SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)

Accredited by NAAC-An ISO 9001:2015 Certified Institution

SUNDARAKKOTTAI, MANNARGUDI–614016.

TAMILNADU, INDIA.

M.Sc., MATHEMATICS

CHOICE BASED CREDIT SYSTEM - LEARNINIG OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(For the candidates admitted in the academic year 2023-2024)

CHOICE BASED CREDIT SYSTEM

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a „cafeteria" type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our College has moved to CBCS and implemented the grading system.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help to formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an

important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE): Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

Generic Elective Courses: An elective course chosen generally from an **unrelated discipline/subject,** with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Non Major Elective (NME): A student shall choose at least two Non-major Elective Courses (NME) from outside his/her department.

Skill Enhancement Courses (SECs): These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge**.**

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester‟s marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester‟s mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTELetc.

Postgraduate Programme:

Programme Pattern: The Post Graduate degree programme consists of **FIVE** vital components. They are as follows:

Part –A	:	Core Course (Theory, Practicals) Core Industry Module, Core Project
Part-B (i)	:	Elective courses
Part-B (ii)	:	Non Major Elective, Skill Enhancement course, Professional Competency course
Part-B (iii)	:	Internship
Part –C	:	Extension activity

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks

Passing Minimum: 50 %

Assignments – 3 = 30%

Tests- 3(Best 2 out of 3) = 50%

Seminar=10 %

Attendance= 10 %

Question Paper Pattern

Part A: includes two subsections

Part A 1 (10X1=10 marks)

One word question/ Fill in/ Match the following/True or False/ Multiple Choice Questions

Two Questions from Each unit

Part A 2(5X2=10 marks)

Short Answers

One question from Each unit

Total Marks - 20

Part B: (5X5=25 marks)
Paragraph Answers
Either/ or type, One Question from each unit

Part C: (10X3=30)
Essay Type Answers
Answer 3 out of 5 Questions
One Question from each unit

Part A: K1 Level
Part B: K2, K3 and K4 Level
Part C: K5 and K6 Level

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S.No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis/Creating	The learner creates a new product or point of view

WEIGHTAGE of K –LEVELS IN QUESTION PAPER

(Cognitive Level) K-LEVELS →	**Lower Order Thinking**			**Higher Order Thinking**			**Total**
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	
END SEMESTER EXAMINATIONS (ESE)	20	25			30		**75**
Continuous Internal Assessment (CIA)	20	25			30		**75**

QUESTION PATTERN FOR END SEMESTER EXAMINATION/ Continuous Internal Assessment

PART		**MARKS**
PART –A I. (No choice ,One Mark) **TWO** questions from each unit **II.** (No choice, Two Mark) **ONE** question from each unit	(10x1=10) (5x2=10)	**20**
PART –B (Either/ or type,5-Marks) **ONE** question from each unit	(5x5=25)	**25**
PART –C (3 out of 5) (10Marks) **ONE** question from each unit	(3x10=30)	**30**
	Total	**75**

BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION							
DURATION: 3.00 Hours.							**Max Mark :75**
K-LEVELS	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total**
PART							**Marks**
PART –A (One Mark, No choice) (10x1=10)	10						**10**
(2-Marks,Nochoice) (5x2=10)	10						**10**
PART –B (5-Marks)(Either/or type) (5x5=25)		5	10	10			**25**
PART –C (10 Marks)(3 out of 5) (3x10=30) Courses having only **K5,K6** levels, K5 level- 3 Questions, K6 level- 2 Questions **(One K6 level question is compulsory)**					20	10	**30**
Total	**20**	**05**	**10**	**10**	20	10	**75**

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) , respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$	$WAM(\text{Weighted Average Marks}) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i. The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as „Outstanding". Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as „Excellent", „Very Good", „Good", and „Above Average" respectively.

iii. Absence from an examination shall not be taken an attempt.

Table- 1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	A+
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below50	**NA**	**RA**

NA- Not Applicable, RA- Reappearance

The candidates performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including previous semester/s is indicated by **Cumulative Grade Point Average (CGPA)**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	**O**	**Outstanding**
8.00 to 8.99	A+	**Excellent**
7.00 to 7.99	**A**	**Very Good**
6.00 to 6.99	**B+**	**Good**
5.00 to 5.99	**B**	**Above Average**

***** The candidates who have passed in the first appearance and within the prescribed duration of the PG Programme are eligible. If the candidate"s Grade is O/A+ with more than one attempt, the performance is fixed as "Very Good"

VISION

To provide quality basic education that is equitably accessible to all and lay the foundation for lifelong learning and service for the common good**.**

MISSION

The aim of education is to cultivate personality integration and to promote quality in higher education and to give overall development to student community**.**

PROGRAMME OUTCOMES FOR M.Sc.,DEGREE PROGRAMMES

PO.No	Programme Outcomes (*Upon completion of the M.Sc.,Degree Programme, the Post graduate will be able to)*
PO-1	**Disciplinary Knowledge**: demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science.
PO-2	**Critical Thinking and Problem Solving**: apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development: solve problems and extrapolate the same to real life situation
PO-3	**Information/digital literacy and Communication Skills:** use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.
PO-4	**Research-related skills:** conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation.
PO-5	**Scientific reasoning and Reflective Thinking:** analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self awareness and reflexivity of both self and society.
PO-6	**Multidisciplinary Approach, Innovation and Entrepreneurship:** propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
PO-7	**Moral and ethical awareness/reasoning:** embrace moral/ethical values in conducting one‟s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work, demonstrate the ability to identify ethical issues related to one‟s work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
PO-8	**Self directed Learning:** work independently, identify appropriate resources required for a project, and manage a project till completion.
PO-9	**Lifelong Learning:** engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge/skill development/reskilling.
PO-10	**Multicultural Competence, Social Interaction and Effective Citizenship:** understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings, and demonstrate empathetic social concern and equity centred national development

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO No.	Program Specific Outcomes **(M.Sc., Mathematics)**
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.

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M.Sc., MATHEMATICS
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM - LEARNINIGOUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)
(For the candidates admitted from the academic year 2023-2024)
ELIGIBILITY: Candidates who have passed Bachelor level Examination in Mathematics.

Sem	Part	Nature of the Course	Course Code	Title of the Paper	Ins. Hours/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	O/S			CIA	ESE	
I	Part A	Core Course -I	P23MA101	Algebraic Structures	6	5	1	-	-	5	3	25	75	100
		Core Course -II	P23MA102	Real Analysis I	6	5	1	-	-	4	3	25	75	100
		Core Course -III	P23MA103	Ordinary Differential Equations	6	5	1	-	-	4	3	25	75	100
	Part B (i)	Elective Course -I	P23MAE1A/ P23MAE1B	Graph Theory and Applications/ Stochastic Processes	5	4	1	-	-	3	3	25	75	100
		Elective Course -II	P23MAE2A/ P23MAE2B	Discrete Mathematics/ Fuzzy Sets and their Applications	5	4	1	-	-	3	3	25	75	100
	Part B (ii)	Non Major Elective - I			2	1	1	-	-	2	3	25	75	100
			TOTAL		**30**	**24**	**6**	**-**	**-**	**21**	-	-	-	**600**
II	Part A	Core Course -IV	P23MA204	Advanced Algebra	6	4	1	-	1	5	3	25	75	100
		Core Course -V	P23MA205	Real Analysis II	6	5	1	-	-	4	3	25	75	100
		Core Course -VI	P23MA206	Partial Differential Equations	6	5	1	-	-	4	3	25	75	100
	Part B (i)	Elective Course -III	P23MAE3A/ P23MAE3B	Algebraic Number Theory / Tensor Analysis and Relativity	5	4	1	-	-	3	3	25	75	100
		Elective Course -IV	P23MAE4A/ P23MAE4B	Probability Theory/ Methods of Mathematical Physics	5	4	1	-	-	3	3	25	75	100
	Part B (ii)	Non Major Elective - II			2	1	1	-	-	2	3	25	75	100
			Total		**30**	**23**	**6**	**-**	**1**	**21**	-	-	-	**600**
III	Part A	Core Course -VII		Complex Analysis	6	4	1	-	1	5	3	25	75	100
		Core Practical -I		Optimization Techniques with Microsoft Excel and Solver(P)	5	4	1	-	1	3	3	25	75	100
		Core Course -VIII		Topology	6	4	1	-	1	5	3	25	75	100
		Core Course - IX		Core Industry Module	6	4	1	-	-	3	3	25	75	100
	Part B (i)	Elective Course -V		Mathematical Statistics / Nonlinear Differential Equations	5	3	-	2	-	3	3	40	60	100
	Part B (ii)	Skill Enhancement Course		Professional Communication Skill	2	1	1	-	-	2	3	25	75	100
	Part B (iii)	Internship/ Industrial visit/ Field visit			-	-	-	-	-	2	-	-	-	-
			TOTAL		**30**	**20**	**5**	**2**	**3**	**23**	-	-	-	**600**

Sem	Part	Nature of the Course	Course Code	Title of the Paper	Ins. Hours/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	O/S			CIA	ESE	
IV	Part A	Core Course -X		Functional Analysis	6	5	1	-	-	5	3	25	75	100
		Core Course -XI		Differential Geometry	5	4	1	-	-	4	3	25	75	100
		Core Course -XII		Mechanics	5	4	1	-	-	4	3	25	75	100
		Core Project		Core Project with viva voce	8	-	2	6		7	3	25	75	100
	Part B (i)	Elective Course -VI		Research Methodology / Financial Mathematics	4	3	1	-	-	3	3	40	60	100
	Part B (ii)	Professional Competency Course		Professional Competency Skill Enhancement Course	2	1	1	-	-	2	3	25	75	100
	Part C	Extension		Extension Activity	-	-				1	-	-	-	-
				TOTAL	**30**	**17**	**7**	**6**	**-**	**26**	-	-	-	**600**
				GRAND TOTAL	**120**					**91**	-	-	-	**2400**
Extra Credit				MOOC/SWAYAM/NPTEL (Atleast one)		-				2	-	-	-	-
				Value Added Courses (Atleast One Per Year)		-				2	-	-	-	-

L-Lecture **T-Tutorial** **P-Practical** **S-Seminar**

Credit Distribution for M.Sc., MATHEMATICS

S.No	Part	Subject	No. of Courses	Total Credits
1	A	Core Course –Theory	11	49
2		Core Practical	1	3
3		Core Project Work Viva - Voce	1	7
4		Core Industry Module	1	3
5		Elective Course	6	18
6		Non Major Elective	2	4
7	B	Skill Enhancement Course	1	2
8		Professional Competency Course	1	2
9		Internship/Industrial visit/Field Visit	1	2
10	C	Extension Activity	1	1
Total			**26**	**91**

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components of Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

NON MAJOR ELECTIVE (NME) OFFERED BY THE DEPARTMENT

Semester	Part	Course	Course Code	Title of the Paper
I	Part B (ii)	NME-I	P23NMEMA11	Computational Mathematics using Sagemath
II		NME-II	P23NMEMA22	Mathematical documentation using LATEX

Semester: I -CC- I: Algebraic Structures

Ins. Hrs./Week: 6 **Course Credit**:5 **Course Code**: P23MA101

UNIT-I : **(20 Hours)**

Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).

UNIT-II : **(18 Hours)**

Solvable groups - Direct products - Finite abelian groups- Modules

UNIT-III : **(17 Hours)**

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.

UNIT-IV :

Jordan form - rational canonical form. **(17 Hours)**

UNIT-V: **(18 Hours)**

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Total Lecture Hours- 90

COURSE OUTCOME

The students should be able to

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

TEXT BOOKS

1. I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.

UNIT I : Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)
UNIT II : 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
UNIT III : Chapter 6: Sections 6.4, 6.5
UNIT IV : Chapter 6 : Sections 6.6 and 6.7
UNIT V : Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)

REFERENCE BOOK(S)

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.

E-RESOURCES

1. http://mathforum.org,
2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org,
4. www.algebra.com

Semester: I -CC- II: Real Analysis I

Ins. Hrs./Week: **6** **Course Credit**:4 **Course Code**: P23MA102

UNIT-I : Functions of bounded variation **(17 Hours)**

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.

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

UNIT-II : The Riemann - Stieltjes Integral **(14 Hours)**

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.

UNIT-III : The Riemann-Stieltjes Integral **(14 Hours)**

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.

UNIT-IV : Infinite Series and infinite Products **(15 Hours)**

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

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

UNIT-V: Sequences of Functions **(15 Hours)**

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.

Total Lecture Hours- 75

COURSE OUTCOME :

The students should be able to

1. Analyze and evaluate functions of bounded variation and Rectifiable Curves.
2. Describe the concept of Riemann-Stieltjes integral and its properties.
3. Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.
4. Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.
5. Formulate the concept and properties of inner products, norms and measurable functions.

TEXT BOOK(S) :

1. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

UNIT I : Chapter – 6 : Sections 6.1 to 6.8
Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18
UNIT II : Chapter - 7 : Sections 7.1 to 7.14
UNIT III : Chapter - 7 : 7.15 to 7.26
UNIT IV : Chapter - 8 Sec, 8.20, 8.21 to 8.26
Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23
UNIT V : Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13

REFERENCE BOOK(S) :

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.

E_RESOURCES :

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics
3. http://www.opensource.org
4. www.mathpages.com

Semester: I-CC-III: Ordinary Differential Equations

Ins. Hrs./Week: 6 **Course Credit**: 4 **Course Code**: P23MA103

UNIT-I : Linear equations with constant coefficients (17 Hours)

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

UNIT-II : Linear equations with constant coefficients (14 Hours)

Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

UNIT-III : Linear equation with variable coefficients (14 Hours)

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.

UNIT-IV :Linear equation with regular singular points (15 Hours)

Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.

UNIT-V : **(15 Hours)**

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.

Total Lecture Hours- 75

COURSE OUTCOME

The students Should be able to

1. Establish the qualitative behavior of solutions of systems of differential equations .

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

3. Analyze solutions using appropriate methods and give examples.

4. Formulate Green's function for boundary value problems.

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

TEXT BOOKS

1. E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987. UNIT I : Chapter 2: Sections 1 to 6

UNIT II : Chapter 2 : Sections 7 to 12.
UNIT III : Chapter : 3 Sections 1 to 8 (Omit section 9)
UNIT IV : Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)
UNIT V : Sections 1 to 6 (Omit Sections 7 to 9)

REFERENCE BOOK(S)

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.

E_RESOURCES :

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

http://www.opensource.org, www.mathpages.com

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Semester: I- EC-I(1) : Graph Theory and Applications

Ins. Hrs./Week**: 5** Course Credit**: 3** Course Code**: P23MAE1A**

UNIT- I : Introduction and Path and Circuits **(15 Hours)**

Graph - Application of Graphs - Finite and Infinite Graphs - Incidence -Degree-Isolated Vertex- Pendent Vertex - Null Graph – Isomorphism – Sub graphs – Walks- Path-Circuits - Connected Graphs-Disconnected Graphs and Components - Euler Graphs.

UNIT-II: Path and Circuits **(15 Hours)**

Operation on Graphs -Definition for Decomposition-Deletion -Fusion - More on Euler Graphs and theorem-Arbitrarily Traceable Graphs - Hamiltonian Circuits - Hamiltonian Path -Complete Graph and Theorem.

UNIT –III: Trees and Fundamental Circuits **(15 Hours)**

Trees - Some properties of Trees - Pendant Vertices in a Tree - Distance and Centers in a Tree – Cuts-Sets - Some Properties of a cut-set - All cut-sets in a graph - Fundamental Circuits and Cut-sets - Connectivity and Separability.

UNIT- IV: Matrix Representation of Graph **(15 Hours)**

Incidence Matrix-Circuit matrix - Fundamental Circuit Matrix and Rank of B - Cut -Sets Matrix - Adjacency Matrix.

UNIT –V: Directed Graphs **(15 Hours)**

Introduction - Definition and Basic Properties - Some Applications-Connecter Problem - Kruskal's Algorithm- Shortest Path Problem - Dijkstra's Algorithm.

Self-study report on application of Graph Theory

Total Lecture hours-75

COURSE OUTCOME

The students should be able to

1. Recognize the use of graphs and their applications.
2. Identify Hamiltonian Paths and Circuits in the graphs.
3. Solve problems using basic Fundamental circuit & Cut Sets.
4. Understand the concept of matrix representation of graphs

5. Apply the graph theory in modern real world problems.

TEXT BOOKS

1. Narsingh Deo. 2011. Graph Theory with applications to Engineering and Computer Science, PHI Learning PVT. Ltd, New Delhi.
2. Arumugam. S and Ramachandran. S. 2006. Invitation to Graph Theory, SciTech Publications (India) PVT. Ltd., Chennai.

UNIT-I	Chapter 1 : Sec. 1.1 to1.5 &
	Chapter 2 : Sec. 2.1, 2.2, 2.4 to 2.6 of [1]
UNIT-II	Chapter 2 : Sec.2.7 to 2.9 of [1]
UNIT-III	Chapter 3 : Sec. 3.1 to 3.4&
	Chapter 4 : Sec. 4.1 to 4.5of [1]
UNIT-IV	Chapter 7 : Sec. 7.1 to 7.4, 7.6, 7.9 of [1]
UNIT-V	Chapter 10 : Sec. 10.0, 10.1&
	Chapter 11 : Sec 11.0, 11.1, 11.2 of [2

REFERENCE BOOK(S)

1. Balakrishnan. V.K.1997.Theory and problems of Graph Theory. MC Graw Hill Education (India) PVT. New Delhi.
2. Gary Chartrand and Ping Zhang, 2004.Introduction to Graph Theory, Tata McGraw Hill Edition.India.
3. Gary Chartrand, Linda Lesniak and Ping Zhang. 2016. Graphs and Diagraphs, CRC Press, United States
4. Jonathan L., Jay Yellen and Mark Anderson, 2019. Graph Theory and its Application, Third Edition. CRC Press, United States.
5. Richard J. Treduea. 1993. Introduction to Graph Theory. Dover Publications, New York.

E-RESOURCES

1. http://empresa.bellarica.org
2. http://math.stackexchange.com
3. http://www.nrce.niepa.ac.in
4. http://meskc.ac.in
5. http://www.goodreads.com

Semester: I-EC-I (2): STOCHASTIC PROCESSES

Ins. Hrs./Week: 5 **Course Credit**: 3 **Course Code**: P23MAE1B

UNIT –I: **(15 Hours)**

Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary processes -Markov Chains : Definitions and examples – Higher Transition probabilities.

UNIT – II: **(15 Hours)**

Classification of states and chains – determination of Higher transition probabilities – stability of aMarkov system.

UNIT – III: **(15 Hours)**

Markov processes with Discrete state space : Poisson processes and their extensions – Poisson processand related distribution – Generalization of Poisson process- Birth and Death process.

UNIT – IV: **(15 Hours)**

Renewal processes and theory : Renewal process – Renewal processes in continuous time – Renewal equation – stopping time : Wald's equation – Renewal theorems.

UNIT – V: **(15 Hours)**

Stochastic processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 Steady state Behaviour – transient behaviour of M/M/1Model.

Total Lecture Hours- 75

COURSE OUTCOME

The students should be able to

1. Understand the classification of stochastic processes and the idea of Markov chains in various field.
2. Understand the types of States, chains and communication relations
3. Understand the concept of Poisson processes and its properties
4. Understand the notions of renewal processes and renewal equations
5. Compute queuing model with its characteristics.

TEXT BOOK

1. J. Medhi, Stochastic Processes, Second edition, New Age International Publishers, NewDelhi,1981.

UNIT I : Chapter II &III: Sec 2.1 to 2.3 & 3.1, 3.2
UNIT II : Chapter III : Sec 3.4 to 3.6
UNIT III : ChapterIV : Sec 4.1 to 4.4
UNIT IV : ChapterVI : Sec 6.1 to 6.5
UNIT V : ChapterX : Sec 10.1 to 10.3

REFERENCE BOOK(S) :

1.SamuelKarlin, Howard M. Taylor, A first course in stochastic processes, Academic press, SecondEdition,1975. 2.NarayanBhat, Elements of Applied Stochastic Processes, John Wiley,1972.

E_RESOURCES :

1.https://www.kent.ac.uk/smsas/personal/lb209/files/sp14.pdf

2.https://bookboon.com/en/stochastic-processes-2-ebook

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2023 – 2024)

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: I- EC-II(1) : Discrete Mathematics

Ins. Hrs./Week: 5 **Course Credit**: 3 **Course Code**: P23MAE2A

UNIT I **(15 Hours)**

Relations and Functions: Binary relations, equivalence relations and partitions, partial order relations, inclusion and exclusion principle, Hasse diagram. Functions, inverse functions, compositions of functions**.**

UNIT II **(15 Hours)**

Mathematical Logic: Logic operators, Truth tables, Normal Forms

UNIT III **(15 Hours)**

Mathematical Logic: Theory of Inference for the Statement Calculus, Predicate calculus, Inference Theory of Predicate Calculus, Quantifiers.

UNIT IV **(15 Hours)**

Lattices: Lattices as Partially Ordered Sets. Their Properties, Lattices as algebraic Systems, Sub lattices, Direct Product and homomorphism. Some Special Lattices - Complete, Complemented and Distributive Lattices, Isomorphic Lattices.

UNIT V **(15 Hours)**

Boolean algebra: Various Boolean identities, the switching Algebra Example, Sub Algebras, Direct Production and Homomorphism. Boolean Forms and their Equivalence, Midterm Booleanforms, Sum of Products, Canonical Forms. Minimization of Boolean Functions. TheKarnuagh Map Method

Total Lecture Hours - 75

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COURSE OUTCOME

The students will be able to

1. Understand the notion of mathematical thinking and algorithmic thinking.
2. Understand the basics of discrete probability and to apply them in problems solving.
3. Understanding the concept of relations and functions.
4. Study the concept of logical operators.
5. Study the concept of error detection, Group codes, decoding and error correction.

TEXT BOOK(S) :

1.Trembly. J.P & Manohar. R, Discrete Mathematical Structures with Applications to Computer
Science, McGraw- Hill.
UNIT–I Chapter 2 : Sec. 2.3, 2.4.1, 2.4.2 &2.4.3
UNIT–II Chapter 1 : Sec. 1.1 to 1.3
UNIT–III Chapter 1 : Sec. 1.4 to 1.6
UNIT–IV Chapter 4 : Sec. 4.1
UNIT–V Chapter 4 : Sec. 4.2 to 4.4

REFERENCE BOOK(S) :

1. Liu, C.L, Elements of Discrete Mathematics, McGraw-Hill Bookco.
2. K.D Joshi, Foundations of Discrete Mathematics, Wiley Eastern Limited.
3. Kenneth G. Roden, Discrete Mathematics and its Applications, McGraw- Hill international editions, MathematicsSeries.

E_RESOURCES :

1. https://www.freebookcentre.net/Mathematics/Discrete Mathematics-Books-Download.html
2. https://www.cs.yale.edu/homes/aspnes/classes/202/notes

Semester: I-EC-II (2): Fuzzy Sets and Their Applications

Ins. Hrs./Week: 5 **Course Credit: 3** **Course Code:** P23MAE2B

UNIT –I: From Classical Sets to Fuzzy Sets **(15 Hours)**

Introduction of Fuzzy Sets – Fuzzy sets- Basic types – Fuzzy power sets - Fuzzy sets: Basic Concepts - Related Theorem – Cutworthy property – Strong Cutworthy property – Fuzzy Sets Versus Crisp Sets- Additional Properties of α-cuts – Related Theorems – Extension Principle for Fuzzy sets – Related Theorems.

UNIT – II: Operations on Fuzzy Sets **(15 Hours)**

Types of Operations – Fuzzy Complements – First Characterization Theorem of Fuzzy Complements – Second Characterization Theorem of Fuzzy Complements – Fuzzy Intersections- t- Norms – Characterization Theorem of t-Norms - Fuzzy Unions- t-Conorms - Characterization Theorem of t-Conorms – Combinations of Operations – Theorems on Combinations of Operations.

UNIT – III: Fuzzy Arithmetic **(15 Hours)**

Fuzzy Numbers – Theorems on Fuzzy Numbers - Linguistic variables – Arithmetic operations on intervals – Properties of Arithmetic operations – Arithmetic operations on Fuzzy numbers – Related Theorems on Arithmetic operations on Fuzzy numbers - Lattice of Fuzzy numbers – Related Theorems on Lattice of Fuzzy numbers.

UNIT – IV: Fuzzy Relations **(15 Hours)**

Binary Fuzzy Relations – Binary Relations on a Single Set – Reflexive - Irreflexive – Antireflexive – symmetric – Antisymmetric – Strictly Antisymmetric – Transitive – Nontransitive – Antitransitive - Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Ordering Relations – Fuzzy Morphisms.

UNIT – V: Fuzzy Decision Making **(15 Hours)**

Individual Decision Making – Multiperson Decision Making – Fuzzy Ranking Methods –Fuzzy Linear Programming – Cost vector – Constraint matrix – Right-hand side vector – Related problems in all these.

Total Lecture Hours- 75

COURSE OUTCOME

The students should be able to

1. Discuss the Fuzzy sets and properties of α- cuts.
2. Understand the Fuzzy Sets Operations.
3. Recognize the concept of Fuzzy Arithmetic.
4. Describe the Binary Fuzzy Relations & Fuzzy compatibility Relations.
5. Compute the Ranking methods & Fuzzy Linear Programming.

TEXT BOOKS

1. George J.Klir and Bo Yuan. 2006. Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice Hall learning Private limited, India.

UNIT - I	Chapter 1 : Sec. 1.1,1.3, 1.4 & Chapter 2 : Sec. 2.1 and 2.3
UNIT -II	Chapter 3 : Sec. 3.1 to 3.4
UNIT -III	Chapter 4 : Sec. 4.1 to 4.5
UNIT -IV	Chapter 5 : Sec. 5.3 to 5.8
UNIT -V	Chapter 15 : Sec. 15.2, 15.3, 15.6, 15.7

REFERENCE BOOK(S)

1. Ganesh. M. 2006.Introduction to Fuzzy Sets and Fuzzy Logic, Prentice Hall of India.
2. George J. Klir. and Bo Yuan. 1996. Fuzzy Sets, Fuzzy Logic and Fuzzy Systems, World Scientific Publishing, Co. Pvt. Ltd., Singapore.
3. Lotfi A Zadeh and Rafik A Aliev. 2019. Fuzzy Logic Theory and Applications (Part I and Part II), World Scientific Publishing, Co. Pte. Ltd., Singapore.
4. Timothy J. Ross. 2010. Fuzzy Logic with Engineering Applications, Third Edition.Wiley India Pvt. Ltd, New Delhi.
5. Zimmermann H.J. 1991. Fuzzy Set Theory and its Applications, Allied Publishers Limited, India

E-RESOURCES

1. https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf
2. file:///C:/Users/ELCOT/Desktop/FUZZY%20MATHEMATICS.pdf
3. https://www.iitk.ac.in/eeold/archive/courses/2013/intel-info/d1pdf3.pdf
4. https://www.mv.helsinki.fi/home/niskanen/zimmermann_review.pdf
5. https://www.myreaders.info/06-Fuzzy_Set_Theory.pdf

Semester: I- NME - I : Computational Mathematics using Sagemath

Ins. Hrs./Week: 2 **Course Credit**: 2 **Course Code**: **P23NMEMA11**

UNIT I : Getting Started with SageMath **(6 Hours)**

Introduction and Installation of SageMath - Exploring integers, solving equations in SageMath - 2D and 3D plotting in SageMath.

UNIT II : Calculus with SageMath **(6 Hours)**

Applications of derivatives - Applications of Integrals - Partial Derivatives and gradients, jacobians - Local maximum-minimum - Application of local maximum and minimum

UNIT III : Linear Algebra with SageMath **(6 Hours)**

RREF and Solving system of linear Equations - Vector spaces in SageMath - Linear Transformations with SageMath

UNIT IV : Linear Algebra with SageMath **(6 Hours)**

Eigenvalues and Eigenvectors with SageMath - Inner Product Spaces in SageMath - Gram-Schmidt Process.

UNIT V : Numerical Analysis with SageMath **(6 Hours)**

QR- Factorization, Singular Value Decomposition (SVD) - Numerical Solution of algebraic equations - Numerical Solutions of system linear equations - Interpolations - Numerical Integration.

Total Lecture Hours- 30

COURSE OUTCOME:

The students will be able to

2. Solve equations in SageMath
3. Compute problems in Calculus with SageMath
4. Calculate problems in Linear Algebra with SageMath
5. Evaluate problems in Eigenvalues and Eigenvectorswith SageMath
6. Analyse problems in Numerical Analysis with SageMath

REFERENCE BOOKS:

1. Mathematical Computation with Sage by Paul Zimmermann available from on http://www.sagemath.org.
2. An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods by Razvan A Mezei, Springer.
3. Sage for Undergraduates, Gregory V. Bard.

Semester: II -CC- IV: Advanced Algebra

Ins. Hrs./Week: 6 **Course Credit**: 5 **Course Code**: P23MA204

UNIT-I : **(20 Hours)**
Extension fields – Transcendence of e.

UNIT-II : **(18 Hours)**
Roots or Polynomials.- More about roots

UNIT-III : **(18 Hours)**
Elements of Galois theory.

UNIT-IV : **(19 Hours)**
Finite fields - Wedderburn's theorem on finite division rings.

UNIT-V : **(15 Hours)**
Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.

Total Lecture Hours- 90

COURSE OUTCOME

The students should be able to
1. Prove theorems applying algebraic ways of thinking.
2. Connect groups with graphs and understanding about Hamiltonian graphs.
3. Compose clear and accurate proofs using the concepts of Galois Theory.
4. Bring out insight into Abstract Algebra with focus on axiomatic theories.
5. Demonstrate knowledge and understanding of fundamental concepts including extension

TEXT BOOKS

1. I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.

UNIT I : Chapter 5: Section 5.1 and 5.2

UNIT II : Chapter 5: Sections 5.3 and 5.5

UNIT III : Chapter 5 : Section 5.6

UNIT IV : Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT V : 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

REFERENCE BOOK(S)

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.

E-RESOURCES

1. http://mathforum.org,
2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org,
4. www.algebra.com

Semester: II -CC- V: Real Analysis II

Ins. Hrs./Week: 6 **Course Credit**: 4 **Course Code**: P23MA205

UNIT-I :Measure on the Real line **(15 Hours)**

Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability

UNIT-II : Integration of Functions of a Real variable **(15 Hours)**

Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals

UNIT-III : Fourier Series and Fourier Integrals **(15 Hours)**

Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - 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 – Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem

UNIT-IV : Multivariable Differential Calculus **(15 Hours)**

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

UNIT-V : Implicit Functions and Extremum Problems **(15 Hours)**

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.

(15 Hours)

Total Lecture Hours- 75

COURSE OUTCOME

The students should be able to

1. Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.
2. Analyze the representation and convergence problems of Fourier series.
3. Analyze and evaluate the difference between transforms of various functions.
4. Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

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

TEXT BOOKS

1. 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)

UNIT I : Chapter - 2 Sec 2.1 to 2.5 (de Barra)

UNIT II : Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

UNIT III : Chapter 11 : Sections 11.1 to 11.15 (Apostol)

UNIT IV : Chapter 12 : Section 12.1 to 12.14 (Apostol)

UNIT V : Chapter 13 : Sections 13.1 to 13.7 (Apostol)

REFERENCE BOOK(S)

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

E-RESOURCES

1. http://mathforum.org

2. http://ocw.mit.edu/ocwweb/Mathematics

3. http://www.opensource.org

Semester: II -CC- VI: Partial Differential Equations

Ins. Hrs./Week: 6 **Course Credit**: 4 **Course Code**: P23MA206

UNIT- I : Partial Differential Equations of the first order **(15 Hours)**

Partial Differential Equations- Origins of first order Partial differential equations- Cauchy's problem for first order equations- Linear equations of the first order - Integral surfaces Passing through a given curve - Surfaces Orthogonal to a given system of surfaces.

UNIT-II: Partial Differential Equations of the first order **(15 Hours)**

Cauchy's Method of Characteristics- Compatible systems of first order equations- Charpit's Method- Special types of first order equations- Some Example problems - Solutions Satisfying Given Conditions- Jacobi's Method.

UNIT –III: Partial Differential Equations of the Second order **(15 Hours)**

The Origin of Second Order Equations -Linear Partial Differential Equations with Constant co-efficient - Some Theorems- Example problems - Equations with variable coefficients- Characteristic curves of second order equations.

UNIT- IV: Partial Differential Equations of the Second order **(15 Hours)**

Characteristics of equations in three variables- The solution of Linear Hyperbolic equations - Separation of variables - The method of Integral Transforms – Non-Linear equations of the second order.

UNIT –V: Laplace's Equation **(15 Hours)**

Elementary solutions of Laplace's equations- Examples Problems-Families of equipotential Surfaces- Boundary Value Problems-Separation of Variables -Kelvin's Inversion-The Theory of Green's Function of Laplace's equation.

Total Lecture Hours – 75

COURSE OUTCOME

The students should be able to,

1. Solve linear partial differential equations.
2. Match the information from partial derivative models to interpret reality.
3. Formulate appropriate numerical methods for solving various problems in PDE(Partial Differential Equations).
4. Analyze the fundamental principles of PDE to solve hyperbolic, parabolic and elliptic equations.
5. Apply PDE in scientific and research problems.

TEXT BOOK(S)

1. Ian N. Sneddon. 2006. Elements of Partial Differential Equations**,** Dover Publication –INC, NewYork..

UNIT - I Chapter 2 : Sec. 1 to 6

UNIT - II Chapter 2 : Sec. 8 to 13

UNIT - III Chapter 3 : Sec. 1,4 to 6
UNIT - IV Chapter 3 : Sec. 7 to 11
UNIT - V Chapter 4 : Sec. 2 to 5, 7 ,8

REFERENCE BOOK(S)

1. Bhargava and Chandramouli. 2015. Differential Equations, Prakashan Edition III. New Delhi.
2. Copson.E.T.1973. Partial Differential Equations, Cambridge University Press, London.
3. Raisinghania.M.D.1988.Advanced Differential Equations, S. Chand and Company Ltd, New Delhi.
4. Walter A. Strauss. 2007. Partial Differential Equations An Introduction, Brown University, Rhode Island.
5. Zachmanoglou E.C. and Dale W. Thoe. 1986. Introduction to Partial Differential Equations and its Applications, Dover Publications, New York.

E-RESOURCES

1. http://www.math.toronto.edu/ivrii/PDE-text Book/
2. https://math.stackexchange.com
3. http://www.nrce.niepa.ac.in
4. http://www.mathworks.com
5. http://ocw.mit.edu

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI- 614016

(For the Candidates admitted in the academic year 2023 – 2024)

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: II- EC-III(1) : Algebraic Number Theory

Ins. Hrs./Week: 5 **Course Credit**: 3 **Course Code**: P23MAE3A

UNIT I **(15 Hours)**

Introduction – Divisibility – Primes – The Binomial Theorem – Congruences – Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.

UNIT II **(15 Hours)**

Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and Power Residues –Congruences of degree two.

UNIT III **(15 Hours)**

Number theory from an Algebraic Viewpoint – Groups, rings and fields – Quadratic Residues- The Legendre symbol (a/r) where r is an odd prime – Quadratic Reciprocity – The Jacobi Symbol (P/q) where q is an odd positive integer.

UNIT IV **(15 Hours)**

Binary Quadratic Forms – Equivalence and Reduction of Binary Quadratic Forms – Sums of three squares – Positive Definite Binary Quadratic forms – Greatest integer Function – Arithmetic Functions – The Mobius Inversion Formula – Recurrence Functions – Combinatorial number theory .

UNIT V **(15 Hours)**

Diophantine Equations – The equation ax+by=c – Simultaneous Linear Diophantine Equations – Pythagorean Triangles – Assorted examples.

Total Lecture Hours - 75

COURSE OUTCOME:

The students will be able to

1. Apply the Fermat's, Euler's and Wilson's Theorems.
2. Understand the Primitive roots and power Residues.
3. Understand the concept of Number theory from an Algebraic Viewpoint
4. Analyse the Positive Definite Binary Quadratic forms.
5. Calculate the Diophantine Equations.

TEXT BOOK

1. Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, An Introduction to the Theory of Numbers, Fifth edn., John Wiley & Sons Inc, 2004.

UNIT I Chapter 1 and Chapter 2 : Sections 2.1 to 2.3

UNIT II Chapter 2 : Sections 2.4 to 2.9

UNIT III Chapter 2 : Sections 2.10, 2.11 and Chapter 3: Sections 3.1 to 3.3

UNIT IV Chapter 3 : Sections 3.4 to 3.7 and Chapter 4

UNIT V Chapter 5: Sections 5.1 to 5.4.

REFERENCES

1. Elementary Number Theory, David M. Burton W.M.C. Brown Publishers, Dubuque, Lawa, 1989.

2. Number Theory, George Andrews, Courier Dover Publications,1994.

3. Fundamentals of Number Theory, William J. Leveque Addison-Wesley Publishing Company, Phillipines, 1977.

E_RESOURCES :

1.https://www.researchgate.net/publication/243403247_An_Introduction_to_the_Theory_of_Numbers_6t h_edition_by_GH_Hardy_and_EM_Wright

2.https://www.tandfonline.com/doi/pdf/10.1080/00107510903184414

3.https://www.scribd.com/doc/227913422/G-Hardy-An-Introduction-to-the-Theory-of-Numbers-6th-edpdf

4.https://ocw.mit.edu/courses/mathematics/18-781-theory-of-numbers-spring-2012/lecture-notes/

5.http://www.fuchs-braun.com/media/532896481f9c1c47ffff8077fffffff0.pdf

6.https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2013/05/An-Introductoryin-Elementary-Number-Theory.pdf

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SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI- 614016

(For the Candidates admitted in the academic year 2023 – 2024)

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: II - EC- III (2) : Tensor Analysis and Relativity

Ins.hrs / Week : 5 **Course Credit : 3** **Course code: P23MAE3B**

UNIT I : Invariance **(15 Hours)**

Invariance-Transformations of coordinates and it's properties - Transformation by invariance - Transformation by covariance and contra variance - Covariance and contra variance - Tensor and Tensor character of their laws - Algebras of Tensors - Quotient Tensors - Symmetric and Skew Symmetric Tensors - Relative Tensors.

UNIT II : Metric Tensor **(15 Hours)**

Metric Tensor - The fundamental and associated tensors - Christoffel's symbols – Transformationa of Christoffel's symbols - Covariant Differentiation of Tensors –Formulas for Covariant Differentiation - Ricci Theorem - Riemann Christoffel Tensor and their Properties.

UNIT III : Einstein Tensor **(15 Hours)**

Einstein Tensor - Riemannian and Euclidean Spaces (Existence Theorem) - Thee-systems and the generalized Kronecker deltas - Application of the e-systems.

UNIT IV : Special Theory of Relativity **(15 Hours)**

Special Theory of Relativity: Galilean Transformation - Maxwell's Equations - The ether Theory - The Principle of Relativity Relativistic Kinematics: Lorentz Transformation equation - Events and simultaneity - Example Einstein Train- Time dilation - Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - World line - Example - Twin paradox – addition of velocities - Relativistic Doppler effect.

UNIT V : Relativistic Dynamics **(15 Hours)**

Relativistic Dynamics: Momentum - energy - Momentum - energy four vector - Force – Conservation of energy - Mass and energy - Example - inelastic collision - Principle of equivalence - Lagrangian and Hamiltonian formulations .Accelerated Systems: Rocket with constant acceleration - example - Rocket with constant thrust.

Total Lecture Hours-75

COURSE OUTCOME

The Students should be able to

1. Gain Knowledge to the transformations of coordinates and its Properties.
2. Understand the concepts of Christoffel Tensor and its Properties.
3. Describe the concepts of Riemannian and Euclidean Spaces.
4. Apply the knowledge and broad understanding of Special Relativity.
5. Deliberate the meaning and significance of the postulate of Special Relativity.

TEXT BOOK(S)

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

2. SokolnikoffI.S.1964. Tensor Analysis. John Wiley and Sons, New York.

UNIT I Chapter 2 : Sec 18 to 28 of (2)
UNIT II Chapter 2 : Sec 29 to 37 of (2)
UNIT III Chapter 2 : Sec 38 to 41 of (2)
UNIT IV Chapter 7 : Sec 7.1 and 7.2 of (1)
UNIT V Chapter 7 : Sec 7.3 and 7.4 of (1)

REFERENCE BOOK(S)

1. FridtjovIrgens. 2019. Tensor Analysis. Springer Nature, Switzerland.
2. Mc Connell A. J. 2014. Applications of Tensor Analysis. Dover Publications Inc, New York.
3. James G.Simmonds. 1994. A Brief on Tensor Analysis. Springer Science Business Media, New York.
4. Richard A. Silverman. 1994. Vector and Tensor Analysis its Applications. Dover Publications Inc. New York.
5. Richard L.Bishop, Samuel I.Goldberg. 1994.Tensor Analysis on Manifolds. Dover Publications Inc. New York.

E_RESOURCES

1. https://web.math,princeton.edu combinatories
2. https://audiophile.tam.cornell.edu
3. http://ruina.tam.cornell.edu/Courses/ME6700/references/block_tensor_anlysis.pdf
4. http://www.ita.uni-heidelberg.de/~dullemond/lectures/tensor/tensor.pdf
5. https://arxiv.org/pdf/math/0403252.pdf

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI- 614016

(For the Candidates admitted in the academic year 2023 – 2024)

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: II - EC- IV (1) : Probability Theory

Ins.hrs / Week : 5 **Course Credit : 3** **Course code: P23MAE4A**

UNIT-I : Random Events **(15 hours)**

Random Experiment – Sample Space and Elementary Event - Event – Axiomatic Probability – Some Theorems on Probability – Addition Theorem of Probability – Extension of Addition Theorem of Probability to n Events – Simple Problems –Conditional Probability – Independent Event – Multiplication Theorem of Probability for Independent Events - Bayes Theorem.

UNIT-II : Random Variables and Distribution Functions **(15 hours)**

Introduction – Distribution Function – Discrete random Variable – Continuous Random Variable – Continuous Distribution Function.

UNIT-III : Mathematical Expectation **(15 hours)**

Introduction – Mathematical Expectation – Expected Value of Function of a random Variable – Properties of Expectation – Properties of Variance – Covariance –Some Inequalities Involving Expectations.

UNIT-IV : Moment Generating Function **(15 hours)**

Moment Generating Function – Characteristic Function – Some Important Theorems – Cheebychev's Inequality

UNIT-IV : Discrete Probability Distribution **(15 hours)**

Discrete Uniform Distribution – Bernoulli Distribution – Binomial Distribution - Poisson Distribution.

Total Lecture Hours-75

COURSE OUTCOME

The Students should be able to

1. To define Random Events, to describe Probability, Multiplication Theorem of Probability for Independent Events, to apply Bayes
2. To define Distribution Function, to find Continuous Distribution Function
3. To define Expectation, to fin Covariance
4. To define Moments Generating Function and Chebyshev Inequality
5. To discuss Bernoulli Distribution, Binomial Distribution & Poisson Distribution.

TEXT BOOK(S)

1.S.C. Gupta, V.K.Kapoor, 2002, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Educational Publishers, New Delhi

UNIT-I : Chapter : 3 : Sec. 3.8.1, 3.8.2, 3.8.5, 3.9, 3.9.1, 3.9.2, 3.10, 3.12, 3.13 & Chapter : 4 : Sec. 4.2

UNIT-II : Chapter : 5 : Sec. 5.1 to 5.4
UNIT-III : Chapter : 6 : Sec. 6.1 to 6.7
UNIT-IV : Chapter : 7 : Sec. 7.1, 7.3 to 7.5
UNIT-V : Chapter : 8: Sec. 8.1, to 8.5

REFERENCE BOOK(S)

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*, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.
7. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

E_RESOURCES :

1. http://mathforum.org,
2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org,
4. http://www.probability.net

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DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: II - EC- IV (2) : Methods of Mathematical Physics

Ins.hrs / Week : 5 **Course Credit : 3** **Course code: P23MAE4B**

UNIT I **(15 hours)**

Boundary value problems and series solution - Examples of boundary value problems - Eigen values, eigen functions and the Sturm-Liouville problem - Hermitian operator, their eigen values and eigen functions.

UNIT II **(15 hours)**

Bessel functions - Bessel functions of 'the second kind, Hankel functions Spherical Bessel functions - Legendre polynomials - Associated Legendre polynomials and spherical harmonics.

UNIT III **(15 hours)**

Hermite polynomials - Laguerre polynomials - The Gamma function - The Dirac Delta function

UNIT IV **(15 hours)**

Non homogeneous boundary value problems and Green's function - Green's function for one-dimensional problems - eigen function expansion of Green's function - Fourier transform method of constructing Green's function.

UNIT V **(15 hours)**

Green's function in higher dimensions - Green's function for Poisson's equation and a formal solution of electrostatic boundary value problems ~ Wave equation with source - the quantum mechanical scattering problem.

Total Lecture Hours-75

COURSE OUTCOME

The students should be able to

1. Apply Boundary value problems and series solution
2. Understand and classify Hankel functions Spherical Bessel functions
3. Analyse and solve Laguerre polynomials
4. Solve Non homogeneous boundary value problems and Green's function
5. Apply Wave equation with source.

TEXT BOOK(S)

[1] P.K. Chattopadhyay -Mathematical Physics, Wiley Eastern Limited, 1990.

Unit I : Sections 4.2 to 4.5

Unit II : Sections 5.1 to 5.5

Unit III : Sections 5.6 to 5.9 Unit IV : Sections 6.1 to 6.4
Unit V : Sections 6.5. to 6.8.

REFERENCE(S)

[1] B.D. Gupta, Mathematical Physics, Vikas Publishing House Pvt Ltd, New Delhi, 1993.
[2] Goyal AK Ghatak, Mathematical Physics- Differential Equations and Transform Theory, McMillan India Ltd, 1995.
[3] Kryzeg, Higher Engineering Mathematics.

E_RESOURCES :

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9783527617210
2. https://www.youtube.com/watch?v=TgnaYFlnnCk

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DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Semester: II- NME - II : Mathematical documentation using LATEX

Ins. Hrs./Week: 2 **Course Credit**: 2 **Course Code**: P23NMEMA22

UNIT – I **(6 Hours)**

Basic Structure of Latex 2e - Input file structure - Layout -Editors - Forward Search- Inverse Search - Compiling - Conversion to various formats.

UNIT – II **(6 Hours)**

Typesetting simple documents - sectioning - Titles- page layout -listing – enumerating - quote - letter formats.

UNIT – III **(6 Hours)**

Using package amsmath typing equations labeling and referring.

UNIT – IV **(6 Hours)**

Figure inclusion - Table inclusion.

UNIT – V **(6 Hours)**

Bibliography - Index typing - Beamer presentation Styles.

Total Lecture Hours-30

COURSE OUTCOME:

The students will be able to:

1. Type their own mathematical article/notes/book/journal paper/project work.
2. Meticulously prepare their own mathematical notes.
3. Understand basic structure of Latex 2e and conversions of them to various formats.
4. Typeset and compile documents with titles, sectioning and enumeration etc.
5. Use various style files and in particular amsmath, amsfonts, amsthm.
6. Understand how to align math equations, matrices etc.
7. Include the figures in various formats into their latex document and compile it successfully.
8. Utilize bibtex feature of including bibliographies and indexes.

REFERENCES:

1. Leslie Lamport. LATEX: A Document Preparation System, Addison-Wesley, Reading, Massachusetts, second edition, 1994.

2. Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl., The (Not So) Short Introduction to LATEX2e, Samurai Media Limited
3. LATEX Tutorials - A Primer, Indian TeX Users Group
4. H. J. Greenberg. A Simplified introduction to LATEX
5. Using Kile - KDE Documentation,
6. Amsmath and geometry package available in Ctan.org. 36

E_RESOURCES :

1. http://mirrors.ctan.org/info/lshort/english/lshort.pdf
2. https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
3. https://www.ctan.org/tex-archive/info/simplified-latex/
4. https://docs.kde.org/trunk4/en/extragear_office/kile/quick-using.html