C. U. SHAH UNIVERSITY

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WADHWAN CITY

FACULTY OF SCIENCES

M.Sc.

MATHEMATICS

SEM - III

Syllabi (CBCS)

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCES

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME:AdvancedReal Analysis SUBJECT CODE:5SC03ARA1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			Total Marks
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives:-The purpose is to provide students an opportunity to study the drawbacks of the Riemann-Stieltjes integral and introduce them to measure theory and the Lebesgue integral.

Prerequisites:-

Knowledge ofalgebra and σ-algebra of sets, Borel sets, measurable sets and Lebesgue measure on $\mathbb{R}$ etc.

Course outline:-

Sr. No.	Course Contents
1	Measure space and different examples, finite, σ-finite, complete and saturated measures, measurable functions and Lusin's theorem and applications. Integration, general convergence theorems.
2	Signed measure, Hahn decomposition, Jordan decomposition. Lebesgue decomposition theorem, Radon-Nikodym theorem, Radon-Nikodym derivatives, LebesgueStiltjes integral.
3	Cumulative distributions and properties. L^p-Spaces, Holder's inequality, Minkowski inequality, Riesz-Fischer's theorem, Riesz representation theorem, density in L^p-Spaces.
4	Caratheodory's extension theorem, product measure, Fubini's Theorem, Tonelli's theorem, regularity of Baire and Borel Measures.

Learning Outcomes:-

After successful completion of this course, students will be able:

- To describe measure space, different measures.
- To understand Holder's inequality and Minkowaski's inequality.
- To slolve problems using Lusin's theorem,Radon-Nikodym theorem, Radon-Nikodymderivatives,Riesz-Fischer's theorem and Riesz representation theorem.
- To describe application of Lusin's theorem.

Books Recommended:-

1. 'Real Analysis',**Royden,H.L.,***Mc. Millan, 1998.*
2. 'Introduction to Measure Theory', **Berra,G. de,***van-Nordstrand, 1974*.
3. 'Measure Theory', **Halmos,P.R.,***van-Nordstran, 1970.*

E-Resources:-

1. http://www.maths.ox.ac.uk/courses/course/22909/material
2. web.media.mit.edu/~lifton/snippets/measure_theory.pdf
3. http://terrytao.wordpress.com/2009/01/04/245b-notes-1-signed-measures-and-the-radon-nikodym-lebesgue-theorem/
4. http://www.britannica.com/EBchecked/topic/22486/analysis/218295/Measure-theory

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FACULTY OF SCIENCES

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME: Functional AnalysisSUBJECT CODE: 5SC03FUA1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			Total Marks
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives:-This course aims to provide a knowledge of normed linear space, separation and extension theory, Banach space, closed graph theorem, open mapping theorem, bounded inverse theorem and weak, weak* convergence.

Prerequisites:-

Knowledge of inner product space, metric space etc.

Course outline:-

Sr. No.	Course Contents
1	Normed linear spaces (examples and basic properties), Holder-Minkowski Inequalities; Bounded linear transformations. Space of bounded linear transformations.
2	Hahn-Banach Theorems (separation and extension), strict convexity and uniqueness of Hahn-Banach extension, Banach spaces, Uniform boundedness principle (consequences and examples), Convergence of Quadrature formulae.
3	Closed graph Theorem. Projections. Open mapping Theorem, bounded inverse theorem. Spectrum of a bounded linear transformation and its parts. Spectrum of a finite rank operator.
4	Duals and transposes, duals of $l^P$and $C[a,b\}$, weak and weak* convergence, Bolzano-Weiestrass Property.

Learning Outcomes:-

After successful completion of this course, students will be able to

- Understand Holder-Minkowski Inequalities and Duals and transposes.
- Explain separation and extension theorems, open mapping theorem and closed graph theorem.
- Find dual of l^P and $C[a, b\}$, difference between weak and weak* convergence.

Books Recommended:-

1. 'Functional Analysis', **Limaye,B.V.,***New Age International (P) Ltd., 2001.*
2. 'Text book of Functional Analysis: A problem oriented approach', **Krishnan,V. K.,***Prentice Hall of India, 2001.*
3. 'Functional Analysis-a first course', **Nair, T.,** *Printice Hall of India, 2002.*
4. 'Foundations of Functional Analysis', **Ponnusamy, S.,** *Narosa Pub. House, 2004*

E-Resources:-

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=111106047
2. http://en.wikipedia.org/wiki/Functional_analysis
3. http://mathworld.wolfram.com/FunctionalAnalysis.html
4. http://www.mat.uniroma2.it/~cannarsa/cam_0607.pdf

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DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME: Mathematical Methods-I SUBJECT CODE:5SC03MAM1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	Total Marks
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives:-Learn about the three most important classes of partial differential equations of applied mathematics,that is, the heat equation, the wave equation, and Laplace's equation. To find solution of above equation by using Fourier series, Fourier integral and Laplace transform.

Prerequisites:-

Knowledge of Calculus, Ordinary and Partial Differential Equations.

Course outline:-

Sr. No.	Course Contents
1	Fourier series and applications to boundary value problems and summation of infinite series.
2	Fourier integral representation and applications. Fourier transforms, computations of Fourier transforms of functions, properties of Fourier transforms, convolution and Fourier transform, applications to the boundary value problems involving Heat equation, Wave equation and Laplace equations.
3	Laplace transform, Laplace transforms of some functions, properties of Laplace transform, inverse transform, convolution theorem, applications to solutions of ordinary differential equations, applications to the solutions of diffusion equation and wave equation.

4	Green's function and its applications, Gram-Schmidt orthonormalization method to Legendre polynomials, Hermite polynomials, Jacobi polynomials, Z-transform.

Learning Outcomes:-

After successful completion of this course, students will be able to

- Solve Boundary Value problems.
- Use Laplace Transform, Fourier Transform in IVP as well as BVP.
- Find different ways to solve Laplace equation, Heat equation and wave equation.

Books Recommended:-

1. 'Introduction to Partial Differential Equations', **Shankar, R.**, *PHI Learning Pvt. Ltd., 2006.*
2. 'Mathematical Methods', **Courant and Hilbert**, *John Wiley & Sons.*
3. 'Special Functions of Mathematical Physics and Chemistry', **Sneddon,I. N.**,*University Mathematical Texts.*
4. 'Applied Mathematics for Engineers and Physicists', **Pipes,L. A.**, *McGraw-Hill, 1970.*
5. 'Higher Engineering Mathematics', **Grewal,B.S.**, *Khanna Publishers, New Delhi, 2004.*
6. 'Advanced Differential Equations', **Raisinghania,M. D.**, *S. Chand and Sons, New Delhi.*

E-Resources:-

1. http://mathworld.wolfram.com/FourierTransform.html
2. http://tutorial.math.lamar.edu/Classes/DE/LaplaceIntro.aspx
3. http://en.wikipedia.org/wiki/Z-transform

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COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME:Theoriesof Ringand FieldSUBJECT CODE:5SC03TRF1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	Total Marks
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives:-This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings, fields and some related structures. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

Prerequisites:-Knowledge of Group and Ring Theory up to bachelor degree.

Course outline:-

Sr. No.	Course Contents
1	Review of basic ring theory, Euclidean ring, principal ideal ring, unique factorization domain, polynomial rings.
2	Polynomial rings over rational field, irreducible polynomials, Eisenstein irreducibility criterion, finite fields.
3	Extension fields, algebraic and transcendental extensions, normal extension,automorphisms of extension.
4	Galois extension, the fundamental theorem of Galois theory,solvability by radical, Abel's theorem.

Learning Outcomes:-

By the end of the module students should be able to understand:

- The abstract definition of a group, and be familiar with the basic types of examples, including numbers, symmetry groups and groups of permutations and matrices.
- What subgroups are, and be familiar with the proof of Lagrange's Theorem.
- The definition of various types of ring, and be familiar with a number of examples, including numbers, polynomials, and matrices.
- Unit groups of rings, and be able to calculate the unit groups of the integers modulo n.

Books Recommended:-

1. 'Topics in Algebra', **Herstein, I.N.,***Wiley Eastern. Ltd., New Delhi*.
2. 'Algebra', **Artin, M.,** *Prentice Hall of India*.
3. 'Basic Algebra, Vol. II',**Jacobson, N.,***Hundastan Publ. Co., Delhi.*
4. 'Basic Abstract Algebra',**P.B. Bhattacharya, S. K. Jain and S. R.Nagpaul,***Cambridge University Press, South Indian Edition.*

E-Resources:-

1. en.wikipedia.org/wiki/Abstract_algebra
2. http://www.maths.tcd.ie/~dwilkins/Courses/311/
3. http://www.math.uiuc.edu/~r-ash/Algebra.html
4. http://www.extension.harvard.edu/open-learning-initiative/abstract-algebra
5. en.wikibooks.org/wiki/Abstract_Algebra
6. http://www.math.niu.edu/~beachy/abstract_algebra/
7. http://abstract.ups.edu/download.html
8. http://archives.math.utk.edu/topics/abstractAlgebra.html
9. http://www.math.umn.edu/~garrett/m/algebra/
10. http://mathworld.wolfram.com/AbstractAlgebra.html

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COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME: AdvancedComplex Analysis **SUBJECT CODE:5SC03ACA1**

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	Total Marks
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives: -This course aims to provide knowledge of Cauchy's theorem, Cauchy's integral formula, Meromorphic functions, Schwarz lemma, Spaces of continuous functions $C(G,\omega)$ and Poisson's integral formula on a circle.

Prerequisites:-

Basic knowledge of Complex numbers, functions, analytic function etc.

Course outline:-

Sr. No.	Course Contents
1	The index of a close curve, behavior of the index on the components, different versions of Cauchy's theorem and Cauchy's integral formula, Morera's theorem, analogy between entire function and polynomials, open mapping theorem.
2	Counting zeroes, Meromorphic functions, the argument principle, Rouche's theorem and its application, maximum principle, Schwarz lemma and its application, convex functions, Hadmard's theorem.
3	Spaces of continuous functions $C(G,\omega)$, topology of uniform convergence on compact sets, space of analytic functions, Arzela-Ascoli theorem, Montel's theorem, Hurwitz's theorem, Riemann mapping theorem. Behavior of the function and Riemann's theorem on removable singularity, Casorati-Weierstrass theorem.

4	Comparison of entire functions and polynomials with respect to singularity, analytic continuation, Poisson's integral formula on a circle, Luca's theorem, Parsevals identity, Weierstrass factorization theorem, Genus and order of entire functions, Walli's formula, Jensen's inequality, Poisson-Jenson's inequality, Runge's theorem, harmonic functions.

Learning Outcomes:-

After successful completion of this course, students will be able to

- Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied context
- Demonstrate accurate and efficient use of complex analysis techniques
- apply the Cauchy residue theorem to evaluate real integrals, manipulate Laplace and Fourier transforms and apply them to ordinary and partial differential equations

Books Recommended:-

1. 'Functions of one complex variable', **Conway, J. B.,** *Springer Verlag.*
2. 'Real and Complex Analysis', **Rudin, W.,***McGraw Hill, 1967.*

E-Resources:-

1. http://faculty.etsu.edu/gardnerr/5510/notes/IV-4.pdf
2. http://www.math.uiuc.edu/~r-ash/CV/CV3.pdf
3. https://www.youtube.com/watch?v=h9LLlyKA3S4
4. http://en.wikipedia.org/wiki/Casorati%E2%80%93Weierstrass_theorem
5. http://www.math.umn.edu/~edman/tex/CA_prelim.pdf

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COURSE: M.Sc. **SEMESTER: III**

SUBJECT NAME:ProblemSolving-II SUBJECT CODE:5SC03PRS1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester							
					Theory				Practical			Total Marks
Th	Tu	Pr	Total		Sessional Exam		University Exam		Internal		University	
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

Objectives:-Objective of this course is to develop skills of example solving.

Prerequisites:-

Knowledge of particular topics up to graduate or post graduate level.

Course outline:-

Sr. No.	Course Contents
1	Partial Differential Equations (PDEs): Only Problems based on the following topics,Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs, Classification of second order PDEs, General solution of higher order PDEs with constantcoefficients, Method of separation of variables for Laplace, Heat and Wave equations.
2	Numerical Analysis: Only Problems based on the following topics,Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange interpolation, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

3	Abstract Algebra: Only Problems based on the following topics, Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems, Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields.

Learning Outcomes:-After successful completion of this course students will be able to solve examples of respective topics. And hence it will be useful to them for NET/SET Examination.

Books Recommended:-

1. 'UGC CSIR NET/SET (JRF & LS) Mathematical Sciences', **Sharma, P., Sharma,N., Singh, S.***Arihant Publications (India) Limited.*
2. 'Elementary Course in Partial Differential Equations', **Amarnath, T.,***Narosa Publ. House, New Delhi*.
3. 'Advanced Differential Equations',**Raisinghania, M. D.**, *S. Chand & Co.*
4. 'Higher Engineering Mathematics', **Grewal, B.S. and Grewal, J.S.**, *Khanna Publ., New Delhi.*
5. 'Numerical Methods',**Kandasamy, P.,Thilagavathy K., Gunavathi, K.**, *S. Chand & Co.*
6. 'Topics in Algebra', **Herstein, I.N.,***Wiley Eastern. Ltd., New Delhi*.

E-Resources:-

1. http://mathworld.wolfram.com/PartialDifferentialEquation.html
2. http://www.academia.edu/2391781/Numerical_Methods_Solved_Examples
3. en.wikibooks.org/wiki/Abstract_Algebra
4. http://www.math.niu.edu/~beachy/abstract_algebra/