ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

(AFFILIATED TO UNIVERSITY OF MYSORE & REACCREDITED BY NAAC WITH B^{++} GRADE)

PROGRAMME: M.Sc in MATHAMATICS

CBCS with Learning Outcome Based Curriculum

Academic years: 2020-22

{Approved in the Academic Council Meeting held on 12.01.2021}

{The Academic Year of 2020-21 was commenced on 24.01.2021 due to first wave of Covid-19 Pandemic}

ST. PHILOMENA'S COLLEGE (AUTONOMOUS) MYSORE
(AFFILIATED TO UNIVERSITY OF MYSORE)
PROGRAMME: M.Sc IN MATHEMATICS
(For Candidates admitted during the Academic year 2020 -2021 onwards)

Preamble

The aim of the post graduate education is to provide high quality education as well as a supportive learning environment for the students to reach their full academic potential. The higher education has to inculcate in students the spirit of hard work and research aptitude to know the essence of Mathematics. This is the third revision of the curriculum Board of Studies in Mathematics has designed the curriculum for M.Sc.Mathematics so as to monitor, review and enhance educational provision which ensures the Post Graduate Education remains intellectually demanding and relevant to current needs of Mathematics graduates. The thrust is given in fostering a friendly and stimulating learning environment which will motivate the students to reach high standards, enable them to acquire real insight into Mathematics and become self-confident, committed and adaptable graduates. With this in mind, we aim to provide a firm foundation in every aspect of Mathematics and to develop analytical, experimental, computational logical and reasoning skills of students.

The syllabi gives the foundation of Mathematics and evolution of Mathematics Education. The goal of the syllabus is to make the study of Mathematics, interesting and encouraging to the students to study in-depth which helps them for research. The syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of research and its applications.

The syllabiis prepared after discussion at length with number of faculty members of the subject from different universities and research fields. The units of the syllabus are well defined, taking into consideration the level and the requirement tothe students.

The following modifications are incorporated in the revised syllabus from the academic year 2020-21.

Sl. No.	Semester	Existing Paper replaced	New Paper	Credits	Justification	Percentage of Changes
1.	**First**	**-**	**Probability and Statistics (SC)**	**4**	Statistical methods are an important tool in the activities because they provide the researcher with both descriptive and analytical methods for dealing with the variability in observed data. We believe that this course will best serve students in many applications of interdisciplinary fields	**100**
2.	**Second**	**-**	**Operations Research (SC)**	**4**	Operations Research is a science of decision-making. It's a splendid area for graduates of mathematics to use their knowledge and skills in creative ways to solve complex problems and have an impact on critical decisions.	**100**
3.	**Second**	**_**	**Classical Mechanics (SC)**	**4**	In classical mechanics we use mathematical concepts like differential equations and phase flows, smooth mappings and manifolds, Lie groups and Lie algebras. Henceforth in order to give a basic idea of Classical Mechanics we are	**100**

					introducing this course.	
4.	**Third**	**_**	**Literature Survey (SC)**	**4**	To encourage and to nurture the student ideas in the area of research and to discover the relationships between research studies and the ideas.	
5.	**Fourth**	**-**	Transforms and Calculus of Variation **(SC)**	**4**	As the subject is a powerful mathematicaltool,finding applications in subjects as diverse as statics, optics, differential geometry, approximate solutions of differential equations. we are introducing this course.	**100**

SELF STUDY PAPERS OFFERED

Sl. No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1.	**Second**	LATEX-type setting	**SC- Self Study**	**2**	**100**
2.		Maple –A mathematical tool	**SC- Self Study**	**2**	**100**

NEW INTERDISCPLINARY COURSES OFFERED TO SISTER DEPARTMENT

S. I No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1.	**Second**	Numerical Computations in Science –I	**SC- ID**	2	100
2.	**Fourth**	Numerical Computations in Science –II	**SC- ID**	2	100

NEW OPEN ELECTIVE COURSE OFFERED TO UNRELATED DEPARTMENT

S. I No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1	**Third**	Differential Equations and Its Applications	**SC-OE**	**2**	**100**

CHANGES IN THE EXISTING PAPERS

S. I	Semester	Title of the course	Justification	Percentage

No				of Change
1.	First	Group theory Unit-1: Number theory	To concentrate more into group theoretical aspect	25
2.	Second	Ordinary and Partial Differential Equations Unit 3	To focus on Equations passing through a given curve, Surfaces orthogonal to given system of surfaces, Non-linear PDE of first order, Cauchy's method of characteristics and Compatible system	20

TOTAL CHANGES ≈ 24%

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VISION AND MISSION OF THE COLLEGE

VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet**.**

MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, which inculcates life skills to become good citizens with integrity and discipline**.**

VISION AND MISSION OF THE DEPARTMENT

VISION:

To strive for excellence in mathematical sciences that ignites students for interdisciplinary domains.

MISSION:

1. To provide quality education and research in Mathematics through updated curriculum, effective teaching learning process.
2. To inculcate innovative skills, team-work, ethical practices among students in turn to meet societal expectations

PO No.	Programme Educational Objectives (PEOs)
PEO-1	**PROFESSIONAL GROWTH** Keep on discovering new avenues in the chosen field and exploring areas that remain conducive for research and development.
PEO-2	**CORE PROFICIENCY** To expertise the students to organize, understand, evaluate, and solve problems by providing hands on experience through modern tools necessary for practice.
PEO-3	**TECHNICAL PROFICIENCY** To have the interdisciplinary knowledge and relating them the technical aspect as the impact of the subject concerned is very wide.
PEO-4	**MANAGEMENT SKILLS** Encourage personality development skills like time management, crisis management, Stress interviews and working as a team.
PEO-5	**LEARNING ENVIRONMENT** To provide students with knowledge and capability in formulating and analysis of mathematical models of reallife applications.

Mapping of Mission of the department with Programme Educational Objectives

Mission	Programme Educational Objectives (PEOs)

	PEOs-1	PEOs-2	PEOs-3	PEOs-4	PEOs-5
M1	✓	✓		✓	
M2			✓		✓

Programme Outcomes (POs)

	At the end of the programme, the students will be able to:
PO-1	Apply knowledge of Mathematics, in all the fields of learning including higher research and its extensions
PO-2	Explain the knowledge of contemporary issues in the field of Mathematics and applied Sciences.
PO-3	Work effectively as an individual, and also as a member or leader in multi-disciplinary teams
PO-4	Adjust themselves completely to the demands of the growing field of Mathematics by lifelong learning
PO-5	Crack lectureship and fellowship exams approved by UGC like CSIR – NET ,SET and GATE**.**

Programme Specific Outcomes (PSOs)

PSO No.	**Upon completion of the Programme the student will -**
PSO-1	Develop problem-solving skills and apply them independently to problems in pure and applied mathematics.
PSO-2	Analyse complex mathematical ideas and arguments.
PSO-3	Improve their own learning and performance.
PSO-4	Develop abstract mathematical thinking.
PSO-5	Apply the knowledge of mathematical concepts in interdisciplinary fields.
PSO-6	Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and scientific investigations.
PSO-7	Pursue research in challenging areas of pure/applied mathematics.

Mapping of Programme Educational Objectives with Program Outcomes and Programme Specific outcomes

	Programme Outcomes					Program Specific Outcomes						
Programme Educational Objectives	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**	**PSO-7**
PEOs-1	✓	✓				✓	✓					✓
PEOs-2	✓	✓				✓	✓		✓		✓	
PEOs-3			✓	✓			✓	✓		✓	✓	
PEOs-4				✓	✓	✓		✓		✓		
PEOs-5			✓		✓			✓	✓			✓

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M.Sc- Mathematics - Course Structure [Credits Distribution]

I Semester						**Total Credits**
Sl. No	**Code**	**Title**	**Type (HC/SC)**	**L:T P**	**Credit**	
1		Group Theory	**HC**	**3:1:0**	**4**	**20**
2		Real Analysis-I	**HC**	**3:1:0**	**4**	
3		Real Analysis-II	**HC**	**3:1:0**	**4**	
4		Introduction to Complex Analysis	**HC**	**3:1:0**	**4**	
5		Anyone of the Soft-Core Course to be chosen from List A	**SC**		**4**	
II Semester						
1		Ring and Field Theory	**HC**	**3:1:0**	**4**	**18**
2		Real Analysis-III	**HC**	**3:1:0**	**4**	
3		Advanced Complex Analysis	**HC**	**3:1:0**	**4**	
4		Anyone of the Soft-Core Course to be chosen from List B	**SC**		**4**	
5		Numerical Computations in Science –I	**SC-ID**	**2:0:0**	**2**	
	Self-Study Papers					

		LATEX-type setting	**SC**		**2**	
		Maple –A mathematical tool	**SC**		**2**	
III Semester						
1		Elements of Functional Analysis	**HC**	**3:1:0**	**4**	**20**
2		Topology-I	**HC**	**3:1:0**	**4**	
3		Any two of the Soft-Core Course to be chosen from List D	**SC**		**4**	
4			**SC**		**4**	
5		**Open Elective (offered from other dept.)**	**OE**		**4**	
IV Semester						
1		Measure and Integration	**HC**	**3:1:0**	**4**	**18**
2		Topology-II	**HC**	**3:1:0**	**4**	
3		Any two of the Soft-Core Course to be chosen from List E	**SC**		**4**	
4			**SC**		**4**	
5		Numerical Computations in Science -II	**SC-ID**	**2:0:0**	**2**	
HC-44 + SC-28 + OE-4 = 76						

Semester wise soft- core elective papers offered to M.Sc. Mathematics

List A- Soft-Core Courses					
S. I No	**Semester**	**Title of the paper**	**Type**	**L:T:P**	**Credits**
1	**First**	Linear Algebra with Applications	**SC**	3:1:0	4
2		Combinatorics and Graph Theory	**SC**	3:1:0	4
3		Probability and Statistics	**Skill**	3:1:0	4

List B- Soft-Core Courses					
S. I No	**Semester**	**Title of the paper**	**Type**	**L:T:P**	**Credits**
1		Ordinary and Partial Differential Equation	**Skill**	3:1:0	4

2	**Second**	Operations Research	**SC**	3:1:0	4
3		Classical Mechanics	**SC**	3:1:0	4

List C- Soft-Core Self StudyCourse				
S. I No	**Semester**	**Title of the paper**	**L:T:P**	**Credits**
1	**Second**	Maple-A Mathematical Tool	-	2
		LATEX- Type setting	-	2

List D- Soft-Core Courses					
S. I No	**Semester**	**Title of the paper**	**Type**	**L:T:P**	**Credits**
1	**Third**	Theory of Numbers	**SC**	3:1:0	4
2		Graph theory	**SC**	3:1:0	4
3		Literature Survey	**Ability**	2:2:0	4
4		Galois Theory	**SC**	3:1:0	4
5		Commutative Algebra	**SC**	3:1:0	4

List E- Soft-Core Courses					
S. I No	**Semester**	**Title of the paper**	**Type**	**L:T:P**	**Credits**
1	**Fourth**	Project Work	**Ability**	3:1:0	4
2		Transforms and Calculus of Variation	Skill	3:1:0	4
3		TheoryofPartitions	**SC**	3:1:0	4
4		Advanced Functional Analysis	**SC**	3:1:0	4

Open / Generic Elective Courses Offered ToOther Departments

SI No	**Semester**	**Title of the paper**	**Type**	**L:T:P**	**Credits**
1	Third	Differential Equations and Its Applications	OE	2:0:0	2

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ST. PHILOMENA'S COLLEGE (AUTONOMOUS)
Programme:M.Sc in Mathematics
(For Candidates admitted during the Academic year 2020-2021 onwards)

FIRST YEAR - SEMESTER – I

<table>
<tr><td>Course Title</td><td colspan="9">Group Theory</td></tr>
<tr><td>Course Type</td><td colspan="2">Hard Core- Theory</td><td>Total Hours</td><td>48</td><td colspan="2">Hours/Week</td><td>04</td><td>Credits</td><td>04</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2"></td><td rowspan="2">Evaluation</td><td>Internal</td><td colspan="3">C1+C2 = 15+15</td><td colspan="2">30 Marks</td><td rowspan="2">100</td></tr>
<tr><td>External</td><td>Duration</td><td>C3</td><td>03Hrs</td><td colspan="2">70 Marks</td></tr>
<tr><td colspan="10">General Objective
To introduce the concepts and to develop working knowledge on Groups, Normal Subgroups, Automorphism groups, Finite groups.</td></tr>
<tr><td>CO No.</td><td colspan="9">Course Objectives</td></tr>
<tr><td>CO-1</td><td colspan="9">To identify the concept of Normal groups and Quotients groups</td></tr>
</table>

CO-2	To analyse Permutation groups and Counting principle.		
CO-3	To understand Sylow's theorem and its applications		
CLOs No.	**Course Learning Outcomes(CLOs)** After completing this course, the student will be able to	**PSOs Addressed**	**CLDs**
CLO-1	Understand the properties of the algebraic structure with one binary operation	PSO-1	Understand
CLO-2	DescribeNormal groups and Quotients groups.	PSO-2	Analyse
CLO-3	Analyse Permutation groups and Counting principle.	PSO-2	Analyse
CLO-4	Explain Sylow theorem and its applications	PSO-1	Apply
Unit	**Course Content**		**Duration**
1	**Groups and Subgroups** Binary operation, Definition of algebraic structure and groups Subgroups and cosets Lagrange's Theorem, Cyclic subgroups Normal subgroups andfactor groups		12 hours
Extra Reading /Key Words:Subgroups of finite non-abelian groups.			
2	**Isomorphism** Homomorphism- kernel and image Thefundamental theoremofhomomorphism Twolaws ofisomorphism.		12 hours
Extra Reading /Key Words:Homomorphism and Isomorphism			
3	**PermutationGroups** Group of permutations, Alternative group, Signature of Permutation Cayley'stheorem		12 hours
Extra Reading /Key Words:PermutationGroups			
4	**Sylow's theorems** Sylow's theorems Direct products,Simple groups and Finite Abelian Groups		12 hours
Extra Reading /Key Words:Sylow's theorems and Direct products			

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of Publication
1	Algebra	Thomas W. Hungerford	Springer International Edition, NewYork	5th	2010
2	ContemporaryAbstractAlgebra,	J. A. Gallian	NarosaPublishingHouse	4th	2009
3	Algebra	Michael Artin	Prentice-Hall ofIndia	9th	2008
4	Abstract Algebra	D.S. DummitandR. M.Foote	JohnWileyandSons	10th	1999
5	TopicsinAlgebra	I.N. Herstein	VikasPublishing House	4th	2013
6	AFirst courseinAbstract Algebra	J.B. Fraleigh	Addison-Wesley	3rd	2009
7	UniversityAlgebra	N. S.Gopalakrishnan	New AgeInternational	2nd	2009

FIRST YEAR - SEMESTER – I

Course Title	Real Analysis-I							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	C3	Duration	03hrs	70 Marks	

General Objective

To learn the properties of Real numbers, Sequences and Series and the concept of convergence of sequences and series.

CO No.	Course Objectives
CO-1	To understand the Archimedean property and basic properties of Real number.
CO-2	To locate Sequence and Series comprising convergence sequences, upper and lower limits.
CO-3	To find the nature of a series through series tests.

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the basic properties of real numbers	PSO-1	Understand
CLO-2	Apply the properties of the sequences	PSO-2	Apply
CLO-3	Test the convergence of a given series	PSO-4	Analyse, Apply

Unit	Course Content	Duration
1	**Properties of Real Numbers** The extended real number system n-dimensional Euclidean space Binomial inequality, the Power Mean inequality, Cauchy's Schwarz inequality, Holder's and Minkowski's inequality	12 hours
Extra Reading /Key Words: Extended real number system and Euclidean space .		
2	**Sequences ofReal Numbers** Numerical sequences Convergent sequences Cauchy sequences	12 hours
Extra Reading /Key Words: Sequences		
3	**SeriesofReal Numbers-I** Series of real numbers, Series of non-negative terms, The number `e'and test of convergence	12 hours
Extra Reading /Key Words: Series		
4	**SeriesofReal Numbers-II** Multiplications of series, Re-arrangements. Double Series, infinite products.	12 hours
Extra Reading /Key Words: Double Series and Infinite products.		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication

1	PrinciplesofMathematical Analysis	W. Rudin	Int. Student edition,McGrawHill	3rd	1997
2	MathematicalAnalysis	T. M. Apostal	AddisonWesley, Narosa, NewDelhi,	2nd	1998
3	Methods of Real Analysis	R. R. Goldberg	OxfordandIBH,NewDelhi	5th	2008
4	Analysis I and Analysis II	TorenceTao	HindustanBookAgency, India,	6th	2006
5	Introduction to real analysis	Robert G Bartle	John Wiley and Sons. Inc	4th	2014
6	ElementaryAnalysis:TheTheoryofCalculus	KennethA. Ross	SpringerInter, Edition,2004.	4th	2008

FIRST YEAR - SEMESTER – I

Course Title	Real Analysis-II							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

General Objective

To enable the students to appreciate various aspects of Countability, Metric spaces and understand continuous functions, Riemann-Stieltje's integral

CO No.	Course Objectives
CO-1	To understand countability and to describe topological properties of Metric space.
CO-2	To distinguish continuity and uniform continuity with examples and to infer the compactness in continuity and connectedness.
CO-3	To derive the differentiability from limiting of functions and clarify the properties and mean value theorems of differentiable functions.
CO-4	To understand the concept of Riemann- Stielije'sIntegrability and its properties and discuss Rectifiable curves.

Mapping of CLOs with PSOs &CDLs			
CLOs No.	**Course Learning Outcomes(CLOs)** After completing this course, the student will be able to	**PSOs Addressed**	**CLDs**
CLO-1	Understand countable and uncountable sets and describe the topological properties on metric space.	PSO-1	Understand
CLO-2	Differentiate continuity and uniform continuity with examples and infer the compactness in continuity and connectedness.	PSO-2	Analyse
CLO-3	Derive the differentiability from limiting of functions and clarify the properties and mean value theorems of differentiable functions.	PSO-4	Evaluate
CLO-4	Explain the concept of Riemann- Stielije'sIntegrability and its properties and discuss Rectifiable curves.	PSO-3	Create
Unit	**Course Content**		**Duration**
1	**Basic Topology** Finite sets, Countable and uncountable sets, The topology of the real line.		12 hours
Extra Reading /Key Words: Countablityand thetopology of the real line.			
2	**Limits and Continuity** Limit of a function Continuous functions, Properties ofcontinuous functions,discontinuities, Monotonicfunctions		12 hours
Extra Reading /Key Words: Limits and Continuity			
3	**Differentiation** Differentiability, Meanvaluetheorems, L'Hospitalrule, Taylor's theorem, Maximaandminima, Functionsof bounded variation		12 hours
Extra Reading /Key Words: Differentiability, Convex and Concave functions			
4	**Riemann-Stieltje'sIntegral** Definition and existence of integral. Propertiesoftheintegral Integrationand differentiation. First andsecondmeanvaluetheorems.		12 hours
Extra Reading /Key Words: Riemann-Stieltje'sIntegral and Motivation for Measure Integrals.			

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	PrinciplesofMathematicalAnalysis	W. Rudin	Int. Student edition,McGrawHill,	3rd	1997
2	MathematicalAnalysis,	T. M. Apostal	AddisonWesley, Narosa, NewDelhi,	2nd	1998
3	Methods OfReal Analysis	R. R. Goldberg	OxfordandIBH,NewDelhi	5th	2008
4	Analysis I and Analysis II,	TorenceTao	HindustanBookAgency, India,	6th	2006
5	ElementaryAnalysis:TheTheoryofCalculus	KennethA. Ross	SpringerInter, Edition,2004.	4th	2008

FIRST YEAR - SEMESTER – I

Course Title	Introduction to Complex Analysis								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)

To enable the students to appreciate and critically evaluate the analytic, harmonic functions and complex integration.

CO No.	Course Objectives
CO-1	To understand the essence of complex field
CO-2	To analyse Analytic functions and exponential functions.
CO-3	To apply Cauchy's theorem for disk and the Integral formula.
CO-4	To understand Local properties of Analytic functions.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Explain the essence of Complex Field	PSO-1	Understand
CLO-2	Analyse Analytic functions and exponential functions.	PSO-2	Analyze
CLO-3	Apply Cauchy's theorem for disk and the Integral formula.	PSO-4	Evaluate
CLO-4	Understand Local properties of Analytic functions.	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Fundamentals of Complex Numbers** Algebra of complex numbers geometric representation of complex numbers Riemann sphere and Stereographic projection Lines, Circles. Limits and Continuity.	12 hours
Extra Reading /Key Words: Stereographic projectionand Limits and Continuity.		
2	**Sequence and Series** Analytic functions Cauchy-Riemann equations Harmonic functions, Polynomials and Rational functions. Elementary theory of power series - sequences, series, uniform convergence of power series, Abel's limit theorem, The elementary functions.	
Extra Reading /Key Words: Analytic functions and sequence of functions		
3	**Topology and Complex Integration** Topology of the complex plane. Linear fractional transformations, Cross-ratio, Symmetry, Elementary conformal mappings. Complex integration – Line integrals, Rectifiable arcs.	12 hours
Extra Reading /Key Words: Cross-ratio, conformal and isogonal mappings and Complex integration		

4	**Cauchy's Theorems** Cauchy's theorem for a rectangle. Cauchy's theorem in a Circular disk, Cauchy's integral formula. Local properties of analytic functions.	12 hours
Extra Reading /Key Words: Cauchy's theorem, Local properties of analytic functions		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Complex Analysis	L. V. Ahlfors	McGraw-Hill, Kogakusha	3rd	1979
2	Functions of one complex variable,	J. B. Conway	Narosa, New Delhi.	2nd	1998
3	Invitation to Complex Analysis	R. P. Boas	The Random House	1st	1987
4	An Introduction to Complex Function Theory	B. C. Palka	Springer	1st	1991
5	Foundations of Complex Analysis,	S. Ponnusamy	Narosa	4th	1995

FIRST YEAR - SEMESTER – I

Course Title	Linear Algebra with Applications							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To introduce the concepts and to develop working knowledge on Vector Spaces, Inner Product Spaces, Linear Transformation on these spaces and their canonical forms and types of linear transformations.

CO No.	Course Objectives
CO-1	To identify the Algebra of Linear Transformations and Characteristics roots.
CO-2	To analyse Linear Transformation.
CO-3	To understand Hermitian, Unitary and Normal Transformation

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the concepts of Liner independence, bases and Dual spaces.	PSO-1	Understand
CLO-2	Discuss Algebra of Linear Transformations and Characteristics roots.	PSO-4	Analyse
CLO-3	Analyze rational canonical forms and Determinants.	PSO-2	Analyse
CLO-4	ApplyHermitian, Unitary and Normal Transformations.	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Vector Spaces** Vector Spaces, Linear Independence and bases, Dual space, Application to find rank and solution of homogeneous system of linear equations	12 hours
Extra Reading /Key Words: Vector Spaces andsystem of linear equations		
2	**Inner Products Space** Inner Products and Norms and Bilinear forms The Gram-Schmidt Orthogonalization Process Orthogonal Complements Linear transformation and matrices, Determinates and cramer's rule	12 hours
Extra Reading /Key Words:Inner Products Space, Orthogonal and Orthonormal sets		
3	**Eigenvalues and Eigenvectors** Eigenvalues and Eigenvectors Cayley-Hamilton Theorem Unitary Transformations, Hermitian Transformations, Normal Transformation	12 hours
Extra Reading /Key Words: Eigenvalues and Eigenvectors and Diagonalizabality		

4	**Canonical Forms** The Real Quadratic form The Triangular form The Jordan Canonical Form The Minimal Polynomial; The Rational Canonical Form	12 hours
Extra Reading /Key Words: Canonical Forms		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Linear Algebra	S. Friedberg, A. Insel, and L. Spence	PHI	4th	2009
2	Linear Algebra	K. Hoffman and R. Kunze	Prentice-Hall of India	2nd	1978
3	Finite Dimensional Vector Space	P. R. Halmos	Princeton, N.J.D.VanNostrand Company	3rd	1958
4	Linear Algebra	Lang. S.	Addison Wesley Pub. Co. Reading, Mass	1st	1972

FIRST YEAR - SEMESTER – I

Course Title	Combinatorics and Graph Theory							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To introduce the concepts and to develop working knowledge on partially ordered sets, Lattices, Boolean Algebra, Permutations, Combinations and basic concepts of Graph Theory

CO No.	Course Objectives

CO-1	To identify the concept of Blocks – Cutpoints of graphs
CO-2	To analyse Königsberg bridge problem.
CO-3	To understand Pigeon-hole principle and its applications

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the definitions namely, cut points, bridges, blocks of graphs	PSO-1	Understand
CLO-2	Apply the knowledge of graph theory knowledge in solving some realworld problems	PSO-5	Apply
CLO-3	Explain Permutations and Combinations and its application	PSO-2	Analyse
CLO-4	Explain Pigeon-hole principle and its applications	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Basics of Lattices** Partially ordered sets, Lattices, Complete lattices, Distributive Lattices Complements, Boolean Algebra, Boolean expressions Application to switching circuits	12 hours
Extra Reading /Key Words: Boolean Algebra		
2	**Permutations and Combinations** Permutations and Combinations Pigeon-hole principle Principle of inclusion and exclusion	12 hours
Extra Reading /Key Words:Aplications of permutations and Combinations		
3	**Basics of Graphs** The Königsberg bridge problem Definition, Vertices of graphs, Walks and connectedness, Degrees Operations on graphs,	12 hours
Extra Reading /Key Words:Traversability and line graphs		

4	**Blocks and acyclic graphs** Blocks - Cut points, bridges Block graphs and Cut point graphs Tree-Elementary properties of trees	12 hours
Extra Reading /Key Words:Connectivity and line connectivity		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Elements of Discrete Mathematics	C. L. Liu	McGraw-Hill	1st	1986
2	Discrete Mathematics and its Applications	Kenneth H. Rosen	McGraw-Hill	4th	2002
3	Graph Theory	F. Harary	Addition Wesley Reading Mass	1st	1969
4	Basic Graph Theory	K. R. Parthasarathy	Tata McGraw-Hill, New Delhi	2nd	1994
5	Introduction to Graph Theory	D. B. West	Pearson EducationInc.,	2nd	2001

FIRST YEAR - SEMESTER – I

Course Title	Probability And Statistics							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	
COURSE OBJECTIVES (COs) To study probability density function, Mathematical Expectation, Marginal and Conditional								

Distributions, Some Special Distributions and The Central Limit Theorem.

CO No.	Course Objectives
CO-1	To understand some special mathematical expectations and Chebyshev's inequality.
CO-2	To study Marginal and conditional distributions, the correlation co-efficient and Stochastic independence.
CO – 3	To apply the Trinomial and Multinomial Distributions, The Poisson Distribution and The Gamma and Chi-square distributions to solve problems.
CO – 4	To study the t & F distributions and their applications.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand some special mathematical expectations and Chebyshev's inequality.	PSO-1	Understand
CLO-2	Study Marginal and conditional distributions, the correlation co-efficient and Stochastic Independence.	PSO-2	Analyse
CLO-3	Apply the Trinomial and Multinomial Distributions, The Poisson Distribution and The Gamma and Chi-square distributions to solve problems.	PSO-5	Apply
CLO-4	Study the t & F distributions and their applications.	PSO-5	Apply

Unit	Proposed Course Content	Duration
1	**Probability Density Functions** Random variables The probability density functions The distribution function Certain probably models Mathematical expectation Some special mathematical expectation Chebyshev's inequality.	12 hours

Extra Reading /Key Words: Probability Density Functions

2	**Marginal and conditional distributions** Conditional probability Marginal and conditional distribution The correlation and co-efficient Stochastic independence.	12 hours
Extra Reading /Key Words:Conditional probability, Marginal and conditional distributions		
3	**Distributions** The Binomial and the Trinomial Distributions Multinomial Distributions The Poisson Distribution The Gamma and Chi-square distribution The Normal distribution.	12 hours
Extra Reading /Key Words: The Binomial and the Trinomial Distributions		
4	**The t & F distributions** Sampling theory transformations of variables of the discrete type Transformations of variables of continuous type The t & F distributions - Distribution of order statistics.	12 hours
Extra Reading /Key Words:t & F distributions		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Introduction to Mathematical Statistics	R.V. Hogg and A.T. Craig,	Macmillan	1st	1978
2	A Basic Course in Probability Theory,	R. Bhattacharya and E. C. Waymire	Springer	2nd	2007
3	An Introduction to Probability and Statistics	A. K. Md. EshanesSalah andV.K.Rahotgi	Wiley	3rd	2015
4	An Introduction to Probability Theory and Its Applications, Vol. 1 and Vol.2	W. Feller	Wiley	3rd	1968

FIRST YEAR - SEMESTER – II

Course Title	Rings and Field Theory							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100

			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To introduce the concepts and to develop working knowledge on
Rings, Field theory and Field Extension

CO No.	Course Objectives
CO-1	To understand the properties of rings and fields.
CO-2	To know the application of homomorphism and field extension
CO-3	To locate the different field extensions

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand theconcept of rings	PSO-1	Understand
CLO-2	Apply the properties of different ideals	PSO-5	Apply
CLO-3	Discuss Extension fields and Roots of polynomials.	PSO-3	Analyze

Unit	Proposed Course Content	Duration
1	**Rings** Rings, Integral domains and Fields, Homomorphisms, Ideals and Quotient Rings, Prime and Maximal ideals	12 hours
Extra Reading /Key Words:Rings and its Homomorphisms		
2	**Ideal** Euclidean and principal ideal rings, Polynomials, Zeros of a polynomial, Factorization, Irreducibility criterion.	12 hours
Extra Reading /Key Words:Ideals and Polynomial rings		

3	**Fields** Adjunction of roots, Kronecker's lemma, Algebraic and transcendental extensions Finite fields.	12 hours
Extra Reading /Key Words:Kronecker's lemma, Algebraic and transcendental extensions		
4	**Extensions of fields** Separable and inseparable extensions Perfect and imperfect fields Theorem on the primitive element.	12 hours
Extra Reading /Key Words: Separable and inseparable extensions, Perfect and imperfect fields		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Algebra	Thomas W. Hungerford	Springer International Edition, New York.	2nd	2002
2	Algebra	Michael Artin	Prentice-Hall of India, New Delhi	2nd	2015
3	Contemporary Abstract Algebra	Joseph A. Gallian	Narosa	4th	1999
4	Abstract Algebra	D. S. Dummit and R. M. Foote	John Wiley and Sons,	2nd	1999
5	Topics in Algebra	I. N. Herstein	John Wiley & Sons	2nd	1975
6.	A First course in Abstract Algebra,	J. B. Fraleigh	Addison-Wesley	7th	2003
7	University Algebra	N. S. Gopalakrishnan	New Age International	2nd	1986

FIRST YEAR - SEMESTER – II

Course Title	Real Analysis-III						
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15		30 Marks	100

			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To learn the sequences and series functions and their convergence, uniform convergence, differentiation and helps to understand the concept of functions of several along with proofs of Taylor`s theorem.

CO No.	Course Objectives
CO-1	To Understand Uniform convergence and continuity.
CO-2	To Study the Stone-Weierstrass theorem and its applications.
CO-3	To Study the Taylor's theorem and its applications.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand Uniform convergence and continuity.	PSO-3	Understand
CLO-2	Apply the properties exponential and logarithmic functions.	PSO-2	Apply
CLO-3	Analyze the functions of two variables.	PSO-1	Analyse

Unit	Proposed Course Content	Duration
1	**Sequences and series of functions** Sequences and series of functions Discussions of main problem Uniform convergence, Uniform convergence and continuity Uniform convergence and integration Uniform convergence and differentiation	12 hours
Extra Reading /Key Words: Sequences of functions		
2	**Special functions** Power series The exponential and logarithmic functions The trigonometric functions Improper integrals and their convergence	12 hours
Extra Reading /Key Words: Special functions		

3	**Functions of two Variables** Functions of two variables. Partial derivatives Continuity and differentiability The chain rule, Jacobians	12 hours
Extra Reading /Key Words: Functions of several variables		
4	**Implicit Function and Taylor's Theorem** The Implicit function theorem Taylor's theorem, Maxima and Minima Lagrange's multipliers	12 hours
Extra Reading /Key Words: Implicit Function and Lagrange's multipliers		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	PrinciplesofMathematicalAnalysis	W. Rudin	Int. Student edition,McGrawHill,	3rd	1997
2	MathematicalAnalysis	T. M. Apostal	AddisonWesley, Narosa, NewDelhi,	2nd	1998
3	Methods of Real Analysis	R. R. Goldberg	OxfordandIBH,NewDelhi	5th	2008
4	Analysis I and Analysis II	TorenceTao	HindustanBookAgency, India,	6th	2006
5	ElementaryAnalysis:TheTheoryofCalculus	KennethA. Ross	SpringerInter, Edition,2004.	4th	2008

FIRST YEAR - SEMESTER – II

Course Title	Advanced Complex Analysis						
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15		30 Marks	100

			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To enable the students to appreciate and critically evaluate the residues, harmonic functions and infinite products

CO No.	Course Objectives
CO-1	To understand Residues and argument principles.
CO-2	To know the nature of harmonic functions.
CO-3	To express entire function in Taylor series.
CO-4	To understand infinite products of complex numbers through Jensen's formula and Hadamard's theorem.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand Residues and argument principles	**PSO-1**	Understand
CLO-2	Explain the nature of Harmonic functions	**PSO-2**	Analyse
CLO-3	Apply Taylor's series to study the annulus of convergence.	**PSO-5**	Apply
CLO-4	Evaluate infinite products of complex numbers through Jensen's formula and Hadamard's theorem.	**PSO-2**	Evaluate

Unit	Proposed Course Content	Duration
1	**Residues** The Calculus of Residues The residue theorem, argument principle Evaluation of definite integrals.	12 hours

Extra Reading /Key Words: Residues and Complex Integration

2	**Harmonic functions** Harmonic functions – Definition and basic properties Mean value property Poisson's formula, Schwarz's theorem and reflection principle	12 hours
Extra Reading /Key Words: Harmonic functions		
3	**Power series** Power series expansions The Weierstrass theorem The Taylor series The Laurent series.	12 hours
Extra Reading /Key Words: Taylor seriesand Laurent series.		
4	**Partial fractions and Entire Functions** Partial fractions and factorization Partial fractions, Mittag - Leffer's theorem Infinite products, Canonical products, The Gamma and Beta functions, Sterling's formula. Entire functions – Jensen's formula, Hadamard's theorem	12 hours
Extra Reading /Key Words: Entire functions and Infinite products		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Complex Analysis	L. V. Ahlfors	McGraw-Hill	3rd	1979
2	Functions of one complex variable,	J. B. Conway	Narosa, New Delhi.	2nd	1998
3	Invitation to Complex Analysis	R. P. Boas	The Random House	1st	1987
4	An Introduction to Complex Function Theory	B. C. Palka	Springer	1st	1991
5	Foundations of Complex Analysis,	S. Ponnusamy	Narosa	4th	1995

FIRST YEAR - SEMESTER – II

Course Title	Ordinary and Partial Differential Equations						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	04	Credits	04

Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To introduce advanced concepts in differential equation and to make familiar with its applications.

CO No.	Course Objectives
CO-1	To understand ODE and its standard properties of the solution.
CO-2	To apply power series method and some standard methods to solve them.
CO-3	To interpret the PDEs and to find the integral surfaces.
CO-4	To understand Heat, Laplace and Wave Equation

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand ODE's and their standard properties of the solution.	**PSO-1**	Understand
CLO-2	Apply power series method and some standard methods to solve the ODE's.	**PSO-3**	Apply
CLO-3	Interpret the PDEs and to find the integral surfaces.	**PSO-2**	Analyse, Evaluate
CLO-4	Describe Heat, Laplace and Wave Equation.	**PSO-5**	Analyse
CLO-5	Express realworld problems mathematically using differential equations.	**PSO-5**	Creating
Unit	Proposed Course Content		**Duration**

1	Ordinary Differential Equations First order equations Existence and uniqueness theorems Continuous dependence on initial conditions Wronskian theory Explicit methods to find solutions, method of variation of parameters Review of linear differential equations with constant & variable coefficients, Fundamental existence and uniqueness theorem for system and higher order equations (Picard's and Piano theorems), System of linear differential equations, an operator method for linear system with constant coefficients, Phase plane method.	12 hours
Extra Reading /Key Words: Ordinary Differential Equations, Fundamental existence and uniqueness theorem		
2	**Series Solutions and Second Order ODE** Power series solutions Ordinary points, regular and irregular singular points. Sturm separation and comparison theorems. Sturm-Liouville equations, Green's functions, Construction of Green's functions Eigenvalues and Eigen functions of Sturm-Liouville equations, Eigen function expansions.	
Extra Reading /Key Words: Green's functions and Sturm-Liouville problem		
3	**Partial differential equations** Order and degree, Origin of first-order PDE, Determination of integral surfaces of linear first order partial differential Equations passing through a given curve, Surfaces orthogonal to given system of surfaces, Non-linear PDE of first order, Cauchy's method of characteristics, Compatible system Charpit's method, Jacobi's method of solution.	12 hours
Extra Reading /Key Words: Partial Differential Equations and Cauchy's method of characteristics		
4	**Three Fundamental Equations** Classification of second order semi-linear partial differential equations, Derivations of heat equation, Laplace equation and wave equation, Solutions of heat equation, Laplace equation and wave equation by the method of separation of variable	12 hours
Extra Reading /Key Words: Heat, Laplace and wave equation		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Differential Equations with Applications and Historical Notes	George F. Simmons	Tata McGraw Hill, New Delhi	3rd	2003
2	Elementary differential equations and boundary value problems	Williams E Boyce and Richard.C. DI Prima,	John Wiley and sons, New York	1st	1967
3	An Introduction to Ordinary Differential Equations	Earl A. Coddington	Prentice Hall of India Private Ltd. New Delhi	2nd	1991
4	Elements of Partial Differential Equations	Ian N. Sneddon,	Dover Publications, Inc. Mineola, New York	2nd	2006
5	Partial Differential Equations for Scientists and Engineers	S. J. Farlow	Dover Publications, Inc. Mineola, New York	1st	1993

FIRST YEAR - SEMESTER – II

Course Title	Operations Research							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To discuss the methods of solving Integer Programming Problems, NLPP programming algorithms and Inventory models.

CO No.	Course Objectives
CO-1	To remember the simplex and graphical method of LPP to solve the IPP.
CO-2	To understand and apply dynamic programming problems in any multistage situation to make series of decisions.
CO-3	Understand and apply the procedure to make decisions in real life problems.
CO-4	Understand the class of inventory models and applies the technique to find solution.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the methods of solving integer programming problems.	PSO-1	Understand
CLO-2	Determine the solution for LPP in multistage.	PSO-2	Analyze
CLO-3	Understand game theory to find solutions to problems.	PSO-5	Evaluate
CLO-4	Understand the concept of EOQ models and its types.	PSO-3	Understand
CLO-5	Discusses The Methods Of Solving Integer Programming Problems, NLPP Programming Algorithms And Inventory Models - Skill Development.	PSO-1	Apply

Unit	Proposed Course Content	Duration
1	**Integer Programming Problem** Introduction Gomory's All –IPP Method Gomory's mixed integer method Branch and bound method Zero-one programming problems.	12 hours
Extra Reading /Key Words:Integer Programming Problemmethods		
2	**Dynamic Programming** Introduction The recursive equation approach Characteristics of Dynamic Programming Dynamic Programming algorithm Solution of discrete Dynamic Programming problem Solution of LPP by Dynamic Programming.	12 hours
Extra Reading /Key Words:Dynamic Programming		

3	**Games And Strategies** Introduction Two person zero sum games The maximin - minimax principle, Games without Saddle points Mixed Strategies-Solution of 2x 2 rectangular games-Graphical method Dominanceproperty-Algebraic method for m x n games.	12 hours
Extra Reading /Key Words: Games And Strategies		
4	**Inventory Models** EOQ problem with price breaks Multi item Deterministic problem Inventory problem with uncertain demand Systems of Inventory Control – Probabilistic inventory problems	12 hours
Extra Reading /Key Words:Inventory ModelsandSystems of Inventory Control		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Operation Research	Gupta P.K and Hira S.	S Chand &Co.Ltd.New Delhi.	2nd	2005
2	Operation Research Methods & Applications.	Mariappan .P.	New Century Book House Private Limited	3rd	2001
3	Operation Research .	PanneerSevvam	Prentice Hall of India Pvt , New Delhi	5th	2003
4	Operation Research Theory & Applications	Sharma J.K.	Macmillan India Limited, Chennai	3rd	2007
5	Operations Research An Introduction	TahaHamadyA	Pearson Education Publishing Limited, New Delhi.	4th	2002

FIRST YEAR - SEMESTER – II

Course Title	Classical Mechanics							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To contribute a thorough knowledge about the mechanical system of particles, applications of Lagrange's equations and Hamilton's equations.

CO No.	Course Objectives
CO-1	To understand the preliminaries of mechanical system.
CO-2	To determine the equation of motion for the mechanical system using Lagrange's equation.
CO-3	To interpret the applications of Lagrange's equation.
CO-4	To determine the solution of various dynamical systems by applying the Hamilton's principle.

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs	CLDs
CLO-1	Recall and relate the basic notions of the mechanical system.	**PSO-1**	**Remember**
CLO-2	Derive Lagrange's equations from D'Alembert's and Hamilton's principles and apply these equations to holonomic and non holonomic systems.	**PSO-2**	**understand**
CLO-3	Compare Lagranges equation and Hamilton's equations.	**PSO-1**	**remember**
CLO-4	Build the nature of the dynamics is reflected in the properties of the phase space trajectories.	**PSO-5**	**understand**

Unit	Proposed Course Content	Duration

1	**Introductory Concepts** The mechanical system -Equations of motion Units- Generalised co-ordinates Degrees of freedom ,configuration space – example Constraints -Holonomic ,non holonomic and unilateral constrainsVirtual Work -Virtual displacement - principle of virtual work D'Alembert's principle, Generalised force Energy and Momentum.	12 hours
Extra Reading /Key Words:Equations of motion and Degrees of freedom		
2	**Lagrange's Equations** Derivation of Lagrange's Equations Spherical and double pendulum Lagrange multipliers and constraint forces Integrals of the motion -Ignorable co-ordinate The kepler's problem Routhian function - conservative system – natural systems,Liouville's System.	12 hours
Extra Reading /Key Words:Lagrange multipliers and conservative system		
3	**Special Applications Of Lagrange's Equations** Rayleigh's Dissipation function, Gyroscopic system – velocity dependent potentials Hamilton's Principle Stationary values of a function - constrained stationary values stationary value definite integral The brachistochrone problem – Geodesic path Non-holonomic systems , Multipliers rule	12 hours
Extra Reading /Key Words:Hamilton's Principle and Non-holonomic systems		
4	**HAMILTON'S EQUATIONS** Hamilton's equations-Derivation of Hamilton's equations The form of Hamilton function,Legendre transformation Other variational principles , Modified Hamilton's principle , Principle of least action and example - Phase space.	12 hours
Extra Reading /Key Words: Legendre transformation and Principle of least action		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Classical Dynamics	Greenwood D.T.	Prentice Hall of India	3rd	1979

2	An Introduction To Fluid Dynamics	Batchelor G.K.	ManasSaikia for foundation Books Pvt Ltd, NewDelhi	2nd	2005
3	Classical Mechanics	Gupta S.L, Kumar. V, Sharma.H.V	PragathiPrakashan, Meerut.	19th	2003
4	Mechanics Of Fluids	Irving H.Shames	McGraw Hill Company Limited, New Delhi. .	4th	2003
5	Classical Mechanics	Rana N.C., Joag P.S.	Tata McGraw Hill Company Limited,New Delhi.	5th	2004

FIRST YEAR - SEMESTER – II

Course Title	Numerical Computations in Science –I							
Course Type	Hard Core- Theory		Total Hours	32	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	To solve nonlinear equations in one variable and system of equations
CO-2	To solve interpolation problems and to approximate solutions of differential equations.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Solve nonlinear equations in one variable and system of equations	PSO-1	Apply

CLO-2	Solving a differential equation using an appropriate numerical methods.	PSO-5	Apply

Unit	Proposed Course Content	Duration
1	**Systems of equations and Interpolations** **Iterative methods:**Bisection method, Newton-Raphson method, Secant method, the method of successive approximations. Solution of a polynomial equation **Linearalgebraicequations:** TheGausseliminationmethod,LUdecompositionmethod,Gauss-Jordon method, Anintroduction tothesolutionofsimultaneous non-linearequations. **Interpolations:**Introduction, Newton interpolation formulae,extrapolation,Lagrangeinterpolation. Splineinterpolation.	16 hours
Extra Reading /Key Words:Systems of equations and Interpolations		
2	**NumericalIntegration and Solution of Differential equation.** **Least-squares approximation of functions**: Introduction, linearregression, algorithm for linear regression. Polynomial regression, fitting exponential and trigonometric functions. **Numericalintegration**:Trapezoidalmethod,Simpson'srule,errors andalgorithms.Gaussian quadratureformulae. **Numerical solution of differential equations**: Euler method, Runge-Kutta methods, Runge- Kutta 4th order formulae, redictor-corrector method. Comparison of predictor-corrector and Runge-Kutta methods.	16 hours
Extra Reading /Key Words:Least-squares approximation and Numericalintegration		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Anintroduction tonumerical analysis	AtkinsonK.E.	John Wiley andSons,USA	1st	1988
2	Numerical recipesinC	Press W.H., Flannery B.P., Teukolsky S.A. and Vetterling W.T	CambridgeUniversityPress,UK,1989	2nd	2007
3	Numerical Methods for Scientific and Engineering	Computation M.K. Jain, S.R.K. Iyengar and R.K.Jain	New Age International Publishers	4th	2003

FIRST YEAR - SEMESTER – II

Course Title	LATEX-Type Setting (Self Study Paper)							
Course Type	Hard Core- Theory		Total Hours	-	Hours/Week	-	Credits	02
Course Code		Evaluation	Internal				15 Marks	50
			External	Duration	C3	02Hrs	35 Marks	

COURSE OBJECTIVES (COs)

To enable the students to acquire knowledge about type setting of LATEX in the preparation of documents and promote them to create research article in portable document file format.

CO No.	Course Objectives
CO - 1	Illustrate simple type setting of Latex with font size and font type.
CO - 2	Understand page setting and numbering of documents.
CO - 3	Acquire knowledge about parts of a document and understand how to divide the document.
CO - 4	Illustrate basic commands and custom commands.
CO - 5	Exemplify Mathematics miscellany with new operators and understands many faces of mathematics like Symbols.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO - 1	Understand simple type setting of Latex with font size and font type.	**PSO -6**	U
CLO - 2	Acquire knowledge about type setting of LATEX in the preparation of documents and promote them to create research article in portable document file format - Skill Development.	**PSO - 6**	An
Unit	**Proposed Course Content**		**Duration**

1	**The Document** Latex - A small example Simple typesetting, Fonts Type size. Document Class Page style Page numbering.	12 hours
2	**TYPESETTING MATHEMATICS** Formatting length Parts of a document Dividing the document. Custom commands, More on mathematics. Mathematics miscellany, New operators The many faces of mathematics – Symbols.	12 hours

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Practical Latex	George Gratzer	Springer	1st	2014
2	Treatment and content as in Latex Tutorials	-	**Indian TEX Users Group, Trivandrum, India.**	-	-

FIRST YEAR - SEMESTER – II

Course Title	Maple – A Mathematical tool (Self Study Paper)							
Course Type	Hard Core- Theory		Total Hours	24	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To enable the students to get exposed to standard mathematical packages.

CO No.	Course Objectives
CO-1	To introduce the language of Computer algebra system -Maple.
CO-2	To make the students to visualise sequences, series and functions.
CO-3	To approximate various solutions using commands in Maple
CO-4	To know the nature of few functions through plots.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the significance of Maple	**PSO-2**	**Understand**
CLO-2	Visualise sequences, series and functions.	**PSO-3**	**Apply**
CLO-3	Approximate various solutions using commands in Maple	**PSO-5**	**Apply**
CLO-4	Interpret the nature of few functions through plots.	**PSO-2**	**Analyze**

Unit	Proposed Course Content	Duration
1	**Introduction** How to Get Started Entering Math Combining Text and Math Solving Equations Expressions, Functions, and Procedures Commands and Packages	**12 hrs**
2	**Plotting and Data Structures** 2-D and 3-D Plots Working with Matrices Creating Matrices and Vectors Data Structures Sequences Arrays, Matrices and Vectors	**12hrs**

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Introduction to Mathematics with maple	P AdamsK.Smith and Rudolf Vyborny	Word Scientific	1st	2004
2	Maple-Portal Tutorial	-	-	-	-

SECOND YEAR - SEMESTER – III

Course Title	Elements of Functional Analysis							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To study the Normed linear spaces, Banach spaces, Hilbert Spaces, and operators on these spaces.

CO No.	Course Objectives
CO-1	To understand the properties of contraction mapping.
CO-2	To know the application of Open mapping theorem.
CO-3	To study theorthogonal complements and conjugate space.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Study Continuous linear transformations and the Hahn-Banach theorem.	PSO-1	Understand
CLO-2	Understand the Open Mapping Theorem and its	PSO-1	Understand

	applications.		
CLO-3	Obtain Orthogonal complements, Orthonormal sets and conjugate space.	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Metric Completion.** Metric completion. Banach's contraction mapping theorem and applications, Baire' category theorem, Ascoli - Arzela theorem	12 hours
Extra Reading /Key Words: Completion ,isometry		
2	**Normed Linear Space** Linear spaces and linear operators, Norm of a bounded operator The Hahn – Banach extension theorem Stone - Weirstrass theorem	12 hours
Extra Reading /Key Words: Defining Norm and Hilbert Space		
3	**Banach Space** Open mapping theorem, Closed Graph theorems The Banach –Steinhaus Principle Of Uniform Boundedness	12 hours
Extra Reading /Key Words: Projections on Banach spaces		
4	**Hilbert Spaces** The orthogonal projection Nearly orthogonal elements, Riesz's lemma, Riesz's representation theorem.	12 hours
Extra Reading /Key Words: Orthonormal spaces		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Introduction to Topology and Modern Analysis	G. F. Simmons	Tata McGraw-Hill	2nd	2002
2	Introduction to Functional Analysis	A. E. Taylor	Wiley, New York,	1st	1958

3	Elements of Functional Analysis	A. Page and A. L. Brown	Van Nostrand Reinhold Company	1st	1970
4	Functional Analysis	George Bachman and Lawrence Narici	Dover Publications	2nd	2000
5	A Course in Functional Analysis	J. B. Conway	Springer	2nd	1985
6.	Introductory functional analysis with applications	Erwin Kreyszig	Wiley, New York	1st	1978

SECOND YEAR - SEMESTER – III

Course Title	Topology-I							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To learn the essentials of topological spaces and their properties in terms of continuity, connectedness and compactness.

CO No.	Course Objectives
CO-1	To understand the topological spaces.
CO-2	To discuss the continuous functions
CO-3	Toanalyze the connected spaces.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the topological spaces	PSO-3	Understand

CLO-2	Discuss Continuous functions	PSO-2	Apply
CLO-3	Analyze Connected spaces	PSO-1	Analyze

Unit	Proposed Course Content	Duration
1	**Topological Space.** Definitions and examples Basis for a topology The order topology The product topology on X xX, The subspace topology Closed sets and limit points	12 hours
Extra Reading /Key Words:Seperable space, countable base		
2	**Continuous Functions** Continuous functions The product topology The metric topology The quotient topology	12 hours
Extra Reading /Key Words:Normality of continuous functions, Convexity and continuity		
3	**Connectedness** Connected spaces Connected sets on the real line Path connectedness	12 hours
Extra Reading /Key Words:continuity and connectedness		
4	**Compactness** Compact spaces Compact sets on the real line Limit point compactness Local compactness	12 hours
Extra Reading /Key Words:continuity and compactness		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	A First Course in Topology	J. R. Munkres	Prentice Hall India	2nd	2000
2	Introduction to Topology and Modern Analysis	G. F. Simmons	McGraw-Hill, Kogakusha	1st	1968

3	General Topology	S. Willard	Addison Wesley, New York	1st	1970
4	Topology	J. Dugundji	Allyn and Bacon, Boston	1st	1966
5	Introduction to topology	Bert Mendelson	Dover Publication	3rd	1990

SECOND YEAR - SEMESTER – III

Course Title	Theory of Numbers							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To learn basic knowledge of numbers, functions like arithmetical, Mobius function, Euler function. It will give the glimpse of Fibonacci and Lucas series and describes the concept of continued fraction.

CO No.	Course Objectives
CO-1	To understand the Fundamental theorem of Arithmetic.
CO-2	To Discuss Arithmetical Functions.
CO-3	To introduce the application of continued fraction

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the Fundamental theorem of Arithmetic	PSO-3	Understand
CLO-2	Discuss the Arithmetical Functions	PSO-2	Apply
CLO-3	Apply the knowledge of continued fraction in	PSO-1	Apply

	approximation		
Unit	**Proposed Course Content**		**Duration**
1	**Prime Numbers and Farey series** Prime numbers The Fundamental theorem of Arithmetic The series of Reciprocals of primes The Euclidean Algorithm. Fermat and Mersenne numbers Farey series, Farey dissection of the continuum Irrational numbers-Irrationality of m^{th} root of N, e and π		12 hours
Extra Reading /Key Words: Prime NumbersandFarey series			
2	**Arithmetical Functions** Arithmetical Functions – The Mobius function, The Euler' function and Sigma function The Dirichlet product of Arithmetical functions Multiplicative functions Averages of Arithmetical functions – Euler summation formula, Some elementary asymptotic formulas The average orders of d(n), $\sigma(n)$, $\varphi(n)$, $\mu(n)$ An application to the distribution of lattice points visible from the origin		12 hours
Extra Reading /Key Words: Arithmetical Functions and Multiplicative functions			
3	**Continued fractions-I** Finite continued fractions Convergent of a continued fraction Continued fractions with positive quotients Simple continued fractions(SCF) The representation of an irreducible rational fraction by a SCF		12 hours
Extra Reading /Key Words: Finite Continued fractions			
4	**Continued fractions-II** The continued fraction algorithm and Euclid's algorithm The difference between the fraction and its convergent Infinite simple continued fractions The representation of an irrational number by an infinite continued fraction Equivalent numbers and periodic continued fractions, some special quadratic surds		12 hours
Extra Reading /Key Words: Infinite Continued fractions			

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	An Introduction to Theory of Numbers	G. H. Hardy and E. M. Wright	Oxford University Press	5th	1979
2	An Introduction to the Theory of Numbers	I. Niven, H. S. Zuckerman and H. L. Montgomery	John Wiley and Sons, Inc., New York	5th	2004
3	Ramanujan's Note Books Volume-1 to 5	Bruce C. Berndt	Springer		
4	Number Theory	G. E. Andrews	Dover Books	1st	1994
5	Introduction to Analytic Number Theory	T. M. Apostol	Narosa Publishing House, New Delhi	1st	1998

SECOND YEAR - SEMESTER – III

<table>
<tr><td>Course Title</td><td colspan="9">Graph Theory</td></tr>
<tr><td>Course Type</td><td colspan="2">Soft Core- Theory</td><td>Total Hours</td><td>48</td><td>Hours/Week</td><td>04</td><td>Credits</td><td colspan="2">04</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2"></td><td rowspan="2">Evaluation</td><td>Internal</td><td colspan="3">C1+C2 = 15+15</td><td colspan="2">30 Marks</td><td rowspan="2">100</td></tr>
<tr><td>External</td><td>Duration</td><td>C3</td><td>03Hrs</td><td colspan="2">70 Marks</td></tr>
<tr><td colspan="10">COURSE OBJECTIVES (COs)

Tounderstand the fundamentals of concepts of graph theory. Also able to describe the idea of line graphs, distance concept, colorablity, relations between graphs and matrices.</td></tr>
<tr><td>CO No.</td><td colspan="9">Course Objectives</td></tr>
<tr><td>CO-1</td><td colspan="9">To understand the definitions namely, cut vertex, bridge and blocks of a graph.</td></tr>
<tr><td>CO-2</td><td colspan="9">To study the properties of trees and connectivity.</td></tr>
<tr><td>CO-3</td><td colspan="9">To identify Eulerian graphs and apply results to identify Hamiltonian graphs.</td></tr>
<tr><td>CO-4</td><td colspan="9">To understand the concepts Planarity including Euler identity.</td></tr>
<tr><td colspan="10">Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. The</td></tr>
</table>

keywords are used at the end of each unit to define CLOs.			
CLOs No.	**Course Learning Outcomes (CLOs)** After completing this course, the student will be able to	**PSOs Addressed**	**CLDs**
CLO-1	Understand the definitions namely, cut vertex, bridge and blocks of a graph.	PSO-1	Understand
CLO-2	Identify Eulerian graphs and apply results to identify Hamiltonian graphs.	PSO-2	Apply
CLO-3	Discuss and understand the importance of the concepts Matchings and Colorings.	PSO-5	Apply
Unit	**Proposed Course Content**		**Duration**
1	**Trees and Connectivity** Characterization of trees, Spanning Tree, Centres and centroids. Cut-points, bridges, and blocks Block graphs and cut-point graphs Connectivity and line connectivity		12 hours
Extra Reading /Key Words:Topological indices			
2	**Traversability and line graphs** Euler graphs and Hamiltonian graphs Definition and Some properties of line graphs Characterization of line graphs Line graphs and traversability.		12 hours
Extra Reading /Key Words: Hypo hamiltonian , Hypo traceable			
3	**Factorization and Planarity** 1-factorization and 2-factorization Planar graphs and Euler's formula Vertex colouring , Chromatic number		12 hours
Extra Reading /Key Words: Plane triangulation, tri colouring			
4	**Algebraic Graph Theory and Domination Theory** The adjacency matrix, The incidence matrix The cycle matrix Domination numbers -Some elementary properties		12 hours
Extra Reading /Key Words: Distance matrix			

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Graph Theory	Frank Harary	Addition Wesley Reading Mass	3rd	1969
2	Graph Theory with applications	J. A. Bondy and U. S. R. Murthy	Elsevier	2nd	1976
3	Graph Theory With Applications to Engineering and Computer Science	N. Deo	Prentice Hall of India	1st	1987
4	Basic Graph Theory	K. R. Parthasarathy	Tata McGraw-Hill, New Delhi	2nd	1994
5	Introduction to Graph Theory	D. B. West	Pearson Education Inc.	2nd	2001
6	Domination Theory	V. R. Kulli	Vishwa International Publications	4th	2012

SECONDYEAR - SEMESTER – III

Course Title	Galois Theory							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To learn the idea of Galois Theory in abstract algebra it also extends the concept of Galois Theory in a field.

CO No.	Course Objectives
CO-1	To Discuss The basic isomorphisms of algebraic field theory.
CO-2	To Study the field extension.
CO-3	To understand the elements of Galois Theory.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Discuss The basic isomorphisms of algebraic field theory.	PSO-3	Understand
CLO-2	Study the field extension	PSO-2	Apply
CLO-3	Understand the elements of Galois Theory	PSO-1	Apply

Unit	Proposed Course Content	Duration
1	**Algebraic study of fields** Algebraically closed fields and algebraic closures The existence of an algebraic closure The basic isomorphisms of algebraic field theory	12 hours
Extra Reading /Key Words: Existence of an algebraic closure		
2	**Algebraic study of fields** Automorphisms and fixed fields The Frobeniusautomorphism The isomorphism extension theorem	12 hours
Extra Reading /Key Words: Isomorphism extension theorem		
3	**Field extension** The index of a field extension Splitting fields Separable extensions Perfect fields Normal extensions	12 hours
Extra Reading /Key Words:Galois groups over the rationals		
4	**Galois theory** The main theorem of Galois theory Galois groups over finite fields Symmetric functions Cyclotomic extensions Constructible numbers	12 hours
Extra Reading /Key Words: solvability by radicals		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	A First Course in Abstract Algebra	J. B. Fraleigh	Narosa Publishing House	3rd	2013
2	Galois Theory	Ian Steward	Chapman and Hall	3rd	1945
3	Galois Theory	Joseph Rotman	Universitext Springer	2nd	1998
4	Algebra	Michael Artin	Prentice-Hall of India, New Delhi	5th	1991
5	Contemporary Abstract Algebra	Joseph A. Gallian	Narosa Publishing House	4th	1999
6	Abstract Algebra	D. S. Dummit and R. M. Foote	John Wiley and Sons	5th	1999
7	Topics in Algebra	I. N. Herstein	Vikas Publishing House, New Delhi	4th	1997

SECOND YEAR - SEMESTER – III

<table>
<tr><td>Course Title</td><td colspan="9">Commutative Algebra</td></tr>
<tr><td>Course Type</td><td colspan="2">Hard Core- Theory</td><td>Total Hours</td><td>48</td><td>Hours/Week</td><td>04</td><td>Credits</td><td colspan="2">04</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2"></td><td rowspan="2">Evaluation</td><td>Internal</td><td colspan="3">C1+C2 = 15+15</td><td colspan="2">30 Marks</td><td rowspan="2">100</td></tr>
<tr><td>External</td><td>Duration</td><td>C3</td><td>03Hrs</td><td colspan="2">70 Marks</td></tr>
<tr><td colspan="10">COURSE OBJECTIVES (COs)

To give the extended idea of rings, ideals, nilpotent, units, nilradicals, modules, Artinian and Noetherian rings and Artinian and Noetherian modules.</td></tr>
<tr><td>CO No.</td><td colspan="9">Course Objectives</td></tr>
<tr><td>CO-1</td><td colspan="9">To give the extended idea of rings, ideals, nilpotent, units, nil radicals</td></tr>
<tr><td>CO-2</td><td colspan="9">To introduce module theory.</td></tr>
<tr><td>CO-3</td><td colspan="9">To study Artinian and Noetherian modules.</td></tr>
<tr><td colspan="10">Mapping of CLOs with PSOs &CDLs</td></tr>
</table>

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the properties of Nilradicals, Jacobson radicals	PSO-1	Understand
CLO-2	Explain Modules properties	PSO-2	Analyze
CLO-3	Identify Noetherian and Artinian Modules	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Rings and ideal** Rings and ring homomorphisms, Ideals and Quotient rings Zero-divisors, nilpotent elements and units, Prime ideals and maximal ideals.	12 hours
Extra Reading /Key Words:Local Ring		
2	**Radicals** The prime spectrum of a ring The nil radical and Jacobson radical Operation on ideals Extension and contraction	12 hours
Extra Reading /Key Words:Operation on ideals		
3	**Modules** Modules and modules Homomorphisms Submodules and quotient modules	12 hours
Extra Reading /Key Words:Modules		
4	**Direct sums and Free module** Direct sums, Free modules Finitely generated modules Nakayama Lemma, Simple modules Exact sequences of modules	12 hours
Extra Reading /Key Words: Schur's Lemma		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Introduction to Commutative Algebra,	M. F. Atiyah and I. G. Macdonald	Avalon Publishing	1st	1994
2	Introduction to Rings and Modules	C. Musili	Narosa Publishing House	1st	1997
3	Under-graduate Commutative Algebra	Miles Reid	Cambridge University Press	1st	1995
4	Commutative Algebra	N. S. Gopalakrishnan,	Oxonian Press	1st	1984
5	Commutative algebra- With a view toward algebraic geometry.	David Eisenbud,	Springer-Verlag,	1st	1995.

SECOND YEAR - SEMESTER – III

<table>
<tr><td>Course Title</td><td colspan="9">Literature Survey</td></tr>
<tr><td>Course Type</td><td colspan="2">Hard Core- Theory</td><td>Total Hours</td><td>24</td><td>Hours/Week</td><td>02</td><td>Credits</td><td colspan="2">02</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2"></td><td rowspan="2">Evaluation</td><td>Internal</td><td colspan="3">C1+C2</td><td colspan="2">30 Marks</td><td rowspan="2">100</td></tr>
<tr><td>External</td><td>Duration</td><td>C3</td><td>02Hrs</td><td colspan="2">70Marks</td></tr>
<tr><td colspan="10">Course Objectives
To develop research ideas and to make the survey on the subject in context</td></tr>
<tr><td>CO No.</td><td colspan="9">Course Objectives</td></tr>
<tr><td>CO-1</td><td colspan="9">To ignite the research thoughts.</td></tr>
<tr><td>CO-2</td><td colspan="9">To understand the challenges in research</td></tr>
<tr><td>CLOs No.</td><td colspan="6">Course Learning Outcomes (CLOs)
After completing this course, the student will be able to</td><td colspan="2">PSOs Addressed</td><td>CLDs</td></tr>
<tr><td>CLO-1</td><td colspan="6">Make the survey of the chosen Mathematics Domain</td><td colspan="2">PSO-1</td><td>Understand</td></tr>
<tr><td>CLO-2</td><td colspan="6">To know the challenging problems that to be solved</td><td colspan="2">PSO-2</td><td>Analyze</td></tr>
<tr><td colspan="10">Students are expected to do the survey of the literature in the chosen mathematics field and need to submit the synopsis of the survey to the teacher incharge</td></tr>
</table>

SECOND YEAR - SEMESTER – III

Course Title	Differential Equations with applications(OE)							
Course Type	Hard Core- Theory		Total Hours	24	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2			30 Marks	100
			External	Duration	C3	02Hrs	70Marks	

Course Objectives

To stress the significance of Differential equations and to introduce fundamental concepts of differential equations

CO No.	Course Objectives
CO-1	To illustrate the applications of differential equations
CO-2	To Solve few realworld simple problems using differential equations

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the essence of differential equation in interdisciplinary fields	PSO-1	Understand
CLO-2	Model some standard systems using differential equations	PSO-2	Analyze
CLO-3	Apply the knowledge in solving some physical phenomenon	PSO-3	Apply

Unit	Proposed Course Content	Duration
1	**Introduction** Differential equations of first order, Ordinary and partial differential equations, Formation of Differential equations, Solutions of differential equations Variable separable method, Homogeneous equation, Linear equation of first order, Exact differential equations, problems thereon.	12 hours

Extra Reading /Key Words:linear system with periodic coefficient.

2	**Second order Differential equations and its application** Solving linear differential equation with constant coefficients Methods to find complementary function, Applications in electric circuit, Rectilinear and vertical motion, Oscillations of a spring	12 hours
Extra Reading /Key Words:Separable Equations, Initial and boundary value problem		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Differential Equations with Applications and Historical Notes	G. F. Simmons	Tata McGraw-Hill	2nd	1991
2	Higher Engineering Mathematics	H.K.Dass and Er.RajnishVerma	S.Chand	3rd	2014
3	Engineering Mathematics-II	Dr.K.S.Chandrashekar	Sudha Publication	2nd	2015

SECOND YEAR - SEMESTER – IV

Course Title	Measure and Integration								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)

The objective of this course is to generalize the concept of integration using measures and to develop the concept of analysis in abstract situations.

CO No.	Course Objectives
CO – 1	Understand the Lebesgue measure and Lebesgue measurable sets.
CO – 2	Discuss the properties of measurable function.
CO – 3	Apply the concepts of integration to Lebesgue integral.
CO – 4	Understand the absolute continuous function and differentiation of definite integral.
CO – 5	Describe the properties of general measure space and Radon -Nikodym theorem.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Explain the lebesgue measure and lebesgue measurable sets.	PSO-1	Understand
CLO-2	Derive the properties of lebesgue measurable function.	PSO-1	Apply
CLO-3	Illustrate the relation between Riemann integral and the lebesgue integral of bounded and non-negative functions.	PSO-4	Analyze
CLO-4	Express the properties of general measure space and prove Radon -Nikodym theorem.	PSO-5	Evaluate

Unit	Proposed Course Content	Duration

1	**Lebesgue Measure** Lebesgue outer measure, Measurable sets, Lebesgue measure, A non-measurable set, Measurable functions	12 hours
Extra Reading /Key Words:Hausdorff measure, complex measure		
2	**The Lebesgue Integral** Lebesgue Integral of a bounded function over as set of finite measure, The integral of a non-negative function The general Lebesgue integral Differentiating indefinite integrals	12 hours
Extra Reading /Key Words:Ergodic measure, fractals.		
3	**Differentiation and Integration** Continuity of monotone functions Differentability of monotone function Lebesgue's theorem Functions of bounded variation Jordan's theorem Absolutely continuous functions Differentiating indefinite integrals	12 hours
Extra Reading /Key Words:Convex functions, Bounded linear functions on Lp Space.		
4	**Measure and Integration** Measure spaces, Measurable functions, integration Signed measures, the Radon - Nikodym theorem, Outer measure and measurability.	12 hours
Extra Reading /Key Words:Ergodic measure, fractals.		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Real Analysis	Royden H.L. and Fitzpatrick P.M	PHI learning Pvt Ltd, Delhi,	4th	2013
2	Measure And Integration	Barra G.De	New age International Ltd., New Delhi.	2nd	2006
3	Real Analysis	Carthers N. L	Cambridge University Press	3rd	2006
4	Real Mathematical Analysis	Charles Chapman Pugh	Springer-New York	1st	2004

SECOND YEAR - SEMESTER – IV

Course Title	Topology-II							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

Togeneralize the concept of integration using measures and it helps to develop the concept of analysis in abstract situations.

CO No.	Course Objectives
CO-1	To Distinguish Urysohn's lemma and the Tietze extension theorem.
CO-2	To Discuss Tychonoff's theorem, locally compact spaces, Compactness of metric spaces.
CO-3	To Understand Fundamental group of a circle and punctured plane.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Distinguish Urysohn's lemma and the Tietze extension theorem	PSO-4	Understand
CLO-2	Discuss Tychonoff's theorem, locally compact spaces, Compactness of metric spaces and Ascoli's theorem	PSO-2	Apply
CLO-3	Describe Fundamental group of a circle and punctured plane	PSO-1	Analyze

Unit	Proposed Course Content	Duration
1	**Countability and Separation Axioms** The countability axioms The separation axioms Normality of a compact Hausdorff space	12 hours

Extra Reading /Key Words: countability axioms

2	**Applications of Countability and Separation Axioms** Urysohn's lemma Tietze's extension theorem Urysohn'smetrization theorem Partitions of unity	12 hours
Extra Reading /Key Words:Partitions of unity		
3	**Tychonoff's Theorem** Tychonoff's theorem on the product of compact spaces Local finiteness Paracompactness Normality of a paracompact space	12 hours
Extra Reading /Key Words:Tychonoff's Theorem		
4	**The Fundamental Group** Definition of fundamental group The Fundamental group of a circle The Fundamental group of the punctured plane Essential and Inessential Maps The Fundamental Theorem of Algebra	12 hours
Extra Reading /Key Words: Fundamental group of a circle		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	A First Course in Topology	J. R. Munkres	Prentice Hall India	2nd	2000
2	Introduction to Topology and Modern Analysis	G. F. Simmons	McGraw-Hill, Kogakusha	1st	1968
3	General Topology	S. Willard	Addison Wesley, New York	1st	1968
4	Topology	J. Dugundji	Allyn and Bacon, Boston	1st	1966
5	General Topology	J. L. Kelley	Van Nostrand and Reinhold Co., New York	1st	1955

SECOND YEAR - SEMESTER – IV

Course Title	Transforms and Calculus of Variation							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To study the Integral Transforms, Integral equations and Calculus Of Variations.

CO No.	Course Objectives
CO-1	To know the application integral transforms.
CO-2	To understand the essence of integral equations.
CO-3	To estimate the extremal of a functional.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Apply Laplace transform for solving RLC Circuits and motion of the spring	PSO-1	Apply
CLO-2	Model the problem through integral equations.	PSO-3	Analyze
CLO-3	Find the extremal of a functional	PSO-5	Apply

Unit	Proposed Course Content	Duration
1	**Laplace transforms**: Definitions, properties, Laplace and inverse Laplace transforms of some elementary functions Convolution theorem.	12 hours

Extra Reading /Key Words: Laplace transforms

2	**Fourier transforms**: Definitions, properties Fourier transforms of some elementary functions Convolution theorems Fourier transform as a limit of Fourier Series.	12 hours
Extra Reading /Key Words:Fourier transforms of some elementary functions		
3	**Integral Equations**: Volterra integral equations Resolvent kernel of Volterra integral equations Solution of integral equations by resolvent kernel, The method of successive approximations Fredholm integral equations	12 hours
Extra Reading /Key Words:Fredholm integral equations		
4	**Calculus Of Variations**: Extrema of functionals- Euler's equation Isoperimetric problems, Moving boundary problems, Rayleigh Ritz method, Galerkin's Method or Weighted Residual Method, Problems on Weirstrass and Legendre Condition for extremum.	12 hours
Extra Reading /Key Words:Extrema of functionals		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	The Calculus of Variations	Brunt and Bruce Van	Springer-Verlag, New York,	2nd	2004
2	Schaum's Outline of Laplace Transforms	Spiegel,Murray R.	Schaum's Outline Series	1st	1965
3	Linear and Nonlinear Integral Equations Methods and Applications	Abdul-MajidWazwaz	Springer-Verlag, New York	1st	2011
4	A First Course in Integral Equations	Abdul-MajidWazwaz	World Scientific	1st	2015
5	Introduction to the Calculus of Variation	Hans Sagan	Dover Publication	2nd	1993

SECOND YEAR - SEMESTER – IV

Course Title	Variational Analysis And Optimization								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)

To give the concept from convex analysis, variational inequalities and optimization.

CO No.	Course Objectives
CO-1	To study the Convex function and its characterizations
CO-2	To have a detailed study on Subdifferentiability and Monotonicity
CO-3	To understand the Classical Variational Inequalities.
CO-4	To study the Generalized Variational Inequalities

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the Convex function and its characterizations	**PSO-1**	**Understand**
CLO-2	Explain Subdifferentiability and Monotonicity	**PSO-2**	**Analyze**
CLO-3	Know the essence of Classical Variational Inequalities.	**PSO-5**	**Apply**
CLO-4	Optimize conditions through Generalized Variational Inequalities	**PSO-3**	**Apply**

Unit	Proposed Course Content	Duration
1	**Prerequisites of Convex Analysis** Convex Set, Hyperplanes, Convex function and its characterizations, Generalized convex functions and their characterizations, Optimality criteria, Kuhn-Tucker optimality criteria.	12 hours

Extra Reading /Key Words:Convex function andKuhn-Tucker optimality criteria		
2	**Subdifferentiability and Monotonicity** Subgradients and subdifferentials, Monotone and generalized monotone maps, generalizations and their relations with convexity.	12 hours
Extra Reading /Key Words:Monotone		
3	**Classical Variational Inequalities** Variational inequalities and related problems, Existence and uniqueness results Solution methods.	12 hours
Extra Reading /Key Words:Existence and uniqueness results		
4	**Generalized Variational Inequalities** Generalized variational inequalities and related topics, Basic existence and uniqueness results.	12 hours
Extra Reading /Key Words:Generalized variational inequalities		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Generalized Convexity,NonsmoothVariational and Nonsmooth Optimization	Q. H. Ansari, C. S. Lalitha and M. Mehta:	Taylor and Francis Group, New York,	1st	2014
2	Generalized Convexity and optimization: Theory and application	Alberto Cambini,LauraMartein	SpringerInter, Edition	1st	2008

SECOND YEAR - SEMESTER – IV

Course Title	Theory of Partitions							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	04	Credits	04
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

To learn idea of partition of numbers, generating function, Jacobi's triple product, summations formula and their applications. Alsoit paves the way to study identities like Rogers-Ramanujan, Euler's, Gauss, Heine's, Jacobi's identities.

CO No.	Course Objectives
CO-1	To understand the concepts of Partitions of numbers.
CO-2	To discuss Jacobi's triple product identity and its applications
CO-3	To study the Rogers - Ramanujan Identities.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand the concepts of Partitions of numbers.	PSO-3	Understand
CLO-2	Discuss Jacobi's triple product identity and its applications	PSO-2	Apply
CLO-3	Study the Rogers - Ramanujan Identities.	PSO-1	Apply

Unit	Proposed Course Content	Duration
1	**Partitions** Partitions of numbers The generating function of p(n) Other generating functions	12 hours

Extra Reading /Key Words: Partitions of numbers

2	**Euler theorems and its applications** Two theorems of Euler Jacobi's triple product identity and its applications	12 hours
Extra Reading /Key Words: Jacobi's triple product identity		
3	**Summation Formula and its Applications** 1ψ1 - summation formula and its applications Combinatorial proofs of Euler's identity Euler's pentagonal number theorem Franklin's combinatorial proof	12 hours
Extra Reading /Key Words: 1ψ1 - summation formula		
4	**Congruence Properties** Congruence properties of partition function The Rogers - Ramanujan Identities	12 hours
Extra Reading /Key Words: Rogers - Ramanujan Identities		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	An Introduction to Theory of Numbers	G. H. Hardy and E. M. Wright	Oxford University Press	5th	1979
2	An Introduction to the Theory of Numbers	I. Niven, H. S. Zuckerman and H. L. Montgomery	John Wiley and Sons, Inc., New York	5th	2004
3	Ramanujan's Note Books Volume-1 to 5	Bruce C. Berndt	Springer		
4	The Theory of Partitions	G. E. Andrews	Addison Wesley	1st	1976
5	Partition Theory	A. K. Agarwal, Padmavathamma, M. V. Subbarao	Atma Ram & Sons, Chandigarh	1st	2005

SECOND YEAR - SEMESTER – IV

Course Title	Advanced Functional Analysis								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)

To enable the students to appreciate various aspects of Countability, Metric spaces and understand continuous functions, Riemann-Stieltje's integral

CO No.	Course Objectives
CO-1	To understand Bounded linear operators on Hilbert spaces.
CO-2	To relate the Projections on a Banach space and pairs of closed linear subspaces.
CO-3	To understand Spectral resolution.
CO-4	To study Banach algebras and their involution.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes(CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Understand Bounded linear operators on Hilbert spaces.	**PSO-1**	**Understand**
CLO-2	Relate the Projections on a Banach space and pairs of closed linear subspaces.	**PSO-5**	**Apply**
CLO-3	Interpret Spectral resolution.	**PSO-2**	**Analyse**
CLO-4	Explain Banach algebras and their involution.	**PSO-7**	**Creating**
Unit	**Proposed Course Content**		**Duration**

1	**Linear operators On Hilbert space** Bounded linear operators on Hilbert spaces The adjoint of an operator, self adjoint operators, Positive operators, properties of normal and unitary operators. One to one correspondence between projections on a Banach space and pairs of closed linear subspaces of the space Properties of orthogonal projections on Hilbert spaces.	**12hours**
Extra Reading /Key Words:Hilbert cube		
2	**Spectral resolution** Spectral resolution of an operator on a finite dimensional Hilbert space H and the spectral theorem of a normal operator on H.	**12hours**
Extra Reading /Key Words:Completion,isometry		
3	**Banach algebras** The structure of commutative Banach algebras - properties of the Gelfand mapping, the maximal ideal space, multiplicative functional and the maximal ideal.	**12hours**
Extra Reading /Key Words:The Conjugate of an operator		
4	**Involutions in Banach algebras** Applications of spectral radius formula. Involutions in Banach algebras, the Gelfand - Neumark theorem.	**12hours**
Extra Reading /Key Words:Projections on Banach spaces		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Introduction to Topology and Modern Analysis	G. F. Simmons	Tata McGraw-Hill	2nd	2002
2	Introduction to Functional Analysis	A. E. Taylor	Wiley, New York,	1st	1958
3	Elements of Functional Analysis	A. Page and A. L. Brown	Van Nostrand Reinhold Company	1st	1970
4	Functional Analysis	George Bachman and Lawrence Narici	Dover Publications	2nd	2000
5	A Course in Functional Analysis	J. B. Conway	Springer	2nd	1985
6.	Introductory functional analysis with applications	Erwin Kreyszig	Wiley, New York	1st	1978

SECOND YEAR - SEMESTER –IV

Project Work

Type: Minor Project

A project workinvolves self-study to be carried out by the student (on a research problem of current interest or on an advanced topic not covered in the syllabus) under theguidance of a faculty member. Project work shall be initiated in the third semester itself through literature survey and theproject report (dissertation) shall be submitted at the end of the fourth semester.

Project Evaluation

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his / her progress in the form of seminars in addition to the regular discussion with the guide. Components of evaluation are as follows:

Component – I (C_1): Periodic Progress and Progress Reports (15)

Component – II (C_2): Results of Work and Draft Report (15)

Component – III (C_3): Final Viva Voce and evaluation (70). The report evaluation is for 40 and the Viva –voce examination is for 30.

SECOND YEAR - SEMESTER –IV

Course Title	Numerical Computations in Science -II								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	04	Credits	04	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)

To enable the students to use numerical techniques as a tool for solving certain class of problems

CO No.	Course Objectives
CO-1	To solve nonlinear equations in one variable and system of equations
CO-2	To solve interpolation problems and to approximate solutions of differential equations.

Mapping of CLOs with PSOs &CDLs

Course Learning Outcomes (CLOs): The CLOs indicate what a student has learnt after the successful completion of a course. The CLO statements are prepared by considering the course content covered in each unit of a course.For every course there may be 5 or more CLOs. **The keywords are used at the end of each unit to define CLOs.**

CLOs No.	Course Learning Outcomes (CLOs) After completing this course, the student will be able to	PSOs Addressed	CLDs
CLO-1	Solve nonlinear equations in one variable and system of equations	PSO-1	Apply
CLO-2	Solving a differentialequation using anappropriatenumericalmethods.	PSO-5	Apply

Unit	Proposed Course Content	Duration
1	**Numerical Methods for Ordinary Differential Equations** Single Step and Multi Step Methods Taylor Series Method : Modified Euler and Heun's Methods System of First Order Initial Value Problems : Taylor Series Method Multi Step Methods and Predictor-Corrector Methods	16 hours

Extra Reading /Key Words: Picard's theorem on existence and uniqueness of a solutions

2	**Boundary value problems** Method of finite difference-ODE Classification of PDE Finite difference methods for Laplace and Poisson equations Finite difference method for heat conduction equation Finite difference method for wave conduction equation	16 hours
Extra Reading /Key Words:Heat and Wave equations		

REFERENCES

Sl. No	Title of the book	Author(s)	Publisher	Edition	Year of publication
1	Numerical Methods for Scientific and Engineering Computation	M.K. Jain, S.R.K. Iyengar and R.K. Jain	New Age International Publishers	4th	2003
2	Numerical Analysis	R.L. Burden, D.J. Faires and A.M. Burden	Cenage Learning Publishers	10th	2004
3	Analysis of Numerical Methods	E. Isaacson and H.B. Kellar,	John Wiley & Sons	1st	1966
4	Numerical Methods for Engineers and Scientists,	Sharma. J.N.	Narosa Publ. House New Delhi	2nd	2010
5	A Friendly Introduction to Numerical Analysis.	Bradie, B	Pearson Prentice Hall	1st	2006
6	Numerical Methods for Scientific and Engineering Computation	M.K. Jain, S.R.K. Iyengar and R.K. Jain	New Age International Publishers	4th	2003
7	Numerical Algorithms,	KrishnamurthyE.VndSenS.K,	AffiliatedEast WestPressPvt.Ltd.,India	1st	1993

Blue Print of the Question Paper

St. Philomena's College (Autonomous), Mysore

M. Sc-Mathematics (CBCS)

I/II/III/IV- Semester Examination: 2020-21

Subject:

Time: 3 Hours **Max Marks: 70**

Sl. No			Marks
Section – A (MCQ)			
1	a		1
	b		1
	c		1
	d		1
Section – B			
2	a		2
	b		2
	c		2
Section – C Answer any three from the following			
	3		3x10=30
	4		
	5		
	6		
Section –D Answer any three from the following			
	7		3x10=30
	8		
	9		
	10		

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