BISHOP CHULAPARAMBIL MEMORIAL COLLEGE, KOTTAYAM

B. Sc MATHEMATICS (FROM 2009 ONWARDS)

GRADUATE PROGRAMME OUTCOMES,

PROGRAMME SPECIFIC OUTCOME

COURSE OUTCOMES

BOARD OF STUDIES

1. Dr. Varghese Mathew

Associate Professor

Department of Mathematics

Govt. College, Nattakom

2. Mr. Manesh Jacob

Assistant Professor

Department of Mathematics

Marthoma College, Thiruvalla

3. Dr. George Mathew

Associate Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

4. Mrs. Sosamma Mathew

Associate Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

5. Mrs. Salma Mary K Abraham

Associate Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

6. Dr. Stephy Thomas

Assistant Professor

Department of Statistics

Bishop Chulaparambil Memorial College, Kottayam

7. Mrs. Ann Johns

Assistant Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

8. Mrs. Anu Varghese

Assistant Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

9. Mr. Liju Alex

Assistant Professor

Department of Mathematics

Bishop Chulaparambil Memorial College, Kottayam

GPO No.	Graduate Programme Outcomes
GPO No. 1	**Disciplinary Knowledge & Critical Thinking:** Articulate knowledge of one or more disciplines that form a part of UG programme. Critically think, analyse, apply and evaluate various information and follow scientific approach to the development of knowledge.
GPO No. 2	**Communication Skill:** Communicate thoughts and ideas clearly in writing and orally. Develop careful listening, logical thinking and proficiency in interpersonal communication.
GPO No. 3	**Environmental Awareness:** Sustainable approach to use of natural resources. Capable of addressing issues, promoting values and give up practices that harm the ecosystem and our planet.
GPO No. 4	**Ethical Awareness:** Uphold ethics/morals in all spheres of life. Identify and avoid unethical behaviour in all aspects of work.
GPO No. 5	**Social Commitment:** Be aware of individual roles in society as nation builders, contributing to the betterment of society. Foster social skills to value fellow beings and be aware of one's responsibilities as international citizens.
GPO No. 6	**Lifelong learners:** Equip students to be life long learners. Be flexible to take up the changing demands of work place as well as for personal spheres of activities.

PSO NO.	PROGRAMME SPECIFIC OUTCOMES	GPO No.
PSO 1	To understand the fundamental concepts of mathematics and to develop deep interest in Mathematics and its allied areas.	GPO 1,3,5
PSO 2	To understand mathematics as a language which can be used for all scientific studies.	GPO 1,3
PSO 3	To enrich problem solving, computational, mathematical reasoning skills.	GPO 1,4,5
PSO 4	To apply various theories and concepts in mathematics to solve, analyse, practical problems.	GPO 3,5,6
PSO 5	To prepare the students to pursue higher education in mathematics by improving their abstract mathematical and statistical skills.	GPO 4,6
PSO 6	To understand the basics of summarising the data and deduct conclusions about the large group based on the proportion of the group.	GPO 1,5
PSO 7	To enable students to describe the various concepts in mathematics and effectively communicate and interact among a diverse set of audience.	GPO 2,4,5
PSO 8	Understanding the basic statistical distribution and model probability associated with some practical scenarios.	GPO 1,4,6

PROGRAMME SPECIFIC OUTCOMES – B.Sc MATHEMATICS

B.Sc. MATHEMATICS

SEMESTER 1 CORE COURSE OUTCOMES

MM1B01: FOUNDATIONS OF MATHEMATICS

Course Outcome No.	**Course Outcomes**	**Cognitive Level**	**PSO No.**
CO 1	To understand the basic concepts of set theory and to Apply set properties.	Un,Ap	PSO 1,2,3
CO 2	To understand the types of relations and functions and to Apply their different properties.	Un,Ap	PSO 1,2,3
CO 3	To understand the basic concepts of proposition and logical operators, and get the ability to write propositions using logical operators.	Un,Ap	PSO 1,2,3
CO 4	To classify valid and invalid arguments	Un,Ap	PSO 1,2,3
CO 5	To Apply logical operations to prove the theorems.	Un,Ap	PSO 1,2,3
CO 6	To understand fundamental concepts of congruence and learn Fermat's theorem and Wilson's theorem and applying this theorems to solve congruences.	Un,AP	PSO 1,2,3
CO 7	To get an idea about Euler's phi function.	Un	PSO 1

- **Un- Understand, Ap- Apply**

Module		Course Description	Hrs.	Co. No.
I	**1.0**	**Module I: Set Theory**	**15**	
	1.1	Sets	3	1
	1.2	Set operations	4	1
	1.3	Functions	4	1
	1.4	Sequences and summations	4	1
II	**2.0**	**Module II: Relations**	**20**	
	2.1	Relations and their properties	4	2
	2.2	n-ary relations and their applications,	4	2
	2.3	Representing relations,	4	2
	2.4	Equivalence relations,	4	2
	2.5	Partial orderings	4	2
II	**3.0**	**Module II: Basic Logic**	**20**	
	3.1	Propositional logic	3	3
	3.2	Propositional equivalences	2	3
	3.3	Predicates and quantifiers	3	4
	3.4	Nested quantifiers	3	4
	3.5	Rules of inference	3	4
	3.6	Introduction to proofs	3	5
	3.7	Proof methods and strategy.	3	5
IV	**4.0**	**Module IV: Theory of Numbers**	**17**	
	4.1	Divisibility theory in the integers	1	6
	4.2	the greatest common divisor	1	6
	4.3	the Euclidean algorithm (division algorithm)	1	6
	4.4	Primes.	1	6
	4.5	The fundamental theorem of arithmetic.	1	6
	4.6	The theory of congruence.	3	6
	4.7	Basic properties of congruence.	1	6

	4.8	Fermat's little theorem	2	6
	4.9	Wilson's theorem.	2	6
	4.10	Euler's phi-function.	2	7
	4.11	Euler's generalization of Fermat's theorem.	2	7

MM1B01: FOUNDATION OF MATHEMATICS
4 hours/week (Total Hours 72)3 credits

Syllabus

Text Books:

1. K.H. Rosen: Discrete Mathematics and its Applications (Sixth edition), Tata McGraw Hill Publishing Company, New Delhi.
2. S. Bernard and J.M Child: Higher Algebra, AITBS Publishers, India,2009

Module 1: Set theory (15 hours)

Sets, set operations, functions, sequences and summations
(Text - 1 Chapter - 2)

Module 2: Relations: (20 hrs.)

Relations and their properties, n-ary relations and their applications, representing relations, equivalence relations, partial orderings.
(Text – 1 Chapter 7 excluding Section 7.4)

Module 3 : Basic Logic (20 hrs.)

Pre-requisite: Nil.

Propositional logic, Propositional equivalences, Predicates and quantifiers nested quantifiers, Rules of inference, Introduction to proofs, Proof methods and strategy.
(Text book 1, Chapter - 1).

Module 4 Theory of Numbers (17 hrs.)

Divisibility theory in the integers, the greatest common divisor, the Euclidean algorithm (division algorithm), Primes. The fundamental theorem of arithmetic. The theory of
congruence. Basic properties of congruence. Fermat's little theorem Wilson's theorem. Euler's
phi-function. Euler's generalization of Fermat's theorem.
(Text – 2 , Chapter – 1 and 26)

References :

1.Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi. (Reprint 2009).
2. P.R. Halmos : Naive Set Theory, Springer. .
3. George E. Andrews : Number Theory, HPC.
4. Ian Chiswell & Wifrid Hodges: Mathematical Logic, Oxford university press
5. Graham Everest, Thomas Ward: An Introduction to Number Theory, , Springer
6. Fernando Rodriguez Villegas: Experimental Number Theory, Oxford University Press
7. Richard Johnsonbaugh – Discrete Mathematics (Pearsons)
8. C.Y Hsiung Elementary Theory of Numbers, Allied Publishers

B. Sc MATHEMATICS

SEMESTER IICORE COURSE OUTCOMES

MM2B01: ANALYTIC GEOMETRY, TRIGONOMETRY AND MATRICES

COURSE OUTCOME NO.	COURSE OUTCOMES	Cognitive Level	PSO NO.
CO 1	To understand the tangent and normals of a conic.	Un, Ap	PSO 1
CO 2	To get an idea of Pole and Polar and conjugate diameters of Ellipse.	Un, Ap	PSO 1, 4
CO 3	To study the polar Co–ordinates and polar equation of line and circles .	Un	PSO 1
CO 4	To get an idea of polar equation of a conic..	Un, Ap	PSO 1,4
CO 5	To understand the polar equations of tangents and normals.	Un	PSO 1
CO 6	To get an idea of circular and hyperbolic functions of complex variables.	Un	PSO 1
CO 7	To explain separation of functions of complex variables into real and imaginary parts.	Un	PSO 1
CO 8	To apply C+iS method to solve summation of infinite series.	Un,Ap	PSO 1,4
CO 9	To apply various methods to find the solution of system of linear equations, rank of a matrix and classify different types of matrices and its properties.	Ap, An	PSO 4
CO 10	To get an idea about characteristic roots and characteristic vectors of a matrix and	Un	PSO 1
CO 11	To understand Cayley Hamilton Theorem and application of theorem in different problems.	Un,Ap	PSO 1,3,7

- An- Analyze, Ap-Apply, Un-Understand

Module		Course Description	Hrs.	Co. No.
I	**1.0**	**Module I**	**25**	
	1.1	Tangent of a conic	2	1
	1.2	Normal of a conic	2	1
	1.3	Orthoptic Locus	2	1,2
	1.4	Chords in terms of given points	2	1,2
	1.5	Pole	2	2
	1.6	Polar	3	2
	1.7	Conjugate diameters of Ellipse	3	2
	1.8	Asymptotes of a hyperbola,	3	2
	1.9	Conjugate hyperbola	3	2
	1.10	Rectangular hyperbola.	3	2
II	**2.0**	**Module II**	**10**	
	2.1	Polar Co-ordinates	1	3
	2.2	Polar Equation of a line	1	3
	2.3	Polar Equation of a Circle	2	3
	2.4	Polar Equation of a Conic	2	4
	2.5	Polar Equations of tangents & normals	2	4
	2.6	Chords of conic sections	2	5
III	**3.0**	**Module III: Trigonometry**	**17**	
	3.1	Circular functions of complex variables	3	6
	3.2	Hyperbolic functions of complex variables	3	6
	3.3	Separation of functions of complex variables into real & imaginary parts	3	6
	3.4	Factorization of polynomials with complex roots	4	6
	3.5	Summation of infinite Series by c + is method	4	7
IV	**4.0**	**Module 1V: Differential Calculus**	**20**	
	4.1	Rank of a matrix	2	9
	4.2	Elementary transformations of a matrix	2	9

	4.3	Reduction to normal form	2	9
	4.4	Row reduced method for finding rank of a matrix	2	9
	4.5	Solution of homogenous system of linear equations	3	9
	4.6	Solution of non-homogenous system of linear equations	3	9
	4.7	Characteristic roots and characteristic vectors of a matrix	3	10
	4.8	Cayley Hamilton theorem and simple applications	3	11

MM2B01: ANALYTIC GEOMETRY, TRIGONOMETRY AND MATRICES
4 hours/week (Total Hours: 72) 3 credits

Syllabus

Text books:

1. Manicavachagom Pillay , Natarajan – Analytic Geometry (Part I, Two Dimensions)
2. S.L. Loney – Plane Trigonometry Part – II, S. Chand and Company Ltd.
3. Frank Ayres Jr - Matrices, Schaum's Outline Series, TMH Edition.

MODULE I (25hrs)

Tangents and Normals (parametric form only) of a conic, Orthoptic locus. Pole and Polar. Chordin terms of given points. Conjugate diameters of ellipse and hyperbola. Asymptotes of a hyperbola, conjugate hyperbola and rectangular hyperbola. **(Relevant sections of Text 1)**

MODULE II (10 hrs.)

Polar co-ordinates, polar equation of a line, polar equation of a circle and polar equation of a conic. Polar equations of tangent and normal to these curves**. (Relevant sections of Text 1)**

MODULE III: Trigonometry (17 hrs.)

Circular and hyperbolic functions of a complex variable. Separation into real and imaginary parts. Factorisation of x^n-1, x^n+1, $x^{2n} - 2x^n a^n \cos n\theta + a^{2n}$, Summation of infinite series by C + i S method. **(Relevant sections of Text 2, Chapter – V , VII , IX)**

MODULE IV: Matrices (20 hrs.)

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary matrices only. Systems of Linear equations: System of non-homogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications**.**

Reference Books:

1. S.K . Stein – Calculus and analytic Geometry , (McGraw Hill)
2. A. N. Das – Analytic Geometry of Two and Three Dimension (New Central Books)
3. Thomas and Finney - Calculus and analytical geometry (Addison-Wesley)
4. Shanti Narayan - Matrices (S. Chand & Company

B. Sc MATHEMATICS

SEMESTER III CORE COURSE OUTCOMES

MM3B01: CALCULUS

COURSE OUTCOME NO.	**COURSE OUTCOMES**	**Cognitive Level**	**PSO NO.**
CO 1	To get the ability to expand a function using Taylor's and Maclaurin's series.	Un,Ap	PSO 1,3
CO 2	To apply the concepts of differential calculus in various curves.	Un,Ap	PSO1,3,4
CO 3	To understand the fundamental concepts of partial derivatives.	Un	PSO 1
CO 4	To get an idea to find saddle points, extreme values using partial derivatives.	Un,Ap	PSO 1,3,4
CO 5	To apply various methods to find volume of solids using integral calculus.	Ap	PSO 3,4
CO 6	lerstand how to find the length of an arc and length of a function.	Un,Ap	PSO 1,4
CO 7	ly various method to find area and volume of regions using double and triple integrals	Ap	PSO 3,4

Module		Course Description	Hrs.	CO NO.
I	**1.0**	**Module I: Differential Calculus**	**30**	
	1.1	Successive Differentiation.	3	1
	1.2	Expansion of functions using Maclaurin's theorem and Taylor's theorem.	3	1
	1.3	Concavity and points of inflexion	3	2
	1.4	Curvature and Evolutes.	3	2
	1.5	Length of arc as a function derivatives of arc	3	2
	1.6	Radius of curvature – Cartesian equations.	3	2
	1.7	Centre of curvature,	3	2
	1.8	Evolutes and Involutes,	3	2
	1.9	Properties of evolutes.	3	2
	1.10	Asymptotes and Envelopes.	3	2
II	**2.0**	**Module II: Partial Differentiation**	**20**	
	2.1	Partial derivatives	4	3
	2.2	The chain rule.	4	3
	2.3	Extreme values and saddle points,	4	3
	2.4	Lagrange multipliers,	4	4
	2.5	Partial derivatives with constrained variables	4	4
III	**3.0**	**Module III: Integral Calculus**	**20**	
	3.1	Substitution and area between curves,	4	**5**
	3.2	Volumes by Slicing and rotation about an axis.	4	**5**
	3.3	Volumes by cylindrical shells	4	**5**
	3.4	Lengths of Plane Curves	4	**6**
	3.5	Areas of surfaces of Revolution and the theorems of Pappus.	4	**5**
IV	**4.0**	**Module IV: Multiple Integrals**	**20**	
	4.1	Double integrals,	4	**7**
	4.2	Areas, Double integrals in polar form	4	**7**
	4.3	Triple integrals in rectangular coordinates	4	**7**
	4.4	Triple integrals in cylindrical and spherical coordinates,	4	**7**
	4.5	substitutions in multiple integrals	4	**7**

MM3B01: CALCULUS
5 hours/week 4 credits

Syllabus

Text Books:

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.
2. Shanti Narayan and P. K. Mittal– Differential Calculus (S. Chand & Co.) 2008.

Module I: Differential Calculus (30 hrs.)

Successive Differentiation . Expansion of functions using Maclaurin's theorem and Taylor's theorem. Concavity and points of inflexion. Curvature and Evolutes. Length of arc as a function derivatives of arc, radius of curvature – Cartesian equations. Centre of curvature, Evolutes and Involutes, properties of evolutes. Asymptotes and Envelopes.(Pedal equation and Newtonian Method excluded)

(Text 2 Chapter - 5, Chapter – 6, Chapter 13, Chapter – 14 , Chapter - 15 section 15.1 to 15.4, Chapter – 18 section 18.1 to 18.8)

Module II: Partial Differentiation (20 hrs.)

Partial derivatives, the chain rule. Extreme values and saddle points, Lagrange multipliers, Partial
derivatives with constrained variables.

(Text 1 Section 14.3, 14.4, 14.7, 14.8, 14.9)

Module III: Integral Calculus (20 hrs.)

Substitution and area between curves, volumes by Slicing and rotation about an axis.
Volumes by cylindrical shells, Lengths of Plane Curves, Areas of surfaces of Revolution and the theorems of Pappus..

(Text 1 Section 5.6, 6.1, 6.2, 6.3, 6.5)

Module IV: Multiple Integrals. (20 hrs.)

Double integrals, Areas, Double integrals in polar form, Triple integrals in rectangular coordinates,
Triple integrals in cylindrical and spherical coordinates, substitutions in multiple integrals.

(Text 1 Section 15.1, 15.2 (area only) 15.3, 15.4, 15.6 ,15.7)

Reference:

1. T. M. Apostol – Calculus Volume I & II (Wiley India)
2. Widder – Advanced Calculus, 2nd edition
3. K. C. Maity & R. K. Ghosh – Differential Calculus (New Central Books Agency)
4. K. C. Maity & R. K. Ghosh – Integral Calculus (New Central Books Agency)

BSc MATHEMATICS

SEMESTER IV CORE COURSE OUTCOME

MM4B01 : VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS

Course Outcomes No.	**Course Outcomes**	**Cognitive Level**	**Pso No.**
CO 1	To understand the vector equation and Parametric equations for lines and equation for a plane in space.	Un, Ap	PSO 1
CO 2	To get the idea of curvature and Directional derivatives.	Un, Ap	PSO 1, 4
CO 3	To understand the concepts of vector integration and also find path independence and conservative fields.	Un	PSO 1
CO 4	To get the idea of Green's theorem, Stokes theorem and divergence	Un, Ap	PSO 1,4
CO 5	To understand the fundamental concepts of polynomial functions and related theorems	Un	PSO 1
CO 6	To apply various method to solve cubic and biquadratic equations	Un,Ap	PSO 1,3,4
CO 7	To apply numerical methods to solve algebraic as well as transcendental expressions.	Ap	PSO 3,4

MODULE		COURSE DESCRIPTION	HRS.	CO.NO.
I	**1.0**	**Module I**	**20**	
	1.1	Lines and planes in space	2	1
	1.2	Cylinders and Quadric surfaces,	2	1
	1.3	Vector functions Arc length	3	1
	1.4	Unit tangent vector,	2	1
	1.5	Curvature and Unit normal vector	3	2
	1.6	Torsion and Unit Binormal vector	2	2
	1.7	Directional derivatives and gradient vectors	3	2
	1.8	Tangent planes and Differentials	3	2
II	**2.0**	**Module II: Integration in Vector Fields**	**30**	
	2.1	Line integrals	3	3
	2.2	Vector fields	3	3
	2.3	Work circulation and flux,	3	3
	2.4	Path independence,	3	3
	2.5	Potential functions and conservative fields	3	3
	2.6	Green's theorem in the plane,	3	4
	2.7	Surface area and surface integrals,	3	4
	2.8	Parameterized surfaces	3	4
	2.9	Stokes' theorem (statement only),	3	4
	2.10	Divergence theorem and unified theory (no proof).	3	4
III	**3.0**	**Module III: Theory of Equations**	**25**	
	3.1	Statement of fundamental Theorem of algebra.	3	5
	3.2	Deduction that every polynomial of degree n has n and only n roots	3	5
	3.3	Relation between roots and coefficients.	4	5
	3.4	Transformation of equations.	3	5
	3.5	Reciprocal equations.	3	5

	3.6	Cardan's method	3	6
	3.7	Ferrari's method.	3	6
	3.8	Symmetric functions of roots.	3	6
IV	**4.0**	**Module IV: Introductory Methods of Numerical Solutions**	**15**	
	4.1	Bisection Method	3	7
	4.2	Method of False position	3	7
	4.3	Iteration Method	4	7
	4.4	Newton - Raphson Method	5	7

MM4B01: VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS

5 hours/week (Total Hours:80) 4 credits

Syllabus

Text Books:

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.

2. Bernard and Child - Higher Algebra, AITBS Publishers, India

3. S.S. Sastry - Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Module I (20 hrs.)
Lines and planes in space., Cylinders and Quadric surfaces, Vector functions Arc length and Unit tangent vector, Curvature and Unit normal vector, torsion and Unit Binormal vector, Directional derivatives and gradient vectors , tangent planes and Differentials **(Sections 12.5 ,12.6 , 13.1 , 13.3 , 13.4 , 13.5 , 14.5 , 14.6 of Text 1)**

Module II: Integration in Vector Fields (30 hours) Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields, Green's theorem in the plane, Surface area and surface integrals, Parameterized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof). **(Sections 16.1 to 16.8 of Text 1)**

Module III: Theory of Equations (25 hours) Statement of fundamental Theorem of algebra. Deduction that every polynomial of degree n has n and only n roots. Relation between roots and coefficients. Transformation of equations. Reciprocal equations. Cardan's method, Ferrari's method. Symmetric functions of roots. **(Chapter 6 and Descartes Rule of signs also, 11, 12 of Text 2)**

Module IV: Introductory Methods of Numerical Solutions (15 hours) Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method **(Sections 2.2, 2.3, 2.4, & 2.5 of Text 3)**

References:

1. Erwin Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.
3. Shanti Narayan, P.K Mittal – Vector Calculus (S. Chand)
4. Merle C. Potter, J. L. Goldberg, E. F. Aboufadel – Advanced Engineering Mathematics (Oxford)
5. Ghosh, Maity – Vector Analysis (New Central books)

COURSE OUTCOMES

B.Sc MATHEMATICS

SEMESTER 5 CORE COURSE : MM5CRT05 - MATHEMATICAL ANALYSIS

Course Outcomes No.	Course Outcomes	Cognitive Level	PSO No.
CO 1	To understand the set of real numbers as a complete ordered field and to distinguish the properties of real numbers and other algebraic structures similar to real numbers.	Un, An	PSO 1,
CO 2	To understand the topological properties of the set of real numbers	Un	PSO 1,2
CO 3	To recognize different methods to establish the convergence of sequence and to find the limit.	Re	PSO 2,3,5
CO 4	To learn the necessary and sufficient conditions of convergence of different classes of sequences and to Apply the convergence to Approximate some irrationals.	Un, Ap	PSO 4,5
CO 5	To identify various types of convergent and divergent sequences.	Un	PSO 7
CO 6	To understand the fundamental algebraic and topological properties of Complex numbers	Un, Ap	PSO 3,5

Un- Understand, Re- Remember, Ap – Apply, An – Analyze

COURSE DESCRIPTION

MM5CRT05 - MATHEMATICAL ANALYSIS

MODULE	SECTION	COURSE DESCRIPTION	HOURS	CO.NO.
I	**MODULE I: REAL NUMBERS**		15	
	1.1	Introduction to Real number system	1	1,2
	1.2	Real numbers as a Field structure	2	1,2
		Ordering Property	2	1,2
		Supremum, Infemum of Bounded sets	3	1,2
		Problems in Supremum and infemum	2	1,2
		Completeness property of reals	1	1,2
	1.3	Archimedian property of real numbers.	2	1,2
		Dedekinds form of completeness property	2	1,2
2	**MODULE II: TOPOLOGY OF REAL NUMBERS**		**25**	
2	2.1	Neighbourhood of a point.	1	3,4
		Interior point of a set.	2	3,4
		Open set..	2	3,4
	2.2	Limit point of a set.	3	3,4
		Bolzano weierstrass theorem for sets.	3	3,4
		Closed sets	3	3,4
		Closure of a set	2	3,4
	2.2	Dense sets.	2	3,4
		Countable Sets	2	3,4
		Uncountable sets	3	3,4

3	**MODULE III: SEQUENCES**		**30**	
3	3.1	Introduction to Sequence	1	5,6
		Definition, Basic Properties of Sequence	3	5,6
		Limit Theorems	3	5,6
		Limit Theorems – Continuation	2	5,6
	3.2	Problems in Limit Theorems Introduction to Monotone sequences	3	5,6
		Definition, Elementary Properties of Monotone sequences	2	5,6
		Properties of Monotone sequences	2	5,6
		Monotone Convergence theorem	3	5,6
	3.3	Monotone Subsequence theorem	2	5,6
		Bolzano Weierstrass Theorem	2	5,6
		The Cauchy Criterion of convergence	3	5,6
		Divergent sequences definition, classification	2	5,6
	3.3	Discussion of examples	2	5,6
4	**MODULE IV: COMPLEX NUMBERS**		**20**	
4	4.1	Definition and Introduction	2	7,8
		Algebraic Properties of Complex Numbers	3	7,8
		Exponential forms. Arguments of products and quotients	4	7,8
	4.1	Some inequalities of complex numbers	3	7,8
	4.2	Topological Properties of Complex Numbers	6	7,8
	4.3	Review of the sections	2	7,8

B.Sc DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 5)
FIFTH SEMESTER
MM5B01: MATHEMATICAL ANALYSIS

5 hours/week **4 credits**

Text Books:

1. S.C.Malik, Savitha Arora _ Mathematical analysis. RevisedSecond edition.

2. J.W. Brown and Ruel.V.Churchill _ Complex variables and applications, 8th edition. Mc.Graw Hill.

Module I **15 hours**

Intervals. Bounded and unbounded sets, supremum, intimum. Order completeness in R. Archimedian property of real numbers. Dedekinds form of completeness property.
(Sections 2.6, 3, 4.1 ,4.2, 4.3, 4.4 of text 1)

Module II **25 hours**

Neighbourhood of a point. Interior point of a set. Open set. Limit point of a set. Bolzano weierstrass theorem for sets. Closed sets, closure of a set. Dense sets. Countable and uncountable sets.
(Sections : 1.1,1.2,1.3,2,2.1,2.2,3.1,3.2,3.3,3.4,3.5,4 of chapter 2 of text 1)

Module III **30 hours**

Real sequences. The range, bounds of a sequence. Convergence of sequences. Some theorems, limit points of a sequence. Bolzano weierstrass theorem for sequences. Limit interior and superior. Convergent sequences. Cauchy's general principle of convergence. Cauchy's sequences. Statements of theorem without proof in algebra of sequences. Some important theorems and examples related to them. Monotonic sequences, subsequences.
(Sections : 1.1,to 1.5, 2.to2,3. 4 to5 ,6 ,6.1 ,7,8 9, 9.1 of chapter 3 of text 1)

Module IV

complex numbers **20 hours**

Sums and products. Basic algebraic properties. Further properties. Vectors and moduli. Different representations. Exponential forms. Arguments of products and quotients. Product and powers in exponential form. Foots of complex numbers. Regions in the complex plane.
(Section 1 to 11 of chapter 1 of text 2.)

References:

1. Robert G Bartle and Donald R Sherbert –Introduction to real analysis 3rd edition.Wiley
2. Richard R Goldberg – Methods of real analysis 3rd edition , Oxford and IBM Publishing Co (1964)
3. Shanti Narayan – A Course of mathematical analysis , S Chand and Co Ltd(2004)
4. Elias Zako – Mathematical analysis Vol1, Overseas Press, New Delhi(2006)
5. J. M .Howie – Real Analysis, Springer 2007
6. K.A Ross - Elementary Real Analysis, Springer, Indian Reprint
7. M.R Spiegel – Complex Variables, Schaum's Series

BSc MATHEMATICS

SEMESTER V CORE COURSE OUTCOMES

MM5B02: DIFFERENTIAL EQUATIONS

Co No.	Course Outsomes	Cognitive Level	Pso No.
CO 1	To understand fundamental concepts of differential equation and its orders.	Un	PSO 1,2
CO 2	To get an idea to form a differential equation.	Un	PSO 2,3
CO 3	To understand basics orthogonal trajectories.	Un	PSO 3,4
CO 4	To Apply various methods to solve differential equations.	Ap	PSO 2,3
CO 5	To learn the idea power series and its solutions.	Un	PSO 3,4
CO 6	To understand the basics of partial differential equations.	Un	PSO 5,7
CO 7	To identify various solution techniques to solve partial differential equations	Ap	PSO 3,5

MODULE		COURSE DESCRIPTION	Hrs.	CO
I	**1.0**	**Module I: Ordinary differential equations**	**25**	
	1.1	Exact differential equations and integrating factors	5	1,2
	1.2	Separable equations and equations reducible to this form	5	1,2
	1.3	linear equations and Bernoulli equations	5	1,2
	1.4	Special integrating factors and transformations	5	1,2
	1.5	Orthogonal and oblique trajectories	5	3
II	**2.0**	**Module:II**	**30**	
,	2.1	Basic theory of linear differential equations.	6	1,2,4
	2.2	The homogeneous linear equation with constant coefficients.	6	1,2,4
	2.3	The method of undetermined coefficients,	6	1,2,4
	2.4	Variation of parameters	6	1,2,4
	2.5	The Cauchy – Euler equation	6	1,2,4
III	**3.0**	**Module:III**	**33**	
	3.1	Power series solution about an ordinary point,	3	5
	3.2	Solutions about singular points	10	5
	3.3	The method of Frobenius , Bessel's equation and Bessel Functions,	10	5
	3.4	Differential operators and an operator method.	10	5
IV	**4.0**	**Method IV: Partial Differential equations**	**20**	
	4.1	Surfaces and Curves in three dimensions,	4	6,7
	4.2	solution of equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	4	6,7
	4.3	Origin of first order and second order partial differential equations	4	6,7
	4.4	Linear equations of the first order	4	6,7
	4.5	Lagrange's method	4	6,7

MM5B02: DIFFERENTIAL EQUATIONS

6 hours/week (Total Hour: 108)4 credits

Syllabus

Text Books:

1. Shepley L. Ross - Differential Equations, 3rd ed., (Wiley India).
2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)

Module I: Ordinary differential equations (25 hrs.)

Exact differential equations and integrating factors (proof of theorem 2.1 excluded) , separable equations and equations reducible to this form,, linear equations and Bernoulli equations, special
integrating factors and transformations. Orthogonal and oblique trajectories.
(Sections 2.1 , 2.2, 2.3 , 2.4, 3.1 of Text 1)

Module II (30 hrs.)

Basic theory of linear differential equations. The homogeneous linear equation with constant coefficients. The method of undetermined coefficients, Variation of parameters, The
Cauchy – Euler equation.
(Section 4.1 , 4.2 , 4.3, 4.4, 4.5 of Text 1)

Module III (33 hrs.)

Power series solution about an ordinary point, solutions about singular points, the method
of Frobenius , Bessel's equation and Bessel Functions, Differential operators and an operator
method.
(Section 6.1, 6.2, 6.3, 7.1 of Text 1)

Method IV: Partial Differential equations (20 hrs.)

Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method
(Chapter 1, section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

Reference:

1. A.H.Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
2. George. F. Simmons – Differential equation with applications and historical notes (Tata Mc Graw Hill)
3. W.E. Boyce & R.C. Diprima - Elementary Differential Equations and boundary value Problems, (Wiley India)
4. S. Balachandra Rao & H. Ranuradha – Differential Equation with Applications and Programs (Universities Press)

5. R. K. Ghosh & K. C. Maity - An Introduction to Differential Equations (New Central Books Agency)
6. B. K. Dutta – Introduction to Partial Differential Equations (New Central Books) .
Murrary –.Differential Equations. Macmillian
7. E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
8. Sankara Rao - Introduction to Partial Differential Equation,2nd edition, PHI.
9. Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

B. Sc MATHEMATICS

Course Outcomes

SEMESTER 5 CORE COURSE MM5CRT07 ABSTRACT ALGEBRA

Course outcome number	Course outcomes	Cognitive level	PSO No:
CO1	To understand the fundamental concepts in Group theory and their properties	U	PSO 1
CO 2	To explain the various types of groups	U	PSO 1,4
CO 3	To solve problems related to Group Theory	Ap	PSO 4
CO 4	To learn the concepts of isomorphism and homomorphism for groups and rings	U	PSO 1
CO 5	To understand the fundamental concepts in Ring theory and their properties	U	PSO 1
CO 6	To solve problems related to rings.	Ap	PSO 4

Un- Understand, Re- Remember, Ap – Apply, An – Analyze

Module	Course Description	Hours	CO No
1	**GROUPS AND SUBGROUPS**	**25**	
1.1	Binary operations	2	1,2
1.2	Isomorphic Binary structures	2	1,2
1.3	Groups-definition and examples	2	1,2
1.4	Elementary properties of groups	2	1,2,3
1.5	Finite group and group tables	2	1,3
1.6	Subgroups	2	1,2,3
1.7	Cyclic subgroups	2	1,2,3
1.8	Functions and permutations	2	1,2
1.9	Groups of permutations	3	1,2
1.10	Cycles and cyclic notations	3	1,2
1.11	Even and Odd permutations, Alternating Groups	3	1,2
2	**PERMUTATIONS,COSETS AND DIRECT PRODUCTS**	**25**	
2.1	Cyclic groups	2	1,2,3
2.2	Elementary properties of cyclic groups	3	1,2
2.3	Subgroups of finite cyclic groups	3	1,2
2.4	Isomorphism-Definition and elementary properties	3	1,2,3
2.5	Cayley's theorem	3	1,2
2.6	Cosets and theorem of Lagrange	3	1,2
2.7	Application of cosets in inner automorphism	3	3
2.8	Factor Groups	2	1,2
2.9	Simple Groups	3	1,2
3	**HOMOMORPHISMS AND FACTOR GROUPS**	**20**	
3.1	Homomorphism	2	1,2,3,4

3.2	Properties of homomorphism	3	1,2
3.3	Fundamental homomorphism theorem	2	1,2,3,4
3.4	Applications	2	3
3.5	Ring and Fields-definitions and basic properties	3	5,6
3.6	Homomorphism of rings	2	4,5,6
3.7	Isomorphism of rings	2	4,5,6
3.8	Divisors of zero and cancellation	2	5,6
3.9	Integral domains	2	5,6
4	**CHARACTERISTICS OF RINGS AND FIELDS**	**20**	
4.1	The characteristic of a ring.	3	5,6
4.2	Quotient Ring	3	1,5,6
4.3	Ideals	3	1,5,6
4.4	Coset Ring ideals	3	5,6
4.5	Criteria for the existence of Coset Ring Ideals	4	5,6
4.6	Quotient Rings	4	1,5,6

BSc DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 7)
FIFTH SEMESTER
MM5B03: ABSTRACTALGEBRA

5 hours/week **4 credits**

Text book:

John B.Fraleigh - A first course in Abstract Algebra (3rd Edition), (Chapters 1-7 ,11-13 , 23, 24 and 28)

Module 1 **(25 hours)**

Binary operation-Groups,Definition and elementary properties-finite groups and group tables-subsets and sub groups-cyclic sub groups-functions and permutations- groups of permutations-examples.Cycles and Cyclic notations-even and odd permutations-the alternating groups.

Module 2 **(25 hours)**

Cyclic Groups-Elementary Properties-Classification of cyclic groups-Subgroups of finite cyclic groups-Isomorphisms-Definition and elementary properties-How to show that two groups are isomorphic(Not Isomorphic)-Cayle's Theorem-Groups of Cosets--Applications-Criteria for the existence of a coset group-inner automorphisms and normal subgroups-Factor groups-Simple groups

Module 3 **(20 hours)**

Homomorphism-Definition and Elementary Properties-The Fundamental Homomorphism theorem-Applications. Rings,Definition and Basic Properties-Multiplicative questions;Fields-Integral Domains-Divisors of Zero And Cancellation-Integral Domains.

Module 4 **(20 hours)**

Characteristic of a Ring- Quotient Ring and Ideals-Criteria For The Existence of a Coset Ring-Ideals And Quotient Rings.

References :

1. I.N Herstein - Topics in Algebra

2. Joseph A Gullian - A Contemporary Abstract Algebra,Narosa Pub.House .
3. Hillbert – Algebra
4. Artin – Algebra , PHI
5. P.B Bhattacharya , S. K Jain and S. R . Nagpaul –Basic Abstract Algebra , 2nd edition, Cambridge University Press
6. Durbin – Modern Algebra , An introduction , 5th edition , Wiley
7. Chatterjee - Abstract Algebra , 2nd edition, PHI
8. M. K. Sen, S. Ghosh - Topics in Abstract Algebra (University Press)

COURSE OUTCOMES

MM5B04: FUZZY MATHEMATICS

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To understand the basic concepts of fuzzy sets.	Un	1,2,3
CO 2	To get an idea of operations on fuzzy sets.	Un , Ap	1,2
CO 3	To learn the combinations of operations.	Un	1,4
CO 4	To get an idea of fuzzy numbers & arithmetic operations on fuzzy numbers.	Un, Ap	1,5
CO 5	To understand the concepts of fuzzy logic.	Un	1,3,4
CO 6	To get an idea of fuzzy propositions & quantifiers.	Un	1,4,5
CO 7	To understand applications of fuzzy sets in various fields.	Un, Ap	1,2,3

COURSE DESCRIPTION

Module		Course Description	Hrs	CO.No.
1	**1.0**	Module I	**20**	
	1.1	Introduction	**3**	**1,7**
	1.2	Crisp Sets: An Overview	**3**	**1,7**
	1.3	Fuzzy sets: Basic types	**3**	**1,7**
	1.4	Fuzzy sets: Basic concepts	**3**	**1,7**
	1.5	Additional properties of α cuts	**4**	**1,7**
	1.6	Representation of fuzzy sets	**4**	**1,7**
2	**2.0**	Module II : Operations on Fuzzy sets	**30**	
	2.1	Types of Operations	**6**	**2,3**
	2.2	Fuzzy complements	**6**	**2,3**
	2.3	Fuzzy intersections: t norms	**6**	**2,3**
	2.4	Fuzzy Unions: t conforms	**6**	**2,3**
	2.5	Combinations of operations	**6**	**2,3**
3	**3.0**	Module III : Fuzzy Arithmetic	**20**	
	3.1	Fuzzy numbers	**5**	**4,7**
	3.2	Arithmetic operations on Intervals	**5**	**4,7**
	3.3	Arithmetic operations on fuzzy numbers	**5**	**4,7**
	3.4	Fuzzy equations	**5**	**4,7**
4	**4.0**	Module IV : Fuzzy logic	**20**	
	4.1	Classical logic: An overview	**3**	**5**
	4.2	Multivalued logics	**3**	**6**
	4.3	Fuzzy propositions	**3**	**5,6**
	4.4	Fuzzy quantifiers	**3**	**5,6**
	4.5	Linguistic Hedges	**4**	**5,6**
	4.6	Inference from Conditional Fuzzy propositions	**4**	**5,6**

MM5B04: FUZZY MATHEMATICS

SYLLABUS

Text Book:

George J. Klir and BoYuan, - *Fuzzy Sets and Fuzzy Logic Theory and Applications'*, Prentice Hall of India Private Limited New Delhi, 2000.

Module - I **(20 Hrs)**

Introduction , Crisp Sets: An Overview ,Fuzzy Sets: Basic Types ,Fuzzy Sets: Basic concepts. Additional properties of α cuts, Representation of fuzzy sets, Extension principle of fuzzy sets. (Chapter 1 – 1.1, 1.2, 1.3 and 1.4 and Chapter 2– 2.1 , 2.2 , 2.3)

Module - II

Operations on Fuzzy Sets: **(30 Hrs)**

Types of Operations , Fuzzy complements , Fuzzy intersections: t – norms , Fuzzy Unions: t – conorms , Combinations of operations .(Theorems 3.7 , 3.8 ,3.11 ,3.13, 3.16 and 3.18 statement only)
(Chapter 3 – 3.1, 3.2, 3.3, 3.4, 3.5)

Module - III

Fuzzy Arithmetic **(20 Hrs)**

Fuzzy numbers , Arithmetic operations on Intervals , Arithmetic operations on Fuzzy numbers. (Exclude the proof of Theorem 4.2) Lattice of fuzzy numbers, Fuzzy equations
Chapter 4 – 4.1, 4.3, 4.4, 4.5 , 4.6)

Module - IV

Fuzzy Logic **(20 Hrs)**

Classical Logic: An Overview , Multivalued Logics , Fuzzy propositions , Fuzzy quantifiers ,Linguistic Hedges, Inference from Conditional Fuzzy propositions ,
Chapter 8 – 8.1, 8.2, 8.3, 8.4, 8.5 and 8.6 only)

BSc MATHEMATICS

SEMESTER V OPEN COURSE OUTCOMES

MM5D02: APLICABLE MATHEMATICS

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To understand basic mathematics	Un	PSO 1,2
CO 2	To get familiar with shortcut methods to solve problems	Ap	PSO 3
CO 3	To understand types of numbers and improve arithmetic skills	Un	PSO 3,1
CO 4	To enrich problem solving and reasoning skill.	Ap	PSO 3
CO 5	To get the idea of permutation and combination and solve the related problems.	Un,Ap	PSO 1,4
CO 6	To aquire knowledge in trigonometry and Apply this concepts to analyse and solve problems.	Un,Ap	PSO 1,4
CO 7	To prepare the students to approach competitive examinations.	Ap	PSO 3,4

Module		Course Description	Hrs	Co. No.
1	**1.0**	**Module I**	**18**	
	1.1	Types of numbers	1	1,2,3,4
	1.2	Quadratic Equations	2	2,3,5,6
	1.3	Permutations and Combinations	3	2,3,5,6
	1.4	Applications of Permutations	3	2,3,5,6
	1.5	Trigonometry- introduction	3	2,3,5,6
	1.6	Values of trigonometric ratios	3	2,3,5,6
	1.7	Heights& Distances	3	2,3,5,6
2	**2.0**	**Module II**	**18**	
	2.1	Probability- introduction	3	7,2,3,4
	2.2	Sample spaces and events	3	7,2,3,4
	2.3	Differential calculus	3	7,2,3,4
	2.4	Product rule	3	1,2,3,4
	2.5	Quotient rule	3	1,2,3,4
	2.6	Integral calculus	3	1,2,3,4
3	**3.0**	**Module III**	**18**	
	3.1	Simple average	1	1,2,3,4
	3.2	HCF & LCM of integers	2	1,2,3,4
	3.3	Fractions & Simplifications	3	1,2,3,4
	3.4	Squares & Square roots	3	1,2,3,4
	3.5	Ratio & Proportion	3	1,2,3,4
	3.6	Percentage	3	1,2,3,4
	3.7	Profit & Loss	3	1,2,3,4
4	**4.0**	**Module IV**	**18**	
	4.1	Elementary mensuration	3	7,2,3,4
	4.2	Area and perimeter of polygons	3	7,2,3,4

	4.3	Elementary Algebra	3	7,2,3,4
	4.4	Simple interest	3	1,2,3,4
	4.5	Compound interest	3	1,2,3,4
	4.6	Time & Work	3	1,2,3,4

MATHEMATICS OPEN COURSE
MM5D02: APPLICABLE MATHEMATICS
4 hours/week (Total hour: 72)4 credits

The objective of module – 1 & 2 is to prepare students of all streams, particularly those with arts and commerce back ground for their higher studies. A detailed study is not necessary from these modules. All questions asked to be of arts students' standard

Module – 1 (18 hours)

Types of numbers, Quadratic equations (Solution of quadratic equations with real roots only), Logarithms – All rules with out proof, Multiplication and division of numbers, Evaluating expressions of the form $x^{p/q}$, x any real number, p & q are integers, Permutations and combinations – simple applications, Trigonometry introduction, Values of trigonometric ratios of 0^0, 30^0, 45^0, 60^0& 90^0, Heights and distances – Simple cases - (application of sinx, cosx, tanx, and their reciprocals only). Two dimensional geometry- Introduction, plotting points and drawing graph of the lines of the form ax + by + c = 0.

Module – 2 (18 hours)

Probability – Introduction – Sample spaces and events, Simple examples like tossing coin , tossing die etc.., Differential Calculus - Differentiation – Standard results (derivatives) with out proof, Product rule, Quotient rule and function of function rule), Integral calculus (Integration simple cases, with and with out limits)

No core text book is needed for Modules 1 & 2

The objective of module – 3 & 4 is to prepare students of all streams, particularly those with arts and commerce back ground to approach competitive examinations. Detailed explanation and short cut method for solving problems are to be introduced to students, so that they can acquire better understanding of concepts and problem solving skill. Assignments not less than 20 questions may be given from each topic of these modules. (For University examinations it is to be specified, whether a problem is solved in detail or use some short cut method.

Module – 3 (18 hours)

HCF and LCM of numbers, Fractions, Squares and square roots, cube and cube roots, simplifications, Ratio and Proportion, Percentage, Profit and loss, Simple average (No Weighed average)

(Sections – 2, 3, 5, 6, 7, 9,10,11,

Module – 4 (18 hours)

Simple interest, Compound interest, Time and work, Work and wages, (Exclude Pipes and Systems from the core reference), Time and distance, Elementary mensuration – Area and perimeter of polygons, Elementary Algebra, (Simplifications of algebraic expressions)

(Sections - 14, 15, 17, 18, 21, 22, 23)

Core Reference – M. Tyra, & K. Kundan- CONCEPTS OF ARITHMETIC, BSC PUBLISHING COMPANY PVT.LTD.

SEMESTER VI CORE COURSE OUTCOMES

MM6B01–REAL ANALYSIS

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To get an idea of convergence of infinite series	Un	PSO 1
CO 2	To understand the various tests for convergence.	Un	PSO 1
CO 3	To get an idea of uniform continuity and compare it with continuity.	Un, An	PSO 1,4
CO 4	To understand the concept of continuous functions and its properties	Un	PSO 1,4
CO 5	To understand Riemann integration.	Un	PSO 1
CO 6	To get an idea of Riemann integrable functions and fundamental theorem of calculus.	Un, Ap	PSO 1,4
CO 7	To introduce the concepts of pointwise and uniform convergence of sequence and series.	Un, Ap	PSO 1,4
CO 8	To get an idea about how to interchange limits.	Un, Ap	PSO 1,4

Module		Course Description	Hrs.	CO. No.
I	**1.0**	**Module I- Infinite Series**	**20**	
	1.1	Convergence of infinite series	4	1
	1.2	Positive term series	4	1
	1.3	Comparison tests	4	1
	1.4	Alternating series	4	2
	1.5	Absolute convergence	4	2
II	**2.0**	**Module II - Continuous Functions**	**25**	
	2.1	Continuous functions	6	3
	2.2	Continuous functions on intervals	7	4
	2.3	Uniform continuity	6	3,4
	2.4	Monotone and inverse functions	6	4
III	**3.0**	**Module III- The Riemann Integral**	**30**	
	3.1	The Riemann integral	10	5
	3.2	Riemann integrable functions	10	5,6
	3.3	The fundamental theorem	10	6
IV	**4.0**	**Module IV- Sequences And Series Of Functions**	**15**	
	4.1	Pointwise convergence	5	7
	4.2	Uniform convergence	5	7,8
	4.3	Series of functions	5	7

MM6B01: REAL ANALYSIS

5 hours/week (Total hours:70) 4 credits

Syllabus

Text book:

S.C.Malik and Savitha Arora - mathematical Analysis, 2nd Edition.

Module I : Infinite Series (**20 hours)**

A necessary condition for convergence. Cauchy`s general principle of convergence for a series. Positive term series. A necessary condition for convergence of positive term series. Geometric series. The comparison series $\sum\frac{1}{hP}$ comparison test for positive term series without proof. Cauchy`s root test DALEMBERTÈS RATIO test. Raabe's test. Gauss`s test. Series with arbitrary terms. Alternating series. Absolute convergence

(Section 1.1 to 1.4,2 ,2.1 to 2.3,3,4,5,6,9,10,10.1,10.2 of chapter 4 of Text 1)

Module II : **Continuous functions** (**25 hours)**

Continuous function (a quick review). Continuity at a point, continuity in an interval. Discontinuous functions. Theorems on continuity. Functions continuous on closed intervals. Uniform continuity.

(Section 2.1 to 2.4 ,3,4 of chapter 5 of Text 1)

Module III : **Riemann Integration** (**30 hours)**

Definitions and existence of the integral. Inequalities of integrals. Refinement of partitions of integrability. Integrability of the sum of integrable functions. The integrals as the limit of a sum. Some applications. Some integrable functions. Integration and differentiation. The fundamental theorem of calculus.

(Section 1 to 9 of chapter 9 of Text 1)

Module IV : **Uniform Convergence** (**15 hours)**

Point wise convergence. Uniform convergence on an interval. Cauchy`s criterion for uniform convergence. A test for uniform convergence of sequences. Test for uniform convergence of series. Weierstrass`s M-test, Abel`s test. Statement of Dirichelet`s test without proof.

(Section 1 to 3.2 of Text 1)

Reference

1. Robert G Bartle and Donald R Sherbert–Introduction to real analysis 3rd edition**.**
2. Shanti Narayan and P.k Mital – A Course of mathematical analysis, S Chand and
3. J. V Deshpande – Mathematical analysis and Applications
4. Chatterjee - Real analysis, PHI
5. Royden - Real analysis, 3rd edition, PHI
6. R. A. Gordon - Real Analysis 2nd Edn. (Pearson)
7. Nanda, Saxena – Real Analysis (Allied)

COURSE OUTCOMES

MM6B02 Complex Analysis

CO NO.	COURSE OUTCOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To understand the concept of Analytic functions and will be familiar with the elementary complex functions	Un	PSO 1,2
CO 2	To apply Cauchy Riemann equations to solve problems involving differentiability of complex functions	Ap	PSO 4
CO 3	To analyze and demonstrate examples of harmonic functions	An	PSO 3,4
CO 4	To understand the theory and techniques of complex integration	Un	PSO 1
CO 5	To understand and apply the theory of the power series expansion of analytic functions.	Un,Ap	PSO 1,4
CO 6	To identify different types of singularities and calculate residues.	Un	PSO 1
CO 7	To understand and apply fundamental theorems in complex analysis.	Un,App	PSO1,4

- An: Analyse Ap: Apply Re: Remember Un: Understand

COURSE DESCRIPTION

MM6B02:COMPLEX ANALYSIS

Module		Course Description	Hrs	Co.No.
I	**1.0**	**Module I: Analytic functions**	**28**	
	1.1	Functions of a complex variable	1	1
	1.2	Limits, continuity & derivatives	2	1
	1.3	Cauchy – Riemann equation	2	1 ,2
	1.4	Sufficient condition for differentiability	2	2
	1.5	Analytic functions	2	2
	1.6	Harmonic functions	2	2,3
	1.7	Elementary functions	2	2
	1.8	Exponential function	2	2
	1.9	Logarithmic function	2	1,2
	1.10	Complex exponents	2	1,2
	1.11	Trigonometric functions	2	1,2
	1.12	Hyperbolic functions	2	1,2
	1.13	Inverse trigonometric functions	2	1,2
II	**2.0**	**Module II: Integrals**	**25**	
	2.1	Derivatives of functions	2	4
	2.2	Definite integrals of functions	2	4
	2.3	Contours & Contour integrals	3	4
	2.4	Cauchy-Goursat theorem	3	4,7
	2.5	Simply & multiply connected domains	2	4,7
	2.6	Cauchy’s integral formula	2	4,7
	2.7	Extension of Cauchy’s integral formula	2	4,7
	2.8	Liouville’s theorem	3	4,7
	2.9	Fundamental theorem of algebra	3	4,7
	2.10	Maximum modulus principle	3	4,7

III	**3.0**	**Module III: Series**	**15**	
	3.1	Convergence of sequences & series	4	5
	3.2	Taylor's series & Examples	4	5
	3.3	Proof of Taylor's theorem	3	5
	3.4	Laurent's series & Examples	4	5
IV	**4.0**	**Module IV: Residues and poles**	**18**	
	4.1	Isolated singular points	2	6
	4.2	Residues	3	6
	4.3	Cauchy's residue theorem	2	6,7
	4.4	Three types of isolated singular points& examples	2	6
	4.5	Residues at poles	3	6
	4.6	Applications of residues	3	6
	4.7	Evaluation of improper integrals &Examples	3	6

MM6CRT11 : COMPLEX ANALYSIS
5 hours/week (Total Hrs: 90) 4 credits
Syllabus

Text book:

James Ward Brown & Ruel V. Churchill - Complex variables and applications (8th edition)

Pre-requisites (4 hours.)

A quick review on Complex numbers and its properties, vectors and moduli, complex conjugates, exponential forms, arguments and its properties, roots of complex numbers, and regions in complex plane.

(No question shall be asked from this section.)

Module I: Analytic functions (28 hours)

Functions of a complex variable, limits, theorems on limits, continuity, derivatives, differentiation formulas, Cauchy-Riemann equation, sufficient condition for differentiability, analytic functions, examples, harmonic functions. Elementary functions, the Exponential function, logarithmic function, complex exponents, trigonometric functions, hyperbolic functions, inverse trigonometric and hyperbolic functions.

Chapter 2 (Sections 12, 15, 16, 18 to 22, 24 to 26); Chapter 3 (Sections 29, 30, 33 to 36).

Module II: Integrals (25 hours)

Derivatives of functions, definite integrals of functions, contours, contour integrals, some examples, upper bounds for moduli of contour integrals, antiderivates , Cauchy-Goursat theorem (without proof), simply and multiply connected domains, Cauchy's integral formula, an extension of Cauchy's integral formula, Liouville's theorem and fundamental theorem of algebra, maximum modulus principle.

Chapter 4 (Sections 37 to 41, 43, 44, 46, 48 to 54);

Chapter 5 (Sections 55 to 60 and 62).

Module III: Series (15 hours)

Convergence of sequences and series, Taylor's series, proof of Taylor's theorem, examples, Laurent's series (without proof), examples.

Chapter 5 (Sections 55 to 60 and 62)

Module IV: Residues and poles (18 hours)

Isolated singular points, residues, Cauchy's residue theorem, three types of isolated singular points, residues at poles, examples. Applications of residues, evaluation of improper integrals, example.

Chapter 6 (Sections 68 to 70 and 72 to 74);

Chapter 7 (Section 78)

BSc MATHEMATICS

SEMESTER VI CORE COURSE OUTCOMES

MM6B03: DISCRETE MATHEMATICS

Co No.	**Course Outcomes**	**Cognitive Level**	**Pso No.**
CO 1	To understand fundamental concepts of graphs and get an idea about its matrix representation.	Un,Ap	PSO 1,4
CO 2	To understand fundamental concepts of trees and their properties.	Un	PSO 1
CO 3	To discuss about Chinese Postman problem and Travelling Salesman problem	Un	PSO 1
CO 4	To understand the fundamental concepts of cryptography	Un	PSO 1
CO 5	To understand the basic concepts of posets and their diagrammatical representations	Un	PSO 1
CO 6	To discuss with lattices, semi lattices, sub lattices	Un	PSO 1

Module		Course Description	Hrs.	Co no.
I	**1.0**	**MODULE I - GRAPH THEORY**	**40**	
	1.1	An introduction to graph	5	1
	1.2	Definition of a graph	5	1
	1.3	More definition	6	1
	1.4	Vertex degrees	6	1
	1.5	Sub graphs	6	1
	1.6	Paths and cycles	6	1
	1.7	The matrix representation of graphs	6	1
II	**2.0**	**MODULE II - GRAPH THEORY**	**20**	
	2.1	Trees	2	2
	2.2	Definition and simple properties	3	2
	2.3	Bridges	2	2
	2.4	Spanning trees	2	2
	2.5	Cut vertices and connectivity	2	2
	2.6	Euler's tours	3	2
	2.7	The Chinese postman problem	2	3
	2.8	Hamiltonian graphs	2	3
	2.9	The travelling salesman problem	2	3
III	**3.0**	**MODULE III- INTRODUCTION TO CRYPTOGRAPHY**	**15**	
	3.1	Caesar Cipher	5	4
	3.2	Public key Cryptography,	5	4
	3.3	The Knapsack Cryptosystem	5	4
IV	**4.0**	**MODULE IV – POSET AND LATTICES**	**15**	
	4.1	Diagrammatical Representation of a Poset	1	5
	4.2	Isomorphisms	2	5
	4.3	Duality	2	5
	4.4	Product of two Posets	2	5
	4.5	Lattices	2	6
	4.6	Semilattices	2	6
	4.7	Complete Lattices	2	6

	4.8	Sublattices	2	6

MM6B03: DISCRETE MATHEMATICS

5 hours/week (Total Hour: 90) 4 credits

Syllabus

Text books:

1. John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers
2. David M Burton - Elementary Number Theory 6th Edition TMH
3. Vijay K. Khanna - Lattices and Boolean Algebras- First Concepts, Vikas Publishing House Pvt Ltd.

Module I : Graph Theory (40Hrs)

An introduction to graph. Definition of a Graph, Graphs as models, More definitions, Vertex Degrees, Sub graphs, Paths and cycles The matrix representation of graphs (definition example only) **(Section 1.1 to 1.7 of text 1)**

Trees and connectivity. Definitions and Simple properties, Bridges, Spanning trees, Cut vertices and connectivity.
(Section 2.1, 2.2, 2.3 & 2.6 of text 1)

Module 2 (20 Hrs)

Euler Tours and Hamiltonian Cycles .Euler's Tours, The Chinese postman problem .Hamiltonian Graphs, The travelling salesman problem, Matching and Augmenting paths, Hall`s Marria

ge Theorem-statement only, The personnel Assignment problem, The optimal Assignment problem **(Section 3.1(algorithm deleted) 3.2(algorithm deleted), 3.3, 3.4 (algorithm deleted))** Matching
(Section 4.1,4.2 4.3(algorithm deleted),4.4 (algorithm deleted) of text 1

Module 3: Introduction to Cryptography (15 Hrs.)

From Caesar Cipher to Public key Cryptography, the Knapsack Cryptosystem
(Section 10.1, 10.2 only of text 2)

Module 4: Poset and Lattices (15 Hrs.)

Diagrammatical Representation of a Poset, Isomorphisms, Duality, Product of two Posets, Lattices, Semilattices, Complete Lattices, Sub lattices.
(Chapter 2 of text 3)

Reference:

1. Douglas B West Peter Grossman - Introduction to Graph Theory
2. W.D.Wallis - A Biginner's Guide to Discrete Mathematics, Springer
3. R. Balakrishnan, K. Ranganathan - A textbook of Graph Theory, Springer International Edition
4. S.Arumugham, S. Ramachandran - Invitation to Graph Theory, Scitech. Peter Grossman,
5. J.K Sharma - : Discrete Mathematics(2nd edition), (Macmillion)
6. S. A. Choudam –A First Course in Graph Theory (Macmillian)
7. Theory (Macmillian)

BSc MATHEMATICS

SEMESTER VI CORE COURSE OUTCOMES

MM6B04: LINEAR ALGEBRA AND METRIC SPACES

Course Outcomes No.	**Course Outcomes**	**Cognitive Level**	**Pso No.**
CO 1	To understand the fundamental concept of vector spaces.	Un	PSO 1
CO 2	To understand the basic concept of row space of a matrix	Un	PSO 1
CO 3	To understand the fundamental concept of linear transformation and its matrix representation.	Un	PSO 1
CO 4	To understand the fundamental concept of metric spaces.	Un	PSO 1
CO 5	To understand the concepts open sets , closed sets, cantor sets.	Un	PSO 3,5
CO 6	To understand the concept of convergence and completeness.	Un	PSO 4,5
CO 7	To understand Baire's Theorem and continuous mapping	Un	PSO 1,4

Module		Course Description	Hrs	Co.No.
I	**1.0**	**Module 1: Vector Spaces**	**25**	
	1.2	Vectors	5	1
	1.3	Subspace	5	1
	1.4	Linear Independence	5	1
	1.5	Basis and Dimension	5	1
	1.6	Row Space of a Matrix	5	2
II	2.0	**Module 2: Linear Transformations**	**30**	
	2.1	Functions	5	3
	2.3	Linear Transformations	5	3
	2.4	Matrix Representations	5	3
	2.5	Change of Basis	5	3
	2.6	Properties of Linear Transformations	5	3
III	**3.0**	**Module 3:** Metric Spaces	**15**	
	3.1	Definition and Examples	5	4
	3.2	Open sets, Closed Sets.	5	5
	3.3	Cantor set	5	5
IV	**4.0**	**Module 4**	**20**	
	4.1	Convergence,	6	6
	4.2	Completeness,	7	6
	4.3	Continuous Mapping (Baire's Theorem included)	7	7

MM6B04: LINEAR ALGEBRA AND METRIC SPACES

5 hours/week(Total Hour:90)4 credits

Syllabus

Text Book:

1. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (Second Edition), Academic Press 2009, an imprint of Elsevier.
2. G. F. Simmons -- Introduction to Topology and Modern analysis (Tata Mc Graw Hill)

Module 1: Vector Spaces (25 hours)

Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix.
(Chapter – 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5 of text 1)

Module 2: Linear Transformations (30 hours)

Functions, Linear Transformations, Matrix Representations, Change of Basis, Properties of Linear Transformations.
(Chapter –3 Sections 3.1, 3.2, 3.3, 3.4, 3.5 of text 1)

Module 3: Metric Spaces (15 hours)

Definition and Examples, Open sets, Closed Sets. , Cantor set
(Chapters: - 2, Sections 9, 10, 11 of text 2)

Module 4 (20 hours)

Convergence, Completeness, Continuous Mapping (Baire's Theorem included)
(Chapter: -2, Sections 12, 13)

Reference:

1. N. Herstein – Topics in Algebra , Wiley India
2. Harvey E. Rose - Linear Algebra, A Pure Mathematical Approach, Springer
3. Devi Prasad, - Elementary Linear Algebra, Narosa Publishing House
4. K. P. Gupta – Linear Algebra, Pragathi Prakashan
5. Promode Kumar Saikia – Linear Algebra, Pearson
6. Derek J. S. Robinson – A Course in Linear Algebra with Applications, Allied.

BSc MATHEMATICS

SEMESTER VI CORE COURSE OUTCOME

MM6D01 : OPERATIONS RESEARCH

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To understand the basic concepts of Linear programming	**Un**	**PSO 1**
CO 2	Describe guidelines on Linear programming model formulation and examples of Linear programming.	**Un,Ap**	**PSO 1,4**
CO 3	Describe various definition and graphical method to find solutions of Linear programming problems.	**Un**	**PSO 1**
CO 4	To understand special cases in Linear programming.	**Ap**	**PSO 4**
CO 5	To learn standard form of an LPP, Simplex algorithm, Big M method and different types of Linear programming solutions and solve problems related to them.	**Un,Ap**	**PSO 1,4**
CO 6	To understand duality, standard results on duality and advantages of duality and related theorems.	**Un**	**PSO 1**
CO 7	Explain transportation problems and assignment problems and solve problems related to them.	**Un**	**PSO 1, 3**
CO 8	To understand the basic concepts of queuing theory	**Un**	**PSO 1, 3**

Module		Course Description	Hrs.	CO NO.
I	**1.0**	**Module I: : Mathematical Preliminaries**	**10**	
	1.1	Euclidean Space : Vectors and vector space Linear dependence, dimensions of a vector space	1	1
	1.2	Basis. Convex sets : open and closed sets in e_n,	1	1
	1.3	Convex linear combinations,	1	1
	1.4	Convex sets	1	1
	1.5	Intersection of convex sets	1	1
	1.6	Convex hull of a set	1	1
	1.7	Vertices of a convex set	1	1
	1.8	Convex polyhedron	1	1
	1.9	Hyper planes, half spaces and polytopes	1	1
	1.10	Separating and supporting hyper planes, (All Theorems without proof)	1	1
	1.11	**Linear programming –** introduction	**10**	1,2,3
	1.12	LP in two dimensional space,	5	1,2,3
	1.13	General LPP, Feasible solution, Basic and basic feasible solution, optimal solution	5	1,2,3
II	**2.0**	**Module II: Linear Programming Contd.**	**20**	
	2.1	Simplex method (numerical example) Simplex tableau,	2	4,5
	2.2	Finding the first b.f. s.,	2	4,5
	2.3	Artificial variables,	2	4,5
	2.4	Degeneracy	2	4,5
	2.5	simplex multipliers	2	4,5
	2.6	Duality in LPP	2	4,5
	2.7	Duality theorems	2	4,5,6
	2.8	Application of duality.	2	4,5,6
	2.9	Dual simplex method	4	4,5,6
III	**3.0**	**Module III: Transportation and Assignment Problems**	**17**	
	3.1	Introduction	2	7

	3.2	Transportation problem,	2	7
	3.3	Transportation array	2	7
	3.4	Transportation matrix	2	7
	3.5	Triangular basis	2	7
	3.6	Finding a basic feasible solution	2	7
	3.7	Testing of optimality	2	7
	3.8	Loop in a transportation problem	1	7
	3.9	Change the basis,	1	7
	3.10	Assignment problem	1	7
III	**4.0**	**Module IV: Queuing Theory**	**15**	
	4.1	Characteristic Queuing Process	5	8
	4.2	Transient- state and Steady – state	5	8
	4.3	Probability distribution in Queuing system	5	8

MM6D01 : OPERATIONS RESEARCH
4 hours/week(Total hour:72) 3 credits

Syllabus

Text Books:

1. K. V Mital and C. Mohan - Optimization Methods in Operations Research and System Analysis (3rd edition) (New Age International)
2. J. K. Sharma : Operation Research Theory and Application (3rd edition)

Module 1: Mathematical Preliminaries (10 hrs.)

Euclidean Space : Vectors and vector space Linear dependence, dimensions of a vector space,basis. Convex sets : Open and closed sets in E_n, convex linear combinations, convex sets, intersection of convex sets, convex hull of a set, vertices of a convex set, convex polyhedron, hyper planes, half spaces and polytopes, separating and supporting hyper planes, (All Theorems without proof)

Linear Programming (10 hrs)

Introduction, LP in two dimensional space, general LPP, Feasible solution, Basic and basic feasible solution, optimal solution.

Ch. 1 (Section 1 – 5 and 11 – 18 of text 1)

Module 2: Linear Programming Contd. (20 hrs)

Simplex method (numerical example) Simplex tableau, Finding the first b.f. s., artificial variables, Degeneracy, simplex multipliers, Duality in LPP, Duality theorems, Application of
duality, Dual simplex method.

Ch. 3 (Section 1 – 20 except 16 of text 1)

Module 3: Transportation and Assignment Problems (17 hrs)

Introduction, transportation problem, Transportation array, Transportation matrix, triangular Basis, finding a basic feasible solution, testing of optimality, loop in a transportation problem, Change the basis, Degeneracy, Unbalanced problem, Assignment problem.

Ch. 4 (Section 1 – 11 & 14 of text 1)

Module 4: Queuing Theory (15 hrs)

Introduction, Essential features of queuing system, Calling population, Characteristic Queuing
Process, Queue discipline, Service Process (or Mechanisms) , Performance measure of Queuing system. Transient- state and Steady – state, Relationship among Performance measure. Probability distribution in Queuing system, Distribution of arrival (Pure Birth Process),Distribution of interracial times (Exponential process) Distribution of departure (Pure Death Process) Distribution of Service Times.

Ch. 16 (Section 16.1 – 16.4 of text 2)

Reference:

1. Operation Research by Kanti Swarup, P. K. Gupta and Man Mohan - (Sultan Chand and Sons)
2. Problems in Operations Research by Gupta P. K. and Hira D. S. - (S. Chand)
3. Operations Research by Ravindran A., Philip D. T. and Solberg J. J. - (John Wiley and Sons)
4. B. K. Mishra , B. Sharma – Optimization Linear Programming (Ane Books)
5. Mokhtar S. Bazaraa, J. J. Jarvis, H.D. Sherali – Linear Programming and Network Flows (Wiley India)

COMPLEMENTARY COURSE FOR PHYSICS, CHEMISTRY

COURSE OUTCOMES

SEMESTER I COMPLEMENTARY COURSE OUTCOMES

MP1C01: Differential Calculus and Trigonometry

COURSE OUTCOME NO.	COURSE OUTCOMES	Cognitive Level	PSO NO.
CO 1	To understand the concept of rate of change and limits.	Un	PSO 1
CO 2	To get an idea of derivatives.	Un	PSO 3,4
CO 3	To understand the concepts of implicit differentiation.	Ap, An	PSO 4
CO 4	To get an idea of extreme value of functions.	Un	PSO 1
CO 5	To understand monotic functions and the first derivative tests.	Un,Ap	PSO 1,3,7
CO 6	To get an idea of partial derivatives.	Un	PSO 1,3
CO 7	To understand the summation of infinite series based on C+i S method.	Un, Ap	PSO 1, 3,4

Module		Course Descriprtion	Hrs.	Co No.
I	**1.0**	**Module 1:Differential Calculus**	**22**	
	1.1	Rates of change and limits	1	1,2
	1.2	Calculating limits using the limit laws	3	1,2
	1.3	The precise definition of a Limit	3	1,2
	1.4	One sided limits and limits at infinity**,**	3	1,2
	1.5	Derivative of a function,	3	1,2
	1.6	Differentiation rules,	3	1,2
	1.7	The Derivative as a rate of change	3	1,2
	1.8	Derivatives of trigonometric functions,	3	1,2
II	**2.0**	**Module II: Applications of Derivatives**	**15**	
	2.1	Extreme values of functions,	5	3,4
	2.2	The Mean Value Theorem,	5	3,4
	2.3	Monotonic functions and the first derivative test.	5	5
III	**3.0**	**Module III: Partial Derivatives**	**15**	
	3.1	Functions of several variables (Definition only)	5	6
	3.2	Partial derivatives	5	6
	3.3	The Chain Rule	5	6
IV	**4.0**	**Module IV: Trigonometry**	**20**	
	4.1	Basic Concepts of Circular Functions and Exponential Functions – Relationship Expansion of Powers of Sin x	3	7
	4.2	Expansion of trigonometric functions	3	7
	4.3	Circular and Hyperbolic Functions	3	7
	4.4	Inverse Hyperbolic Functions	3	7
	4.5	Problems of Circular and Hyperbolic Functions	3	7
	4.6	Summation of Series , C+iS Method	5	7

MP1C01: Differential Calculus and Trigonometry
4 hours/week (Total Hour: 72)3 credits

Syllabus

Text Books: -

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. S.L. Loney – Plane Trigonometry Part – II, AITBS Publishers India, 2009.

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Module 1: Differential Calculus (22 hrs)

Rates of change and limits, calculating limits using the limit laws, the precise definition of a limit, one sided limits and limits at infinity**,** derivative of a function, differentiation rules, the derivative as a rate of change, derivatives of trigonometric functions, the chain rule and parametric equations, implicit differentiation.

(Sections 2.1 – 2.4, 3.1 – 3.6 of Text 1)

Module II: Applications of Derivatives (15 hrs)

Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test.

(Sections 4.1 - 4.3 of Text 1)

Module III: Partial Derivatives: (15 hrs)

Functions of several variables (Definition only), Partial derivatives, The Chain Rule

(Sections 14.3 - 14.4 of Text 1)

Module 1V: Trigonometry (20hrs)

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, $\sin^n \theta$, $\cos^n \theta$, $\sin^n \theta \cos^m \theta$ Circular and hyperbolic functions, inverse circular and hyperbolic function. Separation into real and imaginary parts.

Summation of infinite series based on C + iS method. (Geometric, Binomial, Exponential, Logarithmic and Trigonometric series)

(Relevant Sections in Chapter 3 – 5 and Chapter 8of Text 2)

Reference Books :

1. Shanti Narayan : Differential Calculus (S Chand)
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.
3. S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
4. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

SEMESTER II COMPLEMENTARY COURSE OUTCOME

MP2C01– INTEGRAL CALCULUS AND MATRICES

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To get an idea of matrices and rank of a matrices.	Un	PSO 1,4
CO 2	To understand the concept of elementary transformations.	Un	PSO 1
CO 3	To understand the concept of linear equations.	Un, App	PSO 1,4
CO 4	To get an idea about how to find volumes using cross sections.	Un, App	PSO 1,4
CO 5	To understand volumes using cylindrical shells.	Un, App	PSO 1,4
CO 6	To get an idea of Arc lengths and areas of revolution.	Un, App	PSO 1,4
CO 7	To introduce the concepts of double integrals over general regions and by using this find the area of that regions .	Un, App	PSO 1,4
CO 8	To get an idea about triple integrals.	Un, App	PSO 1,4

Module		Course Description	Hrs.	CO. No.
I	**1.0**	**Module I- Integral Calculus**	**15**	
	1.1	Indefinite integrals	3	4
	1.2	Definite integrals	3	5
	1.3	Fundamental theorem of calculus	3	6
II	**2.0**	**Module II – Application of integrals**	**20**	
	2.1	Volumes using cross sections	5	4
	2.2	Volumes using Cylindrical shells	5	5
	2.3	Arc lengths	5	4
	2.4	Areas of surface of revolution	5	5
III	**3.0**	**Module III–Multiple Integrals**	**17**	
	3.1	Double integrals over rectangles	2	7
	3.2	Double integrals over general regions	5	7
	3.3	Area by double integration	5	8
	3.4	Triple integrals over rectangular regions	5	8
IV	**4.0**	**Module IV- Matrices**	**20**	
	4.1	Rank of a matrix	4	1
	4.2	Elementary transformations	4	2
	4.3	Systems of linear equations.	4	3
	4.4	Cayley-Hamilton theorem	4	2
	4.5	Systems of homogeneous equations	4	3

MP2C01: Integral Calculus and Matrices
4 hours/week (Total hours:)3 credits

Syllabus
Text Books: -

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. Frank Ayres Jr : Matrices, Schaum's Outline Series, TMH Edition.

Module I: Integral Calculus: (15 hrs)

A quick review of indefinite integral as anti derivative. The Definite integral. The fundamental theorem of Calculus
(Section 5.3 and 5.4 of Text -1).

Module II : Application of Integrals (20 hrs)

Substitution and area between curves, Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution and the theorem of Pappus (excluding theorem of Pappus)
(Section 5.6, 6.1, 6.3, 6.5 of Text - 1),

Module III: Multiple Integrals (17 hrs)

Double Integrals, area of bounded region in plane only, Double Integrals in Polar form, Triple integrals in rectangular co-ordinates, Volume of a region in space
(As in Sections 15.1, 15.2, 15.3, 15.4 of Text - 1)

Module IV: Matrices
(20hrs)

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary matrices only. Systems of Linear equations: System of non homogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications
(Text 2, Chapters – 5, 10, 19, 23).

Reference Books :

1. Shanti Narayan , P .K . Mittal :Integral Calculus (S. Chand & Company)
2. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand.
3. David W. Lewis - Matrix Theory (Allied)

III SEMESTER COMPLEMENTARY COURSE OUTCOMES

MP3C01: Vector Calculus , Differential Equations and Analytic Geometry

Co No.	Course outcomes	Cognitive level	PSO No:
CO1	To understand the basics of vector differentiation and integration .	Un	PSO 1
CO 2	To understand how vector calculus is used in finding velocity, acceleration, curvature etc. of moving particles, density, mass etc. of thin wires etc.	Un, Ap	PSO 1, 4
CO 3	To understand the important theorems in vector integration : Green's theorem, Stoke's theorem and divergence theorem and solve problems using these theorems.	Un, Ap	PSO 1,3,4
CO 4	To get an idea about ordinary differential equations.	Un,Ap	PSO 1,3,4
CO 5	To identify different conics and its properties	Re	PSO 1,4
CO 6	To solve and graph problems related to conic	Ap	PSO 4

MODULE		COURSE DESCRIPTION	Hrs.	CO NO.
I	**1.0**	**Module I: Vector valued Functions**	**15**	
	1.1	Vector Functions	3	1
	1.2	Arc length and unit Tangent vector **T**,	3	1
	1.3	Curvature and unit Normal Vector **N**	3	1
	1.4	Torsion and unit Binormal vector **B**	3	1
	1.5	Directional Derivatives and Gradient Vectors	3	1
II	**2.0**	**Module II: Integration in Vector Fields**	**25**	
	2.1	Line Integrals,	2	2
	2.2	Vector fields and Work,	2	2
	2.3	Circulation and Flux,	2	2
	2.4	Path independence,	2	2
	2.5	Potential Function and Conservation Fields	2	2
	2.6	Green's theorem in Plane	3	3
	2.7	Surface area and Surface integral	3	3
	2.8	Parameterised Surface,	3	3
	2.9	Stoke's theorem	3	3
	2.10	The Divergence theorem and a Unified theory	3	3
III	**3.0**	**Module: Ordinary differential equations**	**25**	
	3.1	Exact Differential Equation,	3	4
	3.2	Linear Equations	3	4
	3.3	olutions by Substitutions,	3	4
	3.4	Equations of first order and not of first degree	3	4
	3.5	First order equations of higher Degree solvable for p	3	4
	3.6	Equations solvable for y	3	4
	3.7	Equations solvable for x	3	4
	3.8	Equations of first degree in x and y - Lagrange's and Clairaut's Equation	4	4

IV	**4.0**	**Module IV: Analytic Geometry**	**25**	
	4.1	Conic sections and Quadratic equations,	5	5,6
	4.2	Classifying Conic Sections by Eccentricity,	5	5,6
	4.3	Conics and Parametric equations	5	5,6
	4.4	The Cycloid, polar co-ordinates	5	5,6
	4.5	Conic Sections in Polar coordinates	5	5,6

MP3C01: Vector Calculus, Differential Equations and Analytic Geometry

(5 hours/week (Total hour :) 4 credits)

Syllabus

Text :-

1. A. H Siddiqi , P Manchanada : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)

2. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.

Module I: Vector valued Functions
(15hrs.)

Vector Functions, Arc length and unit Tangent vector **T**, Curvature and unit Normal Vector **N**,
Torsion and unit Binormal vector **B,** Directional Derivatives and Gradient Vectors**.**
(Sections 13.1, 13.3, 13.4, 13.5 and 14.5 of text 2)

Module II: Integration in Vector Fields (25 hrs.)

Line Integrals, Vector fields and Work, Circulation and Flux, Path independence, Potential
Function and Conservation Fields, Green's theorem in Plane (Statement and problems only),
Surface area and Surface integral, Parameterised Surface, Stoke's theorem(Statement and
Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only).
(Sections 16.1 to 16.8 of text 2)

Module III: Ordinary differential equations (25 hrs.)

Exact Differential Equation, Linear Equations , Solutions by Substitutions, Equations of first
order and not of first degree , First order equations of higher Degree solvable for p , Equations
solvable for y , Equations solvable for x, Equations of first degree in x and y - Lagrange's and
Clairaut's Equation
(sections 2.1 , 2.2 , 2.3 , 2.4 , 3.1 , 3.2 , 3.3 , 3.4 , 3.5 of text 1)

Module IV: Analytic Geometry (25 hrs.)

Conic sections and Quadratic equations, Classifying Conic Sections by Eccentricity, Conics and
Parametric equations, The Cycloid, polar co-ordinates, Conic Sections in Polar coordinates.
(Sections 10.1, 10.2, 10.4, 10.5, 10.8 of Text 2)
(exclude the pedal Method and Newtorian Method)

Reference Books :

1. Shanti Narayan , P .K . Mittal :Vector Calculus (S. Chand & Company)
2. P.P.G Dyke : An introduction to Laplace Transfoorms and Fourier Serices (Springer 2005)
3. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.
4. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
5. Merle C. Potter – Advanced Engineering Mathematics , Oxford University Press

SEMESTER IV COMPLEMENTARY COURSE OUTCOME

MP4C01: FOURIER SERIES, DIFFERENTIAL EQUATIONS, NUMERICAL ANALYSIS AND ABSTRACT ALGEBRA

Course Outcomes No.	Course Outcomes	Cognitive Level	Pso No.
CO 1	To understand fundamental concepts of periodic functions, trigonometric series, Fourier series.	Un	PSO 1
CO 2	To get an idea about power series, and solving differential equations using power series method.	Un, Ap	PSO 1, 3,4
CO 3	To understand fundamental concepts of Bessel's Functions	Un	PSO 1
CO 4	To understand the concepts of Surfaces and Curves in three dimensions	Un	PSO 1
CO 5	To get an idea about solving the equation of the form $\frac{R}{dz}=\frac{Q}{dy}=\frac{P}{dx}$	Un, Ap	PSO 1, 3,4
CO 6	To understand the fundamental concepts of first order and second order partial differential equations.	Un,	PSO 1
CO 7	To understand the basic concepts of Lagrange's method and apply this method to solve differential equations.	Un, Ap	PSO 1, 3,4
CO 8	To apply numerical methods to solve algebraic as well as transcendental expressions	**U**n, Ap	PSO 1, 3,4
CO 9	To understand the fundamental concepts of group and their properties	Un	PSO 1
CO 10	To understand the fundamental concepts of rings and their properties	Un	PSO 1
CO 11	To understand the fundamental concepts of vector spaces and their properties	Un	PSO 1

MODULE		COURSE DESCRIPTION	HRS.	CO.NO.
I	**1.0**	**<u>Module I</u>: Special Functions**	**25**	
	1.1	Periodic functions	1	1
	1.2	Trigonometric series	2	1
	1.3	Fourier series	2	1
	1.4	Functions Of Any Period p=2L	2	1
	1.5	Even and odd functions	2	1
	1.6	Half range expansions	3	1
	1.7	A brief introduction to power series	2	2
	1.8	Power series method for solving differential equations	2	2
	1.9	Legendre equations	2	2
	1.10	Legendre polynomials $P_n(x)$	2	2
	1.11	Rodrigues' Formula	3	2
	1.12	Bessel's Equation	3	3
	1.13	Bessel's Functions	2	3
II	**2.0**	**<u>Module II</u>: Partial Differential Equations**	**15**	
	2.1	Surfaces and Curves in three dimensions	3	4
	2.2	Solution of equation of the form $\frac{R}{dz}=\frac{Q}{dy}=\frac{P}{dx}$	3	5
	2.3	Origin of first order and second order partial differential equations,	3	6
	2.4	Linear equations of the first order	3	6
	2.5	Lagrange's method	3	7
III	**3.0**	**<u>Module III</u>: Numerical Analysis**	**25**	
	3.1	Absolute, relative and percentage errors.	3	8
	3.2	A general error formula.	3	8
	3.3	Error in a series Approximation.	3	8
	3.4	Bisection method ,	3	8
	3.5	Methods of false position	3	8

	3.6	Iteration method	3	8
	3.7	Acceleration of convergence: Aitken's Δ^2 Process	4	8
	3.8	Newton Raphson Method, the quotient – Difference method	3	8
IV	4**.0**	**<u>Module IV</u>: Abstract algebra**	**25**	
	4.1	Groups.	2	9
	4.2	Subgroups,	2	9
	4.3	Cyclic groups	3	9
	4.4	Groups of Permutations and Homomorphisms,	4	9
	4.5	Rings	4	10
	4.6	Fields	5	10
	4.7	Vector Spaces	5	11

MP4C01: FOURIER SERIES, DIFFERENTIAL EQUATIONS, NUMERICAL ANALYSIS AND ABSTRACT ALGEBRA

5 hours/week(Total hours:90) 4 credits

Syllabus

Text books :

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)
3. S.S. Sastry : Introductory methods of Numerical Analysis ,4th edition (Prentice Hall)
4. John B Fraleigh - A first course in Abstract Algebra (7th Edition) Pearson Education

Module I: Special Functions (25 Hrs.)

Fourier Series: Periodic Functions, Trigonometric Series, Functions of any period p = 2L, Fourier Series, Even and Odd functions, Half-range Expansions. Legendre Polynomials – A brief introduction to power series and power series method solving Differential equations. Legendre equation and Legendre Polynomials , Rodrigues' Formula, Bessel's Equation .Bessel's Functions **(Sections 10.1, 10.2, 10.3, 10.4, 4.1, 4.3 , 4.5 of Text 1 – Excluding Proofs**).

Module II: Partial Differential Equations (15 Hrs.)

Surfaces and Curves in three dimensions, solution of equation of the form $\frac{R}{dz}=\frac{Q}{dy}=\frac{P}{dx}$. Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method

(Chapter 1 , section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

Module III: Numerical Analysis (25 Hrs.)

Absolute , relative and percentage errors. A general error formula . Error in a series Approximation. Bisection Method , Methods of false position , Iteration Method , Acceleratio of convergence: Aitken's Δ^2 Process, Newton Raphson Method, the quotient – Difference method .

(section 1.3, 1.4, 1.5 , 2.1 , 2.2 , 2.3 , 2.4, 2.5 and 2.11 of Text 3)

Module IV: Abstract algebra (25 Hrs.)

Groups, Subgroups, Cyclic groups, Groups of Permutations and Homomorphisms, Rings and Fields , Vector Spaces.

(Section 1.4, 1.5, 1.6, 2.8, 3.13, 4.18, 6.30 of text 4)

References:

1. Stephen Andrilli, David Hecker - Elementary Linear Algebra ,Academic Press
2. Surjeet Singh, Qazi Zameeruddin - Modern Algebra Eighth Esition Vikas Pub. House
3. R. K. Ghosh, K. C. Maity – An Introduction to Differential Equations, New Central Books
4. Shepley L. Ross – Differential Equation , Wiley India
5. Srimanta Pal – Numerical Methods, Oxford University Press
6. Qazi Shoeb Ahamad, Zubir Khan – Numerical and Statistical Techniques, Ane Books