C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Differential Geometry **SUBJECT CODE: MSCMTC201**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-Differential geometry is the study of curves, surfaces and their higher dimensional analogues by means of the calculus. It is one of the oldest and richest branches of mathematics, and remains central to modern pure mathematics as well as to much of theoretical physics.

Prerequisites:-Knowledge Geometry, differentiation and its application up to bachelor degree.

Course outline:-

Sr. No.	Course Contents
1	Space curves, planar curves, parameterization, closed curve, simple closed curve, curvature, torsion, signed curvature, Frenet-Serret equations, fundamental theorem of curve theory, Isoperimetric Inequality, The Four Vertex Problem.
2	Surfaces: smooth surfaces, smooth maps, tangents, normals, first fundamental form, length of the curve on surfaces, isometries of surfaces, conformal mappings of surfaces, surface area.
3	Second fundamental form, normal and geodesic curvatures, principal curvature, Meunier's theorem, Euler's theorem, Gaussian and mean curvature, Gauss map.
4	Gauss equation, Christoffel symbols, Codazzi-Mainardi equations, Theorem Egregium, geodesics, local Gauss Bonnet theorem.

Learning Outcomes:-After this course the student is expected to:

- Appreciate how the calculus can make precise, intuitive ideas of curvature and twisting, and calculate the simplest invariants of curves and surfaces.
- Appreciate the use of linear algebra in a context where vector spaces without preferred bases arise naturally.
- Be able to quote the definitions and results relating to each part of the syllabus, and to reproduce the proofs of some key results.
- Understand the distinction between local and global properties in geometry.
- Understand the distinction between intrinsic and extrinsic properties of surfaces.

Books Recommended:-

1. 'Elementary Differential Geometry', **Andrew Pressly**, *SUMSeries*.
2. 'Introduction to Differential Geometry', **Goetz A.,***Addison Wesley, Publ. Co.*
3. 'Differential Geometry in Three Dimensions', **Weatherburn, C.E.,** *Cambridge University Press*.

E-Resources:-

1. en.wikipedia.org/wiki/Differential_geometry
2. www.math.uga.edu/~shifrin/ShifrinDiffGeo.pdf
3. http://www.cs.elte.hu/geometry/csikos/dif/dif.html
4. http://ocw.mit.edu/courses/mathematics/18-950-differential-geometry-fall-2008/index.htm

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Partial Differential Equations **SUBJECT CODE: MSCMTC202**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-The purpose of this course is to meet the following objectives.

- To give students an awareness of the range of engineering systems which are modelled using partial differential equations.
- To introduce students to, and enable them to use routinely, Fourier series methods for the representation of periodic functions
- To introduce students to, and enable them to use routinely, two widely applicable analytic techniques for the solution of partial differential equations, the D'Alembert method and the method of separation of variables.
- To enable students to recognise hyperbolic, parabolic and elliptic partial differential equations and know the principal differences to be expected in the properties of the solution of each type.
- To enable students to use Fourier series methods both in the solution of partial differential equations and in other wider contexts.

Prerequisites:-Multi-variable calculus, Ordinary differential equations, Linear Algebra.

Course outline:-

Sr. No.	Course Contents
1	Genesis of second order partial differential equations, second order linear partial differential equations with constant coefficients, solutions when f(x, y) to be polynomial, exponential, sine and cosine functions, general method for homogeneous equations.
2	Classification of second ordered partial differential equations and canonical form. Nonlinear second order partial differential equations: solution by Monge's method, special case and general case.
3	Second order partial differential equations with variable coefficients, method of changing variables for special type of equations. Separation of variable Method: solution of Laplace, Wave and diffusion equations, Solution of these equations in different coordinate systems.
4	Boundary value problems: Dirichlet boundary value problems for the upper half plane and a circle, Neumann boundary value problems, Maximum and minimum principles, Harnack's theorem, Green's functions, equipotential surfaces.

Learning Outcomes:-

To analyse the most important partial differential equations encountered in applied mathematics and to describe and analyse numerical methods for these equations.

Books Recommended:-

1. 'Elementary Course in Partial Differential Equations', **Amarnath, T.,***Narosa Publ. House, New Delhi*.
2. 'Elements of Partial Differential Equations',**Sneddon, I. N.,***McGraw- Hill Publ. Co.*
3. 'Higher Engineering Mathematics',**Grewal, B. S. and Grewal, J. S.,***Khanna Publ., New Delhi*.
4. 'Advanced Differential Equations',**Raisinghania, M. D.,** *S. Chand & Co.*
5. 'Partial Differential Equations', **Phoolan Prasad and Ravindran, R.,***Wiley Eastern.*

E-Resources:-

1. en.wikipedia.org/wiki/Partial_differential_equation
2. www.math.umn.edu/~olver/pdn.html
3. www.math.tifr.res.in/~publ/ln/tifr70.pdf
4. www.physics.miami.edu/~nearing/mathmethods/pde.pdf
5. tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx
6. http://mathworld.wolfram.com/PartialDifferentialEquation.html

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Functional Analysis-I **SUBJECT CODE: MSCMTC203**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-To learn:

- Hilbert spaces (inner product, Cauchy-Schwarz inequality, norm, Caucy sequences, abstract Fourier expansions, the xamples l^2 and L^2, direct sums, tensor products),
- Bounded and compact linear operators on Hilbert space (adjoint, projections, partial isometries, trace class, Hilbert-Schmidt class),
- Unbounded operators on Hilbert space, with applications to quantum theory (including Stone's Theorem) and ordinary differential equations (notably Sturm-Liouville problems),
- Spectral theory of bounded and unbounded self-adjoint operators on Hilbert space,
- Banach spaces, with L^p-spaces and the space of bounded operators on Hilbert space as key examples, and the Closed Graph Theorem, Open Mapping Theorem, and Banach-Steinhaus Theorem (i.e. the Principe of UniformeBoundedness), as key Theorems, including the Baire Category Theorem as the key lemma behind these.

Prerequisites:-Basics ofAnalysis, Algebra, Topology.

Course outline:-

Sr. No.	Course Contents
1	Inner product spaces,Polarization identity, Schwarz inequality, Parallelgram Law, orthonormal sets, Gram-Schmidt Orthonormalization, Hilbert spaces.
2	Approximation and optimization, Projections and Riesz representation theorems.
3	Bounded Operators on Hilbert Spaces: Bounded operators and adjoints, Normal, unitary and self-adjoint operators.
4	Spectrum and Numerical Range, Compact self-adjoint operators.

Learning Outcomes:-Students will be able to solve the problems related to content and they will be ready to learn advance courses on functional analysis.

Books Recommended:-

1. 'Functional Analysis',**Limaye, B.V.,***New Age International Publ. Ltd., New Delhi*.
2. 'Real Analysis', **H.L.Royden,***Mc. Millan.*

E-Resources:-

1. en.wikipedia.org/wiki/Functional_analysis
2. www.umn.edu/~arnold/502.s97/functional.pdf
3. www.journals.elsevier.com/journal-of-functional-analysis/
4. http://www.uio.no/studier/emner/matnat/ifi/INF-MAT3360/index-eng.html
5. http://www.math.umn.edu/~garrett/m/fun/
6. http://www.nptel.iitm.ac.in/courses/111105037/

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Real Analysis-I **SUBJECT CODE: MSCMTC204**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-

- To investigate the fundamental concepts of analysis for real functions of a single variable.
- To develop the student's appreciation of methods of proof and ability to develop and present rigorous mathematical arguments.

Prerequisites:-Knowledge of real analysis and algebra up to bachelor degree.

Course outline:-

Sr. No.	Course Contents
1	Algebra and σ-algebra of sets, Borel sets in $\mathbb{R}$, Lebesgue outer measure in $\mathbb{R}$, measurable sets and Lebesgue measure on $\mathbb{R}$, non-measurable set,measurable functions.
2	Littlewood's three principles, Egoroff's theorem, the Lebesgue integral of a bounded function over a set of finite measure, comparison of Riemann and Lebesgue integral, bounded convergence theorem,Lebesgue integral of a nonnegative measurable function.
3	Fatou's lemma, monotone convergence theorem, bounded convergence, Chebyshev's inequality,Beppo-Levis theorem, general Lebesgue integral, Lebesgue's dominated convergence theorem, Convergence in measure, relation with convergence a.e., generalization of Lebesgue's theorem.

4	Differentiation of monotone functions, functions of bounded variation, Jordan's Lemma, differentiation of an integral, continuity and bounded variation of indefinite integral, absolute continuity of indefinite integral, different forms of fundamental theorem of integral calculus, relation between indefinite integral and absolute continuity.

Learning Outcomes:-Students will be able to give rigorous proofs of many theorems of real analysis. Also they will be able to use these theorems to sole problems.

Books Recommended:-

1. 'Real Analysis', **H.L.Royden,***Mc. Millan.*
2. 'An introduction to measure and integration', **Rana, I. K.,***Narosa Publ. House, New Delhi*.
3. 'Introduction to measure theory',**De Barra G.,***Van Nostrand Reinhold Co.*

E-Resources:-

1. en.wikipedia.org/wiki/Real_analysis
2. en.wikipedia.org/wiki/List_of_real_analysis_topics
3. http://www.math.hmc.edu/~su/math131/
4. www.mathcs.org/analysis/reals/
5. ramanujan.math.trinity.edu/wtrench/.../TRENCH_REAL_ANALYSIS.PDF
6. http://en.wikibooks.org/wiki/Real_Analysis

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Algebra-I **SUBJECT CODE: MSCMTC205**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	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, SK Jain and SR 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

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:C Programming and Mathematical algorithms-II

SUBJECT CODE: MSCMTE201

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
2	0	4	6	15	1	35	2	50	35	15	50	100

Objectives:-Objective of this course is to get basic knowledge of C language and to know that how to use C language for solving Mathematics Problems.

Prerequisites:-Basic knowledge about computer and knowledge of Mathematics up to bachelor degree.

Course outline:-

Sr. No.	Course Contents
1	Function definition, calling a function, automatic, static and external variables, recursive functions, function prototype – forward reference, pointers in functions, passing by values and passing by reference. File management : opening a file, closing a file, reading from a file,fscanf() and fprintf() functions writing to a file, standard streams in C, file name, binary files,fread() and fwrite() functions.

2	Structures & unions: declaration of structures, accessing structure members, structure initialization, nested structure, array of structures, structure assignment, structure as a function arguments, unions. typedef declaration. Graphics: setting the mode,setgraphmode, getmaxx, drawpoly, initgraph, getmaxy, putimage, putpixel, rectangle, setbkcolor, setcolor, setfillpattern, setfillstyle, setlinestyle, setpalette functions, line, circle, ellipse, arc, bar charts.
3	Pracical List: Operations on matrices (addition, scalar multiplication, multiplication), Gauss elimination method and its applications. Sequences– sorting, searching, merging.
4	Pracical List: Newton's form of polynomial, interpolation polynomial, divided difference table, numerical integration, numerical solutions of differential equations, elementary graphics.

Learning Outcomes:-After successful completion of this course students will be able to prepare programs in C language to solve problems Operations on matrices, Gauss elimination method and its applications. Sequences– sorting, searching, merging, numerical solutions of differential equations.

Books Recommended:-

1. 'Thinking in C Including object orientated programming with C++', **P. B. Mahapatra,***Wheeler Publishing, New Delhi.*
2. 'The C programming Language', **B. W. Kernighan and D. M. Ritchie,***Prentice Hall of India Pvt. Ltd.*
3. 'Computer Programming in C', **V. Rajaraman,***Prentice Hall of India Pvt. Ltd.*

E-Resources:-

1. www.math.utah.edu/~carlson/c/cbook.pdf
2. en.wikipedia.org/wiki/Algorithm
3. www.aimms.com/aimms/download/.../aimms3lr_advancedalgorithms.pdf
4. www.math.upenn.edu/~wilf/website/CombinatorialAlgorithms.pdf
5. homepages.ulb.ac.be/~bmaresc/A&P.1.pdf
6. en.wikipedia.org/wiki/Linear_programming

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER: II**

SUBJECT NAME:Problems and Exercises in Mathematics-I

SUBJECT CODE: MSCMTE202

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

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

Prerequisites:-Knowledge of Mathematics up to second semester of M.Sc.

Course outline:-

Sr. No.	Course Contents
1	Students will be required to prepare him/herself for any five of the following courses at the level up to M.Sc. second semester of C. U Shah University for problems and exercises. The regular teaching involves intensive problem sessions followed by problem assignments, and the examination would consist of problems only. Algebra, Topology, Real Analysis, Complex Analysis, Functional Analysis, Differential Geometry, Linear Algebra, Differential Equations.

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/SLET Examination.

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME:Number Theory **SUBJECT CODE: MSCMTE203**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-To learn divisibility, congruences, power residues, quadratic reciprocity, diophantine equations, Number theoretic functions, continued fractions and rational approximation, partitions.

Prerequisites:-Knowledge of Bachelor degree Mathematics.

Course outline:-

Sr. No.	Course Contents
1	Divisibility: foundations, division algorithm, greatest common divisor, Euclid's algorithm, Fundamental theorem, properties of primes, Arithmetical functions: the function [x], multiplicative functions, Euler's (totient) function $\varphi(n)$. The Mobius function $\mu(n)$, the functions $\tau(n)$, and $\sigma(n)$, brief introduction of convolution of arithmetical functions, perfect numbers.
2	Congruences: definitions, Chinese Remainder theorem, the theorem of Fermat and Euler, Wilson's theorem, Lagrange's theorem, primitive roots, indices.
3	Miscellaneous topics: finite, infinite continued fractions, linear Diophantine equations $x + by = c$, Pell's equations, Pythagorean triplets, introduction of Fermat's last theorem.
4	Quadratic Fields: algebraic number fields, the quadratic fields, units, primes and factorization, Euclidean fields, the Gaussian field, Gaussian primes.

Learning Outcomes:-

Students will be able for

- Finding the greatest common divisor and least common multiple of a pair of natural numbers, and finding the linear form of the greatest common divisor.
- Prime factorization,
- Solving linear congruences and systems of simultaneous linear congru- ences,
- The theorems of Fermat, Wilson, and Euler,
- Primitive roots modulo primes and prime powers,
- Determining whether a quadratic congruence has solutions, and if so, finding them.

Books Recommended:-

1. 'An introduction to the Theory of Numbers', **Ivan Nivan, H. S. Zuckermann, H. L. Montgomery**, *John Wiley \& Sons Inc.*
2. 'Elementary number theory', **David M. Burton**, *Universal Book stall, New Delhi.*
3. 'A Concise introduction to the Theory of Numbers',**Alan Baker**, *Cambridge Uni. Press, Cambridge*.

E-Resources:-

1. en.wikipedia.org/wiki/Number_theory
2. www.numbertheory.org/
3. http://mathworld.wolfram.com/NumberTheory.html
4. archives.math.utk.edu/topics/numberTheory.html
5. http://www.worldscientific.com/worldscinet/ijnt

C. U. SHAH UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

COURSE: M.Sc. **SEMESTER:II**

SUBJECT NAME: Graph Theory-I **SUBJECT CODE: MSCMTE204**

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)				Evaluation Scheme								
				Theory					Practical (Marks)			
Th	Seminar	Pr	Total	Sessional Exam		University Exam		Total	External	Internal	Total	Total
				Marks	Hrs	Marks	Hrs					
4	0	0	4	30	1.5	70	3	100	--	--	--	100

Objectives:-The objective of this course is to learn concepts of graphs like trees, matrices of the graphs, chromatic numbers, Hamiltonian cycles, matching and covers.

Prerequisites:-Nothing special is required, any person familiar with basic of Mathematics can learn this subject.

Course outline:-

Sr. No.	Course Contents
1	Quick view of basic terms about graphs: graph, vertex degree, paths, cycles, connected graph, tree, Euler graph, fundamental circuits, matrix representation of graphs.
2	Directed Graphs: definitions and examples, vertex degrees, some special types of digraphs, directed path and connectedness, Euler digraphs, trees with directed edges, spanning out-tree and spanning tree, fundamental circuits in digraphs, matrices A and B of digraphs, adjacency matrix of digraph.
3	Chromatic number, chromatic partitioning, chromatic polynomial, Four-color Problem, Hamiltonian cycles: necessary conditions, sufficient conditions, isomorphic graphs.
4	Matching and covers: maximum matching, Hall's matching condition, min-max theorems, independent sets, vertex cover, edge cover.

Learning Outcomes:-

At the end of this course, the student should be able to apply the abstract concepts of graph theory in modeling and solving non-trivial problems in different fields of study.

Books Recommended:-

1. 'Graph Theory with applications to Engg. And Computer Science',**NarsinghDeo**, *PrenticeHall of India Pvt. Ltd., New Delhi*.
2. 'Introduction to Graph Theory', **Douglas B. West.**
3. 'A first look at graph theory', **John Clark and D.A. Holton,***Allied Publishing Ltd.*
4. 'Introduction to graph theory',**Robin J. Wilson.**

E-Resources:-

1. http://en.wikipedia.org/wiki/Graph_theory
2. cr.yp.to/2005-261/bender2/GT.pdf
3. www.cs.columbia.edu/~sanders/graphtheory/
4. http://www.utm.edu/departments/math/graph/
5. http://www.personal.kent.edu/~rmuhamma/GraphTheory/graphTheory.htm
6. http://diestel-graph-theory.com/
7. http://www.graphtheory.com/