SYLLABUS

For

M.A /M.Sc. in Mathematics

2023-25

POST GRADUATE DEPARTMENT
OF

MATHEMATICS

GOVERNMENT (AUTONOMOUS) COLLEGE

ROURKELA

19/07/23

19/07/23

SEMESTER WISE COURSE STRUCTURE FOR THE TWO YEARS P.G. PROGRAMMES IN GOVERNMENT (AUTONOMOUS) COLLEGE ROURKELA

EFFECTIVE FOR THE STUDENTS ADMITTED TO THE FIRST YEAR
POST GRADUATE COURSE DURING THE SESSION 2023-24 AND ONWARDS

Department of Mathematics

Semester	Paper	Course Title	Credits	Marks		
				MidSem.	End Sem.	Total
I	AECC-I	Entrepreneurship Development	2	20+20(assignment)	60	100
	101	Real Analysis	4	20	80	100
	102	Complex Analysis	4	20	80	100
	103	Algebra- I	4	20	80	100
	104	Topology	4	20	80	100
	105	Programming Language- I(Programming in C)	2	15	35	50
	106	Programming Lab – I (Programming in C)	2	--	50	50
		TotalCredit/MarksforFirstSemester	**22**			**600**
II	AECC-II	Enviromental Studies and Disaster Management	2	20+20(assignment)	60	100
	201	Measure Theory and Integration	4	20	80	100
	202	Ordinary Differential Equations	4	20	80	100
	203	Algebra- II	4	20	80	100
	204	Differential Geometry	4	20	80	100
	205	Programming Language-II(Programming in Python)	2	15	35	50
	206	Programming Lab – II (Programming in Python)	2	--	50	50
		TotalCredit/MarksforSecond Semester	**22**			**600**
III	IDC	Foundations of Mathematics (For non-core students)	3	20+20(assignment)	60	100
	301		4	20	80	100
	302		4	20	80	100
	303		4	20	80	100
	304		4	20	80	100
	305	Theory	2	15	35	50
	306	Practical	2		50	50
	307	MOOC'sonepaperfromSwayamorothers	3			
		TotalCredit/MarksforThirdSemester	**26**			**600**
IV	401	¤	4	20	80	100
	402		4	20	80	100
	403		4	20	80	100
	404	Project(ProjectWork(50)+Viva(30)+Presentation(20))	4	50+30+20		100
	405	Theory	4	20/--	80	100
		TotalCredit/MarksforFourthSemester	**20**			**500**
		TotalCredit	**90**			**2300**

OneNon-credit course will be taken by the students during t6e 2year of studyNCC/NSS/Sports/Yoga/Gardening/SociallyUsefulProductiveWork(SUPW)

IDC—InterDepartmentCourseorOpenElective

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IDC SUBJECTS - 2023 AS PER FOLLOWINGS

SL.NO.	SUBJECT
1	Anthropology
2	Chemistry
3	ComputerScience
4	Economics
5	English
6	Geology
7	Hindi
8	History
9	HomeScience
10	Library&InformationScience
11	Odia
12	Physics
13	PoliticalScience
14	Sociology
15	Statistics
16	Zoology
17	Mathematics

(IDC subjects will be added as per availability)

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IDC

INTER DEPARTMENTAL COURSE
SEMESTER III(MA/M.SC)
FOUNDATIONS OF MATHEMATICS
CREDITS-3
(WEEKLY THREE HOURS OF TEACHING)

OBJECTIVE:
The course is intended to be a first course in Basic mathematics for PG students of Non-Mathematics Departments. It will develop tools in logic, graph theory and basic calculus and will provide a comon mathematics foundation for students of all the programs.

OUTCOME:
1.After readind the course the students will be able to do mathematical reasoning.
2.The students will be able to handle basic problems in discrete mathematics and calculus.

UNIT-I

Propositional logic,Conditional statements-Converse, Contrapositive and inverse, Truth tables,Application of propositional logic, Logical Equivalence,De Morgan 's law, Basic idea of predicate and quantifiers.

UNIT-II

Review of sets, Relations, Functions, Equivalence classes,Quotient space,Cardinality of sets,Countable and Uncountable of sets, Principle of Mathematical induction,pigeonhole principle,principle of inclusion and exclusion.

UNIT-III

Graph and Graph models, Terminology, Special graphs,Isomorphism, Planar graphs, Introduction to tree.

UNIT-IV

Concept of calculus,Limit, Continuity, derivative , Integration,Partial derivatives,Rolle's Theorem,Mean Value Theorem(MVT) ,Lagrange MVT, Cauchy MVT, Differential Equation Applications to Mathematical Methods using First order linear Differential Equations.

The Course is Covered by :
1.Rosen Kenneth,Discrete Mathematics and Applications,Mcgraw Hill.
2.Apostol Tom, Calculus Vol-I, II Wiley and sons
3.Martin Brawn,Differential equations and application Springer.

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LIST OF ELECTIVES
SCHEDULE = A

(Each Elective is of 4 Credits)

The Department will offer elective in Semester-III and Semester-IV from the following list avoiding repetitions.

1. ANALYTICAL NUMBERTHEORY
2. ALGEBRAIC NUMBER THEORY
3. ALGEBRAICTOPOLOGY
4. ALGEBRAIC GEOMETRY
5. ADVANCED COMPLEXANALYSIS
6. ADVANCED LINEARALGEBRA
7. COMBINATORICS
8. CRYPTOGRAPHY
9. DATASTRUCTURE
10. DATAANALYTICS
11. DISCRETE DYNAMICALSYSTEMS
12. FLUID MECHANICS
13. FOURIERANALYSIS
14. GRAPHTHEORY
15. INFORMATION THEORY
16. MECHANICS
17. MATHEMATICALMODELLING
18. METHODS IN SCINTIFICCOMPUTING
19. NON LINEAR PARTIAL DIFFERENTIALEQUATION
20. NUMBER THEORY AND FOUNDATIONS OF CRYPTOGRAPHY
21. OPERATORTHEORY
22. OPERATOR ALGEBRA
23. THEORY OFCOMPUTATIONS

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Semester -I

REAL ANALYSIS

PAPER-101

Full Marks :100(End Sem : 80 + Mid Sem: 20) **Credit hours-4**

Objective:

After a first course in real analysis in undergraduate program ,the ideas of uniform continuity, uniform convergence and approximation by polynomials are crucial in analysis. In addition to the Functions of bounded variation and their integrators, the student has to learn differentiating functions from R^n to R^m. The techniques of integration of a function with respect to another function and the basic ideas of finding a Fourier series are also included .

Expected Outcomes:

After studying the course

CO1.The student will understand and solve problems of uniform continuity, uniform convergence and will also test whether a function is of bounded variation or not.

CO2. The student will learn and solve problems about partial derivatives, directional derivatives ,Jacobians, Inverse and implicit theorems .

CO3. The student will be able to calculate Riemann Stieltjes Integrals.

CO4. The student will be able to find the Fourier series and apply it.

UNIT-I

Convergence of a sequence of real numbers, Continuous functions, Uniform continuity,Examples, pointwise and uniform convergence, tests of uniform convergence,Cauchy criterion, Weierstrass M Test, uniform convergence and continuity,uniform convergence and relation to integration and derivatives Weierstrass approximation theorem, power series,functions expressible as power series.

UNIT-II

Differentiation in R^n, Partial derivatives, Directional derivatives,sufficient condition for differentiability, chain rule, ,Mean value theorem, Jacobians, Contraction mapping principle, inverse function theorem, implicit function theorem, rank theorem, differentiation of integrals, Taylor theorem in many variables.

UNIT-III

Function of bounded variation, examples, total variation, Function of bounded variation expressed as difference of increasing functions, rectifiable paths, Riemann Stieltjes Integrals, properties and techniques, sufficient condition for existence of the integral, Necessary condition for existence of the integral, Mean value theorem for Riemann stieltjes integrals, Reduction to Riemann integrals.

UNIT-IV

Basic concepts of Fourier series, Fourier series of even and odd functions, half range series, Fourier series on other intervals, orthogonal systems of functions, Theorem on best approximation, properties of Fourier coefficients, Riesz Fisher theorem, Riemann Lebesgue lemma., Dirichlet integral, Integral representation for the partial sum of a Fourier series. Convergence of Fourier series

The course is covered by:

1. W.Rudin-PrinciplesofMathematicalanalysis-McGrawHill,3rdEd,
2. T Apostol-MathematicalAnalysis-Pearson;2ndedition,.

Books for Reference:

3. Terrence Tao- Analysis-I - Hindustan book agency.
4. Terrence Tao -Analysis- II- Hindustan book agency
5. S C Malik ,SavitaArora –Mathematical Analysis- New Age International -5th edition

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COMPLEX ANALYSIS

PAPER- 102

Full Marks :100(End Sem : 80 + Mid Sem: 20) Credit Hours-4

Objective: The course is a second course in complex analysis as every undergraduate student learns basic complex analysis as a core course. The objective is to make the student understand both the theory and problem components of analytic functions, conformal mappings , complex integration theory,product developments and normal families

Expected Outcomes:

After studying this course the student will be able to

CO1. understand analytic function as a mapping on the plane, Mobius transformation and conformal mappings.

CO2. prove Cauchy theorem on various domains and learn the use of Cauchy integral formula and other results.

CO3. Find singularities and Evaluate contour integral using method of residues.

CO4. Learn about product development,analytic continuation and normal families.

UNIT-I

Review of analytic functions and basic properties, stereographic projections, mappings of elementary functions and cross ratio, Bilinear transformations and its properties, conformal mapping.

UNIT-II

Complex integration and simple version of Cauchy's theorem: Curves, parameterization, line integrals, Cauchy theorems (rectangle, triangle, circular disck), Cauchy integral formula, Liouville's theorem, Morera's theorem, Cauchy inequality, fundamental theorem of algebra, uniqueness and identity theorems, maximum modulus theorems, Gauss- mean value theorem, Schwartz lemma. Poisson integral formula.

UNIT-III

Calculus of residue: Laurent series, Classifications of singularities, evaluation of real integral, argument principle, Rouche's theorem, Hurwitz's theorem, open mapping theorem.

UNIT-IV

Infinite product, Weierstrass product development, Mittag-Leffler's theorem, Analytic continuation, Schwarz reflection principle, Normal families.

Course is covered by:

1. S Ponnusamy and Herb Silverman: Complex variables with Applications: Birkhauser, (2006) (Indian Edition 2012)

(Chapter-2: 2.4; Chapter-3; Chapter-4, Chapter-5: 5.1, 5.2; Chapter-7; Chapter-8; Chapter-9; Chapter-10:10.2; Chapter-11: 11.2; Chapter-12; Chapter-13: 13.1)

Books for References:

1. L. V. Ahlfors - Complex Analysis, McGraw Hill, 3rdEd.,2017.
2. R V Churchill , J W Brown and R F Verhey- Complex Variables and Applications, McGraw Hill, 9th Ed.,2013.
3. J. B. Conway - Functions of one Complex Variable, Springer; 2nd ed. 1978, 7th printing 1995edition.
4. E. M. Stein and R. Shakarchi, Complex Analysis: Princeton University Press, New Jersey, (2003)

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ALGEBRA-I

PAPER-103

Full Marks :100(End Sem : 80 + Mid Sem: 20) **Credit Hours -4**

Objective: The objective of the course is to augment the core courses offered in under graduate level in group theory and linear algebra in a different perspective.

Expected Outcomes:

After studying this course the student will be able to

CO1. Solve problems of basic group theory,groupactions,automorphisms and sylow theory.
CO2. Understand problems of product and semi direct product of groups and solvable groups
CO3. Find eigen value and eigen vectors and calculate various canonical forms.
CO4. Handle problems of unitary, self adjoint, normal operators and bilinear forms.

UNIT-I

Series of groups: Composition series and the Holder program, Transposition and the alternating group, Group actions: Group actions and permutations Representations, Cayley's Theorem, The Class equation, Automorphisms, The Sylow Theorems, The simplicity of alternating group.

UNIT-II

Direct and semi Direct products and abelian groups: Direct products, The Fundamental Theorem of finitely generated abelian groups, Recognizing Direct product,semidirect product, Further topics in Group Theory: p-groups, Nilpotent groups, Solvable groups, A word on free Groups

UNIT-III

Review of vector space fundamentals,matrix representation of linear transformations ,Eigenvalue and eigenvectors,Minimal polynomial, diagonalisation ,triangulable operators, nilpotent form, Jordan canonical form,rational canonical form,

UNIT-IV

Inner product spaces orthogonality . Adjoint of a linear transformation, unitary operators, Self adjoint and normal operators,bilinearforms,matrix of a bilinear form, classification of bilinear forms.

The course is covered by:

1. David S. Dummit, Richard M. Foote, Abstract Algebra, 3rdd Paperback, Wiely, 2011.
2. V Sahay and V Bist : Linear Algebra ,Narosa publishing House , second edition

Books for Reference:

3. I.N.Herstein: TopicsinAlgebra,JohnWileyandSons;2ndedition
4. J. B. Fraleigh: A first Course in Algebra, Pearson, 7th Ed.,2013.
5. J.Gallian:ContemporaryAbstractalgebra,Brooks/Cole;8thedition
6. Hoffman and Kunz: Linear Algebra, Prentice Hall
7. Rao and Bhimasankaran: Linear algebra, Hindustan publishing house

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TOPOLOGY

PAPER-104

Full Marks :100(End Sem : 80 + Mid Sem: 20) **Credit Hours-4**

Objective: This is an introductory course in Topology. The objective of this course is to have knowledge on topologicalspaces,Continuity, connectedness, compactness and separation axioms. Topology on Quotient spaces, Product spaces and metric spaces are also discussed.. The student will also learn on basic ideas of algebraic topology in homotopy, fundamental groups and covering spaces.However the thrust is on learning the point set topology.

Expected Outcomes:.

After taking the course the student will be able

CO1. To understand the concept of a topological space, basis, subbasis with various examples and to understand new topologies like product topology, quotient topology, metric topology etc .

CO2. To solve problems involving continuous maps , homeomorphisms between two spaces , connectedness and compactness.

CO3 To deal with Hausdorff, regular, normal ,separable, first and second countable spaces and Lindelöf spaces.

CO4 To understand homotopy, fundamental groups, and covering spaces.

UNIT-I

[Review (without question in exam)of setTheory,countablesets,uncountablesets, finite and infinite sets.Cartesian product of a family of sets,Axiom of choice and its equivalents(withoutproof)Principle of Induction,Topological Spaces, examples open sets, closed sets, basis and subbasis for a topology, closure and interior of sets, subspace topology, Order topology, Continuous functions, homeomorphisms, Product topology, quotient topology.

UNIT-II

Metric topology, standard topology, uniform topology, lower limit topology, Connectedness, Examples, Local connectedness, Path-connectedness, connected subsets of real line, compact Spaces, Examples, locally compacts spaces, sequential compactness, limit point compactness, compact subsets of real line

UNIT-III

Countabilityaxioms,First and second countable spaces,separable and Lindolfspaces, Separation axioms, Regular & completely regular space, normal spaces, UrysohnLemma,UrysohnmetrizationtheoremTychonoff Theorem, compactness in metric spaces,compact open topology.

UNIT-IV

Homotopy,pathhomotopy, lifting and extension problems,covering projection,coveringspace,examples, Fundamental Group, fundamental Group of circle.

The course is covered by:

1. Munkres J R -Topology, A First Course:Pearson;2ndedition,2000.

Books For Reference:

2. J. Dugundji, Topology, Allyn and Bacon Inc., Boston, 1978
3. K. D. Joshi : Introduction to General Topology (Wiley Eastern Limited).
4. M A Armstrong. Basic Topology. Springer, 1983.
5. O Viro, O Ivanov, V Kharlamov, and N Netsvetaev. Elementary Topology, a problem Text book,American Mathematical society.

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PROGRAMMING LANGUAGE-I (Using -C)

PAPER -105

Full Marks :50 (End Sem:35 + Mid Sem:15) Credit Hours : 2

Objective: C is a general-purpose language, ideal for building mostly state-of-the-art system applications like OS kernels, databases, embedded systems, and graphics packages that are used by billions around the world.

Expected Outcomes:

After studying this course the student will be able to

CO1. Develop a C program.
CO2. Control the sequence of the program and give logical outputs.
CO3. Store different data types in the same memory.
CO4. Repeat the sequence of instructions and points for a memory location.
CO5. Explain the uses of pre-processors and various memory models.

UNIT-1

Over view of C, Constants variables Data types, Operators and Expressions, Meaning I/O Operators.

UNIT-II

Decision making and branching, Looping Arrays, Character, Strings

UNIT-III

User defined function, Structure and Union.

UNIT-IV

Pointers: Introduction, understanding pointer, accessing the address of a variable, chain of pointer, pointer expression, File Management.

The course is covered by:

1. Programming in C -E. Balagurusamy

2. Programming in C- V-Rajaraman

Books For Reference:

1. Mastering in C –Venugopal.

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PROGRAMMING LAB – I (Programming in C)

PAPER - 106

Full Marks: 50 (Record: 20+Practical:20+ Viva:10) **Credit Hours : 2**

Objective: These practicals augment to the theory course taught in C programming to enhance the programming skills.

Expected Outcomes:

CO1: To learn to write codes using basics of C programming.

CO2: To provide hands-on training to help to write and test coding skill of the learner.

Assignments for Practical (Programming in C)

1. Write a program to display "welcome to Govt. Auto. College", Rourkela
2. Write a program to print your "name and postal address".
3. Write a program to print with the help of \n.

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4. Write a program to read and display 2 integer numbers and two float.
5. Write a program to insert two numbers and interchange the location numbers and print them without using third variable.
6. Write a program to insert two numbers and interchange the location by using third variable.
7. Write a program to enter two numbers and find the larger one.
8. Write a program to enter marks of 4 subjects and find the average and grade.
9. Write a program to check whether a number is even or odd by using conditional operator.
10. Write a program to find the greater number by using conditional operator.
11. Write a program to check whether a year is leap year or not.
12. Write a program to check whether a number is prime number or not.
13. Write a program to find the sum of individual digits of a number.
14. Write a program to find the reverse of a number using while loop.
15. Write a program to find the factorial of a number.
16. Write a program to find whether a number is Armstrong number.
17. Write a program to insert 10 elements in an array and print them.
18. Write a program to find the largest and smallest element in an array.
19. Write a program to find the sum of two matrices by using array.
20. Write a program to print elements of an array in reverse order.
21. Write a program to factorial of a number by using function.
22. Write a program to find out area of a circle by using function.
23. Write a program to swap two numbers by using function.
24. Write a program to find greatest common divisor by using function.
25. Write a program to find Emp_no, Name, Dept. and Salary using structure.
26. Write a program to enter two numbers and find the address by using pointer.
27. Write a program to merge two strings by using pointer.
28. Write a program to crate array of 20 characters and reverse an array by using pointer

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Semester - II
MEASURE THEORY AND INTEGRATION
PAPER-201

Full Marks :100(End Sem : 80 + Mid Sem: 20) Credit Hours : 4

Objectives: Measure Theory formalises and generalises the notion of integration. It is fundamental to many areas of mathematics and probability and has applications in other fields such as physics and economics. Students will be introduced to Lebesgue measure and integration, signed measures, the Hahn-Jordan decomposition, the Radon-Nikodym derivative, conditional expectation, Borel sets and standard Borel spaces, product measures, and the Riesz representation theorem.

Expected Outcomes: After completing this subject, students will understand the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration. They will also have an understanding of how these underpin the use of mathematical concepts such as volume, area, and integration and they will develop a perspective on the broader impact of measure theory in Ergodic theory and have the ability to pursue further studies in this and related areas.

UNIT-I

Lebesgue Outer measure, measurable sets, regularity, measurable functions, Borel and Lebesgue measurability, non-measurable sets, integration of nonnegative functions, simple functions, Lebesgue integration of simple, Approximation of measurable functions by simple functions, Fatou's lemma, monotone convergence theorem

G. de Barra: Measure Theory and Integration, Chapter 2(2.1to2.5), Chapter 3(3.1)

UNIT-II

General integrals, properties, Lebesgue dominated convergence theorem, integration of series, Riemann and Lebesgue integrals, differentiation, Dini derivatives, Lebesgue differentiation theorem, Differentiation and integration, Abstract measure spaces, measure and outer measure.

G. de Barra: Measure Theory and Integration, Chapter 3(3.2 to 3.4), Chapter 4(4.1, 4.4, 4.5), Chapter 5(5.1)

UNIT-III

Extension of a measure, uniqueness of the extension, completion of a measure, Integration with respect to a measure. Modes of convergence, convergence in Measure, almost uniform convergence, fundamental in measure convergence, Egorov's theorem, diagrams and counter examples.

G. de Barra: Measure Theory and Integration, Chapter 5(5.2, 5.3), Chapter 7(7.1, 7.2, 7.3, 7.4)

UNIT-IV

Signed measure, absolute continuity, Hahn decompositions, Jordan decomposition, Lebesgue decomposition, Radon-Nikodym theorem, Applications of Radon Nikodym Theorem Product measure, Fubini Theorem.

G. de Barra: Measure Theory and Integration, Chapter 8(8.1, 8.2, 8.3, 8.4), Chapter 10(10.1, 10.2)

The course is covered by:

1. De Barra. G.: Measure Theory and Integration (New age International), 1981

Books for Reference:

1. Royden, H. L: Real Analysis-Pearson, 4th Ed., 2010.
2. Aliprantis C D ,BurkinshawO,Principles of Real Analysis, Elsevier 2011
3. Rudin W: Real and Complex Analysis.(Tata McGraw Hill of India), 3rd Ed,1986
4. HewittandStromberg: Realanalysis-Springer,1975.

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ORDINARY DIFFERENTIAL EQUATIONS

PAPER-202

Full Marks :100(End Sem : 80 + Mid Sem: 20) Credit Hours : 4

Objective: Differential Equations introduced by Leibnitz in 1676 models almost all physical, biological, Chemical, Socio-economic system in nature. The objective of this course is to familiarize the students with qualitative behaviour of solutions differential equations along with existence and uniqueness problems. Also, students will get an insight to the concept of stability on differential equations of first and second order.

Expected Outcomes: A student completing the course will be able to understand the various type of behavior of solutions of differential equations and will be able to model problems in nature using ODE. This is also prerequisite for taking other core courses in partial differential equations, Stability theory, Oscillation theory, Evolution equations, Dynamical systems, Bifurcation theory, Mathematical modeling etc.

UNIT-I

Review of second order differential equations: methods, homogeneous, nonhomogeneous.

Oscillation of Second Order Linear Differential Equations:-Fundamental results, Sturm's Comparison Theorem and Hille-Wintner type oscillation.

Second Order Boundary Value Problem:-Sturm-Liouville differential equation, eigen value problem, Green's function and Picard's Theorem.

UNIT-II

Existence and Uniqueness of Solutions:-Successive approximations, Picard's Theorem, Nonuniqueness of solutions, Continuation and dependence on initial conditions, Existence of solutions in the large.

UNIT-III

System of Linear Differential Equations:-System of first order equations, Existence and uniqueness theorems, Fundamental matrix, Homogeneous and nonhomogeneous linear systems with constant coefficient.

UNIT-IV

Stability:- Autonomous Systems, Stability for linear systems with constant coefficients, Stability for linear systems with variable coefficients, Linear plane autonomous systems, Perturbed systems, Method of Lyapunov for nonlinear systems, Limit cycles.

The course is covered by:

1. S. G. Deo, V. Raghavendra: Ordinary Differential Equations
   Tata McGraw-Hill Publishing Co. Ltd

Books for References;

2. Richard Bellman: Stability Theory of Differential Equations
   McGraw-Hill Book Company, Inc., New York
3. Tyn-Myint-U: Ordinary Differential Equations
   Elsevier North-Holland.
4. G. F. Simmons: Differential Equations with Applications
   McGraw-Hill International Editions
5. G. Birkhoff, G. C. Rota: Ordinary Differential Equations
   John Wiley & Sons, New York

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ALGEBRA-II

PAPER-203

Full Marks :100(End Sem : 80 + Mid Sem: 20) Credit Hours : 4

Objective: As a second course in algebra the objective of this course is to have more knowledge on ring theory and to know about field theory. The concept of Galois theory in fields is central to theory of equations and is a must for all mathematics students. Understanding of these basic theories pave the way for any advance course in algebra.

Expected Outcomes: The knowledge on this course will provide the basis for further studies in advanced algebra like commutative algebra, linear groups, etc., which forms the basics of higher mathematics.

UNIT-I

Review of Ring theory. Euclidean ring, Gaussian integers, Polynomial ring, Polynomial ring over rational field, Polynomial ring over commutative ring, Principal ideal domain, Unique factorization domain

UNIT-II

Field Theory: Basic Theory of Field Extensions, Algebraic Extensions, Classical Straight edge and Compass constructions, Splitting Fields and Algebraic closures

UNIT-III

Separable and inseparable extensions, Cyclotomic polynomials and extensions, Galois Theory: Basic Definitions, The fundamental theorem of Galois theory

UNIT-IV

Finite Fields, composite and simple extension, normal extension, Galois groups of polynomials, solvability by radicals.

The course is covered by:

David S. Dummit, Richard M. Foote, Abstract Algebra, 3rd ed, Wiely, 2011.

Books for Reference:

1. I. N. Herstein, Topics in Algebra, John Wiley and Sons, 2nd Revised edition, 1975.
2. J. B. Fraleigh, A first Course in Algebra, Pearson, 7th Ed., 2014.
3. J. Gallian, Contemporary Abstract algebra, Brooks/Cole Pub Co; 8 edition (2012).

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DIFFERENTIAL GEOMETRY

PAPER-204

Full Marks :100(End Sem : 80 + Mid Sem: 20) Credit Hours : 4

Objective: After a course in Analytic Geometry and Differential geometry of curves at undergraduate level, Differential Geometry is a core component of a post graduate syllabus which introduces the methods of differential manifolds, tensor analysis, vector fields, Lie Group, Lie Algebra etc. The objective is to prepare the students for further coursework and research in geometry in future.

Expected Outcome: After completing this course, a student can opt for a course on Lie Group, Lie Algebra, Symplectic Geometry, Poisson Geometry, Global Analysis, Several Complex Variable, Hyperbolic Geometry, Projective and Algebraic Geometry and all these courses are main component for Mathematical Physics, Relativity, Cosmology and Standard Models.

UNIT-I

Review of calculus in R^n Review of local theory of curves and surfaces, SerretFrenet formula, First fundamental forms, second fundamental form, Normal curvature, Geodesic curvature, Gauss formula, , Weiengarten map, principal curvatures, Gaussian curvature, mean curvature

UNIT-II

Introduction to Manifolds, Differential manifolds, Examples, Tangent vector and tangent space at a point of the manifold, cotangent spaces, Submanifolds, vector fields, Integral curve, Lie bracket, Lie algebra, Definition and example of Lie groups, ,

UNIT-III

Multi linear Algebra: Dual space,tensor products, tensor of type(r.s), Operations with tensors, contractions, quotient law of tensors, metric tensor, associated tensors, symmetric and antisymmetric tensors, Exterior forms, Wedge product , Exterior Algebra, Exterior derivative, Exact forms, Closed forms. Integration on manifolds, Stoke's theorem

UNIT-IV

Affine connection of manifolds, parallel transport, Intrinsic derivative, covariant derivative, curvature tensor, Riemannian metric, Riemannian manifold, Fundamental theorem of Riemannian Geometry, Levi Civita Connection, Riemann Curvature tensor and properties, Bianchi identities, Scalarcurvature,Applications

The course is covered by :

1. Wilmore- Differential and Riemannian geometry, Oxford University Press, 1996
2. Tu L W, Introduction to manifolds,Springer International edition
3. U.C De & A.A Shaikh, Differential Geometry of Manifolds, Narosa, 2009
4. Thorpe-IntroductiontoDifferentialgeometry, Springerverlag,1979

Books For Reference:

1. Chern,Chern,andLam,Lectures in Differential Geometry,Wolrd Scientific(Indian Edition)
2. Warner-FoundationsofdifferentialgeometryandLiegroupsSpringer,1983.
3. NicolaescuLiviu I, Geometry of Manifolds World scientific Indian Edition 2021
4. Boothby - An introduction to differential and Riemannian geometry, Academic Press; 2 edition ,2002

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PROGRAMMING LANGUAGE – II

(Programming in Python)

PAPER-205

Full Marks :50 (End Sem:35 + Mid Sem:15) **Credit Hours : 2**

UNIT -I: [Foundations]

History of Python,Python installations, IDE(Anaconda,pythonidle,jupyter,Eclipse,Scode,etc),Library Packages(Numpy,Pandas,Scikit,seaborn,matplotlib,),Python datatypes,Operators,ConditionalStatements,Control flow statements, Functions,Local and Global Variable, Modules, Collections (String,List,Dict,Tuples,Sets)

UNIT-II:[Methods]

OOPS,Classes and Objects,ADT, Recursion, Inheritance and Types ,Encapsulation, Polymorphism,Array(1D,Index Address Calculation),Stack,Queue,Linked Lists, Searching(Linear and Binary) , Sorting(Quick,Bubble,Merge)

UNIT -III: [Applications-I]

CGI,GUI, Data Visualization Plotting(Bar, Graph),

UNIT- IV[Applications-II]

Linear Algebra, Linear Equations,,Eigen Values and Eigen Vectors,TaylorSeries,Fourier Transform.

The course is covered by :

1. Book: "Python Programming and Numerical Methods A Guide for Engineers and Scientists" by " Qingkai Kong Timmy SiauwAlexandre M. Bayen"

2.Python : The Complete Reference by Martin C. Brown

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PROGRAMMING LAB – II

(Programming in Python)

PAPER - 206

Full Marks: 50 (Record:20 +Practical:20 + Viva:10) Credit Hours : 2

Objective:

These practicals augment to the theory course taught in PYTHON programming to enhance the numerical skills.

Expected Outcomes:

1. To learn to write codes using basics of Python programming
2. To write code for problems from calculus ,linearAlgebra and Numerical analysis.

Assignments for Practical (Programming in Python)

1. Finding the limit of functions,
2. Finding the derivative of functions, higher-order derivatives
3. Finding the maxima and minima
4. Finding the integrals of functions.
5. Verify the continuity of a function at a point
6. Find Area between two curves
7. Finding the length of a curve.
8. Polynomial Interpolation by Lagrange's Method, Newton's Method
9. Find Roots of Equations by Method of Bisection and Newton-Raphson Method
10. Gauss Elimination Method (excluding Multiple Sets of Equations),
11. Doolittle's Decomposition Method only from LU Decomposition Methods
12. Numerical Integration
13. By Newton-Cotes Formulas
14. Trapezoidal rule,
15. Simpson's rule and Simpson's 3/8 rule
16. Finding eigen value and eigen vectors
17. Finding Talor series
18. Finding Fourier transforms
19. Solving linear equations
20. Attempting problems in unit III and IV in Python Theory course

A practical record book should be maintained by the students.

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