing soft skills of the students. For Core subjects, Outsource Guest Lectures by Industrialists and Subject Experts will be arranged to enable the students to get wider exposure.

II. SALIENT FEATURES

- Course is specially designed for a higher level Career Placement.
- Special Guest lectures from Subject Experts will be arranged.
- Special Teaching Oriented Training is part of the Degree Course.
- Course pave the way for enhanced conceptual, analytical & deductive skills to meet the Competitive exams like Banking/TNPSC /IAS/IFS/NET/SET etc.,

III. OBJECTIVES OF THE COURSE

Mathematics to-day is penetrating all fields of human endeavor and therefore it is necessary to prepare the students to scope with the advanced developments in various fields of Mathematics. The objectives of this course are the following:

a) To import knowledge in advanced concepts and applications in various fields of Mathematics.

b) To Provide wide choice of elective subjects with updated and new are as in various branches of Mathematics to meet the needs of all students.

IV. ELIGIBILITY FOR ADMISSION

A candidate who has passed B.Sc., Mathematics / B.Sc., Mathematics (Computer Applications) degree of this University or any other University accepted by the Syndicate equivalent there to, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the Master of Science (M.Sc.,) Degree Examination in Mathematics of this University after a two academic years and the successful completion of all the courses prescribed.

V. DURATION OF THE COURSE

- The Programme shall extend over a period of two academic years consisting of four semesters .Each academic year will be divided into two semesters. Each semester consist of 90 working days.
- The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekananda College of Arts and Sciences for Women with the approval of Periyar University.

VI. CONTINUOUS INTERNAL ASSESMENT

The performance of the students will be assessed continuously and the Internal Assessment Marks will be as under:

1.	Average of two Tests	- 5Marks
2.	Model	-5Marks
3.	Seminar	-5 Marks
4.	Assignment	-5 Marks
5.	Attendance	-5Marks
	Total	=25Marks

ATTENDANCE PARTICULARS

Attendance%	Marks
76-80	1
81-85	2
86-90	3
91-95	4
96-100	5

PASSING MINIMUM IN THE EXTERNAL EXAMINATION

In the University Examinations, the passing minimum shall be 50 % out of 75 Marks (i.e 38 Marks in the External Examinations).

VII. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the University Examination only on earning 75 %of attendance and a satisfactory conduct. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed with supporting evidence.

VIII. CLASSIFICATION OF SUCCESSFUL CANDIDATE

Successful candidates passing the examination of Core Courses (main and allied subjects) and securing marks

a) 75 % and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.

b) 60% and above but below 75 % shall be declared to have passed the examinations in first class.

c) 50% and above but below 60% shall be declared to have passed the examinations in second class.

d) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of two consecutive academic years from the year of admission only will be eligible for rank.

IX. ELIGIBILITYFOR AWARDOFTHEDEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the above degree for a period of not less than two academic years comprising of four semesters and passed the examinations prescribed and fulfilled such conditions have been prescribed therefore.

X. PROCEDURE IN THE EVENT OF FAILURE

If a candidate fails in a particular subject, she may reappear for the End of Semester in the concerned subject in subsequent semesters and shall pass the examination.

XI. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2020-2021 (i.e.,) for the students who are to be admitted to the first year of the programme during the academic year 2020-2021 and thereafter.

XII. TRANSITORY PROVISIONS

Candidates who have undergone the PG programme of study before 2020-2021 shall be permitted to appear for the examinations under those regulations of the year in which the candidates admitted to the programme. Supplementary examination will be conducted within a month. Incase of failure she has to complete within 5 years (2+3).

Thereafter, they will be permitted to appear for the examination only under the regulation then inforce.For the deserving candidates, if a student fails in a single subject she can be provided with maximum 5 marks as grace mark subject to the recommendation of the passing board.

ABOUT THE COLLEGE

Vivekanandha College of Arts and Sciences for Women (Autonomous) was established and hailed into Women's Educational Service in the Year1995. Angammal Educational Trust Chaired by the great Educationalist 'Vidhya Rathna' Prof. Dr. M. KARUNANITHI, B.Pharm., M.S., Ph.D., D.Litt., sponsors this college and other institutions under the name of the great Saint Vivekanandha. Our institutions are situated on either side of Tiruchengode Namakkal Main Road at Elayampalayam, 6 kms away from Tiruchengode. This is biggest women's college in India with more than 7500 girl students and more than 18 departments. The strength of the college was just 65 at the time of its establishment. With the dedication, work, sacrifice and long vision of the chairman, this institution has grown into a Himalaya stage. As a result of which UGC, New Delhi, awarded 2f and 12b, extended Autonomous status for second cycle. The National Assessment and Accreditation Council reaccredited with grade 'A' for its successful performance.

As an Autonomous Institution, academic professionals of the college framed Curriculum and Syllabi in consultation with all its stakeholders to cater the needs of the young women to fulfil the women empowerment and present Industrial needs to the local benefits. The students are empowering with confidence and required skills to face the society.

OUR VISION

- To evolve into a center of excellence in higher education through creative and innovative practices to social equity for women.

OUR MISSION

- To provide sufficient learning infrastructure to the students to pursue their studies.
- To provide good opportunity for higher education and conductive environment to the students to acquire education.
- To provide quality academic programs training activities and research facilities.
- To facilitate industry-institute interaction.

DEPARTMENT OF MATHEMATICS

VISION

- Empowerment of women through Education.
- To upgrade performance standards in the field of Mathematics in order to be a leading department in academic arena.
- To provide excellence in education for all students. We will assess and design courses and learning experiences that promote the academic achievement and the personal and social growth of students.

MISSION

- To Promote Quality Education to Women at all levels.
- To provide students experiences in Mathematics that will empower them to succeed in an ever changing society.
- To empower young women to face the challenges of life with courage and commitment.
- To equip them with enhanced employable skills.

Bloom's Taxonomy Based Assessment Pattern

K1-Remember;**K2**-Understanding;**K3**-Apply;**K4**-Analyze;**K5**- Evaluate;**K6**-Creating.

Theory: 75 Marks

Test- I & II and ESE:

Knowledge Level	Section	Marks	Description	Total
K1,K2	A (Answer all)	10x01=10	MCQ/Define	75
K3,K4	B (Either or pattern)	05x07=35	Short Answers	
K5&K6	C (Answer 3 out of 5)	03x10=30	Descriptive/Detailed	

Programme Outcomes

PO1: Problem Solving Skill

Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.

PO2: Decision Making Skill

Foster analytical and critical thinking abilities for data-based decision-making.

PO3: Ethical Value

Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.

PO4: Communication Skill

Ability to develop communication, managerial and interpersonal skills.

PO5: Individual and Team Leadership Skill

Capability to lead themselves and the team to achieve organizational goals.

PO6: Employability Skill

Inculcate contemporary business practices to enhance employability skills in the competitive environment.

PO7: Entrepreneurial Skill

Equip with skills and competencies to become an entrepreneur.

PO8: Contribution to Society

Succeed in career endeavors and contribute significantly to society.

PO 9: Multicultural competence

Possess knowledge of the values and beliefs of multiple cultures and a global perspective.

PO 10: Moral and ethical awareness/reasoning

Ability to embrace moral/ethical values in conducting one's life.

Programme Specific Outcomes:

PSO1 – Placement

To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.

PSO 2 - Entrepreneur

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO3 – Research and Development

Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

PSO4 – Contribution to Business World

To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO 5– Contribution to the Society

To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

M.Sc., Mathematics

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Programme Educational Objectives:

PEO 1: To provide students with an awareness of skills in lifelong learning and self education.

PEO 2: To cultivate team work, technical writing, and oral communication skills.

PEO 3: To provide students with an appreciation of mathematical impact on society and the Professional responsibilities of mathematician.

Bloom's Taxonomy

K1: Remembering: Retrieving, recognizing, and recalling relevant knowledge from long-term memory.

K2: Understanding: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.

K3: Applying: Carrying out or using a procedure for executing, or implementing.

K4: Analyzing: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.

K5: Evaluating: Making judgments based on criteria and standards through critique and checking.

K6: Creating: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

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Elayampalayam – 637 205.Tiruchengode, Namakkal Dt., Tamil Nadu

CURRICULUM DEVELOPMENT CELL (CDC)
Date: 27.03.2024

Curriculum structure 2024-25 onwards (PG)

(For candidates admitted during 2023-24 onwards)

Semester - III				Semester -IV			
S.No	**Sub.code**	**Sub.Name**	**Credits**	**S.No**	**Sub.code**	**Sub.Name**	**Credits**
1.	23P3	Core-1	5	1.	23P4	Core-1	5
2.	23P3	Core-2	5	2.	23P4	Core-2	5
3.	23P3DE	DSE-1	4	3.	23P4DE	DSE-1	4
4.	23P3DE	DSE-2	4	4.	23P4DE	DSE-2	4
5.	23P3DE	DSE-3	4	5.	23P4DE	DSE-3	4
6.	23P3	Practical / Internship / Mini Project	2	6.	23P4PR	Project	3
		Total	24			Total	25

Note: Credits for Core & DSE may be changed, according to the total credits.
(i.e. 91)

Dr. A. Malarvizhi

(CDC coordinator)

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN [AUTONOMOUS]
ELAYAMPALAYAM, TIRUCHENGODE-637205.
DEPARTMENT OF MATHEMATICS
M. Sc.–MATHEMATICS (TANSCHE)
COURSE PATTERN AND SCHEME OF EXAMINATIONS UNDER OBE
For the Candidates admitted from the year 2023-2024
ACADEMIC YEAR – 2024-25

SEM	SUBJECT CODE	COURSE	SUBJECTTITLE	Hours/ Week	CREDIT	INT. MARK	EXT. MARK	TOT. MARK
I	23P1MAC01	Core Course-I	Algebraic Structures	6	4	25	75	100
	23P1MAC02	Core Course-II	Real Analysis - I	6	4	25	75	100
	23P1MAC03	Core Course-III	Ordinary Differential Equations	5	4	25	75	100
	23P1MADE05	Discipline Specific Elective Course-I	Number Theory	5	3	25	75	100
	23P1MADE06	Discipline Specific Elective Course-II	Fuzzy Sets and Their Applications	4	3	25	75	100
	23P1MAS01	Skill Enhancement Course - I	Differential Equations Using SCI Lab	2	2	25	75	100
	23P1MAAC01	Ability Enhancement Compulsory Course - I	Aptitude Skills	2	2	25	75	100
TOTAL				**30**	**22**	**175**	**525**	**700**

SEM	SUBJECT CODE	COURSE	SUBJECT TITLE	Hours/ Week	CREDIT	INT. MARK	EXT. MARK	TOT. MARK
II	23P2MAC04	Core Course-IV	Advanced Algebra	6	4	25	75	100
	23P2MAC05	Core Course-V	Real Analysis - II	6	4	25	75	100
	23P2MAC06	Core Course-VI	Partial Differential Equations	5	4	25	75	100
	23P2MADE03	Discipline Specific Elective Course-III	Mathematical Methods	4	3	25	75	100
	23P2MADE04	Discipline Specific Elective Course-IV	Discrete Mathematics	5	3	25	75	100
	23P2MAS02	Skill Enhancement Course - II	Mathematical Documentation Using Latex	2	2	25	75	100
	23P2MAAC02	Ability Enhancement Compulsory Course - II	Logical Skills	2	2	25	75	100
	Internship Training during summer vacation.(Credits shall be awarded in III Semester mark sheet)			-	-	-	-	-
TOTAL				**30**	**22**	**175**	**525**	**700**

SEM	SUBJECT CODE	COURSE	SUBJECTTITLE	Hours/Week	CREDIT	INT. MARK	EXT. MARK	TOT. MARK
III	23P3MAC07	Core Course-VII	Complex Analysis	6	5	25	75	100
	23P3MAC08	Core Course-VIII	Topology	5	4	25	75	100
	23P3MADE07	Discipline Specific Elective Course-V	Graph Theory and Applications	5	3	25	75	100
	23P3MADE08	Discipline Specific Elective Course-VI	Mathematical Statistic Analysis	5	3	25	75	100
	23P3MADE09	Discipline Specific Elective Course-VII	Computational Mathematics using C++	5	3	25	75	100
	23P3MADEP1	Discipline Specific Elective Practical - I	Computational Mathematics Lab	2	2	40	60	100
	23P3INT01	Internship	Internship	-	2	-	-	-
	23P3HR01	Value Education	Human Rights	2	1	25	75	100
TOTAL				**30**	**23**	**190**	**510**	**700**

SEM	SUBJECT CODE	COURSE	SUBJECT TITLE	Hours /Week	CREDIT	INT. MARK	EXT.MARK	TOT.MARK
IV	23P4MAC09	Core Course-IX	Functional Analysis	5	4	25	75	100
	23P4MAC10	Core Course-X	Differential Geometry	6	4	25	75	100
	23P4MAC11	Core Course-XI	Measure Theory and Integration	5	4	25	75	100
	23P4MADE11	Discipline Specific Elective Course-XI	Mathematical Methods using Python	4	3	25	75	100
	23P4MADE12	Discipline Specific Elective Course-XII	Numerical Analysis	4	3	25	75	100
	23P4MAPR01	Core Project	Project with Viva Voce	4	4	40	60	100
		EDC		2	2	25	75	100
TOTAL				**30**	**24**	**190**	**510**	**700**
GRAND TOTAL				**120**	**91**	**730**	**2070**	**2800**

DISCIPLINE SPECIFIC ELECTIVE COURSES:

1.	Number Theory and Cryptography	-23P1MADE01
2.	Mathematical Programming	-23P1MADE02
3.	Mathematical Methods	-23P2MADE03
4.	Discrete Mathematics	-23P2MADE04
5.	Number Theory	-23P1MADE05
6.	Fuzzy Sets and Their Applications	-23P1MADE06
7.	Mechanics	-23P2MADE14
8.	Mathematical Statistic Analysis	-23P3MADE08
9.	Computational Mathematics using C++	-23P3MADE09
10.	Probability Theory	-23P4MADE10
11.	Mathematical Methods using Python	-23P4MADE11
12.	Numerical Analysis	-23P4MADE12
13.	Big Data Analysis using R Programming	-23P4MADE13
14.	Graph Theory and Applications	-23P3MADE07
15.	Fluid Dynamics	-23P2MADE15
16.	Core Industry Module	-23P3MADE16
17.	Computational Mathematics Lab	-23P3MADEP1

SKILL ENHANCEMENT COURSES:

1.	Differential equations using SCILAB	- 23P1MAS01
2.	Mathematical documentation using LATEX	- 23P2MAS02
3.	Mathematical Computation With Sage Math	- 23P1MAS03
4.	Office Automation and ICT Tools	- 23P1MAS04
5.	Numerical analysis using SCILAB	- 23P1MAS05
6.	Industrial Mathematics/ Statistics using latest programming packages	- 23P2MAS06
7.	Research Tools and Techniques	- 23P2MAS07

ABILITY ENHANCEMENT COMPULSORY COURSES:

1.	Aptitude Skills	-23P1MAAC01
2.	Logical Skills	-23P2MAAC02

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>23P1MAC01</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms</td></tr>
<tr><td colspan="2" rowspan="6">Course Outline</td><td colspan="7">UNIT-I : Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).
Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5) (12Hrs)</td></tr>
<tr><td colspan="7">UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules
Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5 (12Hrs)</td></tr>
<tr><td colspan="7">UNIT-III : Linear Transformations: Canonical forms – Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5 (12Hrs)</td></tr>
<tr><td colspan="7">UNIT-IV : Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7 (12Hrs)</td></tr>
<tr><td colspan="7">UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9) (12Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 60</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.</td></tr>
</table>

Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I – Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups

CLO 2: Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules

CLO 3: Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.

CLO 4: Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.

CLO 5: Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal .

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P1MAC02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I : Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8
Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.
Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18 (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler’s summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.
Chapter - 7 : Sections 7.1 to 7.14 (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals. Chapter - 7 : 7.15 to 7.26
(12 Hrs)</td></tr>
</table>

	UNIT-IV : 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 – Cesaro summability - Infinite products. **Chapter - 8 Sec, 8.20, 8.21 to 8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23** **(12 Hrs)**
	UNIT-V: Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13** **(12 Hrs)**
Total Hrs	**60 Hrs**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
Reference Books	1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976. 2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976. 3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991. 4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991. 5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964. 6. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Analyze and evaluate functions of bounded variation and Rectifiable Curves.
CLO2: Describe the concept of Riemann-Stieltjes integral and its properties.
CLO3: Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.
CLO4: Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.
CLO5: Formulate the concept and properties of inner products, norms and measurable functions.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">23P1MAC03</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Linear equations with constant coefficients
Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.
Chapter 2: Sections 1 to 6 (12 Hrs)</td></tr>
<tr><td colspan="8">UNIT-II : Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n – Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.
Chapter 2 : Sections 7 to 12. (12 Hrs)</td></tr>
<tr><td colspan="8">UNIT-III : Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.
Chapter : 3 Sections 1 to 8 (Omit section 9) (12 Hrs)</td></tr>
<tr><td colspan="8">UNIT-IV :Linear equation with regular singular points
Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9) (12 Hrs)</td></tr>
<tr><td colspan="8">UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9) (12 Hrs)</td></tr>
<tr><td colspan="2">Total Hours</td><td colspan="8">60 Hrs</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967. 2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001 6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Establish the qualitative behavior of solutions of systems of differential equations .

CLO2: Recognize the physical phenomena modeled by differential equations and dynamical systems.

CLO3: Analyze solutions using appropriate methods and give examples.

CLO4: Formulate Green's function for boundary value problems.

CLO5: Understand and use various theoretical ideas and results that underlie the mathematics in this course.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ADVANCED ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P2MAC04</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Algebraic Structures</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2 (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II : Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5 (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III : Elements of Galois theory.
Chapter 5 : Section 5.6 (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-IV : Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only) (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.
Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
Chapter 7 : Sections 7.3 and 7.4 (12 Hrs)</td></tr>
<tr><td colspan="2">Total Hrs</td><td colspan="6">60 Hrs</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.</td></tr>
</table>

Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II *Rings,*Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Prove theorems applying algebraic ways of thinking.

CLO2: Connect groups with graphs and understanding about Hamiltonian graphs.

CLO3: Compose clear and accurate proofs using the concepts of Galois Theory.

CLO4: Bring out insight into Abstract Algebra with focus on axiomatic theories.

CLO5: Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P2MAC05</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td>1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra) (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra) (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an ortho normal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol) (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1
Chapter 12 : Section 12.1 to 12.14 (Apostol) (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Chapter 13 : Sections 13.1 to 13.7 (Apostol) (12 Hrs)</td></tr>
</table>

Total Hrs	**60 Hrs**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)
Reference Books	1. Burkill,J.C. *The Lebesgue Integral*, Cambridge University Press, 1951. 2. Munroe,M.E. *Measure and Integration*. Addison-Wesley, Mass.1971. 3. Roydon,H.L .*Real Analysis*, Macmillan Pub. Company, New York, 1988. 4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979. 5. Malik,S.C. and Savita Arora. *Mathematical Analysis,* Wiley Eastern Limited. New Delhi, 1991. 6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.

CLO2: Analyze the representation and convergence problems of Fourier series.

CLO3: Analyze and evaluate the difference between transforms of various functions.

CLO4: Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

CLO5: Apply the Cauchy integral theorem in its various versions to compute contour integration.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P2MAC06</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
4</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5) (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 4 : Sections 4.1 to 4.11 (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III :Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7) (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.
Chapter 8 : Sections 8.1 to 8.9 (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V : Green’s Function: The Delta function – Green’s function – Method of Green’s function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.
Chapter 10 : Section 10.1 to 10.9 (12 Hrs)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.
Reference Books	1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964. 2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968. 4. M.D.Raisinghania, *Advanced Differential Equations,* S.Chand & Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To understand and classify second order equations and find general solutions

CLO2: To analyse and solve wave equations in different polar coordinates

CLO3: To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations

CLO4: To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions

CLO5: To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td>Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P3MAC07</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2">5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">UG level Complex Analysis</td></tr>
<tr><td>Objectives</td><td colspan="7">● To give a careful treatment of argument and logarithms and winding numbers
● To introduce analytic functions which are locally a power series and to study the profound Cauchy theory which says analytic functions are complex differentiable (holomorphic) functions on an open set.
● To emphasize that the subject is a amalgamation of ideas from analysis, geometry and topology</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I :Power Series - Uniform Convergence and Continuity - Arguments on C^*- Logarithms - Power Series and Analytic Functions- Cauchy-Riemann Equations
r 1- Chapter 5: Only the Sections 2.3, 3.2, 4.3, 4.4, 5.5 and 5.7 (15 Hrs)</td></tr>
<tr><td colspan="7">UNIT-II : Complex Integration: Integration of functions from R to C - Path Integrals - ML- inequality - A Preview of Cauchy Theory - Cauchy Theory: Cauchy’s Theorem for Star-Shaped Domains - Applications of Cauchy’s Theorem - An Extension of Cauchy’s Theorem - Green’s Theorem and Cauchy’s Theorem.
Chapters 6 and 7. (15 Hrs)</td></tr>
<tr><td colspan="7">UNIT-III : Cauchy Integral Formula:Cauchy Integral Formula - Mean Value Property - Liouville’s Theorem - Morera’s Theorem - Identity Theorem - Maximum Modulus Theorem
Chapter 8 (15 Hrs)</td></tr>
<tr><td colspan="7">UNIT-IV : Isolated Singularities and Laurent Series:Isolated Singularities - Laurent Series - Characterization of Singularities - Meromorphic Functions - Winding Numbers of Closed Curves: Winding Numbers -I - Residue Theorem and its Applications: Residue Theorem - Arugument Principle.
Chapters 9,10 - Section 10.1 only and 11 (15 Hrs)</td></tr>
</table>

	UNIT-V: Extended Complex Plane: Point at Infinity - Fractional Linear Transformations - Functions on the Extended Plane - Real Integrals: Improper Integrals - Evaluation of Real Integrals - Summation of Infinite Series Chapters 13: 13.1 - 13.3 and Chapter 15 **(15 Hrs)**
	Total Hrs. 75 Hrs

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	S.Kumaresan, A Pathway to Complex Analysis, Techno world Publications,2021.
Reference Books	(1) Bak, J., Newman and D.J, Complex Analysis, 3rd edition, Springer Nature, New York,2015. (2) R. Priestely, Introduction to Complex Analysis, Oxford India, 2008. (3) Theodore W. Gamelin, Complex Analysis, Springer Verlag, 2003. (4) Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo,2017. (5) R.V. Churchill & J.W. Brown, Complex Variables and applications, 8th edition, McGraw-Hill, 2017. (6) L.S. Hahn and B. Epstein, Classical Complex analysis, Jones and Barlett Student Edi-tion, 2011. (7) J.B. Conway, Functions of One Complex Variable, Narosa, 2 edn., 2000. (8) S. Ponnusamy and H. Silverman, Complex Variables with applications, Birkhauser,2006. (9) Donald Sarason, Notes on Complex Function theory, Hindustan Book Agency, 1994. (10) V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,http://en.wikipedia.org

Course Learning Outcome(for Mapping with POs and PSOs)

Students will be able to

- **CLO1:**Understand the complex number system from geometric view point. Will gain masteryin arguments on C^* and logarithms and to Get expertise in the concept of convergence of sequences and series of complex numbers, continuity and differentiability of function on complex numbers. Also the students will be able to thoroughly understand and know the importance of power series in complexanalysis.
- **CLO2:** Understand the central theme of Cauchy theory, viz., existence of local primitives andlocal power series expansion.
- **CLO3:**Get acquainted with various techniques of proving fundamental theorem of algebra,open mapping theorem, maximum modulus theorem and Liouville/s theorem.
- **CLO4**: Classify singularities, compute poles and residues and understand the Laurent seriesexpansion.
- **CLO5:**Appreciate and work on the topology of extended complex plane.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P3MAC08</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I : Topological spaces : Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.
Chapter2 : Sections 12 to17 (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II :Continuous functions: Continuous functions – the product topology – The metric topology.
Chapter2 :Sections 18 to 21(Omit Section 22) (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III: Connectedness: Connectedspaces- connected subspaces of the Real line – Components and local connectedness.
Chapter3 : Sections 23 to 25. (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV :Compactness : Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter3 : Sections 26 to 29. (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma–The Tietz extension theorem.(Except - The Urysohn metrization Theorem)
Chapter4 : Sections 30 to 35. (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 75 Hrs</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Reference Books	1. J.Dugundji, *Topology*,PrenticeHallof India,NewDelhi,1975. 2. GeorgeF. Sinmons,*IntroductiontoTopologyandModern Analysis*, McGraw HillBook Co., 1963 3. J.L.Kelly, *General Topology*,VanNostrand, Reinhold Co.,New York 4. L.Steen and J.Subhash,Counter Examples in Topology, Holt, Rinehart and Winston,New York, 1970. 5. S.Willard,*General Topology*, Addison-Wesley,Mass., 1970
Web site and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,http://en.wikipedia.org
Recommended Text	JamesR. Munkres, *Topology*(2nd Edition) Pearson Education Pve. Ltd.,Delhi-2002 (Third Indian Reprint)

Course Learning Outcome(for Mapping with POs and PSOs)

Students will be able to

CLO1: Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.

CLO2: Understand continuity, compactness, connectedness, homeomorphism and topological properties.

CLO3:Analyze and apply the topological concepts in Functional Analysis.

CLO4: Ability to determine that a given point in a topological space is either a limit point or not for a given subset of a topological space.

CLO5: Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent (homeomorphic).

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FUNCTIONAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P4MAC09</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• The idea behind the course is to emphasize very basic results which are needed foranalysts and to give typical applications.
• To study normed linear spaces, four pillars of functional analysis, weak topologies andduality, Hilbert space theory and algebra of bounded linear operators.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Normed Linear Spaces - Examples - Normed Linear Spaces as Metric Spaces - Banachspaces - Hilbert Spaces - Bounded Linear Maps.
Chapter 1: 1.1-1.5. (15 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II:Riesz Representation Theorem for Hilbert Spaces - Finite Dimensional Spaces - Lo- cally Compact Normed Linear Spaces - Quotient Spaces.
Chapter 1: 1.6-1.9. (15 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III : Five Pillars of Functional Analysis: Hahn-Banach Theorem - Open Mapping Theo-rem - Bounded Inverse Theorem - Closed Graph Theorem - Uniform Boundedness Principle.
Chapter 2 except 2.5.1,2.6.1.4 & 2.6.1.5. (15 Hrs)</td></tr>
<tr><td colspan="6">UNIT-IV: General Results on Compact Operators - Compact self-adjoint operators on Hilbertspaces - Dual spaces - Adjoint operators - Hilert space adjoint.
Chapter 3:3.1 & 3.4 and Chapter: 4.1-4.3. (15 Hrs)</td></tr>
<tr><td colspan="6">UNIT-V: Banach Algebras - Spectrum of an element in a Banach Algebra - Spectrum of somestandard operators - Finite Dimensional spectral theorem.
Chapter 5 and Chapter 6: 6.1. (15 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 75 Hrs</td></tr>
</table>

Extended Professional Component(is apart of internal componentonly, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	S.Kumaresan and D.Sukumar, Functional Analysis A first course, Narosa Publishing House,2020.
Reference Books	(1) B. Bollobas, Linear Analysis an introductory course, 2nd edn, Cambridge MathematicalTexts, Cambridge University Press, 1999. (2) B.V. Limaye, Functional Analysis, Revised 3rd edn, New Age International, 2014. (3) C. Goffman and G. Pedrick, A First Course in Functional Analysis, AMS, Chelesea,2017 (4) B. Rynne and M.A. Youngson, Linear Functional Analyis, Springer UMS, 2008 (5) E. Kreyszig, Introductory Functional Analysis with applications, John Wiley, 2007. (6) S. Kesavan, Functional Analysis, Hindustan book agency, 2014. (7) G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2017. (8) M.Thamban Nair, Functional Analysis: A first course, Prentice Hall of India, 2002. (9) K. Yosida, Functional Analysis, Springer-Verlag, 1995.
Web site and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Realize an important characterization: A normed linear space is locally compact if and only if it is finite dimensional.

CLO2: Gain mastery in basic Hilbert space theory: Projection theorem and Riesz representation theorem.

CLO3: Comprehend the important of five pillars of functional analysis namely Hahn-Banach theorems, open mapping theorem, bounded inverse theorem, closed graph theorem and uniform boundedness principle.

CLO4: Gain the Knowledge about Compact self-adjoint operators on Hilbertspaces

CLO5: Study in detail the spectral properties of bounded linear operators.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DIFFERENTIAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P4MAC10</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear Algebra concepts and Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces space curves and their n trinsic properties of a
Surface and geodesics. Further then on-intrinsic properties of surface and the differential geometry of surfaces are explored</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.
ChapterI : Sections 1 to 9. (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II : Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.
ChapterII: Sections 1 to 9. (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III : Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.
ChapterII: Sections 10 to 18. (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-IV: Non Intrinsic properties of a surface:
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.
ChapterIII:Sections 1 o 8. (12 Hrs)</td></tr>
<tr><td colspan="6">UNIT-V: Differential Geometry of Surfaces:
Compact surfaces whose points are umblics- Hilbert‘s lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert‘s Theorem – Conjugate points on geodesics.
ChapterIV:Sections 1 to 8 (Omit 9 to 15). (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 60 Hrs</td></tr>
</table>

Extended Professional Component(is apart of internal Component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T.J.Willmore, *An Introduction to Differential Geometry,* Oxford University Press,(17thImpression)New Delhi2002.(Indian Print)
Reference Books	2. Struik,D.T. *Lectureson Classical Differential Geometry*,Addison–Wesley, Mass. 1950. 3. Kobayashi.S. and Nomizu .K. *Foundations of Differential Geometry,* Inter science Publishers, 1963. 4. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer- Verlag 1978. 5. J.A.Thorpe *Elementary topics in Differential Geometry*, Under-Graduate Texts in Mathematics,Springer-Verlag1979.
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.physicsforum.com

Course Learning Outcome(for Mapping with POs and PSOs)

Students will be able to

CLO1: Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.

CLO2:Evaluate these concepts with related examples.

CLO3: Compose problems on geodesics.

CLO4: Recognize applicability of developable.

CLO5:Construct and analyze the problems on curvature and minimal surfaces

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MEASURE THEORY AND INTEGRATION</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course</td><td rowspan="2">23P4MAC11</td></tr>
<tr><td>Semester</td><td>IV</td><td>Code</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• To provide a concrete setting of Lebesgue measure and Lebesgue integral via the classical concepts of Jordan measure and the Riemann integration.
• To give an expert and thorough study on abstract measuresa and the modern integationtheory including the standard convergence theorems.
• To introduce product measure and study the Fubini’s theorem.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">Unit-I. Measure on R: - outer measure - measurable sets - Regularity- abstract Measures - elementary properties of abstract measures.
Chapter 2 - Section 2.1 to2.3 from [1] and
Chapter 1 - pages 5 -19 (till the end of 1.22) from [2]. (12 Hrs)</td></tr>
<tr><td colspan="7">Unit-II. Integration of positive functions - Integration of complex functions - The role played by sets of measure zero.
Chapter 1 - pages 19 -31 from [2]. (12 Hrs)</td></tr>
<tr><td colspan="7">Unit-III. Measurability on cartesian products - Product Measure- The Fubini’s theorem - Completion of Product measures- convolutions.
Chapter 8 - pages 160-171from [2]. (12 Hrs)</td></tr>
<tr><td colspan="7">Unit-IV. Lp spaces: - convex function and inqualities - completeness of Lp spaces .
Chapter 3 - pages 61 -71 from [2]. (12 Hrs)</td></tr>
<tr><td colspan="7">Unit-V. Signed Measures - Hahn Decomposition - Jordan Decomposition - Radon Nikodym theorem.
Chapter 8 Sections 8.1 -8.3 from [1]. (12 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 60 Hrs</td></tr>
</table>

Extended Professional Component(is apart of internal componentonly, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	(1) G. de Barra, Measure Theory And Integration, NewAge International Pvt.Ltd, 2013. (2) W. Rudin, Real and Complex Analysis 3edn, McGraw-Hill, 2017.
Reference Books	(1) J R.G. Bartle, Elements of Integration and Lebesgue measure, Wiley India Ltd, 2014. (2) C.D. Aliprantis and O.Burkinshaw, Priniciples of Real Analysis 3rd edn, AcademicPress, Inc. New York, 1998. (3) I.K.Rana, An Introduction to Measure and Integration, 2edn ,Narosa Publishing House, NewDelhi, 2007. (4) H.L.Royden, Real Analysis, Pearson, Third edition, 2015. (5) R.G. Bartle, Modern theory of integration, AMS, 2000.
Web site and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

- **CLO1:** Understand the concept of Caratheodory construction of a measure from an outer measure in the concrete cases.
- **CLO2:**Appreciate the power of Riemann integration and its drawbacks. They will be able tocapture the need for the modern integration theory.
- **CLO3:** Understand the proof and apply Fubini's theorem in various cases.
- **CLO4:** Prove the completeness of Lp spaces.
- **CLO5:** Comprehend the idea of Hahn and Jordan decomposition and Radon nikodym theorems.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the Course		**PROJECT WITH VIVA VOCE**					
Paper Number		**CORE**					
Category	Core	**Year**	II	**Credits**	5	**Course Code**	23P4MAPR01
		Semester	IV				
Instructional Hours perweek		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		4			--	4	
Pre-requisite		UG Level Mathematics					

DISCIPLINE SPECIFIC ELECTIVE COURSES:

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">23P1MADE01</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Number Theroy.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. To introduce students to some of the basic ideas of number theory, and to use this as a context in which 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.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">UNIT I : Divisibility and Euclidean algorithm – Congruence, Euler’s Theorem, Wilson’s Theorem,
Chinese Remainder Theorem, Primitive roots - Applications to Factoring.
Chapter 1, Sections 1.1-1.4 (9 Hrs)</td></tr>
<tr><td colspan="8">UNIT II: Finite Fields – Quadratic Residues – Quadratic Reciprocity – The Jacobi symbol.
Chapter 2, Sections 2.1-2.2 (9 Hrs)</td></tr>
<tr><td colspan="8">UNIT III: Cryptosystems – Enciphering Matrices – Public Key Cryptography – Concepts of Public Key Cryptography – Modular Arithmetic – RSA.
Chapters 3&4, Sections 3.1-3.2, 4.1-4.2 (9 Hrs)</td></tr>
<tr><td colspan="8">UNIT IV: Pseudo primes and Strong Pseudo primes – The rho method – Fermat factorization and factor bases and Algorithm – The Continued fraction method and Algorithm.
Chapter 5, Sections 5.1-5.4 (9 Hrs)</td></tr>
</table>

	UNIT V: Elliptic Curves – Basic Facts, Elliptic curves Cryptosystems. **Chapter 6, Sections 6.1-6.2 (9 Hrs)**
Total Hours	**45 Hrs**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	"A Course in Number Theory and Cryptography" by Neal Koblitz, , Springer – Verlag, New York, 1987.
Reference Books	"An Introduction to Theory of Numbers" by Ivan Nivan and Herberts Zucherman, Third Edition, 1972, Wiley Eastern Limited, New Delhi
	"Introduction to Analytic Number Theory" by Tom Apostol, Narosa Publications, New Delhi
	"Elementary Number Theory" by David M. Burton, Wm. C. Brown Publishers, Dubuque, Lowa, 1989.
	"Cryptography and Network Security Principles and Practice" by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.
Website and e-Learning Source	https://www.youtube.com/watch?v=SCvtxjpVQms
	https://www.youtube.com/watch?v=pBELpoglnvQ&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1MADE02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course introduces advanced topics in Linear and non-linear Programming</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I INTEGER LINEAR PROGRAMMING: Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory‘s All Integer Cutting Plane Method - Gomory‘s mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming. Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP.
Chapter-7: 7.1 - 7.7 Chapter-20: 20.1 - 20.5 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II CLASSICAL OPTIMIZATION METHODS: Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe‘s modified Simplex Methods - Beale‘s Method
Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III THEORY OF SIMPLEX METHOD: Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution.
Chapter-25: 25.1 - 25.4, 25.6-25.9 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV REVISED SIMPLEX METHOD: Standard forms for Revised simplex Method - Computational procedure for Standard formI - comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm
Chapter-26: 26.1 - 26.4 Chapter-28: 28.1, 28.2 (9 Hrs)</td></tr>
</table>

	UNIT-V PARAMETRIC LINEAR PROGRAMMING: Variation in the coefficients cj , Variations in the Right hand side, bi . Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming. Chapter-29: 29.1 - 29.3 **(9 Hrs)**
	Total Hrs: 45 Hrs
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill

Recommended Text	1.J.K.Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd.
Reference Books	1.Hamdy A. Taha, Operations Research, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997. 2.F.S. Hillier & J.Lieberman Introduction to Operation Research (7th Edition) TataMcGraw Hill ompany, New Delhi, 2001. 3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization(2nd Edition) Prentice Hall Pvt Ltd., New York, 1979 4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P2MADE03	Title	Batch	2023-2025
		ELECTIVE :MATHEMATICAL METHODS	Semester	II
Hrs/Week	4		Credits	03

Course Outcomes (CO)

CO Number	CO Statement	Knowledge Level
CO1	To understand the concepts of Variational problems.	K2
CO2	To gain knowledge about Variational Problem.	K3, K4
CO3	To understand various types of integral equation.	K1,K2
CO4	To analyze the Fredholm integral equations.	K4
CO5	To Evaluate Gram Schmit orthogonlization process andSolution of Fredholm integral equation of first kind.	K5,K6

UNIT – I: Variational problems with fixed boundaries (9 Hrs)

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

Chapter- 1 (Sec 1.1- 1.7)

UNIT – II : Variational problems with moving boundaries (9 Hrs)

Movable boundary for a functional dependent on two functions – one-side variations – Reflectionand Refraction of extermals – Diffraction of light rays.

Chapter – 2 (Sec 2.1 – 2.5)

UNIT – III : Integral Equation (9 Hrs)

Introduction – Types of Kernels – Eigen Values and Eigen Functions – Connection with differential equation – Solution of an integral equation – Initial value problems – Boundary value problems.

Chapter – 1(Sec 1.1 – 1.3 & 1.5 – 1.8)

UNIT – IV : Solution of Fredholm integral equation (9 Hrs)

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 of successive substitution .

Chapter – 2 (Sec 2.1 – 2.3), Chapter – 4 (Sec 4.1 – 4.5)

UNIT – V : Hilbert – Schmidt Theory (9 Hrs)

Complex Hilbert Space – Orthogonal system of functions – Gram Schmit orthogonlization process - Hilbert – Schmidt Theorem - Solution of Fredholm integral equation of first kind.

Chapter – 3(Sec 3.1 – 3.4 , 3.8 – 3.9)

TOTAL : 45 Hours

Power point Presentations, Seminar & Assignment

TEXT BOOKS:

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

2. **Sudir K.Pundir and Rimple Pundir**, ***Integral Equations and Boundary Value Problems,*** Pragati Prakasam, Meerut, 2005.

REFERENCE BOOKS:

1. **F.B.Hildebrand,** ***Methods of Applied Mathematics***, Prentice Hall of India Pvt. New Delhi, 1968.

2. **R.P.Kanwal,** ***Linear Integral Equations-Theory and Techniques***, Academic Press, New York, 1971.

3. **L.Elsgolts,** ***Differential Equations and Calculus of Variations***, Mir Publishers, Moscow, 1973.

Sadri Hassani, ***Mathematical Methods***, pub 2009.

ONLINE SOURCES:

1. http://physics.bgu.ac.il/~gedalin/Teaching/Master/mmp.pdf

2. http://home.iitk.ac.in/~dasgupta/Mathbook/Imastertrans.pdf

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PO1 3	PO 14	PO 15
CO1	S	M	L	S	S	L	M	L	S	L	S	L	L	L	S
CO2	S	S	M	M	S	M	L	S	M	L	S	M	M	S	M
CO3	S	L	S	S	M	L	S	M	S	M	S	M	M	M	S
CO4	S	L	S	M	M	L	L	M	M	L	M	L	L	L	S
CO5	S	M	L	S	S	S	S	M	S	M	L	S	M	M	M

S - Strong; M - Medium; L – Low

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P2MADE04	Title	Batch	2023-2025
		ELECTIVE: DISCRETE MATHEMATICS	Semester	II
Hrs/Week	5		Credits	03

Course Outcomes (CO)

CO Number	CO Statement	Knowledge Level
CO1	To Remember the basic ideas of foundations and logic.	K1, K2
CO2	To Gain knowledge about Permutations and Combinations	K4
CO3	Demonstrate the concept of Generating functions.	K2
CO4	To analyze the Boolean Functions and Logic gates.	K1,K2, K5
CO5	To Evaluate the theory of Modeling Computation .	K3,K6

UNIT-I: The Foundations - Logic and proofs (9Hrs)

Propositional – Applications of Propositional – Propositional Equivalences – Predicates and Quantifiers. Algorithms : The Growth of functions.

Chapter - 1 (Sec 1.1 – 1.3) , Chapter - 3 (Sec 3.1 – 3.2)

UNIT-II: Counting (9 Hrs)

The Basics of Counting – The Pigeonhole principle – Permutations and Combinations –Generalized Permutations and Combinations – Generating Permutations and Combinations.

Chapter - 5 (Sec 5.1 – 5.3, Sec 5.5, 5.6)

UNIT-III: Advanced Counting Techniques (9Hrs)

Recurrence Relations – Solving Linear Recurrence Relations – Generating Functions.Chapter - 6

(Sec 6.1, 6.2, 6.4)

UNIT-IV: Boolean Algebra : (9 Hrs)

Boolean Functions – Representing Boolean Functions – Logic Gates – Minimization of Circuits.

Chapter - 10(Sec 10.1 – 10.4)

UNIT-V: Modeling Computation **(9 Hrs)**

Finite – State machines with Output – Finite – State machines with no Output – Turing Machines.

Chapter - 12(Sec 12.2, 12.3, 12.5)

TOTAL : **45 Hours**

Power point Presentations, Seminar & Assignment

TEXT BOOK :

Kenneth H.Rosen, ***Discrete Mathematics and its Applications***,7th Edition, WCB/McGraw Hill Education, New York, 2008.

REFERENCE BOOKS :

1. **J.P.Trembley and R.Manohar,** ***Discrete Mathematical Structures applications to Computer Science,***Tata McGraw Hills,New Delhi, 2013.

2. **T.Veerarajan,** ***Discrete Mathematics with Graph Theory and Combinatorics,*** Tata McGraw HillsPublishing Company Limited, 7th Reprint, 2008.

3. **Prof. V.Sundaresan, K.S. Ganapathy Subramaniyan, K.Ganesan,** ***Discrete Matheamtics***, Tata McGraw Hill, New Delhi, 2000.

ONLINE SOURCES:

1. www.freebook centre.net/
2. www.maths for college.com/nm/topics/text book

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	S	S	M	L	M	L	M	L	S	L	L	L	S
CO2	S	L	S	M	M	L	L	M	M	L	M	L	L	L	S
CO3	S	M	L	S	S	L	M	L	S	L	S	L	L	L	S
CO4	S	M	S	S	S	M	S	M	S	L	S	M	M	L	S
CO5	L	L	S	M	S	M	L	S	M	M	L	L	L	L	S

S - Strong; M - Medium; L – Low

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">NUMBER THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1MADE05</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Number Theroy.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. To introduce students to some of the basic ideas of number theory, and to use this as a context in which 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
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.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="8">UNIT I : Divisibility

Introduction - Divisibility-Primes – The Binomial theorem.

Chapter - 1(Sec 1.1. – 1.4) (9 Hrs)</td></tr>
<tr><td colspan="8">UNIT II: Congruence’s

Congruence’s-Solutions of congruence’s – The Chinese remainder theorem – Prime power moduli –Prime modulus.

Chapter - 2(Sec 2.1. – 2.7) (9 Hrs)</td></tr>
</table>

	UNIT III: Quadratic reciprocity Quadratic residues - Quadratic reciprocity -The Jacobi symbol – Binary Quadratic forms. Chapter - 3(Sec 3.1. – 3.4) **(9 Hrs)**
	UNIT IV: Some functions of Number theory Greatest integer function - Arithmetic functions - The Mobius inversion formula- The Recurrencefunctions. Chapter – 4 (Sec 4.1. – 4.4) **(9 Hrs)**
	UNIT V: Some Diaphantine equations and farey fractions The equation ax+by= c – farey sequences – Rational approximations – Irrational numbers. Chapter- 5 (Sec 5.1), Chapter - 6 (Sec 6.1 – 6.3) **(9 Hrs)**
Total Hrs	**45 Hrs**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Ivan Niven and H.S. Zuckerman, An Introduction to the Theory of Numbers, 3rd edition, Wiley Eastern Ltd, New Delhi, 1989.
Reference Books	D.M. Burton, Elementary Number theory, Universal Book Stall, New Delhi 2001

	K. Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, New York, 1972.
	T.M. Apostol, Introduction to Analytic Number Theory, Narosa Publication, House, Chennai, 1980.
	Elementary Number Theory, Seventh Edition, MC Graw-Hill Companies, 2015.
Website and e-Learning Source	https://www.youtube.com/watch?v=SCvtxjpVQms
	https://www.youtube.com/watch?v=pBELpoglnvQ&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2

Course Outcomes (CO)

Students will be able

CLO1: To remember the basic ideas about Integers, Primes, Quadratic Residues.

CLO2: To Understand the concepts of Congruence's and Solutions of congruence's

CLO3: To demonstrate and understanding of Quadratic residues

CLO4: To analyze the Mobius inversion formula.

CLO5: To Evaluate Diaphantine equations and farey fractions

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	S	M	M	S	S	M	L	M	L	L	M	L	L	M	S
CO2	M	M	S	S	S	S	S	L	M	L	L	S	M	L	S
CO3	M	M	S	S	S	S	M	L	L	L	S	M	S	S	S
CO4	S	M	S	S	S	M	M	S	M	L	L	L	M	M	S
CO5	S	M	M	S	S	M	L	M	L	L	M	L	L	M	S

S - Strong; M - Medium; L – Low

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P1MADE06	Title	Batch	2023-25
		ELECTIVE :FUZZY SETS AND THEIRAPPLICATIONS	Semester	I
Hrs/Week	4		Credits	3

Course Outcomes (CO)

CO Number	CO Statement	Knowledge Level
CO1	To understand the basic concepts of fuzzy sets.	K1, K2
CO2	To know about fuzzy complements and intersections.	K2, K3
CO3	To apply the idea about linguistic variables.	K3, K4
CO4	To analyze the binary relations of fuzzy .	K4
CO5	To Evaluate ranking methods.	K5

UNIT-I: From Classical Sets To Fuzzy Sets , Fuzzy Sets Verses Crisp Sets (9 Hrs)

Fuzzy sets : Basic types – Fuzzy sets : Basic Concepts – Additional Properties – cuts – ExtensionPrinciple for fuzzy sets. Chapter 1(Sec: 1.3, 1.4), Chapter 2(Sec:2.1, 2.3)

UNIT-II: Operations On Fuzzy Sets (9 Hrs)

Types of operations – Fuzzy complements- Fuzzy Intersections : t – Norms – Fuzzy Unions –conforms- Combinations of Operations. Chapter 3(Sec: 3.1- 3.5)

UNIT-III: Fuzzy Arithmetic (9 Hrs)

Fuzzy Numbers – Linguistic Variables – Arithmetic Operations On Intervals – Arithmetic Operations On Fuzzy Numbers. Chapter 4(Sec: 4.1- 4.4)

UNIT-IV: Fuzzy Relations (9 Hrs)

Binary Fuzzy Relations- Binary Relations On A Single Set –Fuzzy Equivalene Relations- FuzzyCompatibility Relations- Fuzzy Ordering Relations-Fuzzy Morphisms. Chapter 5 (Sec: 5.3-5.8)

UNIT-V : Fuzzy decision making (9 Hrs)

Individual Decision Making- Muliti person Decision Making- Ranking Methods- Fuzzy Linear

Programming. Chapter 15 (Sec: 15.2, 15.3, 15.6, 15.7)

TOTAL: 45 Hours

Power point Presentations, Seminar ,Quiz, Assignment

TEXT BOOK:

George J.klir and Bo Yuan, ***Fuzzy Sets and Fuzzy Logic Theory and Applications,*** Prentice Hall of India, (2005).

REFERENCE BOOKS:

1. **H.J.Zimmermann,** ***Fuzzy set theory and its applications*** **,** Allied publishers limited (1991).
2. **M.Ganesh ,** ***Introduction to Fuzzy sets and Fuzzy logic,*** Prentice Hall of India , New Delhi, 2006.

ONLINE SOURCES:

- www.ejournal.com
- www.ebook.com
- www.freebookcentre.net

Mapping with Programme Outcomes

PO **CO**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	M	M	S	S	S	S	M	M	L	S	S	M	M	S	S
CO2	M	M	S	S	S	M	S	M	M	L	M	M	M	M	S
CO3	S	M	S	S	S	M	M	S	M	L	L	L	M	M	S
CO4	M	M	S	S	S	S	S	L	M	L	L	S	M	L	S
CO5	S	M	S	S	S	S	M	S	M	L	S	M	M	M	S

S - Strong; M - Medium; L – Low

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P2MADE14	Title	Batch	2023-25
		MECHANICS	Semester	II
Hrs/Week	6		Credits	03

Course Outcomes(CO)

CO Number	CO Statement	Knowledge Level
CO1	Remember the concepts of Energy and momentum.	K1,K2
CO2	Understand the concept of Lagrange's Equations.	K2
CO3	Analyze Hamilton's Principle.	K4
CO4	Apply the concept of Hamilton Principle Function.	K3,K4
CO5	To gain knowledge about Differential forms and Generating Functions.	K2,K3

Unit-I: (9 Hrs)

Introductory concepts: The Mechanical system–Generalized coordinates –Constraints – Virtual work – Energy and Momentum.

Chapter-1(Sec1.1–1.5)

Unit-II: (9 Hrs)

Lagrange'sEquations:DerivationofLagrange’sEquations–Examples–Integralsofthemotion.

Chapter-2(Sec2.1–2.3)

Unit -III: (9 Hrs)

Hamilton'sEquations:Hamilton'sPrinciple–Hamilton’sEquations–Othervariationalprinciples.

Chapter-4(Sec4.1–4.3)

Unit-IV: (9 Hrs)

Hamilton–Jacobi Theory: Hamilton Principle Function–Hamilton-Jacobi Equation– Separability.

Chapter-5(Sec5.1–5.3)

Unit-V : (9 Hrs)

CanonicalTransformation-DifferentialformsandGeneratingFunctions–SpecialTransformations – Lagrange and Poisson Brackets.

Chapter–6(Sec6.1–6.3)

TOTAL: 60Hours

Power point Presentations, Seminar &Assignment

TEXTBOOK:

D.T.Greenwood,"*Classical Dynamics*",Dover Publication, NewYork,1977.

REFERENCEBOOKS:

1. **H.Goldstein, "*Classical Mechanics*",**2ndEdition,NarosaPublishingHouse,NewDelhi.
2. **R.D.Gregory, "*Classical Mechanics*",**CambridgeUniversityPress,2006
3. **F.Gantmacher, *Lecturesin Analytic Mechanics*,**MIRPublilshers,MOSCOW,1975.
4. **I.M.Gelfand and S.V.Fomin**, ***Calculus of Variations***, Prenticehall.
5. **S.L.Loney, *An Elementary Treatise on Staics***, Kalyani Publishers, NewDelhi.

ONLINESOURCES:

1. https://www.britannica.com/science/mechanics
2. https://www.physics.upenn.edu
3. www.khanacademy.org

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	S	M	S	S	M	L	M	L	M	L	S	L	L	L	S
CO2	S	S	M	M	S	M	L	S	M	L	S	M	M	S	M
CO3	S	M	L	S	S	L	M	L	S	L	S	L	L	L	S
CO4	S	L	S	M	M	L	L	M	M	L	M	L	L	L	S
CO5	S	M	S	S	S	S	M	S	M	L	S	M	M	M	S

S-Strong;M-Medium; L– Low

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL STATISTIC ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P3MADE08</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td>Lecture
4</td><td colspan="2">Tutorial
1</td><td colspan="2">LabPractice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">UG level Mathematical Statistics</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UnitI Probability and Random Variables: Probability – Axioms – Combinatorics, Probability on finite sample spaces – Conditional probability and Baye‘s theorem - Independence of events – Random variables– Probabilitydistributionofa randomvariable – Discreteand continuous random variables – Function of a random variable.(Chapter 1: Sections 1.3 to 1.6 and Chapter 2: Sections 2.2 to 2.5) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Unit II Moments and Generating Functions: Moments of a distribution function – Generating functions – Some moment inequalities. (Chapter 3: Sections 3.2 to 3.4) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Unit III Multiple Random Variables: Multiple random variables – Independentrandomvariables–Functionsofseveralrandomvariables. (Chapter 4: Sections 4.2 to 4.4) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Unit IV Multiple Random Variables (Contd.): Covariance, Correlation and moments – Conditional expectation – Some discrete distributions – Some continuous distributions. (Chapter 4: Sections 4.5 and 4.6 and Chapter 5: Sections 5.2 to 5.3) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UnitVLimit Theorems: Modes of convergence –Weak law of large numbers – Strong law of large numbers – Central limit theorems. (Chapter 6: Sections 6.2 to 6.4 and 6.6) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 45 Hrs</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questionsrelatedtotheabovetopics,fromvariouscompetitive examinations UPSC / TNPSC / others to be solved (Tobediscussed during theTutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge,Problem Solving, Analytical ability,ProfessionalCompetency, Professional Communication and Transferrable Skill
RecommendedText	1.V.K.RohatgiandStatistics,JohnWileyPvt,Singapore,2001.

ReferenceBooks	1. G.G.Roussas, A FirstCourse inMathematicalStatistics, Addition Wesley Publ. Co. Mass, 1973. 2. M.Fisz,ProbabilityTheoryandMathematicalStatistics,JohnWiley, New York, 1963. 3. E.J.DudewisgandS.N.Mishra,ModernMathematicalStatistics, John Wiley, New York, 1988.
Websiteand e-LearningSource	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome(for Mapping with POs and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">COMPUTATIONAL MATHEMATICS USING C++</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3MADE09</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td>Lecture
4</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This courses introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I Principles of OOP-Tokens- Expressions, Control Structures- Functions-Classes and Objects-constructors and destructors.
Chapter1 to 6 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II Operator Overloading and type Conversions - Inheritance - Pointers, Virtual Functions and Polymorphism-Managing Console I/O Operations-Working with Files .
Chapter7 to 11 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III Finite Digit Arithmetic and Errors Floating point arithmetic - Propagated Error - Generated Error - Error in Evaluation of a function f(x). - Non-linear Equations: Bisection method- Secant Method - Regula Falsi Method - Newton‘s method - Muller‘s method - Fixed Point method - Chapters 1,2 : Only 2.1 to 2.6 (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV System of Linear Equations Gauss- Elimination Method - Crout‘s method - Inverse of a matrix - Condition numbers and errors - Jacobi‘s method - Gauss-Seidel Method - Relaxation method. Numerical Differentiation and Integration: Numerical Differentiation - Numerical Integration - Newton-Cotes Formulas - GaussianQuadrature-DoubleIntegralChapter3and5:5.1to5.5and5.7 (9 Hrs)
(omit 5.6)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V Ordinary Differential Equations: Difference equation - Differential Equations: Single Step method- Runge- Kutta Method- Multi-step methods Chapter 6: 6.1 to 6.4 (omit 6.5) (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 45 Hrs</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text	1. E.Balagurusamy, Object Oriented Programming with C++,Tata McGraw Hill, New Delhi, 1999. 2. Devi Prasad, An Introduction to Numerical Analysis (3rd edn) Narosa Publishing House, New Delhi, 2006.
Reference Books	1. D. Ravichandran, Programming with C++, Tata McGraw Hill, New Delhi, 1996 2. Conte and de Boor, Numerical Analysis, McGraw Hill, New York, 1990 3. John H. Mathews, Numerical Methods for Mathematics, Science and Engineering (2nd Edn.), Prentice Hall, New Delhi, 2000
Web site and e-Learning Source	http://math forum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome (for Mapping with Pos and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P4MADE10</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties ,characteristic function and basic limit Theorems of probability.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter1: Sections1.1 to 1.7
Chapter2 : Sections2.1 to 2.9 (9 Hrs)</td></tr>
<tr><td colspan="6">UNIT-II: Parameters of the Distribution: Expectation-Moments– The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter3 : Sections3.1 to 3.8 (9 Hrs)</td></tr>
<tr><td colspan="6">UNIT-III: Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent and random variable- Determination of distribution function by the Characteristic function- Characteristic function of multi dimensional random vectors– Probability generating functions.
Chapter4 : Sections4.1 to 4.7 (9 Hrs)</td></tr>
<tr><td colspan="6">UNIT-IV : Some Probability distributions: One point , two point , Binomial – Polya – Hyper geometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter5 :Section 5.1to5.10(OmitSection 5.11) (9 Hrs)</td></tr>
<tr><td colspan="6">UNIT-V: Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem–Lapunov Theroem– Borel-Cantelli Lemma-Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter6:Sections6.1to6.4,6.6to6.9,6.11and6.12.(Omit Sections6.5, 6.10,6.13to 6.15) (9 Hrs)</td></tr>
<tr><td colspan="6">Total Hrs: 45</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M.Fisz, *Probability Theory and Mathematical Statistics,* John Wiley And Sons,NewYork,1963.
Reference Books	1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972 2.K.L.Chung, *A course in Probability*, Academic Press, New York, 1974. 4. R.Durrett, *Probability : Theory and Examples*, (2^{nd} Edition) Duxbury Press, New York, 1996. 5. V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3^{rd}Print). 6. S.I.Resnick, *A Probability Path*,Birhauser,Berlin,1999. 7. B.R.Bhat , *Modern Probability Theory* (3^{rd} Edition), New Age International (P)Ltd, New Delhi, 1999
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,http://www.probability.net

Course Learning Outcome(for Mapping with POs and PSOs)

Students will be able to

CLO1: To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.

CLO2: To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.

CLO3: To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions

CLO4: To define One point, two-point, Binomial distributions, to solve problems of Hyper geometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions

CLO5: To discuss Stochastic convergence, Bernaulli law of large numbers, to elaborate Convergence of sequence of distribution functions, to prove Levy-Cramer Theorems and de Moivre-Laplace Theorems, to explain Poisson, Chebyshev, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL METHODS USING PYTHON</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P4MADE11</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>LabPractice</td><td>Total</td></tr>
<tr><td colspan="2">Per week</td><td colspan="2">3</td><td colspan="2">1</td><td>--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course aims
To introduce to students Python programming.
To learn python coding to implement algorithms for Mathematical problems.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">Unit-I: Introduction to Python Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements. Some simple programs to understand the relational, conditional and logical operators. Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using while loop; Finding the factors of a number using for loop; To check the given number is prime or not (use if... else statement); Find the factorial of a number (use if...if...else).; Simple programs to illustrate logical operators (and, or, not). (9 Hrs)</td></tr>
<tr><td colspan="6">Unit II: Matrices, Differential Calculus & Analytical Geometry of Three Dimensions Python commands to reduce given matrix to echelon form and normal form with examples. Python program/command to establish the consistency or otherwise and solving system of linear equations. Python command to find the nth derivatives. Python program to find nth derivative with and without Leibnitz rule. Obtaining partial derivative of some standard functions Verification of Euler‘s theorem, its extension and Jacobean. Python program for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder. (9 Hrs)</td></tr>
</table>

	Unit III Roots of High-Degree Equations- Systems of Linear Equations Introduction, Simple Iterations Method - Finite Differences Method, Gauss Elimination Method: Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method. **(9 Hrs)**
	Unit IV Numerical differentiation, Integration and Ordinary Differential Equations Introduction & Euler's Method, Second Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method: Plot Numerical and Exact Solutions . **(9 Hrs)**
	Unit V Two-Point Boundary Value Problems Introduction to two-point boundary value Problems: second order differential equations - Higher order differential equations - solution of second order differential equation using Finite Difference Method. **(9 Hrs)**
	Total Hrs: 45
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. www.python.org 2. www.rosettacode.org 3. http://faculty.msmary.edu/heinold/python.html 4. J. Kiusalaas, Numerical methods in engineering with Python 3. Cambridge University Press, 2013. 5. H. P. Langtangen, Solving PDEs in Python: the FEniCS tutorial I. SpringerOpen, 2016
Reference Books	
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome(for Mapping with POs and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P4MADE12	Title	Batch	2023-2025
		Elective: NUMERICAL ANALYSIS	Semester	IV
Hrs/Week	4		Credits	3

Course Outcomes (CO)

CO Number	CO Statement	Knowledge Level
CO1	To recall the basic concepts of Newton's method, Trapezoidal rule andSimpson's rules	K1, K2
CO2	To understand various types of methods to solve the DifferentialEquations.	K2
CO3	To solve the problems of ODE.	K5, K6
CO4	To gain knowledge in Boundary Value Problems And CharacteristicValue Problems	K3, K4
CO5	To Analyze the concept of Numerical Solution Of Partial DifferentialEquations	K4, K5

Unit I: Solution Of Nonlinear Equations (9 Hrs)

Newton's method – Convergence of Newton's method – Bairstow"s Method for quadratic factors. Numerical Differentiation And Integration**:** Derivatives from Differences tables – Higher orderderivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule –Romberg integration – Simpson's rules.

Chapter 1

Unit II : Solution Of System Of Equations (9 Hrs)

The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss **Seidal Iteration –Relaxation method – Systems of Nonlinear equations.**

Chapter 2

Unit III: Solution Of Ordinary Differential Equations (9 Hrs)

Taylor series method – Euler and Modified Euler methods – Rungekutta methods – Multistepmethods – Milne's method – Adams Moulton method.

Chapter 6

Unit IV: Boundary Value Problems And Characteristic Value Problems (9 Hrs)

The shooting method – solution through a set of equations – Derivative boundary conditions –Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

Chapter 6

Unit V:Numerical Solution Of Partial Differential Equations (9 Hrs)

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heatflow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences. **Chapter 8**

Power point Presentations, Seminar & Assignment

TOTAL :45 Hours

TEXT BOOK:

C.F.Gerald and P.O.Wheatley, "*Applied Numerical Analysis"*, Fifth Edition, Addison Wesley, (1998).

REFERENCE BOOKS :

1. **M.K. Venkatraman, "*Numerical Methods in Science and Technology",*** National PublishersCompany, 2nd Edition,(1992).
2. **S.C. Chapra and P.C. Raymond, "*Numerical Methods for Engineers",*** tata McGrawHill, (2000)
3. **P. Kandasamy et al., "*Numerical Methods",*** S.Chand & Company Ltd.(2003).

ONLINE SOURCES:

1. https://nptel.ac.in/downloads/111106054/
2. https://ocw.mit.edu.
3. https://swayam.gov.in
4. www.freebookcentre.net

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	S	S	M	M	M	M	L	S	M	L	L	S
CO2	S	L	S	M	M	L	L	M	M	L	M	L	L	L	S
CO3	S	M	S	S	S	S	M	S	M	L	S	M	M	M	S
CO4	S	M	S	S	S	S	L	S	L	L	S	L	M	M	S
CO5	M	M	S	S	S	S	M	L	L	L	S	M	S	S	S

S - Strong; M - Medium; L – Low

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">BIG DATA ANALYSIS USING R PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P4MADE13</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">LabPractice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basic knowledge in Computer and Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT I Introduction to R programming: What is R? - Installing R and R Studio – R Studio Over view –Working in the Console -Arithmetic Operators – Logical Operations - Using Functions - Getting Help in R and Quitting R Studio- Installing and loading packages. Data structures, variables, and data types in R: Creating Variables - Numeric, Character and Logical Data - Vectors- Data Frames-Factors- Sorting Numeric, Character, and Factor Vectors- Special Values. (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT II Data Visualization using R: Scatter Plots - Box Plots - Scatter Plots and Box-and-Whisker Plots Together- Customize plot axes, labels, Add legends, and add colours. (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT III Descriptive statistics in R: Measures of central tendency- Measures of variability- Skewness and kurtosis-Summary functions, describe functions, and descriptive statistics by group. (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT IV Testing of Hypothesis using R:T-test, Paired Test, correlation, Chi Square test, Analysis of Variance and Correlation (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT V Predictive Analytics: linear Regression model, Non-Linear Least Square, multiple regression analysis, Logistic Regression, Panel Regression Analysis, ARCH Model, GARCH models,VIF model. (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 45</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1. Crawley, M.J.(2006),―Statistics- An introduction using R‖, John Wiley, London 32.
2. Purohit,S.G.;Gore,S.D.and Deshmukh,S.R.(2015),―Statistics using R‖, second edition. Narosa Publishing House, New Delhi.
3. Shahababa B.(2011),―Biostatistics with R‖,Springer, NewYork.
4. Braun & Murdoch(2007),―A first course in statistical programming with R‖, Cambridge University Press, New Delhi.</td></tr>
</table>

Website and e-Learning Source	1. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf 2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html 3. https://smac-group.github.io/ds/ 4. https://www.geeksforgeeks.org/predictive-analysis-in-r

Course Learning Outcome (for Mapping with Pos and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3MADE07</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">Per week</td><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Graph Theory</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I: Basic Results: Introduction-Basic Concepts -Subgraphs-Degrees of Vertices - Paths and Connectedness - Automorphism of a Simple Graph. (Chapter 1: Sections 1.1 - 1.6). Directed Graphs: Introduction-Basic Concepts-Tournaments.
(Chapter2 : Sections2.1-2.3). (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II: Connectivity and Trees: Connectivity: Introduction-Vertex cut and Edge Cut-Connectivity and Edge Connectivity.(Chapter 3: Sections3.1-3.3).Trees: Introduction-Definition,Characterizationand Simple Properties-Centers and Centroids- Cutting the Number of Spanning Trees-Cayley‘s Formula. (Chapter 4: Sections 4.1- 4.5).
(9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III: Independent Sets, Matchings and Cycles: Independent Sets and Matchings: Introduction-Vertex-Independent Sets and Vertex Coverings-Edge-Independentsets-MatchingsandFactors-Matchingsin Bipartite Graphs. (Chapter 5: Sections 5.1- 5.5) . Cycles: Introduction- Eulerian GraphsHamiltonian Graphs. (Chapter 6: Sections 6.1- 6.3). (9 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV: GraphColorings: Introduction-Vertexcolorings-Critical Graphs-Edge colorings of Graphs-Kirkman‘s Schoolgirl- Problem-Chromatic Polynomials.(Chapter 7: Sections 7.1 ,7.2 ,7.3 (7.2.1 & 7.2.3only),7.6,7.8,and7.9). (9 Hrs)</td></tr>
</table>

	UNIT V: Planarity: Introduction- Planar and Nonplanar Graphs –Euler Formula and its Consequences K and K ,3 are Nonplanar Graphs –Dual of a Plane Graph-The Four-ColorTheorem 5 3 and the Heawood Five- Color Theorem-Hamiltonian Plane Graphs-Tait Coloring.(Chapter 8: Sections 8.1 - 8.6 ,8.8 and 8.9). **(9 Hrs)**
	Total Hrs: 45 Hrs
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. R. Balakrishnan and K.Ranganathan,Text Book of GraphTheory, (2nd Edition), Springer, New York,2012.
Reference Books	1. J.A.Bondy and U.S.R.Murty, Graph Theory with Applications, North Holland, New York, 1982. 2. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi. 2003. 3. F.Harary, Graph Theory, Addison–Wesely Pub.Co.TheMass. 1969. 4. L.R..Foulds, Graph Theory Application, Narosa Publ. House, Chennai, 1933.
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome(for Mapping with Pos and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

Programme code	M.Sc	Programme Title	Master of Science (Mathematics)	
Course Code	23P2MADE15	Title	Batch	2023-25
		ELECTIVE :FLUID DYNAMICS	Semester	II
Hrs/Week	5		Credits	3

Course Outcomes (CO)

CO Number	CO Statement	KnowledgeLevel
CO1	To know about the kinematics of fluid and its terminology.	K1, K2
CO2	To Gain knowledge in Equations of Motion of a Fluid	K3, K4
CO3	To understand the concepts of Some Three –Dimensional Flows	K2
CO4	To analyze Some Two -Dimensional Flows	K4
CO5	To Evaluate Viscous Flow and connected properties	K5 ,K6

Unit -I : Kinematics of Fluids in Motion (9 Hrs)

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-Acceleration of a fluid Conditions at a rigid Boundary.

Chapter -2 (Sec 2.1 – 2.10)

Unit-II : Equations of Motion of a Fluid (9 Hrs)

Pressure at a Point in a Fluid at Rest-Pressure at a Point in a Moving Fluid-Conditions at a Boundary of Two inviscid Immiscible Fluids-Euler's Equations of Motion –Bernoulli's Equation –Worked Examples-Discussion of the Case of Steady Motion under Conservative Body Forces.

Chapter- 3 (Sec 3.1 – 3.7)

Unit – III: Some Three –Dimensional Flows (9 Hrs)

Introduction-Sources, Sinks and Doublets-Images in a Rigid Infinite Plane-Axi-Symmetric Flows: Stokes's Stream Function.

Chapter -4 (Sec 4.1 – 4, 4.5)

Unit IV: Some Two -Dimensional Flows (9 Hrs)

Meaning of Two -Dimensional Flow-Use of Cylindrical Polar Co-ordinates-the Stream Function –the Complex Potential for Two –Dimensional, Irrotational, In Compressible Flow –Complex VelocityPotential for Standard Two –Dimensional flows-Some Worked Examples.

Chapter -5 (Sec 5.1 – 5.6)

Unit V: Viscous Flow **(9 Hrs)**

Stress Components in a Real Fluid –Relations between Cartesian Components of Stress-Translational Motion of Fluid Element-the Rate of Strain Quadric and Principal Stresses- Some Further Properties of the Rate of Strain Quadric-Stress Analysis in Fluid Motion- Relations between Stress and Rate of Strain-the co-efficient of Viscosity and Laminar Flow-the Navier – Stokes Equations of Motion ofa Viscous Fluid.

Chapter -5 (Sec 8.1 – 8.9)

TOTAL : 45 Hours

Power point Presentations, Seminar & Assignment

TEXT BOOK :

F.Chorlton, ***Text book of Fluid Dynamics***, CBS Publication New Delhi, 2004.

REFERENCE BOOKS:

1. **G.K.Batchaelor**, ***An Introduction to Fluid Mechanics***, Foundation Books, New Delhi,2002.
2. **S.W .Yuan**, ***Foundations of Fluid Mechanics,*** Prentice Hall of India Pvt. LtD., New Delhi,2000.
3. **R.K.Rathy,** ***An Introduction to Fluid Dynamic***, IBH Publ.Comp. New Delhi, 2002.

ONLINE SOURCES:

1. www.efluids.com
2. www.springer.com

Mapping with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	S	S	M	L	M	L	M	L	S	L	L	L	S
CO2	S	S	M	M	S	M	L	S	M	L	S	M	M	S	M
CO3	S	M	L	S	S	L	M	L	S	L	S	L	L	L	S
CO4	S	L	S	M	M	L	L	M	M	L	M	L	L	L	S
CO5	S	M	S	S	S	S	M	S	M	L	S	M	M	M	S

S - Strong; M - Medium; L – Low

Title of the Course: CORE INDUSTRY MODULES

Paper Number: ELECTIVE

Course Code 23P3MADE16

Suggestive topics for Core Industry Modules:

1. Industrial Statistics Recommended Text:

1. PapoulisA.Probability,RandomVariablesandStochasticprocess,TataMcGrawHill Education Pvt. Ltd., New Delhi
2. BaisnabA.,JasM.,ElementsofProbabilityandStatistics,TataMcGrawHill Education Pvt. Ltd., New Delhi, 1993
3. Fruend John E, Mathematical Statistics, Prentice Hall of India, New Delhi

2. Industrial Processes Recommended Text:

1. H.A.Strobel,ChemicalInstrumentation:ASystematicapproach,2nd Edition(1973) Addition Wesley, Reading, Mass
2. R.L.Pecsok,L.D.Shields,T.CavinsandL.C.Mcwilliam,2nd Edition(1976),john Wiley & Sons, New York
3. E.W.Berg,ChemicalMethodsofSeparations,1st Edition(1963),McGrawHill,New York

3. Chemometrics and quality control in industry

Recommended Text:

1. G.D.Christian,Analyticalchemistry,5th edition(1994),JohnWiley&Sons,New York
2. M.A.Sharat and D.L.Illuran, Chemometrics, John Wiley, NewYork
3. CanlcuttandR.Roddy,StatisticsforAnalyticalChemists,ChapmamandHall,New York

4. Mathematics of Finance and Insurance Recommended Text:

1. JohnC.Hull,Options,FuturesandOtherDerivatives,PrenticeHallofIndiaPrivate Limited
2. SheldonMRoss,AnIntroductiontotheMathematicalFinance,CambridgeUniversity Press
3. Salih N. Nettci, An introduction to the Mathematics of Financial Derivatives, Academic Press, Inc.
4. RobertJ.EllicottandP.Ekkehardkopp,MathematicsofFinancialMarkets,Springer-Verlag, New York
5. C.D.Daykin,T.Pentikainen and M.Pesonen,PracticalRiskTheoryforActuaries, Chapman & Hall.
6. TornaszRolski,HanspterSchmidli,VolkerSchmidtandJozefTeugels,Stochastic Processes for insurance and Finance, John Wiley & Sons Limited

5. Performance modelling of communication networks Recommended Text:

1. ThomasRobertazzi,ComputerNetworksandSystems:QueuingtheoryandPerformance Evaluation, Springer-Verlag, 2000
2. B.R.Hverkort, Performance of Computer Communication systems (Amodelbased approach), Wiley, 1998 and more.

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">COMPUTATIONAL MATHEMATICS LAB</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE PRACTICAL</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P3MADEP1</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td colspan="2">2</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basics of C++</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1) To write, understand C++ program codes for finding the approximate solution of transcendental equations.
2) To write, understand C++ program codes for finding the approximate solution of system of equation and to find spectral radius of given matrix using power method.
3) To write, understand C++ program codes to solve the given initial value problem and to evaluate given integration.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">Write programs based of following methods:
1. Simple Bisection method
2. Bisection with tests for convergence
3. Recursive solution for Bisection
4. Newton's method
5. Secant Method
6. Polynomial interpolation
7. Estimating Derivatives
8. Regula – Falsi method
9. Muller method
10. Gauss elimination method
11. Gauss-Seidal method
12. Gauss-Jacobi method
13. Power method
14. Euler method
15. Runge-Kutta second order method
16. Runge-Kutta fourth order method
17. Trapezoidal rule
18. Simpson’s 1/3rd rule
19. Simpson’s 3/8th rule</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 30</td></tr>
</table>

Course outcomes:

After completing this course, students will be able to

- Reframe C++ program codes for finding the approximate solution of transcendental equations by Bisection, Regula-Falsi, Secant, Newton Raphson method.
- Understand C++ program codes for finding the approximate solution of system of equations by Gauss- Seidal, Gauss-Jacobi and to find spectral radius of given matrix using power method.
- Construct C++ program codes to solve the given initial value problem by using Euler, Runge-Kutta methods and to evaluate given integration by Trapezoidal, Simpsons rules.

SKILL ENHANCEMENT COURSES:

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">DIFFERENTIAL EQUATIONS USING SCILAB</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">23P1MAS01</td></tr>
<tr><td>Semester</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
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<tr><td colspan="2">Pre-requisite</td><td colspan="8"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8"></td></tr>
<tr><td colspan="2" rowspan="6">Course Outline</td><td colspan="8">UNIT I
An Introduction to Scilab–Matrices (6 Hrs)</td></tr>
<tr><td colspan="8">UNIT II
Scilab Programming (6 Hrs)</td></tr>
<tr><td colspan="8">UNIT III
Functions–Plotting (6 Hrs)</td></tr>
<tr><td colspan="8">UNIT IV
Solving Ordinary Differential Equations (6 Hrs)</td></tr>
<tr><td colspan="8">UNIT V
Polynomials in Scilab (6 Hrs)</td></tr>
<tr><td colspan="8">Total Hrs: 30</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">1.PROGRAMMING USING SCILAB, AKHILESH KUMAR</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1.Ordinary Differential Equations with Scilab by Gilberto E.Urroz</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="8">http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL DOCUMENTATION USING LATEX</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>1</td><td>Course Code</td><td>23P2MAS02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">1</td><td colspan="2">1</td><td>--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of</td><td colspan="7">To introduce students with a software that is being widely used for typesetting especially in Mathematics field. To make students know importance of this software for publishing research articles,papers,project reports and books and thereby help them to becomfortable with the software .</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNITI

Installation of LaTeX

i) Installation of Kile and MikeTeX.

ii) Class and packages

iii) Latex programming and commands,sample packages

iv) Error messages : Some sample errors,list of LaTeX error messages
(3 Hrs)

UNIT II
Formatting of output document :

i) Fonts, symbols, indenting, paragraphs, line spacing, word spacing, titles and subtitles

ii) Document class, page style, parts of the documents, table of contents
(3 Hrs)

UNIT III
Formating of output document :

i) Command names and arguments, environments, declarations

ii) Theorem like declarations, comments within text (3 Hrs)

UNIT IV
Mathematical formulae :

i) Mathematical environments, math mode ,mathematical symbols

ii) Graphic package, multi valued functions, drawing matrices

iii) Tables, tables with captions
(3 Hrs)</td></tr>
</table>

	UNIT V **Drawing with LaTeX** i) Picture environments ii) Extended pictures,other drawing packages iii) Preparing book, project report in LaTeX. **(3 Hrs)**
	Total Hrs: 15
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Reference Books	Guide to LATEX, fourth edition, *Helmut Kopka,Patrick W.Daly*
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL COMPUTATION WITH SAGEMATH</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>23P1MAS03</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>1</td><td colspan="2">1</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I First Steps
The Sage Program -Sage as a Calculator (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II Analysis and Algebra
Symbolic Expressions and Simplification – Equations – Analysis - Basic Linear Algebra (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III Programming and Data Structures
Syntax–Algorithmics- Lists and Other Data Structures (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV Graphics
2D Graphics - 3D Curves (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V Computational Domains
Sage is Object- Oriented- Elements, Parents, Categories- Domains with a Normal Form-Expressions vs Computational Domains (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 30</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.Mathematical Computation with SageMath, PaulZimmermann Alexandre Casamayou.</td></tr>
</table>

Reference Books	1. Uri M. Ascher and Linda R. Petzold, Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations. Society for Industrial and Applied Mathematics, 1998, ISBN 0898714128. 2.NogaAlon and JoelH.Spencer,The Probabilistic Method.Wiley-Interscience, 2000, ISBN 0471370460. 3.Bernard Beauzamy, Robust mathematical methods for extremely rare events. On-line, 2009. http://www.scmsa.eu/RMM/BB_rare_ events_2009_08.pdf,20pages.
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">OFFICE AUTOMATION AND ICT TOOLS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P1MAS04</td></tr>
<tr><td>Semester</td><td>I</td></tr>
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<tr><td colspan="2">Objectives of the Course</td><td colspan="7"></td></tr>
<tr><td colspan="2" rowspan="6">Course Outline</td><td colspan="7">UNITI
Office Automation-Office and Office Automation (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT II
Computer Mail Systems –Telecommunication and Word Processor (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT III
WP Hardware Configuration (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT IV
Reprographics-Electronic Mail and Electronic-Filing (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT V
Facsimile Transmission and Micrographics- Voice Technology (6 Hrs)</td></tr>
<tr><td colspan="7">Total Hrs: 30</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1. Office Automation Tools and Technology (UnitI&Unit-II)
2.Office Automation Tools,Yatendrakumar & suithavarshney, Naveen prakashan pvt .Ltd</td></tr>
<tr><td colspan="2">Reference books</td><td colspan="7">1. Office Automation Tools,Dr.Rizwan Ahmed, Naveen prakashan pvt
.Ltd
2. Office Automation Tools, Dr. Babasaheb Ambedkar</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="7">http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,www.mathpages.com</td></tr>
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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">NUMERICAL ANALYSIS USING SCILAB</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P1MAS05</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">Per week</td><td colspan="2">1</td><td colspan="2">1</td><td>--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7"></td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNITI
Transcendental and Polynomial Equations (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT II
System of Linear Algebric Equations and Eigen value Problems (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT III
Interpolation and Approximation (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT IV
Differentiation and Integration (6 Hrs)</td></tr>
<tr><td colspan="7">UNIT V
Ordinary Differential Equations Initial Value Problems (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="7">Total Hrs: 30</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1.Numerical Methods For Scientific And Engineering Computation by M.K. Jain, S. R. K. Iyengar And R. K. Jain.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="7">1.Numerical Methods and principles analysis and algorithms,S.Pal,Oxford University Press</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="7">http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INDUSTRIAL MATHEMATICS USING LATEST PROGRAMMING PACKAGES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>23P2MAS06</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
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<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI
Mathematics in industry- Over view of the case studies- Units and dimensions -Diffusion equations- Heat conduction equations (6 Hrs)

UNIT II
Boundary conditions- Solving the heat/ diffusion equation-Scaling equations - Dimensional analysis (6 Hrs)

UNIT III
Continuous Casting - Introduction to the case study problem - The Boltz mann similarity solution- Amoving boundary problem -The pseudo- steady-state approximate solution-Solving the continuous casting case Study (6 Hrs)

UNIT IV
Water Filtration- Introduction to the case study problem-Stretching transformations- Diffusion from appoint source-Solving the water filtration case study (6 Hrs)

UNIT V
Laser Drilling- Introduction to the case study problem- Method of perturbations-Boundary perturbations- Solving the laser drilling case study (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 30</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Industrial Mathematics Case Studies in the Diffusion of Heat and Matter , GLENN R. FULFORD PHILIP BROADBRIDGE

Reference Books	
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">RESEARCH TOOLS AND TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P2MAS07</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">Per week</td><td>1</td><td colspan="2">1</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI
Research Process-Research Design (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II
Research Problem-Variables and Their Types (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III
Formulation of Hypothesis–Sampling-Tools of Data Collection (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV
Data Analysis- Interpretation of Data (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V
Research Methods - Descriptive or Survey Method - Experimental Method (6 Hrs)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hrs: 30</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.RESEARCH METHODOLOGY:TOOLS AND TECHNIQUES Dr. Prabhat Pandey Dr.Meenu Mishra Pandey ©Bridge Center, 2015</td></tr>
</table>

Reference Books	1. Ackoff, RussellL.(1961).The Design of Social Research, University of Chicago Press: Chicago. 2. Allen, T. Harrell, (1978). New Methods in Social Research, Praeger Publication: New York. 3. Baker, R.P.&Howell,A.C.(1958).The Preparation of Reports, Ronald Press: New York. 4. Barzun, Jacques& Graff.F.(1990).The Modern Researcher, Harcourt, Brace Publication: New York. 5.BerelsonConard&Colton,Raymond.(1978).Research and Report Writing for Business and Economics,Random House: New York.

Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

ABILITY ENHANCEMENT COMPULSORY COURSES

<table>
<tr><td>Title of the Course</td><td colspan="7">APTITUDE SKILLS</td></tr>
<tr><td>Paper Number</td><td colspan="7">AECC 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>1</td><td>Course Code</td><td>23P1MAAC01</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
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<tr><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">--</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">UG level Aptitude skills.</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">1.The main aim of introducing “Quantitative Aptitude”for mathematics students is to develop skill to meet the competitive examinations for better job opportunity.
2.Effort has been made to accommodate fundamental, mathematical aspects to instill confidence among students.
3.Enrich their knowledge and to develop their logical reasoning thinking ability.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT I : Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots andCube roots, Surds and Indices, Problems on Numbers, Divisibility.
Steps of Long Division Method for Finding Square Roots (3 Hrs)</td></tr>
<tr><td colspan="7">UNIT II: Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simpleinterest, Ratio and Proportion, Mixture.
(3 Hrs)</td></tr>
<tr><td colspan="7">UNIT III: Time and Work, Pipes and Cisterns, Basic concepts of Time, Distance and Speed;relationship among them. (3 Hrs)</td></tr>
<tr><td colspan="7">UNIT IV: Concept of Angles, Different Polygons like triangles, rectangle, square, right angledtriangle, Pythagorean Theorem, perimeter and Area of Triangles, Rectangles, Circles. (3 Hrs)</td></tr>
<tr><td colspan="7">UNIT V: Raw and grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events andSample Space, Probability. (3 Hrs)</td></tr>
<tr><td></td><td colspan="7">Total Hrs: 15 Hrs</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.Quantitative aptitude for Competitive examination By R S Agarwal 2. A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal
Reference Books	Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B S
	Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4 th edition
	Analytical and Logical reasoning By Sijwali B S
Website and e-Learning Source	1. https://prepinsta.com/ 2. https://www.indiabix.com/ 3. https://www.javatpoint.com

Course Learning Outcome (for Mapping with POs and PSOs)

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td>Title of the Course</td><td colspan="8">AECC 2: LOGICAL SKILLS</td></tr>
<tr><td>Paper Number</td><td colspan="8">AECC 2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">23P2MAAC02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">2</td></tr>
<tr><td>Pre-requisite</td><td colspan="8">UG level Aptitude skills.</td></tr>
<tr><td>Objectives of the Course</td><td colspan="8">1.The main aim of introducing “Quantitative Aptitude”for mathematics students is to develop skill to meet the competitive examinations for better job opportunity.
2.Effort has been made to accommodate fundamental, mathematical aspects to instill confidence among students.
3.Enrich their knowledge and to develop their logical reasoning thinking ability.</td></tr>
<tr><td rowspan="6">Course Outline</td><td colspan="8">UNIT I :Analogy: Common relationships, Simple Analogy, Number Analogy, Alphabet Analogy. (3 Hrs)</td></tr>
<tr><td colspan="8">UNIT II: Coding- Decoding, Blood relations, Mathematical Operations. (3 Hrs)</td></tr>
<tr><td colspan="8">UNIT III: Arithmetical Reasoning, Directional Sense Test. (3 Hrs)</td></tr>
<tr><td colspan="8">UNIT IV: Logic – Logical Reasoning, Logical Deduction, Two premise arguments, three premise arguments (3 Hrs)</td></tr>
<tr><td colspan="8">UNIT V: Classification. Mirror Images, Cubes and Dice. (3 Hrs)</td></tr>
<tr><td></td><td colspan="8">Total Hrs: 15 Hrs</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
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Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal
Reference Books	Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B S
	Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4 th edition
	Analytical and Logical reasoning By Sijwali B S
	Quantitative aptitude for Competitive examination By R S Agarwal
Website and e-Learning Source	1. https://prepinsta.com/ 2. https://www.indiabix.com/ 3. https://www.javatpoint.com