GOKUL GLOBAL UNIVERSITY
Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Master of Science

Mathematics

Faculty of Science
Gokul Science College
University Campus, State Highway-41,
Siddhpur - 384151, **Dist.** Patan, Gujarat, INDIA, **Mobile :** 9510973863
E- Mail : dean.fac.sci@gokuluniversity.ac.in, **Website :** www.gokuluniversity.ac.in

Gokul Global University

FACULTY OF SCIENCE

Mathematics Department

M.Sc. Semester – I Teaching Scheme with credits

(In Effect from Academic Year 2021 – 22)

Subject Code	Study Components	Hrs/week	Internal	Uni. Exam	Total	Credit
Semester – I						
Discipline Specific Course (DSC)						
MMAT111DSC	Core course – I (Paper – I) **Differential Equation**	5	30	70	100	5
MMAT112DSC	Core course – II (Paper – II) **General Topology**	5	30	70	100	5
MMAT113DSC	Core course – III (Paper – III) **Abstract Algebra**	5	30	70	100	5
MMAT114DSC	Core course – IV (Paper – IV) **Number Theory**	5	30	70	100	5

Subject Elective (SE)						
MMAT115SE MMAT116SE MMAT117SE	Subject Elective – Course – I **Graph Theory** OR **ODE Modeling-I** OR **Fuzzy Sets And Their Applications**	2	15	35	50	2
Generic Electives (EG)						
MMAT118EG MMAT119EG	Generic Electives (EG) **Applications of Mathematics in Insurance** OR **Mathematical Hydrology**	2	50	-	50	2
Total		**24**	**185**	**315**	**500**	**24**

Gokul Global University

FACULTY OF SCIENCE

Mathematics Department

M.Sc. Semester – II Teaching Scheme with credits

(In Effect from Academic Year 2021 – 22)

Subject Code	Study Components	Hrs/week	Internal	Uni. Exam	Total	Credit
Semester – II						
Discipline Specific Course (DSC)						
MMAT211DSC	Core course – I (Paper – I) **Partial Differential Equation**	5	30	70	100	5
MMAT212DSC	Core course – II (Paper – II) **Differential Geometry**	5	30	70	100	5
MMAT213DSC	Core course – III (Paper – III) **Complex Analysis**	5	30	70	100	5
MMAT214DSC	Core course – IV (Paper – IV)	5	30	70	100	5

	Operation Research					
Subject Elective (SE)						
MMAT215SE MMAT216SE MMAT217SE	Subject Elective – Course – I **Integral Transforms** OR **Ode Modeling-II** OR **Algebraic Topology**	2	15	35	50	2
Generic Electives (EG)						
MMAT218EG MMAT219EG	Generic Electives (EG) **Application Of Mathematics In Environmental Studies** OR **Financial Mathematics**	2	50	-	50	2
Total		**24**	**185**	**315**	**500**	**24**

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

M.Sc. Semester – III Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2022-23)

Subject Code	Study Components	Hrs/week	Internal		Total	Paperwise Credit	Semesterwise Credit
Semester – III							
Discipline Specific Course (DSC)							
MMAT311DSC	Core course – I (Paper – I) **Algebra – II (Field Theory)**	5	30		70	100	5
MMAT312DSC	Core course – II (Paper –II) **Functional Analysis – 1**	5	30		70	100	5
MMAT313DSC	Core course – III (Paper -III) **Advanced Linear Algebra**	5	30		70	100	5
MMAT314DSC	Core course – IV (Paper – IV) **Mathematical Statistics – 1**	5	30		70	100	5
Subject Elective (SE)							

MMAT315SE OR MMAT316SE OR MMAT317SE	Subject Elective (SE) **Integral Equation** OR **Special Functions** OR **Classical Mechanics-I**	2	15	35	50	2	**24**
Electives Generic (EG)							
MMAT318EG OR **MMAT319EG**	Electives Generic (EG) **Fuzzy Logic And Control System** OR **Mathematical Population Biology-I**	2	50	-	50	2	

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

M.Sc. Semester - IV Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2022-23)

Discipline Specific Course (DSC)							
MMAT411DSC	Core course – I (Paper -I) **Real Analysis**	5	30	70	100	5	
MMAT412DSC	Core course – II (Paper - II) **Functional Analysis – 2**	5	30	70	100	5	
MMAT413DSC	Core course – III (Paper -III) **Numerical Analysis**	5	30	70	100	5	
MMAT414DSC	Core course – IV (Paper – IV) **Mathematical Statistics – 2**	5	30	70	100	5	
Subject Elective (SE)							
MMAT415SEOR MMAT416SEOR MMAT417SE	Subject Elective (SE) **Research Methodology** OR **Mathematics Of Money** OR **Classical Mechanics-I**	2	15	35	50	2	**24**
Electives Generic (EG)							
MMAT418EGOR MMAT419EG	Electives Generic (EG) **Mathematical Ecology**OR **Mathematical Population Biology-II**	2	50	-	50	2	

GOKUL GLOBAL UNIVERSITY , SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT111DSC**	**Semester :**	I
DIFFERENTIAL EQUATIONS			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Contents	Hours	Weightage
1	Second order differential equations: the method of variation of parameters, Ordinary and singular points, Series solution, Frobenius method: solution in series nears a regular singular points, point at infinity.	15	20%
2	Legendre equation, Legendre polynomial and its properties.	15	20%
3	Bessel's equation, Bessel's function of first and second kind and their properties.	15	20%

4	Gauss hypergeometric equation, Gauss hypergeometric function and its properties, Picard's method of successive approximations.	15	20%
5	Review of simultaneous ordinary differential equations of first order, Pfaffian differential equation, partial differential equation of first order, compatible system of first order partial differential equations, Charpit and Jacobi's method, Cauchy problem.	15	20%

REFERENCE BOOKS:

G. F. Simmons, Differential equations with applications and historical notes,McGraw- Hill International Editions, second edition.

Amarnath, T., Elementary Course in Partial Differential Equations, Narosa Publ.House, New Delhi, 1997.

Sneddon, I. N., Elements of Partial Differential Equations, McGraw-Hill Publ. Co.,1957.

Raisinghania, M. D., Advanced Differential Equations, S. Chand & Co., 1995.

Grewal, B.S. and Grewal, J.S., Higher Engineering Mathematics, (36th Edition),Khanna Publ., New Delhi, 2000.

Somasundaram, D., Ordinary Differential Equations: A First Course, Narosa Publ.House, New Delhi, 2002.

Course Outcomes: At the end of the course, students shall be able to

CO1	explain the concept of differential equation
CO2	Can solve the problems of differential equations
CO3	Classify to differential equation with respect to their order and linearity

CO4	Apply the knowledge of the differential and difference equation which will enable them to Analyze dynamics of the processes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			3	2					3	3	
CO2		2		3				2	1			2
CO3	3					2	3				2	
CO4	2		2			3		2		1	1	

GOKUL GLOBAL UNIVERSITY , SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT112DSC**	**Semester :**	I
GENERAL TOPOLOGY			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Contents	Hours	Weightage
1	Topological Spaces: Topological spaces, basis and sub-basis for a topology (definitions and examples only), The order topology, the product space $\prod X_i$ (for finitely many topological spaces X_i).	15	20%
2	Subspace topology, closed sets, limit points, Continuous Functions: continuous functions, Homeomorphisms, the pasting lemma, Map into products, the metric topology.	15	20%

3	The sequence lemma, Uniform limit theorem, The quotient topology, Connectedness: connected spaces, path connected spaces, connected sets in the real line.	15	20%
4	Components and path-components, locally connected spaces and path connected spaces, Compactness: compact spaces, compact sets in the real line.	15	20%
5	Limit-point compactness, locally compact spaces, one-point compactification.	15	20%

REFERENCE BOOKS:

"Topology - A first course" - by J. R. Munkres, Prentice Hall of India, 1992.

"General Topology" - by S. Willard, Addison Wesley, 1970.

"Topology" - by J. Dugundji, Prentice - Hall of India, 1975.

"Aspects of Topology" - by C. O. Christonson and W. I. Voxman, Marcel DekkerInc., 1977.

"General Topology" – by J. L. Kelley, D. Van Nostraml, 1950.

Course Outcomes: At the end of the course, students shall be able to

CO1	get knowledge of fundamental concepts and methods in general topology
CO2	apply his or her knowledge of general topology to formulate and solve problems of a topological nature in mathematics and other fields where topological issues arise

CO3	Write the definitions of limit point compactness and sequentially compact spaces, and give examples of for both spaces, and explain the relation between the three types of compactness in general topological spaces and in metric spaces.
CO4	Provide an elementary example as appropriate. Illustrating specified behaviour in relation to a given combination oof basic definition and key theorems across the course

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2			3		2		3				
CO2	3				1		3		2		2	
CO3		3	2		2			1				
CO4	3					3				2		2

GOKUL GLOBAL UNIVERSITY , SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT113DSC**	**Semester :**	I
ABSTRACT ALGEBRA			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Contents	Hours	Weightage
1	Group, Subgroup, Normal Subgroups, Quotient groups, Homomorphism of groups. Isomorphic groups, Permutation groups, Direct product of groups, Cayley's theorem, Conjugacy relation on a group and its applications, Solvable groups.	15	20%
2	Group action, Sylow's theorem, Finite abelian groups, Simple groups.	15	20%

3	Ring, Subrings, Ring homomorphism, Ideals and quotient rings, Prime and maximal ideals, Polynomial rings.	15	20%
4	Field of fractions of an integral domain, Divisibility in rings, Euclidean ring, Principal ideal rings.	15	20%
5	Polynomial ring over a rational field, irreducibility criteria, Polynomial ring over a commutative ring, Unique Factorization domain.	15	20%

REFERENCE BOOKS:

Herstein, I.N., Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

Artin, M., Algebra, Prentice Hall of India, 1991.

Jacobson, N., Basic Algebra, Vol. II, Hundastan Publ. Co., Delhi,1984.

P.B.Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2/e), Cambridge University Press, South Indian Edition 2002.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of Group, Subgroup and Normal Subgroups
CO2	Solving problem using the powerful concept of group action.

CO3	Applying the concept of group action to real life problem such as counting
CO4	Reason abstractly about mathematical structures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	3				3		1	2		1	
CO2	3		2		3	2				1		
CO3	3			1			2		3			
CO4		3	2			2		1				2

GOKUL GLOBAL UNIVERSITY , SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT114DSC**	**Semester :**	I
NUMBER THEORY			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs)	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
5 X 15 = 75	30	70 (Paper of 3 hrs)	100

Unit	Contents	Hours	Weightage
1	Divisibility, G.C.D., Primes, the Fundamental theorem of arithmetic, the Euclidean algorithm, The greatest integer function, the Mobius function , the Euler's function , the divisor functions for integer, properties of these functions, multiplicative functions, Mobius inversion formula.	15	20%

2	Congruence, complete residue theorem, Linear Congruence, Reduced residue systems, Euler – Fermattheorem, the Chinese remainder theorem, The exponents of a number mod , primitive roots.	15	20%
3	Quadratic residues, Legendre Symbol and its properties, Gauss,s Lemma, The quadratic reciprocity law, the Jacobi Symbol.	15	20%
4	Diophantine Equations $ax + by = c$ and its positive solutions the equation $X^2 + Y^2 = Z^2$, the equationand the equation $X^4 + Y^4 = Z^4$, sum of squares, the Fermat's Last theorem.	15	20%
5	Algebraic Number Theory Polynomials over a field, Divisibility properties of polynomials, Gauss's lemma, The Eisenstein's irreducibility criterion, Symmetric polynomials, Extensions of a field, Algebraic and transcendental numbers, Bases and finite extensions, Properties of finite extensions, Conjugates and discriminates, Algebraic integers in a quadratic field, Integral bases, Units and primes in a quadratic field, Ideals, Arithmetic of ideals in an algebraic number field, The norm of an ideal, Prime ideals.	15	20%

REFERENCE BOOKS:

David M. Burton "Elementary Number theory", 2nd edition, Wm. C. BrownPublishers, 1989.

I. Niven and H. Zukerman "An introduction to the theory of Numbers" 3rd edition,Wiley Estern University Education, New Delhi, 1985.

T. M. Apostol, "Introduction to Analytic Number theory", Springer studt edition,1995.

S. Lang, Algebraic Number Theory, Addison – Wesley, 1994.

Ian Stewart and D. O. Tall, Algebraic Number Theory, Chapman and Hall, 2001.

Course Outcomes: At the end of the course, students shall be able to

CO1	Explain the concepts of divisibility, prime number congruence & number theorems
CO2	Practice on linear congruence & quadric line & congruence.
CO3	Use Fermat's theorem & Wilson's theorem
CO4	Explain the concept of linear congruence and quadric linear congruence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			2				3		2		
CO2		3			3	2						2
CO3			3				3		2	3		
CO4	2			3		2				3	2	

GOKUL GLOBAL UNIVERSITY , SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT115SE**	**Semester :**	I
GRAPH THEORY			
Course type :	Subject Elective	**Total Credit :**	02
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs)	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
2 X 15 = 30	15	35 (Paper of 1.5 hrs)	50

Unit	Contents	Hours	Weightage
1	Basic facts about graphs such as definition of a graph, tree, Euler graph, Cut-sets, fundamental circuits, matrix representation of graphs, isomorphic graphs and Hamiltonian cycles: necessary conditions, sufficient conditions. **Directed Graphs** : definitions and examples, vector degrees, some types of diagraphs. Directed path and connectedness, Euler diagraphs.	15	50%

2	Trees with directed edges, spanning out-trees/in-tree, fundamental Circuits in diagraphs, matrices A, B, C of diagraphs, and adjacency matrix of d ia-graph. Chromatic number, chromatic partitioning, chromatic polynomial, covering, Four-color Problem.	15	50%

REFERENCE BOOKS:

Narsingh Deo: Graph Theory with applications to Engg. And Computer Sciences. Prentice-Hall of India Pvt. Ltd, New Delhi, 1999.

Douglas B. West: Introduction to Graph Theory.

John Clark and D.A. Holton: A First looks at graph theory Allied Publishing Ltd., 1991

Robin J. Wilson: Introduction to graph theory.

Course Outcomes: At the end of the course, students shall be able to

CO1	Will be able to define the basic concepts of graphs, directed graphs and weighted graphs
CO2	Express and prove hand shaking lemma
CO3	They able to present information quickly and easily

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2

CO1	1					2			3		2	
CO2		3		2			2			3		
CO3	2		1		2			3				2

Gokul Global University, Sidhpur			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT211DSC**	**Semester :**	II
PARTIAL DIFFERENTIAL EQUATION			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Content	Hours	Weightage
1	Origin of second order partial differential equations, linear second order partial differential equations with constant coefficients, solutions for f(x, y) to be polynomial, exponential, sin/cos functions, general method for homogeneous equations.	**15**	20%
2	Second order partial differential equations with variable coefficients, method of changing variables for special type of equations, classification of equations and canonical form.	**15**	20%
3	Non-linear second order partial differential equations: solution by Monge‟s method, special case and general case	**15**	20%
4	Separation of variables: solution of three special equations, Laplace equation, Wave equation and diffusion equation by method of separation of variables, solution of these equations in different coordinate systems.	**15**	20%

5	Boundary value problems: Dirichlet boundary value problems, Neumann boundary value problems, maximum and minimum principles, Harnack‟s theorem, Green‟s functions, Equipotential surfaces.	**15**	20%

REFERENCE BOOKS:

Amaranth, T., Elementary Course in Partial Differential Equations, Narosa Publ.House,New Delhi, 1997.

Sneddon, I. N., Elements of Partial Differential Equations, McGraw - Hill Publ. Co., 1957.

Grewal, B. S. and Grewal, J. S., Higher Engineering Mathematics (36th Edition), Khanna Publ., New Delhi, 2000.

Raisinghania, M. D., Advanced Differential Equations, S. Chand & Co., 1995.

Phoolan Prasad and Ravindran, R., Partial Differential Equations, Wiley Eastern.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students can write down the complete solution of a linear homogeneous wave, heat or Laplace’s equation on a rectangular or rotationally-symmetric domain using separation of variables.
CO2	Students can apply the concept of linearity to solve non-homogenous PDEs by the method of linear superposition
CO3	Apply analytical methods, and physically interpret the solution.

CO4	Understand analogies between mathematical descriptions of different (wave) phenomena in physics and engineering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1				2		2		3			3
CO2	3	2		3		2				3	2	
CO3			1				2	3				2
CO4	2	3			1					3		

Gokul Global University, Sidhpur			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT212DSC**	**Semester :**	II
DIFFERENTIAL GEOMETRY			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Content	Hours	Weightage
1	Space curves, Planar curves, Parameterization, Curvature, Torsion, Signed curvature. Frenet-Serret equations. Fundamental theorem of curve theory.	**15**	20%
2	Isoperimetric Inequality, The Four Vertex Problem, Surfaces: smooth surfaces, Tangents, Normal‟s and orient ability, One parameter family of surfaces: characteristics, Envelope, Edge of regression, Developable.	**15**	20%
3	Quadratic surfaces, Applications of inverse function theorem, first fundamental form, Isometries of surfaces, Surface area.	**15**	20%
4	Second fundamental form, Normal and Principal curvature, Meunier‟s theorem. Euler‟s theorem, Gaussian and mean curvature, Gauss map.	**15**	20%

5	Gauss equation, Christoffel symbols, Codazzi-Mainardi equations, Theorem Egregium, Geodesics, local Gauss Bonnet theorem.	**15**	20%

REFERENCE BOOKS:

Andrew Pressly, Elementary Differential Geometry, SUM Series, 2004.

Goetz A., Introduction to Differential Geometry, Addison Wesley. Publ.Co..1970.

Weatherburn, C.E., Differential Geometry in Three Dimensions. Cambridge University Press,1964.

Course Outcomes: At the end of the course, students shall be able to

CO1	To be able to understand the fundamental theorem for plane curves.
CO2	Involutes and evolutes of space curves with the help of examples
CO3	To be able to compute the curvature and torsion of space curves. Coefficients and their derivatives.
CO4	Explain differential maps between surfaces and find derivatives of such maps.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2		3		1			3		3	3	

CO2		2					3		1			2
CO3		3			2	1		2		3		
CO4	3		3	2				1			2	

Gokul Global University, Sidhpur			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT213DSC**	**Semester :**	II
COMPLEX ANALYSIS			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks) 30	**External** (Marks) 70 (Paper of 3 hrs)	**Total** (Marks) 100

Unit	Content	Hours	Weightage
1	A quick overview of complex number system, polar representation and roots of complex Numbers, the extended plane and its spherical representation, elementary functions and properties.	**15**	20%
2	Continuity, derivatives, Cauchy-Riemann equations. C-R equation in polar coordinates and complex from, analytic functions, harmonic functions, power series, power series as an analytic function. Branch of logarithm its analyticity, analytic functions as mappings.	**15**	20%

3	Contours: contour integrals, anti-derivative, zeros of analytic functions. Cauchy‟s theorem. simply and multiply connected domains and Cauchy‟s integral formula, Cauchy inequality, Principle of deformation of paths, Lowville‟s theorem. Morera,,s theorem, Cauchy‟s theorem and simple connectivity, Goursat‟s theorem.	**15**	20%
4	Fundamental theorem of Algebra, Gauss mean value theorem, Maximum modulus principle. Taylor‟s theorem, Laurent series, absolute and uniform convergence of power series.	**15**	20%
5	Classification of singularities, residues, residues theorem, residues at poles. Evaluation of improper real integrals. Definite integrals with sine and cosine function, Schwarz‟s refection principle, Mobius transformation.	**15**	20%

REFERENCE BOOKS:

Conway, J.B., Functions of One Complex Variable, (Second Edition), Narosa Publ. House, New Delhi, 1994.

Churchil, R.V., Brown, J. and Verle, R., Complex Variables and Applications, McGrawHill Publ.Co., 1974.

Ponnusamy, S., Foundations of Complex Analysis, Narosa Publ. House, New Delhi, 1995.

Choudhary, B., the Elements of Complex Analysis, (Second Edition), Wiley Eastern.

Course Outcomes: At the end of the course, students shall be able to

CO1	Describe basic properties of complex integration and having the ability to compute such integrals.
CO2	Identify curves and regions in the complex plane defined by simple expressions

CO3	Understand the fundamental concept of complex variable theory and skill of contour integration to evaluate complicated real integrals via residue calculus.
CO4	Demonstrate accurate and efficient use of complex analysis techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2			3	1	2					2	
CO2		2	1				2			3		3
CO3		3			3		1		2		3	
CO4	2					3		2				

Gokul Global University, Sidhpur			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT214DSC**	**Semester :**	II
OPERATION RESEARCH			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70 (Paper of 3 hrs)	100

Unit	Content	Hours	Weightage
1	**TRANSPORTATION PROBLEM** : Formulation – Optimal solution, unbalanced transportation problem – Degeneracy – Maximization case. **ASSIGNMENT PROBLEM:** Formulation – Optimal solution – Variants of Assignment Problem.	**15**	20%
2	**THEORY OF GAMES**: Introduction – Minimax (maximin) – Criterion and optimal Strategy – Solution of game with saddle points – Rectangular games without saddle points – Dominance Principle - $m \times 2$and $2 \times n$ games - graphical method.	**15**	20%
3	**PROJECT MANAGEMENT (CPM & PERT):** Network concepts components - rules for network construction - Critical Path Method (CPM) - Project evaluation and Review Technique (PERT).	**15**	20%

4	Elementary queuing models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.	**15**	20%
5	Inventory models: EOQ models with and without shortages, EOQ models with constraints, Replacement and Reliability models.	**15**	20%

REFERENCE BOOKS:

J. K. Sharma, " Operations Research – Theory and Application" , 4th Edition, Macmillan Publishers India Ltd

N.H. Shah, Ravi Gor, Hardik Soni, "Operation Research", PHI.

Hamdy and Tahia, Operation Research: an introduction, Prentice-Hall, 1997.

Operation Research: Theory & Applications, J. K. Sharma, Third Eddition-2007.

Operation Research: Techniques for Management, V. K. Kapoor, S. Chand

Course Outcomes: At the end of the course, students shall be able to

CO1	Analyze any real life system with limited constrains and depict it in a model form
CO2	Convert the problem into a mathematical model
CO3	Understand variety of problems such as assignment, transportation, travelling, salesman etc.
CO4	Formulate and solve problems as networks and graphs.

CO5	Plan and implement suitable materials handling principles and practices in the operations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			2		3		3		3		
CO2			2		2		2		2			1
CO3	2			1			3	2				
CO4		1	2			3				3		2
CO5		2			1		2	3			2	

Gokul Global University, Sidhpur			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT215SE**	**Semester :**	II
INTEGRAL TRANSFORMS			
Course type :	Subject Elective	**Total Credit :**	02
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 2 X 15 = 30	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	15	35 (Paper of 1.5 hrs)	50

Unit	Content	Hours	Weightage
1	Laplace transforms: - Definition of the Laplace transform, Inverse Laplace transform, Linearity, Shifting theorem. Laplace transforms of derivatives and integrals. Unit step function, Dirac"s delta function. Properties of inverse Laplace transform. Convolution Theorem. Complex inversion formula. Application of the Laplace transform to solve ordinary differential equations, partial differential equations, Initial and Boundary value problems, Integral equations, Evaluation of definite Integrals Difference and differential - difference equations.	**15**	50%

2	Fourier Series: Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half range Expansion. Separation of Variables. Use of Fourier Series. D' Alembert's Solution of the Wave Equations. Heat Equation: Solution by Fourier Series. eat Equation: Solution by Fourier Integrals and Transforms. Fourier transform: Definition and properties of Fourier sine, cosine and complex transforms: Convolution theorem. Inversion theorems. Fourier transform of derivatives.	**15**	50%

REFERENCE BOOKS:

"Advanced Engineering Mathematics (8th Edition)", by E. Kreyszig, Wiley-India (2007).

"Higher Engineering Mathematics" B V Ramana, Tata McGraw-Hill.

Fourier transform and its applications, by Ronald Bracewell.

The Laplace transform: Theory and applications, by Joel L. Schiff.

Jain, Iyenger : Advanced Engineering mathematics, Wiley India.

Ian Sneddon : The use of Integral Transform. TMIH, 1979

Course Outcomes: At the end of the course, students shall be able to

CO1	understanding regarding different type of integral transform

CO2	Understand Fourier transform and its properties and will be able to solve the examples based on it.
CO3	Have deep understanding of Laplace Transformation and its real life application.
CO4	Evaluate the Fourier transform of a continuous function and be familiar with its basic properties.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			3		2			2	3		
CO2	2		3			1		2			3	
CO3		2			2		2		1	3		3
CO4			3	2				2				

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT311DSC**	**Semester :**	III
ALGEBRA – II (FIELD THEORY)			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

Unit	Contents	Credit	Weightage
1	Extensions of field, Finite, algebraic and simple field of a polynomial over a field, construction and transcendental numbers.	1	20%
2	Roots of polynomials, the splitting field of a polynomial over a field, construction with straightedge and compass.	1	20%
3	The fixed field of a group of automorphisms, the theorem on symmetric polynomials, normal field extension,	1	20%
4	The Galois group of a polynomial.The fundamental theorem of Galois theory.	1	20%
5	Solvability by radicals, Galois group over the rationals, finite fields.	1	20%

Reference Books:

Herstein, I.N., Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

Artin, M., Algebra, Prentice Hall of India, 1991.

Jacobson, N., Basic Algebra, Vol. I & II, Hindustan Publ. Co., Delhi,1984.

P.B.Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2/e), Cambridge University Press, South Indian Edition 1995.

I. S. Luther and I.B.S. Passi: Algebra Vol. III & Vol. IV, Narosa Publishing House

Course Outcomes: At the end of the course, students shall be able to

CO1	Use diverse properties of field extensions in various areas
CO2	Establish the connection between the concept of field extensions and Galois Theory
CO3	Describe the concept of automorphism, monomorphism and their linear independence in field theory.
CO4	Compute the Galois group for several classical situations. Solve polynomial equations by radicals along with the understanding of ruler and compass construction

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2				3			2			2	
CO2		1	2			2			3			
CO3	2			3	2			2				3

CO4		3		2			1		3	2		

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT312DSC**	**Semester :**	III
FUNCTIONAL ANALYSIS – 1			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

Unit	Contents	Credit	Weightage
1	**Normed linear space:** definition and examples, continuous linear transformations, space $BL(X,Y), BL(X)$ and $BL(X,X), l^p$ & $L^p (for\ 0 \leq p \leq \aleph)$ Banach spaces	1	20%
2	Hann – Banach theorem and its applications, open mapping theorem, dual normed space, natural imbedding of normed space into double dual space of normed space.	1	20%
3	Closed graph theorem, uniform boundedness principal, conjugate of an operator, bounded inverse mapping theorem**.**	1	20%
4	Hilbert space: definition and examples, orthogonal complement, orthonormal set,	1	20%

5	Bessel's inequality, projection theorem, Riesz representation theorem.	1	20%

REFERENCES:

G.F. Simmons: Introduction to Topology and Modern Analysis, Mc.Graw-Hill International Book Company, 1963.

Erwin Kreyszig: Introduction to Functional Analysis with Applications, John Wiley &Sons, 1978.

Balmohan V. Limaye: Functional Analysis, New Age International Limited.

P.K.Jain, O.P Ahuja Functional Analysis, New Age International (P) Ltd. Publishers, &Khalil Ahmed: 1995.

K. Chanrashekhra Rao: Functional Analysis, Narosa, 2002

D. Somasundram: A First Course in Functional Analysis, Narosa, 2006

Course Outcomes: At the end of the course, students shall be able to

CO1	knowledge of central concepts from functional analysis, including the Hahn-Banach theorem.
CO2	Understand and apply fundamental theorems from the theory of normed and Banach spaces, including Hahn-Banach theorem, the open mapping theorem and the closed graph theorem.
CO3	Understand the notation of dot product and Hilbert space.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	3			2			3		3	2	
CO2	2		1			2	3		2			
CO3		2	2	3				2				3

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT313DSC**	**Semester :**	III
ADVANCED LINEAR ALGEBRA			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	Vector space, subspace, bases and dimensions, dual space, Algebra of matrices, rank and determinants of matrices, linear equations; Eigen values and eigenvectors, Cayley – Hamilton theorem.	1	20%
2	Linear transformations: Algebra of linear transformations, characteristic roots, Matrix representation of linear transformations, change of basis,	1	20%
3	Triangular canonical form, diagonal form, nilpotent linear transformations.	1	20%
4	Trace and transpose, a decomposition theorem, Jordan	1	20%

	canonical forms, Rational canonical forms.		
5	Inner product spaces, Pythagorean Theorem, Cauchy–Schwarz Inequality, Triangle Inequality, orthonormal basis; Quadratic forms, reduction and classification of quadratic forms.	1	20%

Reference Books:

Herstein, I.N., "Topics in Algebra" 2nd edition, John Wiley & Sons, Student Edition, New York(2004).

P.B.Bhattacharya, S.K. Jain and S.R. Nagpaul: "First Course in Linear Algebra", Cambridge ,New Age International Ltd Publishers, New Delhi (2008)

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of Vector space and subspace.
CO2	Perform and interpret matrix operation
CO3	Demonstrate an understanding of Inner product space.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1		3			3		2		3	2	
CO2		2		3	2		3		2			
CO3		3	2		1	2				3		3

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT314DSC**	**Semester :**	III
MATHEMATICAL STATISTICS – 1			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	Measures of central tendency and dispersion, moments, Measures of skewness and kurtosis, Classical and axiomatic approach of the theory of probability, additive and multiplicative law of probability, conditional probability and Bayes theorem.	1	20%
2	Random variable, probability mass function, probability density function, cumulative distribution function, Tow and higher dimensional random variables, joint distribution, marginal and conditional distributions, Stochastic independence, function of random variables and their probability density function.	1	20%
3	Mathematical expectations and moments, moment generating function	1	20%

	and its properties, Chebyshev's identity and its applications, Stochastic convergence, central limit (Laplace theorem, Linder berg, Levy's theorem)		
4	**Discrete probability Distributions:** Uniform hyper geometric, Binomial, Poisson, Geometric, Hyper geometric, Multinomial. **Continuous probability Distributions:** Uniform, Exponential, Gamma, Beta, Normal distributions. Normal approximation of Binomial, Poisson distribution etc.	1	20%
5	Least square principal, correlation and linear regression analysis for bi – variate data, partial and multiple correlation coefficients, correlation ratio, association of attributes.	1	20%

Reference Books:

Gupta and Kapoor: Fundamentals of Mathematical Statistics.

S. P. Gupta: Statistical Methods, Sultan Chand & Sons.

Harold J, Larson: Introduction to probability. Theory and Statistical Inference. Wiley 1982.

V. K. Rohatgi: An introduction to probability theory and mathematical Statistics. John Wiley& Sons, 1976.

Course Outcomes: At the end of the course, students shall be able to

CO1	Analyze statistical data using measures of central tendency, dispersion and location.
CO2	Perform and interpret matrix operation
CO3	formulate complete, concise, and correct mathematical proofs.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3		2			2				3	2	
CO2		3		2	1	2		2				3
CO3		2	1				2		2	2		

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT315SE**	**Semester :**	III
INTEGRAL EQUATION			
Course type :	Subject Elective	**Total Credit :**	02
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs)	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
2 X 15 = 30	15	35	50

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	Linear Integral Equations-Definition and classification, conversion of initial and boundary value problems to an integral equation; Eigen values and Eigen functions; solution of homogenous; Fredholm integral equations second kind with separable kernels; Solution of genera l Fredholm integral equationof second kind with separable kernels; Solution of Volterra integral equations of second kind with convolution type , kernels by Laplace transform, Solution of singular integral equations by Fourier transform	1	50%

2	Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations; Resolvent kernels and its results; Conditions of uniform convergence and uniqueness of series solution; Integral equations with symmetric kernels - orthogonal system of functions; Fundamental properties of eigen values and eigen functions and bilinear form, Hilbert-Schmidt theorem, solution of Fredholm integral equation of second kind by using Hilbert Schmidt theorem. Classical Fredholm theory - Fredholm theorems, solution of Fredholm integral equation of second kind by using Fredholm first theorem.	1	50%

Reference Books:

M. Krasnov, A. Kislev, G. Makarenko, Problems and Exercises in Integral Equations (1971).

S.Swarup, Integral Equations (2008)

Courant, R. and Hilber D., Methods of Mathematical Physics, Vol. I, Interscience Press, 1953.

Cordumenau, C., Integral Equations and Appplications, Cambridge University Press, 1991

Kanwal, R. P., Linear Integral Equations, Theory and Techniques, Birkhauser, 1997

Course Outcomes: At the end of the course, students shall be able to

CO1	Solve integral equation of several types.
CO2	Solve Simple IVP and BVP by using Calculus of several variables.
CO3	Understand the relationship between integral and differential equations and transform one type into another.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1				2			3			2	
CO2		2	3		2				2			3
CO3	2			3		2	1			3		

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT411DSC**	**Semester :**	IV
REAL ANALYSIS			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	**Advanced Set Theory:** Equivalent Sets, Countable and Uncountable Sets, The concept of a cardinal number, The cardinals $\aleph_o$ and c, Addition and multiplication of cardinals, Cartesian product, Axiom of Choice, Multiplication of cardinal numbers, Order relation and order types, Well ordered sets, Transfinite induction, Addition and multiplication of ordinals Statements of Zorn's lemma, Maximality principle and their simple implications	1	20%

2	**Lebesgue Measure:** Algebra and $\sigma-$ algebra of sets, $\sigma-$ algebra of Borel sets, Lebesgue outer measure on $\mathbb{R}$, measurable sets. Lebesgue measure, Measurable function. Little wood's three principles, Egoroff's theorem	1	20%
3	**Lebesgue Integral:** Integral of a simple function, Riemann Integral, Lebesgue integral of a bounded functions. The integral of a non-negative functions. The general Lebesgue Integral, Fatou's lemma.	1	20%
4	**Measure and Integration:** Measure space, measurable functions Integration. General convergence theorem, monotone convergence theorem, Lebesgue convergence theorem, convergence in measure.	1	20%
5	**Differentiation & Integration**: Differentiation of monotone functions. Functions of Bounded variation. Differentiation of an Integral. Absolute continuity and convex functions.	1	20%

Reference Books:

W. Rudin: Real & Complex Analysis 3 edition McGraw-Hill, 1966.

G.de Barra: Measure theory and Integration, Wiley Eastern Ltd., 1985.

T. M. Apostol: Mathematical Analysis, Narosa Publication House - 1985.

P. R. Halmos: Measure theory, Springer – 1974.

Course Outcomes: At the end of the course, students shall be able to

CO1	Able to work comfortably with sets.
CO2	Exposure to cardinal numbers and their compatibilities.

CO3	Able to understand Differentiations and Integrations and their applications.
CO4	Ability to acquire knowledge of Convergence series.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2			3	2			3			2	
CO2		2	3			2	2		1			
CO3	3	2		3	2					3		
CO4	1		3				2					3

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT412DSC**	**Semester :**	IV
FUNCTIONAL ANALYSIS – 2			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	Dual and transpose of a Hilbert spaces, adjoint of an operator, self – adjoint, normal, unitary operators, projections.	1	20%
2	Hann – Banach theorem and its applications, open mapping theorem, dual normed space, natural imbedding of normed space into double dual space of normed space.	1	20%
3	Finite dimensional spectral theorem, Weak convergence	1	20%
4	Banach algebra: definition and examples, regular and singular elements, topological divisors of zero, spectral of an element and spectral radius, radical and simplicity..	1	20%

5	Gelfand mapping, applications of the formula of the spectral radius, involutions in Banach algebra, Ideals in C(X), Banach-Stone theorem, Commutative C*-algebras.	1	20%

Reference Books:

G.F. Simmons: Introduction to Topology and Modern Analysis, Mc.Graw-Hill International Book Company, 1963.

Erwin Kreyszig: Introduction to Functional Analysis with Applications, John Wiley &Sons, 1978.

Balmohan V. Limaye: Functional Analysis, New Age International Limited.

P.K.Jain, O.P Ahuja Functional Analysis, New Age International (P) Ltd. Publishers, &Khalil Ahmed: 1995.

K. Chandrasekhar Rao: Functional Analysis, Narosa, 2002

D. Somasundram: A First Course in Functional Analysis, Narosa, 2006.

S. K. Berberain: Lectures in Functional Analysis and Operator theory, Springer Verlag

R Larson : Banach Algebra, Marcell Dekker,1973.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand a strong foundation in functional analysis, focusing on spaces, operators, fundamental theorems and applications.
CO2	Apply the spectral theorem to resolution of integral equation.
CO3	Give an account of basic properties of operators on Banach spaces and Hilbert spaces.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			3		2		2		3		
CO2	2		2	3		2			2		2	
CO3		3	2		2		1	2		2		3

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT413DSC**	**Semester :**	IV
NUMERICAL ANALYSIS			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage

1	**Error Analysis** Errors, Absolute errors, Rounding errors, Truncation errors, Inherent Errors, Major and Minor approximations in numbers **The Solution of Linear Systems** Gaussian elimination method with pivoting, LU Decomposition methods,, Algorithm and convergence of Jacobi iterative Method, Algorithm and convergence of Gauss Seidel Method, Eigen value and eigenvector, Power method **The Solution of Non-Linear Equation** Bisection Method, Fixed point iterative method, Newton Raphson method, Secant method, Method of false position, Algorithms and convergence of these methods	1	20%
2	**Difference Operators** Shift operators, Forward difference operators, Backwarddifference operators, Average and central difference operators **Ordinary Differential Equations** Euler's, Improved Euler's, Modified Euler's methods with error analysis, Runge – Kutta methods with error analysis, Predictor-corrector methods for solving initial value problems, Finite Difference, Collocation and variational methods for boundary value problems	1	20%
3	**Interpolation** Lagrange's interpolation, Newton's divided difference interpolation, Newton's forward and backward difference interpolation, Central difference interpolation, Hermit interpolation, Spline interpolation, Errors and algorithms of these interpolations	1	20%

4	**Numerical Differentiation** Newton's Forward, Backward and central formulae for numerical differentiation **Numerical Integration** Rectangular rule, Trapezoidal rule, Simpson rule, Boole's rule, Weddle's rule, Gaussian quadrature formulae, Errors in quadrature formulae, Newton-Cotes formulae	1	20%
5	**Difference Equations** Linear homogeneous and non-homogeneous difference equations with constant coefficients, Difference reducible to linear form, difference equations with constant coefficieSimultaneousnts.	1	20%

Reference Books:

Curtis F. Gerald and Patrick O. Wheatley, *Applied Numerical Analysis*, (Addison-Wesley Publishing Co. Pearson Education, 2003)

Richard L. Burden and J. Douglas Faires, *Numerical Analysis*, (Brooks/ColePublishing Company,1997)

John H. Mathews, *Numerical Methods for Mathematics, Science and Engineering*,(Prentice Hall International, 2003)

Steven C. Chapra and Raymond P. Canale, *Numerical Methods for Engineers*,(McGraw Hill International Edition, 1998)

Course Outcomes: At the end of the course, students shall be able to

CO1	Apply well-known numerical techniques to solve engineering problems and evaluate the results.
CO2	Understanding the theoretical and practical aspects of the use of numerical methods.
CO3	Implementing numerical methods for a variety of multidisciplinary applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1			2		2	3	3		1		
CO2	2		2		3	2	1				2	
CO3		2		1				3	2			3

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT414DSC**	**Semester :**	IV
MATHEMATICAL STATISTICS – 2			
Course type :	Discipline Specific Course	**Total Credit :**	05
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs) 5 X 15 = 75	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
	30	70	100

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	**Sampling Distribution:** Chi – square, t and F – distributions with their properties, distribution of sample mean and variance, distribution of order statistics and sample range from continuous populations.	1	20%
2	**Point Estimation:** Estimators, properties of unbiasedness, consistency, sufficiency, efficiency, completeness, uniqueness, methods of estimation.	1	20%
3	**Testing of Hypothesis:** Null hypothesis and its test of significance, simple and composite hypothesis, M . P. test, UMP test, Likelihood test **(**excluding properties of Likelihood ratio Test**)**	1	20%

4	**Application of Sampling Distribution:** Test of mean and variance in the normal distribution, Test of single proportion and equality of two proportions, Chi – square test, t – test, F – test.	1	20%
5	**Linear Estimation:** Gauss Markoff linear models, BLUE, Gauss Markoff Theorem, estimation with linear restrictions on parameters, residual sum of squares, analysis of variance, analysis of variance for one way and two way classified data with one observation per cell.	1	20%

Reference Books:

Gupta and Kapoor: Fundamentals of Mathematical Statistics.

S. P. Gupta: Statistical Methods, Sultan Chand & Sons.

Harold J, Larson: Introduction to probability. Theory and Statistical Inference. Wiley 1982.

V. K. Rohatgi: An introduction to probability theory and mathematical Statistics. John Wiley & Sons, 1976.

Course Outcomes: At the end of the course, students shall be able to

CO1	Calculate probabilities and quantiles for sampling distributions related to the normal distribution.
CO2	Construction point interval estimators.
CO3	Students will frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1		2	3	2			2		3	2	

CO2		2	1			2			3		3	
CO3	2	2		3	1		3		2	3		2

GOKUL GLOBAL UNIVERSITY, SIDHPUR			
Programme code :	**MMAT**	**Programme Name :**	M.Sc. Mathematics
Course Code	**MMAT415SE**	**Semester :**	IV
RESEARCH METHODOLOGY			
Course type :	Subject Elective	**Total Credit :**	02
Teaching time (hours)	**Examination Marking scheme**		
Theory (hrs)	**Internal** (Marks)	**External** (Marks)	**Total** (Marks)
2 X 15 = 30	15	35	50

COURSE CONTENT / SYLLABUS

Unit	Contents	Credit	Weightage
1	Research Methodology: An Introduction Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Significance of Research – Research and Scientific Methods – Importance of knowing How Research is Done – Research Process – Criteria of Good Research. Defining the Research Problem What is a Research – Selecting the Problems – Necessity of Defining the Problem – Technique involved in Defining a Problem	1	50%

2	Research Design Meaning of Research Design – Features of a Good Design – Importance Concepts Relating to Research Design – Different Research Design – Basic Principles of Experimental Designs. Scientific Writing , Research Proposal, Research Paper, Review Paper, Thesis, Conference Report, Book Review and Project Report (any two), Reference Writing, Scientific Abbreviations. Preparation and Delivery of Scientific Presentations, Research Report / Thesis Formatting and Typing (Computing),Title page, Certificate, Declaration, Acknowledgement, List of Table, Figures, Abbreviations and Symbols, Chapters Quotations, Table, Figures, Summary, Appendices, References etc.	1	50%

Reference Books:

Research Methodology Methods and Techniques C.R. Kothari

Research Methodology Methods and Statistical Techniques Santosh Gupta

Who to write and publish a scientific paper by Day, R. A.

Guide to write scientific paper by Garson, G. D.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate the ability to choose methods appropriate to research aims and objectives.
CO2	Understand the limitations of particular research methods.
CO3	Develop skills in qualitative and quantitative data analysis and presentation. Develop advanced critical thinking skills.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1		3		2		3	3				
CO2		1	2	2		3			2		2	
CO3		2		2	3	2	1		2	3		3