RAJEEV GANDHI GOVT. POST GRADUATE COLLEGE,

AMBIKAPUR, SURGUJA (CG), INDIA

Learning Outcomes based Curriculum Framework

FOR

MASTER OF SCIENCE PROGRAMME

IN

MATHEMATICS

SEMESTER SYSTEM (CBCS)

SESSION 2023-2024

VISION

To be a global centre of excellence in mathematics for the growth of science and technology.

MISSION

To provide quality education and research in Mathematics through updated curriculum,effective teaching learning process.

To inculcate innovative skills, team-work, ethical practices among students so as to meet societal expectations.

Programme Outcome

PO-1	Basic Knowledge	Capable of delivering basic disciplinary knowledge gained during the programme.
PO-2	In-depth Knowledge	Capable of describing advanced knowledge gained during the programme.
PO-3	Critical thinking and Problem Solving abilities	Capable of analyzing the results critically and applying acquired knowledge to solve the problems.
PO-4	Creativity and innovation	Capable to identify, formulate, investigate and analyze the scientific problems and innovatively to design and create products and solutions to real life problems.
PO-5	Research aptitude and global competency	Ability to develop a research aptitude and apply knowledge to find the solution of burning research problems in the concerned and associated fields at global level.
PO-6	Holistic and multidisciplinary education	Ability to gain knowledge with the holistic and multidisciplinary approach across the fields.
PO-7	Skills enhancement	Learn specific sets of disciplinary or multidisciplinary skills and advanced techniques and apply them for betterment of mankind.
PO-8	Leadership and Teamwork abilities	Ability to learn and work in a groups and capable of leading a team even.
PO-9	Environmental and human health awareness	Learn important aspects associated with environmental and human health. Ability to develop eco-friendly technologies.
PO-10	Ethical thinking and Social awareness	Inculcate the professional and ethical attitude and ability to relate with social problems.
PO-11	lifelong learning skills and Entrepreneurship	Ability to learn lifelong learning skills which are important to provide better opportunities and improve quality of life. Capable to establish independent startup/innovation center etc.

Graduate Attributes in Mathematics

The graduate attributes in mathematics are the summation of the expected course learningoutcomes mentioned in the beginning of each course.

1. Disciplinary knowledge: Capability of demonstrating comprehensive knowledge of mathematics and understanding ofone or more disciplines which form a part of an undergraduate programme of study.

2.Communications skills:

i. Ability to communicate various concepts of mathematics effectively using examplesand their geometrical visualizations.

ii. Ability to use mathematics as a precise language of communication in other branchesof human knowledge.

iii. Ability to communicate long standing unsolved problems in mathematics.

iv. Ability to show the importance of mathematics as precursor to various scientificdevelopments since the beginning of the civilization.

v. Ability to explain the development of mathematics in the civilizational context and its role as queen of all sciences.

3. Critical thinking and analytical reasoning:

i. Ability to employ critical thinking in understanding the concepts in every area ofmathematics.

ii. Ability to analyze the results and apply them in various problem appearing indifferent branches of mathematics.

4. Problem solving:

i. Capability to solve problems in computer graphics using concepts of linear algebra.

ii. Capability to solve various models such as growth and decay models, radioactive decay model, drug assimilation, LCR circuit & population models .

iii. Ability to solve linear system of equations, linear programming problems and network flow problems.

iv. Ability to provide new solutions using the domain knowledge of mathematics

5. Research-related skills

i. Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics.

ii. To know about the advances in various branches of mathematics.

6. Self-directed learning:

Ability to work independently and do in-depth study of various notions of mathematics.

7. Moral and ethical awareness/reasoning:

Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in allaspects.

8. Lifelong learning:

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

Programme Specific Outcomes

The post graduates shall be able to realise the following specific outcomes by the end of program studies: On successful completion of the M.Sc. Mathematics programme a student

PSO-1	Will have a strong foundation in both pure and applied mathematics.
PSO-2	Will be able to apply mathematical skills for solving problems and for preparing various competitive exams.
PSO-3	Will be able to communicate mathematical knowledge effectively, in writing as well as orally.
PSO-4	Will identify applications of mathematics in other disciplines, leading to enhancement of career prospects in different fields and research areas.
PSO-5	Will have basic knowledge of programming and computational techniques as required for employment.
PSO-6	Should have the knowledge of the fundamental axioms in mathematics and capability of developing ideas based on them and inculcate mathematical reasoning.
PSO-7	Will be able to locate and analyse the different mathematical texts with appropriate theoretical framework.
PSO-8	Have the knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in science, social science, engineering and technology.
PSO-9	Should be able to develop analytical skills, critical thinking, creativity, communication and presentation skills through assignments, seminar, project work.
PSO-10	Should be able to apply their skills and knowledge that translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

The M. Sc. programme is a two-year course divided into four semesters. The syllabus and schemes of examination are detailed herewith.

The M.Sc. course shall consist of 20 theory courses. The M.Sc. Mathematics Programme would make the students competent in the field of Mathematics and help them understand its role in modern day technology. Overall, the course would enable the students to understand the fundamental concepts . Knowledge gained through the open electives would be an asset in branching out in fields other than mathematics..

In I/II/III/IV semester there shall be five theory courses each of 70 marks and 30 marks for internal assessment test. In internal assessment, there will be 10 marks for written test, 10 marks for assignment and 10 marks for a seminar in each paper.

Thus there shall be T/I=100 marks for each paper, minimum passing / qualifying marks shall be 36% in each theory/internal assessment. Candidate will be required to pass separately in each theory and internal assessment.

ACADEMIC PROGRAMMES & SCHEMES

M.Sc. (Mathematics)

FIRST SEMESTER (CBCS System)

Paper	Course Type	Course (Paper/Subjects)	External Written Test		Cont. Int. Valuation				
			Max. Marks	Ql. Marks	W. test	Seminar	Assignment	Total	Grand Total
I.	CCC	Advanced Abstract Algebra I	70	25	10	10	10	30	100
II.	CCC	Real Analysis I	70	25	10	10	10	30	100
III	CCC	Topology I	70	25	10	10	10	30	100
IV	OSC	Social Outreach And Internship & Entrepreneurship							100
V	ECC/CB	Constitutionalism & Indian Political System	70	25	10	10	10	30	100
	ECC/CB	Adv.Discrete Mathematics I	70	25	10	10	10	30	100
	ECC/CB	Differential Geometry	70	25	10	10	10	30	100
	ECC/CB	Mathematical Programming	70	25	10	10	10	30	100
	ECC/CB	Complex Analysis- I	70	25	10	10	10	30	100
	TOTAL								500

SECOND SEMESTER (CBCS System)

Paper	Course Type	Course (Paper/Subjects)	External Written Test		Cont. Int. Valuation				
			Max. Marks	Ql. Marks	W. test	Seminar	Assignment	Total	Grand Total
I.	CCC	Advanced Abstract Algebra II	70	25	10	10	10	30	100
II.	CCC	Real Analysis II	70	25	10	10	10	30	100
III	CCC	Topology II	70	25	10	10	10	30	100
IV	OSC	RESEARCH METHODOLOGY & COMPUTER APPLICATION: BASICS							100
V	ECC/CB	ENVIRONMENTAL AND FOREST LAWS	70	25	10	10	10	30	100
	ECC/CB	Advanced Discrete Mathematics (II)	70	25	10	10	10	30	100
	ECC/CB	Algebraic Number Theory	70	25	10	10	10	30	100
	ECC/CB	Complex Analysis-II	70	25	10	10	10	30	100
TOTAL									500

THIRD SEMESTER (CBCS System)

Paper	Course Type	Course (Paper/Subjects)	External Written Test		Cont. Int. Valuation				
			Max. Marks	Ql. Marks	W. test	Seminar	Assignment	Total	Grand Total
I.	CCC	Integration Theory and Functional Analysis (I)I	70	25	10	10	10	30	100
II.	CCC	Partial Differential Equations & Mechanics (I)	70	25	10	10	10	30	100
III	CCC	Operations Research (I)	70	25	10	10	10	30	100
IV	OSC	Intellectual Property Rights	70	25	10	10	10	30	100
V	ECC/CB	Tribal Studies	70	25	10	10	10	30	100
	ECC/CB	Mathematical Modelling	70	25	10	10	10	30	100
	ECC/CB	Fluid Dynamics	70	25	10	10	10	30	10
	ECC/CB	Numerical Analysis-I	70	25	10	10	10	30	10
TOTAL									500

FOURTH SEMESTER (CBCS System)

Paper	Course Type	Course (Paper/Subjects)	External Written Test		Cont. Int. Valuation				
			Max. Marks	Ql. Marks	W. test	Seminar	Assignment	Total	Grand Total
I	CCC	Integration Theory and Functional Analysis (II)	70	25	10	10	10	30	100
II.	CCC	Partial Differential Equations & Mechanics (II)	70	25	10	10	10	30	100
III	CCC	Operations Research (II)	70	25	10	10	10	30	100
IV	OSC	Dissertation							100
V	ECC/CB	Fuzzy Sets and their applications	70	25	10	10	10	30	100
	ECC/CB	Mathematical Economics	70	25	10	10	10	30	100
	ECC/CB	Mathematical Statistics	70	25	10	10	10	30	100
	ECC/CB	Number Theory and Cryptography	70	25	10	10	10	30	100
	ECC/CB	Numerical Analysis-II	70	25	10	10	10	30	10
TOTAL									500

M.Sc. in MATHEMATICS **FACULTY OF SCIENCE**

FIRST SEMESTER (ODD SEMESTER)

	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1)	**MSM 101**	**CCC**	**Advanced Abstract Algebra I**	6	4	3	0	3	0
	MSM 102	**CCC**	**Real Analysis I**	6	4	3	0	3	0
	MSM 103	**CCC**	**Topology I**	6	4	3	0	3	0
	MSM S01	**OSC**	**Social Outreach And Internship & Entrepreneurship**	6	0	0	9	0	4
	MSM A01	ECC/CB	CONSTITUTIONALISM & INDIAN POLITICAL SYSTEM	6	4	3	0	3	0
	MSM A02	ECC/CB	Advanced Discrete Mathematics (I)						
	MSM A03	ECC/CB	Differential Geometry						
	MSM A04	ECC/CB	Mathematical Programming						
	MSM A05	**ECC/CB**	**Complex Analysis- I**						
	MINIMUM CREDITS IN INDIVIDUAL SUBJECT IS 6 AND IN COMPLETE SEMESTER IT WOULD BE 30			**TOTAL-30**					

M.Sc. I Sem.

Paper I – Advanced Abstract Algebra –I

Course Outcome

After Completing the course the students will be able to

CO1- To get full concept of groups.

CO2- To deal with module and also get knowledge about simple modules, free Modules, quotient modules.

CO3- To understand linear transformation, reduction to triangular form, Nilpotent transformation etc.

CO4- To solve many problems related to linear transformation by primary decomposition theorem, Jordan block and Jordan form.

CO5- To get knowledge about smith normal form.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5		✓	✓	✓	
PO_6					
PO_7					
PO_8	✓	✓	✓	✓	✓
PO_9	✓	✓	✓	✓	✓
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓	✓	✓	✓

M.Sc. (MATHEMATICS)		SEMESTER I	
COURSE TITLE: Advanced Abstract Algebra (I)			
COURSE CODE: MSM101		**COURSE TYPE: CCC**	
Credit -6		**Hours-90hrs**	
Theory	**Practical**	**Theory**	**Practical**
Marks			
Theory		**Practical**	

Scheme of Marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 18 hrs	Groups - Normal and Subnormal series. Composition series. Jordan-Holder theorem. Solvable groups. Nilpotent groups. Direct product, commutator sub-group of group.
Unit II 18hrs	Modules - Cyclic modules. Simple modules. Semi-simple modules. Schuler's Lemma. Free modules. Quotient module, homomorphism of module
Unit III 18 hrs	Linear Transformations - Algebra of linear transformation, characteristic roots, matrices and linear transformations
Unit IV 18hrs	Canonical Forms - Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.
Unit V 18 hrs	Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated modules over a Principal ideal domain and its applications to finitely generated abelian groups.

References-

1. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
2. I. N. Herstein: Topics in Albegra, Wiley Eastern Ltd.
3. D. S. Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
4. Vivek Sahai and Vikas Bist: Algebra, Narosa Publishing House, 1999.
5. M.Artin, Algeabra, Prentice -Hall of India, 1991.

M.Sc. I Sem.

Paper II– Real Analysis I

Course Outcome

After Completing the course the students will be able to

CO1- To learn the role of real analysis in mathematics.

CO2- To demonstrate the ability to use & operate sequence and series of function.

CO3- To demonstrate the ability to manipulate use power series.

CO4- To get knowledge about function of several variables, Taylor theorem, Inverse function theorem, Implicit function theorem.

CO5- To gain skill by using Jacobians.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓		✓	✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓	✓	✓	✓

M.Sc. (MATHEMATICS)		SEMESTER I	
COURSE TITLE: Real Analysis(I)			
COURSE CODE: MSM102		COURSE TYPE: CCC	
Credit -6		Hours-90hrs	
Theory	Practical	Theory	Practical
Marks			
Theory		Practical	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 18 hrs	Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Rectifiable curves.
Unit II 18hrs	Sequences and series of functions, pointwise and uniform convergence, Cauchy's criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann- Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem.
Unit III 18 hrs	Power series, uniqueness theorem for power series, Abel's and Tauber's theorems. Rearrangements of terms of a series, Riemann's theorem.
Unit IV 18hrs	Functions of several variables, linear transformations, Derivatives in an open subset of R^n, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.
Unit V 18 hrs	Jacobians extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals. Partitions of unity, Differential forms, Stoke's theorem.

References-

1. Principle of Mathematical Analysis By Walter Rudin (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. Real Analysis By H.L.Roydon, Macmillan Pub.Co.Inc.4th Edition, NewYork .1962.
3. G.de Barra, Measure Theory and Integration, Wiley Eastern Limited,1981.
4. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
5. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing house.

M.Sc. I Sem.

Paper III –Topology–I

Course Outcome

After Completing the course the students will be able to

CO1-To get knowledge about countable & uncountable set and uses of Schroeder Bernstein theorem.

CO2-Undrestand to construct topological space from metric space and using general properties of neighbourhood,open set, closed set, base, subbase etc.

CO3- Apply the property of open set, closed set, interior point, accumulation points and derived sets in deriving the proofs of various theorem.

CO4- Understand the concept of separable axioms, compact space.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓		✓
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5	✓	✓	✓	✓
PO_6				
PO_7				✓
PO_8	✓	✓	✓	
PO_9	✓	✓	✓	
PO_{10}	✓	✓	✓	
PO_{11}	✓	✓	✓	✓

M.Sc. (MATHEMATICS)		SEMESTER I	
COURSE TITLE: Topology I			
COURSE CODE: MSM103		**COURSE TYPE: CCC**	
Credit -6		**Hours-90hrs**	
Theory	**Practical**	**Theory**	**Practical**
Marks			
Theory		**Practical**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 18 hrs	Countable and uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma, well-ordering theorem.
Unit II 18hrs	Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology
Unit III 18 hrs	Alternate methods of defining a topology in terms of terms of Kuratowski Closure Operator and Neighbourhood Systems. Continuous functions and homeomorphism. First and Second Countable spaces. Lindelof's theorems. Separable spaces. Second countability and separability
Unit IV 18hrs	Separation axioms & their characterizations and basic properties. Urysohn's lemma, Tietz extension theorem
Unit V 18 hrs	Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Equivalence of compactness, countable compactness and sequential compactness in metric space, Local compactness

References-

1. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
4. George F. Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
5. J. Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
6. J. L. Kelley, General Topology, Van Nostrand, Reinhold Co., NewYork, 1995.
7. M. J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc. Princeton, N. J., 1963.
8. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc.,Boston, 1962.
9. C. Berge, Topological Spaces, Macmillan Company, New York, 1963.
10. S.S. Coirns, Introductory Topology, Ronald Press, New York, 1961.

M.Sc. I Sem.

Paper IV – Social Outreach And Internship & Entrepreneurship

Course Outcomes:

CO 01. To introduce to the alternative policy approach to address global and local economic environmental problems and to apply market and non-market method for resolving economic environmental problems.

CO 02. On completion of the course, the student will be able to identify the various policy alternatives that can be applied to address an environmental problem.

CO 03. The student will also be able to use market and non-market methods and apply them to estimate the extent of welfare gain or loss associated with any development and conservation programmes.

CO 04. They will also be able to identify factors that determine international cooperation to mitigate global economic environmental problems

CO 05. To convert the Jobseekers into Job providers and transform them as active contributors to national economy.

CO 06. To create entrepreneurship culture.

CO 07. To create self employment

CO 08. To create cooperative culture in sociery

SYLLABUS

Scheme Of Marks :-

1. Social Outreach – 50 Marks (Project Work – 40 Marks & Viva- Voce – 10 Marks)
2. Internship & Entrepreneurship 50 Marks (Project Work – 40 Marks & Viva- Voce – 10 Marks)

Viva Voce – On The Basis Of Their Project And Class Room Study Of Entrepreneurship

Internship :- The student could also be required 15 day internship for preparation of a project report with an enterprise involving product /services

SYLLABUS

Module/Unit & Lecture	Description
Module-1 (Lecture-6)	**Entrepreneurship Concept And Significance** Entrepreneurship: Definition, Concepts of entrepreneurship development, self Employment, Characteristics of successful entrepreneur.
Module-2 (Lecture-6)	**Entrepreneurship Support Institutions And Environment** Institution and schemes of Government of India, Financing- Long, medium and short Term loan, Financial Institutions-NABARD, SIDBI, Nationalised banks etc., DIC- Role Schemes and programmes, documentation of loan application, sanction, acceptance, Release of loan.
Module-3 (Lecture-6)	**Business Opportunities and Business Planning** Market survey and assessment-Demand, Supply and Nature of competition, cost and price of products, selection of enterprise, Identify problem and opportunities, The Project Report.
Module-4 (Lecture-6)	**General Management and Finance** The fourth stage growth model-Planning, Organizing, executing, controlling resources Both human and material, asset management, business communication, Advertisement, public relation, Finance-Meaning, need of financial management, Type of business finance and management, Financial Planning, importance of budgets.
Module-5 (Lecture-6)	**Market Management –** Meaning and Concept of marketing, objectives of marketing management, Marketing Plan.

Suggested References

01. Entrepreneur Development, SS Khanna, S Chand & Company Ltd, Ram Nagar New Delhi.

02. Entrepreneur and Entrepreneurship Development and Planning in India, D. N. Mishra,Chugh Publication, Allahabad.

03. Science Tec. Entrepreneur (A BI Monthly Publication) Centre for Entrepreneurship Development M. P. (CEDMAP), 60 Jall road Jhangerbad, Bhopal-46200-2508.

04. Bullding A Chain of Customers, Richard J Schonberger, The Free Press, New York.

05. Entrepreneurship, Holt, Prentice Hall, New Delhi.

06. Management of Small Scale Industry, Vasant Desal, Himalayan Publishing House, Bombay.

M.Sc. I Sem.

Paper V– Constitutionalism & Indian Political System

Course Outcome

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

CO1 Have a comprehensive understanding of the meaning, features and characteristics of the Preamble of the Constitution of India.

CO2 Describe m details the difference between Constitution and Constitutionalism.

CO3 Compare and contrast the different forms of government, namely - unitary and federal, parliamentary and presidential with particular reference to Indian Political System.

CO4 Demonstrate an in-depth knowledge of the concepts of Citizenship, Fundamental Rights, Constitutional amendment procedures and the judicial system in India.

CO5 Explain in detail the Legislative, Executive and Judicial structure in the Government of India.

CO6 Show interest in research studies in relevant topics, like - decentralization of governance, local self-governance.

MASTER OF SCIENCE		**I SEMESTER**
COURSE CODE:		**COURSE TYPE: ECC**
COURSE TITLE:Constitutionalism & Indian Political System		
Credit: 06 **Theory: 06**		**Hours : 90** **Theory: 90**
MARKS : 100	**THEORY: 70**	**CCA : 30**

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

UNIT - 1 18 Hrs	Meaning: Constitution, Constitutional government & constitutionalism; Difference between Constitution & Constitutionalism; Constitutionalism: Basis, Elements, Features & future. Forms of Government: Democracy & Dictatorship, Unitary & Federal, Parliamentary & Presidential form. Ideals of the Indian Constitution incorporated in the Preamble. Special Features of the Indian Constitution.
UNIT - 2 18 Hrs	Concept of State and Citizenship, Judicial Review and Fundamental Rights, Directive Principles of the State Policy, Fundamental Duties, Procedure to Amend the Indian Constitution, Judiciary: Supreme Court and High Court, Judicial Activism and Public Interest Litigation and Provisions relating to Emergency.
UNIT - 3 18 **H rs**	Union Executive- President, Prime Minister, Council of Ministers. State Executive- Governor, Chief Minister and Council of Ministers. Local Bodies &Panchayati Raj
UNIT - 4 18 Hrs	Parliament of India, State Legislatures, Legislative Bills: Ordinary, Money and Financial, Union State Relations, Principles of the 'Separation of Power and the 'Principles of Check & Balance',Political Parties and Pressure Groups.Challenges before Indian Democracy: Terrorism, Regionalism, Communalism, Linguistics and National Integration.
UNIT - 5 18 Hrs	Controller & Accountant General of India, Solicitor General, Advocate General, Election Commission, Union and State(s) Public Service Commission, Finance Commission.

M.Sc. I Sem.

Paper V- Advanced Discrete Mathematics (I)

Course Outcome

The students will be able

CO1- To determine equivalent logic expression.

CO2- To understand the concept of Homomorphism ,congruence relation.

CO3- To demonstrate the ability to use lattices, Boolean algebra.

CO4- to demonstrate the ability to solve the problem using AND,OR.NOT gates

CO5- To demonstrate the ability to know grammer and language.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	
PO_6	✓	✓	✓	✓	✓
PO_7		✓			✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓	✓	✓	✓
PO_{11}	✓	✓		✓	✓

M.Sc. (MATHEMATICS)	**I SEMESTER**
COURSE CODE: MSM A02	**COURSE TYPE: ECC/CB**
COURSE TITLE: **Advanced Discrete Mathematics (I)**	
CREDIT-06 **THEORY-06**	HOURS-90 THEORY-90
MARKS-100 **Theory-70**	**CCA-30**

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Formal Logic-Statements. Symbolic Representation and Tautologies. Quantifiers, Predicates and Validity. Propositional Logic. Semigroups & Monoids-Definitions and Examples of Semigroups and monoids (including those pertaining to concatenation operation).
18 hrs.	Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct Products. Basic Homomorphism Theorem.
18 hrs.	Lattices-Lattices as partially ordered sets. Their properties. Lattices as Algebraic Systems. Sublattices, Direct products, and Homomorphisms. Some Special Lattices e.g., Complete,Complemented and Distributive Lattices. Boolean Algebras-Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras,
18 hrs.	Direct Products and Homomorphisms. Join-Irreducible elements, Atoms and Minterms. Boolean Forms and Their Equivalence. Minterm Boolean Forms, Sum of Products Canonical Forms. Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND,OR & NOT gates). The KarnaughMap Method.
18 hrs.	Grammars and Languages-Phrase-Structure Grammars. Rewriting Rules. Derivations. Sentential Forms. Language generated by a Grammar. Regular, Context-Free, and Context Sensitive Grammars and Languages. Regular sets, Regular Expressions and the Pumping Lemma. Kleene's Theorem. Notions of Syntax Analysis, Polish Notations. Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

SUGGESTED READINGS	1. Elements of Discrete Mathematics By C. L. Liu 2. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997. 3. J. L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York. 4. Seymour Lepschutz, Finite Mathematics (International) edition (1983), McGraw-Hill Book Company, New York. 5. S. Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co. 6. J. E. Hopcroft and J.D Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House. 7. C. L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co. 8. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India 9. K. L. P. Mishra and N. Chandrashekaran, Theory of Computer Science PHI(2002)

M.Sc. I Sem.

Paper V- DIFFERENTIAL GEOMETRY

Course Outcome

The students will be able

CO1-To develop understanding of basics of differential geometry.

CO2- To understand and solve problems related to surface of revolution.

CO3-To get knowledge about geodesics.

CO4- To demonstrate the ability to solve problem related to non-intrinsic properties of surface.

CO5- To get knowledge about fundamental equation of surface theory, Hilbert lemma.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓			✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓	✓		

M.Sc. (MATHEMATICS)		**I SEMESTER**	
COURSE CODE: MSM A03		**COURSE TYPE: ECC/CB**	
COURSE TITLE: **DIFFERENTIAL GEOMETRY**			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100 (30 + 70)		**PRACTICAL-0**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	**SPACE CURVES-** Definition of a space curve - Arc length - tangent - normal and binormal - curvature and torsion - contact between curves and surfaces - tangent surface - involutes and evolutes - Intrinsic equations - Fundamental Existence Theorem for space curves - Helics.
18 hrs.	**INTRINSIC PROPERTIES OF A SURFACE-**Definition of a surface - curves on a surface - Surface of revolution - Helicoids - Metric - Direction coefficients - families of curves - Isometric correspondence - Intrinsic properties.
18 hrs.	**GEODESICS-** Geodesics - Canonical geodesic equations - Normal property of geodesics - Existence Theorems - Geodesic parallels - Geodesics curvature - Gauss - Bonnet Theorem - Gaussian curvature - surface of constant curvature.
18 hrs.	**NON INTRINSIC PROPERTIES OF A SURFACE** The second fundamental form - Principal curvature - Lines of curvature - Developable - Developable associated with space curves and with curves on surface - Minimal surfaces - Ruled surfaces. Chapter III: Sections 1 to 8
18 hrs.	DIFFERENTIAL GEOMETRY OF SURFACES- Fundamental Equations of Surface Theory - Fundamental Existence Theorem for surfaces - Compact surfaces whose points are umblics - Hilbert's lemma - Compact surface of constant curvature - Complete surfaces.

SUGGESTED READINGS	**Recommended Text** T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print) **Reference Books** 1. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963. 3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

M.Sc. I Sem.

Paper V- MATHEMATICAL PROGRAMMING

Course Outcome

The students will be able

CO1- To analyze and solve mathematical programming models of real life situations.

CO2- To solve optimization problem graphically, algebraically.

CO3- To learn the concept of Simplex method and revised Simplex method.

CO4- To analyze the concept of Goal Programming.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5	✓			✓
PO_6	✓	✓	✓	✓
PO_7			✓	
PO_8	✓	✓	✓	
PO_9		✓	✓	
PO_{10}	✓	✓		✓
PO_{11}	✓	✓		

M.Sc. (MATHEMATICS)	**I SEMESTER**
COURSE CODE: MSM A04	**COURSE TYPE: ECC/CB**
COURSE TITLE: MATHEMATICAL PROGRAMMING	
CREDIT: 6 **THEORY: 6**	**THEORY: 90**
MARKS- 100	**THEORY-70** **CCA-30**

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs	**Integer Linear Programming**-Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming.Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP.
18 hrs	**Classical Optimization Methods-**Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints. Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods - Beale's Method.
18 hrs	**Theory of Simplex Method**-Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution.
18 hrs	**Revised Simplex Method-:**Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method.Bounded Variables LP problem: The simplex algorithm.
18 hrs	PARAMETRIC LINEAR PROGRAMMING-Variation in the coefficients cj , Variations in the Right hand side.Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.

SUGGESTED READINGS	**Recommended Book** 1. J.K.Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd. **Reference Books** 1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997. 2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7th Edition) Tata- McGraw Hill ompany, New Delhi, 2001. 3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979 4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990

M.Sc. I Sem.

Paper V- Complex Analysis-I

Course Outcome

The students will be able

CO1- To learn the role of Cauchy- Goursat theorem and Cauchy integral formula in calculation of contour integration.

CO2- To learn Taylor & Laurent series for expansion of analytic function.

CO3- To understand the concept of Bilinear transformation.

CO4- To know the concept of Hurwitz theorem, Montel theorem

CO5- To understand the concept of Gamma function,Zeta function.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓			

M.Sc. (MATHEMATICS)	**I SEMESTER**
COURSE CODE: MSM A-05	**COURSE TYPE:ECC/CB**
COURSE TITLE: COMPLEX ANALYSIS-I	
CREDIT:6 **THEORY: 6**	**HOURS:90** **THEORY:90**
MARKS-100 **THEORY: 70**	**CCA-30**

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs	Complex Integration, Cauchy-Goursat Theorem, Cauchy integration formula. Higher order derivatives. Morera's theorem, Cauchy's inequality and Liouville's Theorem, Taylor's theorem. Laurent's series
18 hrs	The zero of an analytic function, Singularities, Meromorphic functions, The argument principle, Rouche's theorem The Fundamental theorem of Algebra.. Maximum Modulus principle. Schwarz's lemma, Inverse function theorem.
18 hrs	Bilinear transformation -its properties and classification. Definitions and examples of conformal mapping.
18 hrs	Spaces of analytic function. Hurwitz's theorem. Montel's theorem. Riemann mapping theorem.
18 hrs	Weierstrass's Factorisation theorem. Gamma function and its properties. Riemann Zeta Function. Functional equation,Runge's theorem. Mittag Leftler's theorem

SUGGESTED READINGS	Books Recommended :- • L.V. Ahlfors, Complex Analysis, Mc Graw-Hill, 1979. • D.Sarason, Complex Function theory, Hindustan book Agency • Walter Rudin, Real and Complex analysis. McGraw-Hill Book Company • S. Punnusamy Foundation of complex Analysis, Narosa Publishing House 1997 • J.B. Conway Function of one complex Variable, Springer Verlag.

M.Sc. in MATHEMATICS
FACULTY OF SCIENCE

- **SECOND SEMESTER** (EVEN SEMESTER)

	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
	MSM 201	**CCC**	**Advanced Abstract Algebra (II)**	**6**	**4**	**3**	**00**	**3**	**00**
	MSM 202	**CCC**	**Real Analysis(II}**	**6**	**4**	**3**	**00**	**3**	**00**
	MSM 203	**CCC**	**Topology(II)**	**6**	**4**	**3**	**00**	**3**	**00**
	MSM S02	**OSC**	**Research Methodology & Computer Application**	**6**	**4**	**3**	**00**	**3**	**00**
	MSM B01	ECC/CB	Environmental & Forest Laws	**6**	**4**	**3**	**00**	**3**	**00**
	MSM B02	ECC/CB	Advanced Discrete Mathematics (II)						
	MSM B03	ECC/CB	Algebraic Number Theory						
	MSM B04	**ECC/CB**	**Complex Analysis (II)**						
	MINIMUM CREDITS IN INDIVIDUAL SUBJECT IS 6 AND IN COMPLETE SEMESTER IT WOULD BE 30			**TOTAL= 30**					

M.Sc. II Sem.
Paper I
ADV. ABSTRACT ALGEBRA II

Course Outcome

The students will be able

CO1- To explain the fundamental concepts of adfvanced algebra such as Groups and rings and their role in modern mathematics and applied context.

CO2- To demonstrate accurate and efficient use of algebraic techniques.

CO3- To demonstrate capacity for mathematical reasoning through analysing ,,proving and explaining concepts from advanced algebra.

CO4- To apply problem solving using advanced algebraic techniques applied to diverse situation in physics, engineering and other mathematical contexts.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	✓
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5		✓		✓
PO_6				
PO_7				
PO_8	✓	✓	✓	✓
PO_9			✓	
PO_{10}	✓	✓	✓	✓
PO_{11}	✓	✓	✓	

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM 201		**COURSE TYPE: CCC**	
COURSE TITLE: ADV. ABSTRACT ALGEBRA II			
CREDIT:6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Noetherian and Artinian Modules and rings , Rings – Hilbert basis theorem. Wedderburn Artin theorem , Uniform Modules , Primary Modules , Noether – Lasker theorem.
18 hrs.	Field theory - Extension fields , Algebraic and transcendental extensions , Separable and inseparable extensions.
18 hrs.	Normal extensions , Splitting field , Perfect fields , Finite fields , Primitive Elements , Algebraically closed fields , Automorphisms of extensions
18 hrs.	Galios Field and extensions , Fundamental theorem of Galios theory , Solution of polynomial equations by radicals
18 hrs.	Insolvability of the general equation of degree 5 by radicals , Rational Canonical form , Generalised Jordan form over any field

SUGGESTED READINGS	1. P.B.Bhattacharya, S.K.Jain, S.R. Nagpaul: Basic Abstract Algebra, Cambridge University Press. 2. I.N. Herstein: Topics in Algebra, Wiley Eastern Ltd. 3. Quazi Zameeruddin and Surjeet Singh : Modern Algebra 4. M. Artin : Algebra, Prentice – Hall of India , 1991 5. P.M.Cohn : Algebra ,Vol.I ,II, III,John Wiley & Sons, 6. N. Jacobson: basic Algebra, Vols. I, II, W.H. Freeman 7. S.lang , Algebra , 3rd edition, Addison –Wesley 8. D.S. Malik, J.N. Modeson and M.K.Sen : Fundamentals of Abstract Algebra, Mc Graw – Hill ,International Edition,1997 9. K.B.Datta. : Matrix and linear Algebra, Prentice Hall of India Pvt. Ltd.,New Delhi,2000 10.S.K.Jain , A.Gunawardena and P.B.Bhattacharya : Basic Linear Algebra with MATLAB, Key College Publishing (Springer – Verlag) 2001 11.S. Kumaresan : Linear Algebra , A. Geometric Approach , Prentice - Hall of India. 12. Vivek Sahai and Vikas Bist: Algebra, Narosa Publishing house, 1999.

M.Sc. II Sem.
Paper II- Real Analysis II
Course Outcome

The students will be able

CO1- To understand how Lebesgue measure on R is defined.

CO2- To understand the basic properties of measurable function.

CO3- To understand how measure may be used to construct integrals.

CO4- To know the basic convergence theorem for the Lebesgue integral.

CO5- To understand the relation between Lebesgue differentiation and Lebesgue integration.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	✓
PO_6					
PO_7					✓
PO_8	✓	✓	✓		✓
PO_9			✓	✓	✓
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM 202		**COURSE TYPE: CCC**	
COURSE TITLE: REAL ANALYSIS II			
CREDIT:6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100(30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Lebesgue outer measure , Measurable sets , Regularity, Measurable functions, Borel and Lebesgue measurability
18 Hrs.	Non –measurable sets , Integration of Non – negativite functions , The General integral , Integration of series.
18 hrs.	Measures and outer measures , Extension of a measure , Uniquness of Extension , Completion of a measure , Measure spaces , Integration with respect to a measure , Riemann and Lebesgue Integrals.
18 hrs.	The Four derivatives , Lebesgue differentiation theorem , Differentiation and Integration , Functions of Bounded variation
18 hrs.	The L^p- spaces , Convex functions , Jensen's Inequality, Holder and Minkowski inequalities , Completeness of L^p , Convergence in Measure , Almost uniform convergence.

SUGGESTED READINGS	1.Principle of Mathematical Analysis by W. Rudin 2. Real Analysis by H.L.rudin 3.T.M. apostol , Mathematical analysis ,Narosa Publishing House,New Delhi 4.A.J. white,Real Analysis ,an introduction ,Addison – Wesley Publishing Co. Inc .1968. 5.G.De Barra, Measure Theory and Integration ,Wiley Eastern Limited ,1981 6.E. Hewitt and K.Stromberg.Real and Abstract Analysis ,Berlin,Springer. 7.P.K.Jain and V.P. gupta ,Lebesgue Measure and Integration ,New Age International (P) Limited New Delhi. 8.I.P.Natanson,theory of Functions of a Real Variable ,Vol.I Fredrick Ungar Publishing Co. 1961 9. H.Williamson , Lebesgue Integration ,Holt Rinehart and Winston ,Inc.New York. 10. K. R. Parthasarathy ,Introduction to Probability and Measure , Macmillan Company of India Ltd. Delhi 11.Inder K. Rana , An Introduction to Measure and Integration ,Narosa Publishing House ,Delhi.

M.Sc. II Sem.
Paper III- Topology II
Course Outcome

The students will be able

CO1-To know the definition and basic properties of connected spaces,product

spaces.

CO2- To gain knowledge about Tychonoffs product topology.

CO3- To familiar with the embedding and metrization theorems.

CO4- To understand the concept of Net and Filter.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5	✓	✓	✓	✓
PO_6				
PO_7				
PO_8	✓	✓	✓	
PO_9			✓	
PO_{10}	✓	✓	✓	✓
PO_{11}				

M.Sc. (MATHEMATICS)		II SEMESTER	
COURSE CODE: MSM 203		COURSE TYPE: CCC	
COURSE TITLE: TOPOLOGY II			
CREDIT: 6		HOURS:90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL: 0	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

23 hrs.	Connected spaces , Connectedness on the real line, Components , Locally Connected spaces.
20 hrs.	Product Spaces , Tychonoff Product topology in terms of standard sub base and its characterizations,Projection maps,Connectedness and Product Spaces, Compactness and Product Spaces (Tychonoff Theorem), Countability and product spaces
17 hrs.	Embedding and Metrization, Embedding Lemma and Tychonoff embedding, The Urysohn's metrization theorem,Metrization theorems and Paracompactness – Local Finiteness ,The Nagata –Smirnov metrization theorem,Paracompactness,The Smirnov metrization theorem
12 hrs.	Nets & Filter: topology and convergence of nets, Hausdorfness and nets ,Filters and their convergence, Canonical way of converting nets to filters and vice versa. Ultra filters and compactness.
18 hrs.	The fundamental group and covering spaces – Homotopy of paths ,The fundamental groups, Covering spaces The fundamental group of the circle and the fundamental theorem of Algebra**.**

SUGGESTED READINGS	1.James R. Munkres, Topology ,A First course,Prientice Hall of India Pvt.Ltd.,New Delhi. 2.K.D. Joshi, Introduction to General Topology,Wiley Eastern Ltd. 3.J.Dugundgi,Topology, Allyn and Bacon, (reprinted in India by Prentice Hall of India Pvt.Ltd.) 4. George F.Simmons , Introduction to Topology and Modern Analysis,Mcgraw Hill Book Company) 5. J.Hocking and G.Young , Topology ,Addison –Wiley Reading 6. J.L.Kelley ,General Topology ,Van Nostrand Reinhold Co. ,New York 7. L.steen and J.Seebach , Counter examples in Topology , Holt Rinehart and Winston ,New York. 8.W.Thron, Topologically Structures ,Holt,Rineharts and Winston ,New Delhi 9.Topology,by J.N.Sharma & J.P.Chauhan, Krishna PrakashanMedia (P) Ltd. Meerut.

M.Sc. II Sem.

Paper IV- RESEARCH METHODOLOGY & COMPUTER APPLICATION: BASICS

Course Outcome

After completing the course students will be able to demonstrate-

CO 01- Knowledge of research process reading evaluating developing and analyzing the ideas/ thought in critical/ analytical manner.

CO 02- literature reviews using print and online database of the subject and allied branches in perspectives of its inter -relation and so on.

CO 03- competent use of MLA and APA format for citation of print and electronic materials available .

CO 04- Potentials to identify explain, compare and prepare the key elements of research proposal and research report.

CO 05- Compare and contrast qualitative and quantitative research paradigms and to explain the use of each in research.

CO 06- The rationale for research ethics and importance of local processes for Institutional Review Board reviews for its rational improvisation.

CO 07- How Educational research contributes to the objectives of doctoral programme and specific career in higher education.

CO 08- Competent use of information received in general social welfare and issues relevant and focused in the context of humanity as whole and its positive solutions in larger interest be devised.

M.Sc.(MATHEMATICS)	**II SEMESTER**
COURSE CODE: S02	**COURSE TYPE:OSC**
COURSE TITLE:RESEARCH METHODOLOGY & COMPUTER APPLICATION: BASICS	
CREDIT: 06 **THEORY: 06**	**HOURS : 90** **THEORY: 90**
MARKS : 100 **THEORY: 70** **CCA : 30**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

15 Hrs	**CONCEPT OF RESEARCH :** Meaning and characteristics of research , Steps in research process , Types of research - **(**i) Basic, applied and action research (ii) Quantitative and qualitative research , Areas of research in concern discipline **SELECTION OF PROBLEM FOR RESEARCH :**Sources of the selection of the problem ,Criteria of the selection of the problem ,Drafting a research proposal , Meaning and types of variables ,Meaning and types of hypotheses.
15 Hrs	**TOOLS OF RESEARCH :** Meaning and general information about construction procedure of (i) Questionnaire, (ii) Interview, (iii) Psychological test, (iv) observation (v) Rating scale (vi) Attitute scale and (vii) check list , Advantages and disadvantages of above tools **SAMPLING :**Meaning of population and sample , Importance and characteristics of sample , Sampling techniques - i) Probability sampling : random sampling, stratified random sampling, systematic sampling, cluster sampling ii)Non-probability sampling: incidental sampling, purposive sampling, quata sampling
15 H rs	**METHODS OF RESEARCH-**Meaning and conducting procedure of following methods of research : Historical method, Survey method , Case study , Causal comparative method , Developmental methods , Experimental methods
15 Hrs	**TREATMENT OF DATA :** Level of measurements of data , Steps in treatment of data: editing, coding, classification, tabulation, analysis and interpretation of results **WRITING RESEARCH REPORT :** Sections of report : Preliminary section , Content section: various chapters , Supplementary section: appendices, references, abstract , Format and style

15 Hrs	**Computer Fundamentals** **Computer System :** Features, Basic Applications of Computer, Generations of computers. **Parts of Computer System :** Block Diagram of Computer System ; Central Processing Unit (CPU) ; Concepts and types of Hardware and Software, Input Devices - Mouse, Keyboard, Scanner, Bar Code Reader, track ball ; Output Devices - Monitor, Printer, Plotter, Speaker ; Computer Memory - primary and secondary memory, magnetic and optical storage devices. **Operating Systems - MS Windows :** Basics of Windows OS ; Components of Windows - icons, taskbar, activating windows, using desktop, title bar, running applications, exploring computer, managing files and folders, copying and moving files and folders ; **Control panel :** display properties, adding and removing software and hardware, setting date and time, screensaver and appearance ; **Windows Accessories :** Calculator, Notepad, WordPad, Paint Brush, Command Prompt, Windows Explorer.
15 Hrs	**Office Software Package** **Word Processing - MS Word :**Creating, Saving, Opening, Editing, Formatting, Page Setup and printing Documents ; Using tables, pictures, and charts in Documents ; Using Mail Merge sending a document to a group of people and creating form, letters and label. **Spreadsheet - MS Excel :**Opening a Blank or New Workbook, entering data/Function/ Formula into worksheet cell, Saving, Editing, Formatting, Page Setup and printing Workbooks. **Presentation Software - MS Power Point :** Creating and enhancing a presentation, modifying a presentation, working with visual elements, adding Animations & Transitions and delivering a presentation.

SUGGESTED READINGS	*Agrawal, Y. P. (1988).* ***Better sampling : Concepts, Techniques and Evaluation.****New Delhi : sterling Publishers Private Ltd.Best, J. W. (1993).* ***Research in Education*** *(6th ed.)New Delhi : Prentice-Hall of India Pvt. Ltd.* *Broota, K. D. (1992)* ***Experimental design in Behavioral Research*** *(2nd ed.)* *New Delhi : Wiley Eastern Limited.* *Dasgupta, A. K. (1968).* ***Methodology of Economic Research****.Bombay: Asia Publishing House.Edwards, A. L. (1957).* ***Techniques of Attitude Scale construction.****New York : Appleton-Contury* *Gall, M. D., Gall, J. P. and Borg, W. R. (2007).* ***Educational Research : An introduction*** *(8th ed.) Coston : Allyn and Bacon.* *Garrett, H. E. & Woodworth, R. S. (1969).* ***Statistics in Psychology and Education****.Bombay :Vakils, Fecffer& Simons Pvt. Ltd.* *Goode, W. J. &Hatt, Paul K. (1952).* ***Methods in Social Research.****New York : McGraw-Hill.* *Gopal, M. H. (1964).* ***An Introduction to research Procedure in Social Sciences.*** *Bombay : Asia Publishing House.* *Hillway, T. (1964)* ***Introduction to Research (2nd ed.)*** *Noston : Houghton Miffin.* *Hyman, H. H., et al. (1975****). Interviewing in Social Research.*** *Chicago : University of Chicago Press.* *Kerlinger, F. N. (1983)* ***Foundation of Behavioural Research. (2nd Indian Reprint)*** *New York : Holt, Rinehart and Winston.* *Kothari, C. R. (2007)* ***Research Methodology: Methods & Techniques****(3rd ed.)* *New Delhi :WishwaPrakashan.Fundamentals Of Computers, Dr. P. Mohan, Himalaya Publishing House.* *Microsoft First Look Office 2010, K. Murray, Microsoft Press.* *Fundamental Of Research Methodology And Statistics, Y.K. Singh, New Age* *International (P) Limited, Publishers.Practical Research Methods, Dr Catherine Dawson,* *The Essence Of Research Methodology, Jan Jonker&BartjanPennink, Springer.*

M.Sc. Semester-II

Paper-V: ENVIRONMENTAL AND FOREST LAWS

Course Outcomes

After completing the course the students will able to : -

CO 01- The primary learning outcome is to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.

CO 02- Students will develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.

CO 03- Students will be able to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.

CO 04- Students will be able to assist industries and projects in obtaining environmental clearance and compliances with other environmental laws.

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM B01		**COURSE TYPE: ECC/CB**	
COURSE TITLE: ENVIRONMENTAL AND FOREST LAWS			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	International Environmental laws : Evolution and development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration ,Rio Conference, Rio+5 and Rio+10 ,etc.Global environmental issues and International laws to control Global warming Ozone depletion , Acid rains , hazardous waste,CITES etc. ,Role of UN authorities in protection of Global Environment , Multinational authorities and agreements, future of International laws.
18 hrs.	Environmental Acts ,Rules and Notifications:The following environmental Acts /Rules will be discussed in details ;the rest of the acts ,rules, and notifications will be referred to : (a) Water (Prevention & Control of Pollution) Act and the corresponding Rule. (b) Air (Prevention & Control of Pollution) Act and the corresponding rule. (c) Environment (Protection) Act and Rule (d) Hazardous Waste (Management & Handling) Rules (e) Manufacture ,Storage and Import of Hazardous Chemicals Rules (f) Public Liability Insurance Act and Rule
18 hrs.	Environmental laws in India : Policy and laws , Constitutional and statutory laws in India :Doctrine Principles of State Policy ,Fundamental Duties and Funddamental rights and Panchayati Raj System.Statutory protection of the Human Environment: such as Indian Penal Code ,Factories Act,Motor Vehicle Act, Hazardous Waste legislation for pollution abatement , Forest Policy -1952 and 1988, Forest Conservation Act -1980
18 hrs.	Important Judgements and Cases: Discussion on landmark ,Sriram Chemicals Oleum Leak Case, Ganga Action Plan case ,Bhopal Gas Leak case, etc. Green Benches
18 hrs.	Objectives of the Anti Pollution Acts ,Institutional mechanism ceated under these acts and role and ccontribution in combining environmental pollution .The role of courts requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986 Rule & regulation & guidelines given for disposal of hazardous waste ,municipal and solid waste & bio-medical waste Framework : Rule and regulations of Central & State Government and Central & State pollution control boards for Safeguard for Environmental Protection

SUGGESTED READINGS	1) Enviromental Laws-Mhaskar A.K. 2) Environmental Laws & politics in India- Shyam Diwan & Armin Rasencranz ,Oxford University Press 3) Environmental Protection & Laws, Acts, Rules,Guidelines,complaints & Standard , R.K. Trivedy, Envir.Media 4) Environmental Pollution & Development : Law & Policy ,Chandra Pal Mittal Pubs. 5) Introduction to the Constitution of India ,D.D.Basu Wadhwa and Company Law Publisher,New Delhi 6) Principles of International Environmental Laws –P.sands ,Cambridge University Press London 7) Environmental Legislation in India ,S.K.Choudhary, Oxford IBH ,New Delhi 8) Forest Lawswith explanation ,S.S. Negi,Bishen Singh Mahendrapal Singh Dehradun

M.Sc II Semester
Paper V- Advanced Discrete Mathematics II
Course Outcome

The students will be able

CO1- To demonstrate different traversal methods for trees and graphs.

CO2- To solve model questions in computer science using trees and gaphs.

CO3- To gain knowledge about Finite state machine.

CO4- To formulate and solve problems from diverse areas using application specific analysis and /or graph model.

CO5- To demonstrate the ability to write and evaluate a proof.

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PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5		✓	✓		
PO_6	✓	✓	✓	✓	✓
PO_7	✓				✓
PO_8	✓	✓	✓	✓	✓
PO_9			✓		✓
PO_{10}	✓	✓		✓	
PO_{11}		✓	✓	✓	✓

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM B02		**COURSE TYPE: ECC/CB**	
COURSE TITLE: ADV.DISCRETE MATHEMATICS (II)			
CREDIT: 6		**HOURS:90**	
THEORY: 6	**PRACTICAL:0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100(30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Graph Theory – Definition of (Undirected) Graphs, Paths, Circuits , Cycles , & Subgraphs ,Induced subgraphs ,Degree of a vertex, Connectivity ,{Planar Graphs and their properties,Trees ,Euler's Formula for connectedplanar Graphs,Complete & Complete Bipartite Graphs ,Kurtowski's Theorem (statement only) and its use.
18 hrs.	Spanning Trees, Cut sets, Fundamental Cut –sets ,and Cycle ,Minimal Spanning Trees and Kruskals Algorithm Matrix Representations of Graphs, Euler's Theorem on the Existence of Eulerian Paths and Circuits.
18 hrs.	Graphs .In Degree and Out degree of a Vertex, Weighted undirected Graphs, Dijkstra's Algorithm, Strong Connectivity & Marshall's Algoritm,Directed Trees ,Search Trees, Tree Traversals
18 hrs.	Introductory Computability Theory - Finite State Machines and their Transition , Table Diagrams ,Equivalence of Finite State Machines,Reduced Machines, Homomorphism
18 hrs.	Finite Automata, Acceptors, Non – deterministic , Finite Automata and equivalence of its power to that of Deterministic ,Moore and Mealy Machines Turning Machine and Partial Recursive Functions

SUGGESTED READINGS	1) Elements of Discrete Mathematics By C.L.Liu 2) Graph Theory and its application By N.Deo 3) Theory of Computer Science By K.L.P.Mishra and N. Chandrashekaran 4) J.P.Tremblay & R.Manohar, Discrete Mathemmatical Structures with applications to Computer Science ,McGraw –Hill Book Co. 1997 5) J.L. Gersting ,Mathematical Structures for Computer science,Computer Science Press,New York 6) Seymour Lepschutz ,Finite Mathematics edition,McGraw Hill Book Company ,New York 7) S. Wiitala,Discrete Mathematics – A Unified Approach ,McGraw – Hill Book Co. 8) J.E. Hopcroft and J.D. Ullman ,Introduction to Automata Theory,Language & Computation,Narosa Publishing House.

M.Sc. II Semester
Paper V- Algebraic Number theory
Course Outcome

The students will be able

CO1-To learn about the arithmetic of algebraic number fields.

CO2- To prove theorems about integral bases and about unique factorisation into ring and fields .

CO3-To understand the concept of algebraic numbers and algebraic integers.

CO4- To understand how to factorise an algebraic integer into irreducible.

CO5- To understand how to find the ideals of an algebraic number ring.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓				
PO_6			✓		
PO_7		✓	✓	✓	✓
PO_8	✓	✓	✓	✓	✓
PO_9		✓	✓	✓	✓
PO_{10}	✓	✓		✓	
PO_{11}		✓		✓	✓

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM B03		**COURSE TYPE: ECC/CB**	
COURSE TITLE: ALGEBRAIC NUMBER THEORY			
CREDIT:6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL: 0**	

18 hrs.	ALGEBRAIC BACKGROUND – Rings and Fields –Factorization of Polynomials ,Field Extensions , Symmetric Polynomials , Modules , Free Abelian Groups
18 hrs.	ALGEBRAIC NUMBERS Algebraic numbers , Conjugates and Discriminants ,Algebraic Integers, Integral Bases, Norms and Traces ,Rings of Integers
18 hrs.	QUADRATIC AND CYCLOTOMIC FIELDS Quadratic Fields and Cyclotomatic Fields : Factorization into Irreducible , Trivial Factorization : Factorization into irreducible,Examples of non- unique factorization into irreducible.
18 hrs.	Prime Factorization - Euclidean Domains ,Euclidean Quadratic fields ,Consequences of unique factorization ,The Ramanujan – Nagell Theorem
18 hrs.	Prime Factorization of Ideals ,The norms of an Ideal,Non –unique Factorization in Cyclotomic Fields.
SUGGESTED READINGS	Steward and D. Tall, Algebraic Number Theory and Fermat's Last Theorem A.K.peters Ltd. Natrick ,Mass 2002

M.Sc. II Semester
Complex Analysis –II
Course Outcome

The students will be able

CO1-To compute definite integrals using residue theorem.

CO2-To understand the concept of Analytic continuation and properties of Solutions to complex differential equation.

CO3- To understand the concept of Entire function.

CO4- To know the concept of Hadmard three circle theorem, Hadmard factorization theorem.

CO5- To apply the problem –solving using complex analysis techniques applied to diverse situations in physics, engineering.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5					
PO_6					
PO_7					✓
PO_8	✓	✓	✓	✓	✓
PO_9			✓		✓
PO_{10}	✓	✓		✓	
PO_{11}					

M.Sc. (MATHEMATICS)		**II SEMESTER**	
COURSE CODE: MSM B04		**COURSE TYPE:ECC/CB**	
COURSE TITLE: COMPLEX ANALYSIS -II			
CREDIT: 6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL : 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Residues, Cauchy's residue theorem ,Evaluation of integrals ,Branches of many valued function with special reference to arg z , Log z and z.
18 hrs.	Analytic Continuation ,Uniqueness of analytic continuation along a curve ,Power series method of analytic continuation ,Schwartz Reflection Principle
18 hrs.	Harmonic function on a disc ,Harnack's Inequality and theorem, Canonical product ,Jensen's Formula,Poisson –Jenson formula, Hadmard's three circle theorem.
18 hrs.	Order of an entire function, Exponent of Convergence ,Borel's Theorem, Hadmards Factorization Theorem
18 hrs.	The range of an analytic function ,Bloch's Theorem,The Little Picard theorem, Montel Caratheodary and The Great Picard Theorem
SUGGESTED READING	1) L.V.Ahlfors ,Complex Analysis ,McGraw Hill ,1979 2) D.Sarason ,Complex Function Theory ,Hindustan Book Agency ,Delhi. 3) Walter Rudin ,Real and Complex analysis ,McGraw –Hill Book company 1996 4) E.C.Titchmarsh ,The Theory of Functions ,Oxford University Press ,London 5) S.Ponnusamy Foundations of complex Analysis ,Narosa Publishing House,1997 6) J.B.Conway, Function of One Complex Variable ,Springer Verlag

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- **M.Sc. in MATHEMATICS**
  FACULTY OF SCIENCE
- **THIRD SEMESTER** (ODD SEMESTER)

	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
	MSM 301	**CCC**	**Integration Theory and Functional Analysis (I)**	6	4	3	00	3	00
	MSM 302	**CCC**	**Partial Differential Equations & Mechanics (I)**	6	4	3	00	3	00
	MSM 303	**CCC**	**Operations Research (I)**	6	4	3	00	3	00
	MSM S03	**OSC**	**Intellectual Property Law**	6	4	3	00	3	00
	MSM C 01	ECC/CB	Tribal Studies	6	4	3	00	3	00
	MSM C 02	ECC/CB	Mathematical Modelling						
	MSM C 03	**ECC/CB**	**Fluid Dynamics**						
	MSM C 04	**ECC/CB**	**Numerical Analysis I**						
	MINIMUM CREDITS IN INDIVIDUAL SUBJECT IS 6 AND IN COMPLETE SEMESTER IT WOULD BE 30			**TOTAL= 30**					

M.Sc.III Sem.(Maths)
Integration Theory and Functional Analysis I
Course Outcome

The students will be able

CO1- To acquire basic knowledge of measure and integration theory.

CO2- To analyze measurable set and Lebesgue measure.

CO3- To analyze Lebesgue –Stieltzes integral and Fubini's theorem.

CO4- To understand the knowledge of normed linear space in functional analysis.

CO5- To understand the concept of weak convergence and bounded linear transformation.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					
PO_8					
PO_9	✓	✓	✓	✓	✓
PO_{10}	✓	✓		✓	
PO_{11}					

M.Sc. (MATHEMATICS)		III SEMESTER	
COURSE CODE: MSM 301		COURSE TYPE: CCC	
Course Title: Integration Theory and Functional Analysis (I)			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL: 00	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	**Measure Theory:** Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition. Riesz representation theorem. Extension theorem (Caratheodory).
18 hrs.	Lebesgue-Stieltjes integral, product measures, Fubini's theorem. Differentiation and Integration. Decomposition into absolutely continuous and singular parts.
18 hrs.	Baire sets. Baire measure, continuous functions with compact support. Regularity of measures on locally compact spaces. Integration of continuous functions with compact support, Riesz-Markoff theorem.
18 hrs.	**Functional Analysis :** Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness.
18 hrs.	Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

SUGGESTED READINGS	1. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950. 2. B.Choudhary and S.Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989. 3. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993. 4. S.K. Berberian, Measure and integration, Chelsea Publishing Company, New York, 1965. 5. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981. 6. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 2000. 7. Richard L. Wheeden and Antoni Zygmund, Measure and Integral : An Introduction to Real Analysis, Marcel Dekker Inc. 1977. 8. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962. 9. T.G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979. 10. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977. 11. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966. 12. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967. 13. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.

M.Sc.III Sem.(Maths)

Partial Differential Equations and Mechanics (I)

Course Outcome

The students will be able

CO1- To understand the basic properties of standard PDE's.

CO2- To solve some problems of Green function and Harmonic function.

CO3- To find the solution of Laplace and Poisson equation.

CO4- To analyze the fundamental solution and properties of Heat equation and Wave equation.

CO5-To demonstrate accurate and efficient use of Fourier, Laplace and Legendre transform and their application in the theory of PDE's.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓	✓		
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}					

M.Sc. (MATHEMATICS)		**III SEMESTER**	
COURSE CODE: MSM 302		**COURSE TYPE: CCC**	
COURSE TITLE: Partial Differential Equations and Mechanics (I)			
CREDIT:6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100(30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	**Laplace's Equation**-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.
18 Hrs.	**Heat Equation**-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. **Wave Equation**-Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.
18 hrs.	Nonlinear First Order PDE, Complete Integrals, Envelopes Characteristics, HamiltonJacobi Equations (Calculus of Variations, Hamilton's ODE), Conservation Laws ,Representation of solutions,Seperation of variables
18 hrs.	Laplace and Fourier transforms and their applications,Legendre Transform.
18 hrs.	**Gravitation**: Attraction & Potential of rod, disc, spherical shells and sphere.Surface integral of normal attraction (application & Gauss' theorem).

SUGGESTED READINGS	1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics,Volume 19, AMS, 1998. 2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975. 3. R. C. Mondal, Classical Mechanics, Prentice Hall of India 4. S. L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979. 5. Books on Partial differential equation by 1.N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc. 6. A.S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972. 7. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi. 8. I. M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall. 9. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991. 10. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998. 11. A.S. Ramsey, Newtonian Gravitation, The English Language Book Society and the Cambridge University Press.

M.Sc. III Sem.(Maths)

Operation Research I

Course Outcome

The students will be able

CO1- To understand the application of OR and frame a LP Problem with solution.

CO2- To formulate some real life problem into linear programming problem.

CO3- To use simplex method to find an optimal solution.

CO4- To find optimal solution of transportation problem and assignment problem.

CO5- To formulate and solve parametric, goal programming.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓	✓	✓	✓

M.Sc. (MATHEMATICS)		III SEMESTER	
COURSE CODE: MSM 303		COURSE TYPE: CCC	
COURSE TITLE: OPERATION RESEARCH I			
CREDIT: 6		HOURS:90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL: 0	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

23 hrs.	Operations Research and its Scope. Problem formulation& Graphical solution of Linear Programming Problem, Some properties of convex sets, convex and concave functions.
20 hrs.	Solution of L.P.P. – Simplex method, Two phase method, Big –M method,
17 hrs.	Duality in Linear Programming -Dual Simplex Method. Sensitivity Analysis.
12 hrs.	Parametric Linear Programming, Upper Bound Technique, Linear Goal Programming.
18 hrs.	Transportation and Assignment Problems.

SUGGESTED READINGS	1. F.S. Hillier and G.J. Lieberman. Introduction to Operations ResBareft (SixthEdition), McGraw Hill International Edition, Industrial Engineering Series, 1995. 2. G. Hadley, Linear Programming, Narosa Publishing House, 1995. 3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass. 4. H.A. Taha, Operations Research -An introduction, Macmillan Publishing Co., Inc., New Yark. 5. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi 6. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi. 7. Prem Kumar Gupla and D.S. Hira, Operations Research-An Introduction. S. Cliand & Company Ltd., New Delhi.

M.Sc.III Sem.(Maths)

Intellectual Property Law

Course Outcome

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

CO-01:- The concept and development of all forms of I.P.R.

CO-02:- Distinguish and explain various forms of I.P.R

CO-03:- Identify criteria's to fit one's own intellectual work in particular forms of I.P.R

CO-04:- Apply statutory provisions to protect particular forms of I.P.R

CO-05:- Apply the concept and forms of I.P.R in research field.

COURSE CODE: MSM S02		COURSE TYPE: OSC	
COURSE TITLE: Intellectual Property Law			
CREDIT:6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

12 hrs	**Introduction, Nature, Basic Concepts and International Conventions** : Nature and meaning of Intellectual property, Justification for protection of intellectual property right.,Types of intellectual property. Leading international instrument concerning protection of IP: The Berne Convention (1971), Rome convention (1961) Trade Related intellectual property agreement" (TRIPS)
24 hrs.	**Law of Copyright** Definition, Subject matter of copyright, Ownership of Copyright, Term of Copyright, Rights of Owner, Assignments and Licenses, Infringement of Copyright, Remedies against infringement of copyright
12 hrs.	**Law of Patents** Meaning , Criteria for obtaining patents, Novelty, Utility, Non-obviousness, Non patentable inventions, Procedure for registration, Term of patent, Rights of patent, Basic concept of compulsory license and government use of patent Infringement of patent, Remedies in case of Infringement
24 hrs.	**Law of Trademark** Meaning of mark, trademark, Categories of Trademark- Conventional and Non-conventional Marks, Concept of distinctiveness, Absolute and relative grounds for refusal, Doctrine of honest concurrent use , Procedure of registration of trademarks and Term of protection, Assignment and Licensing Infringement and passing off
18 hrs.	**Design and other forms of Geographical Indication (GI)** 1.Designs, Meaning of Design Protection, Concept of original design, Term of Protection 2.Geographical Indication, Meaning of GI, Difference between GI and Trademark Concept of Authorized user

SUGGESTED READINGS	1. G.B.Reddy, *Intellectual Property Rights and Law,* Gogia Law Agency, Hyderabad. 2. S.R.Myneni, *Intellectual Property Law*, Eastern Law House, Calcutta 3. P Narayanan *Intellectual Property Rights and Law (1999)*, Eastern Law House, Calcutta, India 4. VikasVashistha, *Law and Practice of Intellectual Property*,(1999) Bharat Law House, New Delhi. 5. Comish W.R *Intellectual Property,3rded, (1996),* Sweet and Maxwell 6. P.S. Sangal and Kishor Singh, *Indian Patent System and Paris Convention,* 7. Comish W.R *Intellectual Property, Patents, Copyrights and Allied Rights, (2005)* *8.* Bibeck Debroy, *Intellectual Property Rights, (1998),* Rajiv Gandhi Foundation.

M.Sc.III Sem.(Maths)
TRIBAL STUDIES
Course Outcome

After completing the course the students will able to : -

CO1- Describe the need and importance of Tribal Studies, since tribes constitute a significant portion of Indian Population.

CO2- Identify major tribes of India, with their racial, lingual, and geographical classification.

CO3- Enumerate various issues posing threat to the tribal existence, Identity development.

CO4-Critically describe various Laws, Policies, programmes and Constitutional provisions corresponding to tribal development in India.

CO5-Evaluate various welfare agencies and the programmes related to Scheduled Tribes in the fields of education, employment and social justice.

CO6-Create a deliberate interest in getting involved with the activities initiated for the improvement of the lives of tribals.

M.Sc. (MATHEMATICS)		**III SEMESTER**	
COURSE CODE: MSM C01		**COURSE TYPE: ECC/CB**	
COURSE TITLE: TRIBAL STUDIES			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	**Tribal Studies :** Meaning, Nature, Scope, Need & importance of tribal studies. Meaning, Definition & characteristics of Tribe, Caste & Race
18 hrs.	**Scheduled Tribe in India:** Population Composition of tribal, classification of Indian Tribe – Racial, Lingual, Geographical, Cultural. **Some Major Tribes in India:** Santhal, Khasi, Munda, Bhils. **Some Major Tribes in Central India :** Gond, Baiga, Bharia, Korkus.
18 hrs.	**Illiteracy: Poverty**, Indebt ness, Unemployment, migration & Exploitation Environmental & Degradation. **Problem of Health and sanitation :** Prostitution, Culture Decay due to assimilation. Replacement & Rehabilitation of Tribal population.
18 hrs.	**Welfare-Concept, Characteristics:** Tribal Welfare in post independence period. Constitutional provision & safe guard after independence, Legislation & Reservation Policy.
18 hrs.	**Tribal Development Programs for Scheduled Tribes :** Medical, Education, Economy, Employment & Agriculture Evaluation of Programs **Tribal Welfare & Advisory Agencies in India :** Role of NGO's in tribal development, Role of Christian missionaries in tribal welfare & development. Tribal Welfare Administration.
SUGGESTED READINGS	1. *Tribal Development In India (Orissa)* by Dr. Taradutt 2. *Books on Tribal studies* by PK Bhowmik 3. *Books on 'Tribal Studies'* by W.G. Archer

M.Sc. III Sem.(Maths)

Mathematical Modelling

Course Outcome

The students will be able

CO1- To understand what a mathematical model is and explain the series of steps involved in a mathematical modelling process.

CO2- To state and explain the different classifications of mathematical models stating examples in each classes.

CO3- To explain the essential features of a good model and discuss the benefits of using mathematical modelling.

CO4 -To identify some simple real life problems that can be solved using mathematical models, model the problems ,solve the resulting problem and interpret the solution.

CO5- To acquire basic mathematical modelling skills that will enable them carry out simple modelling tasks individually or as a group.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	✓
PO_6	✓	✓		✓	✓
PO_7	✓	✓	✓		
PO_8	✓	✓	✓	✓	✓
PO_9					
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		III SEMESTER	
COURSE CODE: MSM C02		COURSE TYPE: ECC/CB	
COURSE TITLE: MATHEMATICAL MODELLING			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL: 0	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Mathematical Modelling through Systems of Ordinary differential Equations of the First Order Mathematical modeling in population dynamics, Mathematical modeling of epidemics through systems of ordinary differential equations of first order - Mathematical Models in Medicine, Arms Race, Battles and international Trade in terms of Systems of ordinary differential equations - Mathematical modeling in dynamics through systems of ordinary differential equations of first order.
18 hrs.	Mathematical Modelling through difference equations The need for Mathematical modelling through difference equations - some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical modelling through difference equations in economics and finance
18 hrs.	Mathematical Modelling through difference equations (contd.) Mathematical modelling through difference equations in population dynamics and genetics. Mathematical Modelling through difference equations in probability theory. Miscellaneous examples of Mathematical modelling through difference equations
18 hrs.	Mathematical modelling through Graphs Situations that can be modeled through graphs - Mathematical models in terms of directed graphs - Mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs
18 hrs.	Mathematical Modelling through calculus of Variations and Dynamic Programming Optimization principles and techniques - Mathematical modelling through calculus of variations - Mathematical Modelling through dynamic programming.

SUGGESTED READINGS	1. D. J. G. James and J. J. Macdonald, Case studies in Mathematical Modelling, Stanly Thames, Cheltonham. 2. J.N. Kapur, Mathematical entropy Models. 3. M. Crossand A. O. Moscrcadini, The art of Mathematical Modelling, Ellis Harwood and John Wiley. 4. C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, New York. 5. D. N. Burghes, Modelling with Difference Equations, Ellis Harwood and John Wiley.

M.Sc.III Sem.(Maths)

FLUID DYNAMICS

Course Outcome

The students will be able

CO1-To understand the basic principles of fluid mechanics such as Lagrangian & Eulerian approach etc.

CO2- To use Euler's and Bernoulli's equation and conservation of mass to determine pressure for incompressible and inviscid fluid

CO3- To understand the concept of three dimensional flow, sources, sinks and doublets etc.

CO4-To understand the concept of rotational & irrotational flow, stream function, complex velocity etc.

CO5- To analyse simple fluid flow problem & understand the concept of stress, stain.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	✓
PO_6	✓	✓		✓	✓
PO_7					
PO_8	✓	✓	✓	✓	✓
PO_9					
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		**III SEMESTER**	
COURSE CODE: MSM C03		COURSE TYPE:ECC/CB	
COURSE TITLE: FLUID DYNAMICS			
CREDIT: 6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL : 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Kinematics of Fluids in motion. Real fluids and Ideal fluids - Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.
18 hrs.	EQUATIONS OF MOTION OF A FLUID Pressure at a point in a fluid at rest. - Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.
18 hrs.	Some three dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function
18 hrs.	SOME TWO DIMENSIONAL FLOWS Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrotational incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem.
18 hrs.	VISCOUS FLOWS Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principal stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain - The coefficient of viscosity and Laminar flow - The Navier - Stokes equations of motion of a Viscous fluid.

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

M.Sc.III Sem.(Maths)

Numerical Analysis –I

Course Outcome

The students will be able

CO1-To apply calculus of finite differences.

CO2-To apply various interpolation formulas for equal interval in calculus of finite differences.

CO3-To apply various interpolation formulas for unequal interval in calculus of finite differences.

CO4-To understand central difference interpolation formulas & used in different area.

CO5- To work out numerical differentiation, integration whenever and wherever routine methods are not applicable.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5					
PO_6	✓	✓		✓	
PO_7					
PO_8	✓	✓	✓		✓
PO_9			✓		✓
PO_{10}	✓	✓		✓	
PO_{11}		✓		✓	✓

M.Sc. (MATHEMATICS)		III SEMESTER	
COURSE CODE: MSM C04		COURSE TYPE:ECC/CB	
COURSE TITLE: NUMERICAL ANALYSIS –I			
CREDIT: 6		**HOURS:90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL : 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	.The calculus of Finite Differences:Differences ,fundamental theorem of difference calculus,to express any value of function in term of Δ and the leading differences of of a difference table.The operator E, properties of two operators E and A , Factorial notation ,Differences of zero,Recurrence relation.
18 hrs.	Interpolation with Equal Intervals:Differenty interpolation method,method of curve fitting,use of calculus of finite differences,sub-division of intervals.
18 hrs.	Interpolation with une:qual Intervals:Divided differences, Newton's formula for unequal intervals, relation between divided differences and ordinary differences, Sheppard's rule, Langrange's interpolation formula for unequal intervals, Hermite interpolation formula
18 hrs.	**Central Difference Interpolation Formula:** Gauss's interpolation formula, Sterling's formula, Bessel's formula, Laplace Everett Formula, Use of various interpolation formula
18 hrs.	**Numerical Differentiation And Integration:** Trapezoidal rule, Simpson one-third rule, Simpson three-eight rule, Weddle's rule, Cote's method, Euler-Maclaurin formula, Integration formula
SUGGESTED READING	1.C.E. Froberg, Introduction to Numerical Analysis,Addision Wesley-1979. 2. James B. Scarbrough- Numerical Mathematical Analysis, Oxford And IBH publishing Co. Inc. New York 1982. 3. M.K. Jain- S.R.K. Iyangar- R.K. Jain- Numerical Methid for scientific and Engineering Computation- New Age International (P) Ltd. 1999.

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- **M.Sc. in MATHEMATICS**
  FACULTY OF SCIENCE
- **FOURTH SEMESTER .**

	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per WeeK			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
	MSM 401	**CCC**	**Integration Theory and Functional Analysis (II)**	6	4	3	00	3	00
	MSM 402	**CCC**	**Partial Differential Equations & Mechanics (II)**	6	4	3	00	3	00
	MSM 403	**CCC**	**Operations Research (II)**	6	4	3	00	3	00
	MSM 421	**SSC/PRJ**	**Dissertation**	6	00	00	9	00	4
	MSM D 01	ECC/CB	Fuzzy Sets and their applications	6	4	3	00	3	00
	MSM D 02	ECC/CB	Mathematical Economics						
	MSM D 03	ECC/CB	Mathematical Statistics						
	MSM D 04	ECC/CB	Number Theory and Cryptography						
	MSM D 05	**ECC/CB**	**Numerical Analysis II**						
	MINIMUM CREDITS IN INDIVIDUAL SUBJECT IS 6 AND IN TOTAL IT WOULD BE 30			TOTAL= 30					

M.Sc.IV Sem.(Maths)

Integration Theory And Functional Analysis II

Course Outcome

The students will be able

CO1- To acquire basic knowledge of normed linear space and inner product

space.

CO2- To analyze the concept of different theorem like Hahn Banach theorem,

closed graph theorem, open mapping theorem etc.

CO3- To understand the concept of compact ,self –adjoint and normal operators.

CO4- To understand the concept of the spectrum of bounded linear operator.

CO5- To understand the difference between Banach space and Hilbert space.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	✓
PO_6	✓	✓		✓	✓
PO_7					
PO_8	✓	✓	✓	✓	✓
PO_9					
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		IV SEMESTER	
COURSE CODE: MSM 401		COURSE TYPE: CCC	
COURSE TITLE: INTEGRATION THEORY AND FUNCTIONAL ANALYSIS II			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems.
18 hrs.	Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.
18hrs .	Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity.
18 hrs.	Structure of Hilbert spaces. Projection theorem. Riesz representationtheorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces.
18 hrs.	Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax-Milgram theorem.

SUGGESTED READINGS	1. B.Choudhary and S.Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989. 2. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993. 3. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967. 4. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing. 5. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York. 6. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993. 7. B.V. Limaye, Functional Analysis, Wiley Eastern Ltd. 8. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971. 9. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963. 10. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958. 11. K.Yosida, Functional Analysis, 3'" edition Springer-Verlag, New York, 1971. 12. J.B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 1990. 13. Walter Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1973.

M.Sc.IV Sem.(Maths)

Partial Differential Equations And Mechanics (II)

Course Outcome

The students will be able

CO1- To recognize and use basic concepts and principles of classical mechanics and apply them to simple examples

CO2- To define and understand basic mechanical concepts related to advanced problems involving the dynamic motion of classical mechanical system.

CO3- To able to describe and understand the motion of a mechanical system using Lagrange's, Hamilton's equations.

CO4- To formulate physical problems as PDE's using conservation laws.

CO5- To solve complicated physical problems using the principle of least action.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5					
PO_6	✓	✓		✓	✓
PO_7					
PO_8	✓	✓	✓	✓	✓
PO_9	✓	✓	✓	✓	✓
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		**IV SEMESTER**	
COURSE CODE: MSM 402		**COURSE TYPE: CCC**	
COURSE TITLE: PARTIAL DIFFERENTIAL EQUATIONS AND MECHANICS (II)			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS			
THEORY:100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

25 hrs.	**Analytical Dynamics:** Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic sytems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Uniqueness of solution. Energy equation for conservative fields.
20 hrs.	Hamilton's variables. Hamilton canonical equations. Cyclic coordinates. Routh's equations, Hamilton's Principle,Principle of least action Motivating problems of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Isoperimetric problem. Geodesic.
15 hrs.	Fundamental lemma of calculus of variations. Euler's equation for one dependent function and its generalization to (1) 'n' dependent functions, (ii) higher order derivatives. Conditional extremum under geometric constraints and under integral constraints.
15 hrs.	Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, invariance of Lagrange brackets and Poisson brackets under canonical transformations.
15 hrs.	Hamilton-Jacobi equation. separation of variables in Hamilton –Jacobi equation, Applications of Hamilton-Jacobi equation in the solution of problems.

SUGGESTED READINGS	1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998. 2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975. 3. R.C.Mondal, Classical Mechanics, Prentice Hall of India 4. Books on Partial differential equation by 1.N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc. 5. A.S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972. 6. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi. 7. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall. 8. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991. 9. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998

M.Sc. IV Sem.(Maths)
Operation Research (II)
Course Outcome

The students will be able

CO1- To formulate & solve problems as networks and graph.

. CO2- To develope linear programming models for shortest path, maximum flow, minimal spanning tree, critical path etc.

CO3- To learn the construction of networks of a project and optimal scheduling using CPM and PERT.

CO4-To formulate and solution of linear programming model of two person zero sum games..

CO5- To solve non –linear programming problems using Lagranges multiplier & Kuhn –Tucker condition.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4					
PO_5	✓	✓	✓	✓	✓
PO_6	✓	✓		✓	✓
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓	✓	
PO_{10}	✓	✓	✓	✓	✓
PO_{11}					

M.Sc. (MATHEMATICS)		**IV SEMESTER**	
COURSE CODE: MSM 403		**COURSE TYPE: CCC**	
COURSE TITLE: OPERATION RESEARCH (II)			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS:			
THEORY:100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Network Analysis-Shortest Path Problem. Minimum Spanning Tree Problem. Maximum Flow I Problem. Minimum Cost Flow Problem.Network Simplex Method. Project Planning and Control I with PERT-CPM.
12 hrs.	Dynamic Programming-Deterministic and Probabilistic Dynamic Programming
17hrs.	Game Theory-Two-Person, Zero-Sum Games. Games with Mixed Strategies. Graphical Solution. Solution by Linear Programming.
23 hrs.	Integer Programming-Branch and Bound Technique,Gomory's method of solving I.P.P.
20 hrs.	Nonlinear Programming-One/and Multi-Variable Unconstrained Optimization-Lagrangian method, Kuhn-Tucker Conditions for Constrained Optimization,Wolf's method,Beal's method, Quadratic Programming. Separable Programming.Convex Programming. Non-convex Programming.

SUGGESTED READINGS	1. F.S. Hillier and G.J. Lieberman. Introduction to Operations ResBareft (SixthEdition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software). 2. G. Hadley, Linear Programming, Narosa Publishing House, 1995. 55. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass. 3. H.A. Taha, Operations Research -An introduction, Macmillan Publishing Co., Inc., New Yark. 4. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi 5. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990. 6. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi. 7. Prem Kumar Gupta and D.S. Hira, Operations Research-An Introduction. S. Cliand & Company Ltd., New Delhi.

<table>
<tr><td colspan="4">M.Sc. (MATHEMATICS) IV SEMESTER</td></tr>
<tr><td colspan="4">COURSE CODE: MSM 421 COURSE TYPE: SSC/PRJ</td></tr>
<tr><td colspan="4">COURSE TITLE: DISSERTATION</td></tr>
<tr><td colspan="2">CREDIT:6</td><td colspan="2">HOURS: 135</td></tr>
<tr><td>THEORY: 0</td><td>PRACTICAL: 6</td><td>THEORY: 0</td><td>PRACTICAL:135</td></tr>
<tr><td colspan="4">MARKS: 100</td></tr>
<tr><td colspan="2">THEORY: 0</td><td colspan="2">PRACTICAL:100 (50+50)</td></tr>
<tr><td colspan="4">OBJECTIVE: The main objective of the dissertation is to enable the students to learn on their own as well development of skill related to research and developmental activities. Dissertation should be related to the field of Physics. Dissertation should include declaration by the candidate, certificate by supervisor, Acknowledgement, title and introduction along with the following points:
1. Introduction
2. Review of Literature
3. Materials and Methods
4. Results and Discussions
5. Summary
6. Bibliography</td></tr>
</table>

M.Sc. IV Sem.(Maths)

FUZZY SETS AND ITS APPLICATIONS

Course Outcome

The students will be able

CO1-To distinguish between the crisp set and fuzzy set concept through the learned differences between the crisp set characteristic and the fuzzy set membership function.

. CO2- To understand the extension principles.

CO3- To demonstrate fuzzy relation on fuzzy set .

CO4- To understand the concept of fuzzy logic.

CO5- To analyze possibility theory, evidence theory.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	✓
PO_6	✓	✓		✓	✓
PO_7			✓	✓	✓
PO_8	✓	✓	✓		
PO_9	✓	✓	✓		✓
PO_{10}	✓	✓		✓	✓
PO_{11}	✓		✓	✓	

M.Sc. (MATHEMATICS)		**IV SEMESTER**	
COURSE CODE: MSM D01		**COURSE TYPE: ECC/CB**	
COURSE TITLE: FUZZY SETS AND ITS APPLICATIONS			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY:90**	**PRACTICAL: 0**
MARKS:			
THEORY:100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

23 hrs.	Fuzzy sets-Basic definitions, -level sets. Convex fuzzy sets. Basic Operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms.
20 hrs.	The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.
12 hrs.	Fuzzy Relations on Fuzzy sets, Composition of Fuzzy relations. Min-Max composition and its properties. Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation.
17 hrs.	Possibility Theory-Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.
18 hrs.	Fuzzy Logic-An overview of classical logic, Multivalued logics, Fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions, the compositional rule of inference
SUGGESTED READINGS	1. H.J. Zmmemann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991. 2. G.J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall ol India, New Delhi, 1995.

M.Sc.IV Sem.(Maths)

Mathematical Economics

Course Outcome

The students will be able

CO1- To improve the mathematical skills necessary to study economics.

. CO2- To use appropriate techniques to solve problems with calculus and linear algebra.

CO3- To use mathematics in economics and business applications successfully.

CO4- To develop analytical and organization skills.

CO5- To develop both independent learning and group work skills.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓				✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓		✓	✓	
PO_6	✓	✓			
PO_7	✓		✓	✓	✓
PO_8	✓	✓	✓		
PO_9	✓	✓	✓		✓
PO_{10}	✓	✓		✓	✓
PO_{11}	✓		✓	✓	

M.SC. (MATHEMATICS)		IV SEMESTER	
COURSE CODE: MSM D02		COURSE TYPE: ECC/CB	
COURSE TITLE: MATHEMATICAL ECONOMICS			
CREDIT:6		HOURS: 90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS:			
THEORY: 100 (30+70)		PRACTICAL: 00	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	THE THEORY OF FIRM: Basic Concepts - Optimizing Behavior - Input Demands - Cost Functions - Joint Products - Generalization to m variables - Homogeneous Production functions - CES Production Function.
18 hrs.	PERFECT COMPETITION: Assumptions of Perfect Competition - Demand Functions - Supply Functions - Commodity - Market Equilibrium - An application to Taxation.
18 hrs.	MARKET EQUILIBRIUM: Factor-Market Equilibrium - Existence and Uniqueness of Equilibrium - Stability of Equilibrium - Dynamic Equilibrium with Lagged Adjustment.
18 hrs.	ANALYSIS OF VARIANCE:One way classification and two-way classification. Hypotheses Testing: Poser functions - OC function - Most Powerful test - Uniformly most powerful test - unbiased test
18 hrs.	WELFARE ECONOMICS: Pareto Optimality - the efficiency of Perfect competition - The efficiency of Imperfect competition - External Effects in consumption and Production - Taxes and Subsidies - Social Welfare functions - The theory of Second Best.

SUGGESTED READINGS	**Recommended Book:** 1. William J. Baumol. Economic Theory and Operations Analysis, Prentice Hall of India, New Delhi, 1978 **Reference Books** 1. A.C.Chiang, Fundamental Methods of Mathematical Economics, McGraw Hill, New York, 1984 2. Michael D. Intriligator, Mathematical Optimization and Economic Theory, Prentice Hall, New York, 1971. 3. A. Kautsoyiannis, Modern Microeconomics (2nd edn) MacMillan, New York, 1979

M.Sc.IV Sem.(Maths)

Mathematical Statistics

Course Outcome

The students will be able

CO1- To describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis.

. CO2- To critically evaluate the underlying assumptions of analysis tools.

CO3- To understand and critically discuss the issues surrounding sampling and significance.

CO4- To discuss critically the uses and limitations of statistical analysis.

CO5- To solve a range of problems using the techniques covered and conduct basic statistical analysis of data.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	✓
PO_6	✓	✓			
PO_7		✓	✓	✓	✓
PO_8	✓	✓	✓	✓	
PO_9		✓	✓		✓
PO_{10}	✓	✓		✓	✓
PO_{11}	✓		✓	✓	

M.Sc.. (MATHEMATICS)		IV SEMESTER	
COURSE CODE: MSM D03		COURSE TYPE: ECC/CB	
COURSE TITLE: Mathematical Statistics			
CREDIT:6		HOURS: 90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS			
THEORY: 100 (30+70)		PRACTICAL: 00	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**

ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	SAMPLE MOMENTS AND THEIR FUNCTIONS:Notion of a sample and a statistic - Distribution functions of X, S^2 and (X , S^2) - χ^2 distribution , Student t-distribution, Fisher's Z – distribution, Snedecor's F – distribution, Distribution of sample mean from non-normal populations.
18 hrs.	SIGNIFICANCE TEST : Concept of a statistical test - Parametric tests for small samples and large samples - χ^2 test, Kolmogorov Theorem 10.11.1 - Smirnov Theorem 10.11.2 - Tests of Kolmogorov and Smirnov type - The Wald-Wolfovitz and Wilcoxon -Mann-Whitney tests - Independence Tests by contingency tables.
18 hrs.	ESTIMATION: Preliminary notion - Consistency estimation - Unbiased estimates - Sufficiency - Efficiency - Asymptotically most efficient estimates - methods of finding estimates - confidence Interval.
18 hrs.	ANALYSIS OF VARIANCE : One way classification and two-way classification. Hypotheses Testing: Poser functions - OC function - Most Powerful test - Uniformly most powerful test - unbiased test.
18 hrs.	SEQUENTIAL ANALYSIS : SPRT - Auxiliary Theorem - Wald's fundamental identity - OC function and SPRT - E(n) and Determination of A and B - Testing a hypothesis concerning p on 0-1 distribution and m in Normal distribution.

SUGGESTED READINGS	**Recommended Text** M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963. **Reference Books** 1. E.J.Dudewicz and S.N.Mishra , Modern Mathematical Statistics, John Wiley and Sons, New York, 1988. 2. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern New Delhi, 1988(3rd Edn) 3. G.G.Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973 4. B.L.Vander Waerden, Mathematical Statistics, G.Allen & Unwin Ltd., London, 1968.

M.Sc.IV Sem.(Maths)

NUMBER THEORY AND CRYPTOGRAPHY

Course Outcome

The students will be able

CO1- To study briefly about number theory ,encryption and secrecy.

. CO2- To learn about symmetric key encryption ,stream cipers and DES

CO3- To gain knowledge about factorization problem and discrete logarithm problem.

CO4- To understand finite fields and quadratic residues with basic properties.

CO5- To study briefly about public key cryptography,RSA and discrete logarithm.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓		✓	✓	
PO_6	✓	✓	✓		
PO_7	✓	✓	✓	✓	✓
PO_8	✓	✓	✓		
PO_9			✓		✓
PO_{10}	✓	✓	✓	✓	✓
PO_{11}	✓		✓	✓	

M.Sc. (MATHEMATICS)		**IV SEMESTER**	
COURSE CODE: MSM D04		**COURSE TYPE: ECC/CB**	
COURSE TITLE: NUMBER THEORY AND CRYPTOGRAPHY			
CREDIT: 6		**HOURS: 90**	
THEORY: 6	**PRACTICAL: 0**	**THEORY: 90**	**PRACTICAL: 0**
MARKS:			
THEORY: 100 (30+70)		**PRACTICAL: 00**	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	Elementary Number Theory Time Estimates for doing arithmetic - Divisibility and Euclidean algorithm - Congruences - Applications to factoring.
18 hrs.	Cryptography Some simple crypto systems - Enciphering matrices.
18 hrs.	Finite Fields and quadratic Residues. Finite fields - Quadratic residues and Reciprocity.
18 hrs.	Public Key Cryptography The idea of public key cryptography - RSA - Discrete log – Knapsack.
18 hrs.	Primality and Factoring Pseudoprimes - The rho method - Fermat factorization and factor bases - The Continued fraction method - The quadratic sieve method. Chapter-V

SUGGESTED READINGS	**Recommended Text** Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York, 2002, Second Edition. **Reference Books** 1. Niven and Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi, 1976. 2. David M.Burton, Elementary Number Theory, Wm C.Brown Publishers, Dubuque, Iowa, 1989. 3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972.

M.Sc. IV Sem.(Maths)
Numerical Analysis -II
Course Outcome

The students will be able

CO1- To perform basic mathematical operations on numerical analysis.

. CO2- To investigate numerical solution of difference equation.

CO3- To gain knowledge in finding solution of ordinary differential equation problem.

CO4- To find a numerical solution of differential equation by different method like Euler method, Picard method ,Taylor method etc.

CO5- To research numerical solutions of difference and differencial equation systems.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓		✓	✓	
PO_6	✓	✓			
PO_7			✓	✓	✓
PO_8	✓	✓	✓		
PO_9			✓		✓
PO_{10}	✓	✓		✓	✓
PO_{11}	✓		✓	✓	

M.Sc. (MATHEMATICS)		IV SEMESTER	
COURSE CODE: MSM D05		COURSE TYPE: ECC/CB	
COURSE TITLE: NUMERICAL ANALYSIS –II			
CREDIT: 6		HOURS: 90	
THEORY: 6	PRACTICAL: 0	THEORY: 90	PRACTICAL: 0
MARKS:			
THEORY: 100 (30+70)		PRACTICAL: 00	

Scheme of marks:

i. **Objective type questions: Twelve questions carrying 1 marks each to be asked 10 to be attempted.**
ii. **Short answer type questions: Five questions carrying 3 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 6marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 11 marks each to be set three to be attempted (Word limit 750 words).**

18 hrs.	**Difference Equation I :** Homogeneous linear difference equations with constant coefficients, Existance and uniqueness theorem, Different method for finding particular solution in case of non -homogeneous linear equation
18 hrs.	**Difference Equation II:** Methods of variation of parameters, Method of generating function, non -homogeneous linear difference equation with variable coefficient, Solution of some special types of difference equation, Solution of homogeneous difference equation (degree2), Simultanious difference euation.
18 hrs.	**Numerical Solution of ordinary Differential Equation of I order:** Picard's method of succesive Approximation, Euler's method, Improved Euler's method, Modified Euler's method, Taylor's series Method, Milne's method, Runge's method, Runge- Kutta Method
18 hrs.	**Solution of algebraic and transcendental equation :** Bisection method, method for finding initial approximate value of root, Newton's iterative formula for obtaining square root, Rate of convergence of Newton's method .
18 hrs.	**Simultaneous linear algebraic equation:**Gauss- Jordan ellimination method, Crout's Method, Method of factorization, Jacobi iterative method, Gauss- Seidel iterative method, Relaxation method due to Southwel
SUGGESTED READINGS	1.C.E. Froberg, Introduction to Numerical Analysis,Addision Wesley-1979. 2. James B. Scarbrough- Numerical Mathematical Analysis, Oxford And IBH publishing Co. Inc. New York 1982. 3. M.K. Jain- S.R.K. Iyangar- R.K. Jain- Numerical Methid for scientific and Engineering Computation- New Age International (P) Ltd. 1999.

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