BISHOP CHULAPARAMBIL MEMORIAL COLLEGE, KOTTAYAM

B. Sc MATHEMATICS (FROM 2017 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
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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.

PROGRAMME SPECIFIC OUTCOMES – B.Sc MATHEMATICS

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

B. Sc MATHEMATICS

SEMESTER 1 CORE COURSE OUTCOMES

MM1CRTO1:FOUNDATIONS OF MATHEMATICS

Course Outcome No.	Course Outcomes	Cognitive Level	PSO No.
CO 1	To understand the basic concepts of proposition and logical operators, and get the ability to write propositions using logical operators.	Un	PSO 1,3,4
CO 2	To classify valid and invalid arguments	An	PSO 4
CO 3	To Apply logical operations to prove the theorems.	Un,Ap	PSO3,4
CO 4	To understand the basic concepts of set theory and to Apply set properties.	Un,Ap	PSO 1,3,4
CO 5	To understand the types of relations and functions and to Apply their different properties.	Un,Ap	PSO 1,3
CO 6	To understand the fundamental concepts of polynomial functions.	Un	PSO 1
CO 7	To get an idea about division algorithm for polynomial functions, factor theorem, and remainder theorem.	Un	PSO 1
CO 8	To solve polynomial functions using theorems.	Un,Ap	PSO 1,4

- Un- understand, Ap-Apply,An-Analyze

Module	Course Description	Hrs.	CO No.
I	Module I- Logic	20	
1.1	Propositional logic	4	1,2
1.2	Propositional equivalences	2	1,2
1.3	Predicates and quantifiers	4	1,2
1.4	Rules of inference	5	1,2,3
1.5	Introduction to proofs	5	1,2,3
II	Module II Set Theory	12	
2.1	Sets – Introduction, Definitions, Examples	2	4
2.2	Set operations	5	4
2.3	Functions	5	5
III	Module III Relations	20	
3.1	Relations and their properties	6	5
3.2	Representing Relations- using Matrices and using Digraphs	3	5
3.3	Equivalence relations	5	5
3.4	Partial orderings	6	5
IV	Module IV Theory of Equations	20	
4.1	Roots of equations	1	6
4.2	Relations connecting the roots and coefficients of an equation	1	6,7
4.3	Transform of equations	2	6,7,8
4.4	Special cases	2	6,7,8
4.5	The cubic equations	2	6,7,8
4.6	The biquadratic equation	2	6,7,8
4.7	Character and position of the roots of an equation	2	6,7,8
4.8	Some general theorems	1	6,7,8
4.9	Decartes' rule of signs	1	6,7,8
4.10	Corollaries	2	6,7,8
4.11	Reciprocal equations	4	6,7,8

MM1CRT01: Foundation of Mathematics
4 hours/week (Total Hours: 72) 3 credits
Brief Description of the Course

This course introduces the concepts of mathematical logic methods of proofs, sets, functions, relations and partial orderings. A brief introduction of theory of Equations is also included. These topics are foundations of most areas of modern mathematics and are applied frequently in the succeeding semesters.

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: Basic Logic (20 hours)

Propositional logic, Propositional equivalences, Predicates and quantifiers, Rules of inference, Introduction to proofs.

Text 1: Chapter – 1excluding sections 1.4 & 1.7

Module 2: Set theory (12 hours)

Sets, set operations, functions

Text 1: Chapter – 2 excluding section 2.4

Module 3: Relations (20hours)

Relations and their properties, representing relations, equivalence relations, partial orderings. (Text 1: Chapter 7 excluding Sections 7.2 & 7.4)

Module 4: Theory of Equations (20 hours)

Roots of Equations, Relation Connecting the roots and coefficients of an equation, Transformation of equations, Special Cases, The Cubic equation, The Biquadratic Equation, Character and Position of the Roots of an Equation, Some General Theorems, Descartes's Rule of Signs, Corollaries, Reciprocal Equations

Text 2: Chapter VI Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, Chapter XI Section 1

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. Ian Chiswell&Wifrid Hodges: Mathematical Logic, Oxford university press

COURSE OUTCOMES

MM2CRT02: ANALYTIC GEOMETRY, TRIGNOMETRY, AND DIFFERENTIAL CALCULUS

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 7	To apply C+iS method to solve summation of infinite series.	Un,Ap	PSO 1,4
CO 8	To get an idea about successive differentiation and indeterminate forms.	Un	PSO 1

- Ap – Apply, Un- Understand

COURSE DESCRIPTION

MM2CRT02: ANALYTIC GEOMETRY, TRIGONOMETRY AND DIFFERENTIAL CALCULUS

Module		Course Description	Hrs	Co. No.
I	**1.0**	**Module 1:Conic sections**	**22**	
	1.1	Tangent of a conic	3	1
	1.2	Normal of a conic	4	1
	1.3	Orthoptic Locus	3	1,2
	1.4	Chords in terms of given points	3	1,2
	1.5	Pole	3	2
	1.6	Polar	3	2
	1.7	Conjugate diameters of Ellipse	3	2
II	**2.0**	**Module II:Polar Co-ordinates**	**15**	
	2.1	Polar Co-ordinates	2	3
	2.2	Polar Equation of a line	2	3
	2.3	Polar Equation of a Circle	2	3
	2.4	Polar Equation of a Conic	3	4
	2.5	Polar Equations of tangents &normals	3	4
	2.6	Chords of conic sections	3	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	4	6
	3.4	Factorization of polynomials with complex roots	3	6
	3.5	Summation of infinite Series by c + is method	4	7
IV	**4.0**	**Module 1V:Differential Calculus**	**18**	

	4.1	Successive Differentiation	4	8
	4.2	Chain rule for functions of one variable	4	8
	4.3	n^{th} derivative and some standard results	3	8
	4.4	n^{th} derivative of product functions	4	8
	4.5	Indeterminate forms	3	8

MM2CRT02: ANALYTIC GEOMETRY, TRIGONOMETRY AND DIFFERENTIAL CALCULUS
4 hours/week (Total Hours : 72)

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. Shanti Narayan , P.K.Mittal : Differential Calculus , S.Chand and Company

MODULE I: Conic Sections

Tangent and Normals of a Conic (Cartesian a
terms of given points, Pole and Polar and Conjugate diameters of Ellipse.
Relevant Sections of Text 1

MODULE II: Polar Co-ordinates

Polar Co-ordinates, Polar Equation of a line , Polar Eq
Polar Equations of tangents and Normals , Chords of Conic Sections.
Relevant Sections of Text 1

MODULE III:Trigonometry

Circular and Hyperbolic functions of complex variables, Separation of fun
variables into real and imaginary parts, Factorization of
and Summation of infinite Series by
Relevant Sections of Text 2 Chapter

Module IV: Differential Calculus

Successive Differentiation and Indeterminate forms
Text 3: Chapter 5 and Chapter 10

SEMESTER 3 CORE COURSE OUTCOMES

MM3CRT03: 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	To understand how to find the length of an arc and length of a function.	Un,Ap	PSO 1,4
CO 7	To Apply various method to find area and volume of regions using double and triple integrals	Ap	PSO 3,4

- Ap- Apply, Un- Understand

Course Description MM3CRT03: Calculus				
MODULE		**Course Description**	**Hrs.**	**Co No.**
I	**1.0**	**Module I - Differential Calculus**	**27**	
	1.1	Maclaurin's theorem & Taylor's theorem	4	1
	1.2	Concavity & points of inflexion	4	2
	1.3	Curvature & Evolutes	4	2
	1.4	Radius of curvature	4	2
	1.5	Centre of curvature	4	2
	1.6	Evolutes & Involutes	3	2
	1.7	Asymptotes & Envelops	4	2
II	**2.0**	**Module II – Partial Differentiation**	**18**	
	2.1	Partial derivatives	4	3
	2.2	The chain rule	4	3
	2.3	Exteme values & Saddle points	4	4
	2.4	Lagrange multipliers	4	4
III	**3.0**	**Module III integral calculus**	**20**	
	3.1	Volumes by slicing and rotation about an axis	2	5
	3.2	The disk method	2	5
	3.3	The washer method	2	5
	3.4	Volumes by cylindrical shells	2	5
	3.5	Length of a curve y= f (x)	2	6
	3.6	Length of a parametrically defined curve	2	6
	3.7	Surface area of revolution	2	7
	3.8	Surface area of revolution for parameterized curves	2	7
		Problems to find volumes	2	5,7
		Problems to surface area	2	7
IV	**4.0**	**Module IV multiple integrals**	**20**	

	4.1	Double integrals over rectangular regions	2	7
	4.2	Fubini's theorem for calculating double integrals	2	7
	4.3	Double integrals over general regions	2	7
	4.4	Properties of double integrals	1	7
	4.5	Area by double integration	2	7
	4.6	Triple integrals	2	7
	4.7	Triple integrals in cylindrical coordinates	3	7
	4.8	Triple integrals in spherical coordinates	3	7
	4.9	Substitutions in multiple integrals	3	7

THIRD SEMESTER
MM3CRT03: CALCULUS
5 hours/week (Total Hours: 90) 4 credits
Syllabus

Text Books:

1. Shanti Narayan, P.K.Mittal: Differential Calculus , SChand and Company

2. George B Thomas Jr: Thomas' Calculus (12$_{th}$Edition), **Pearson.**

Module I: Differential Calculus (27 hrs)

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 only. (Parametric, Polar, Pedal equation and Newtonian Method are excluded)
Centre of curvature, Evolutes and Involutes, properties of evolutes. Asymptotes and Envelopes.
Text 1: Chapter 6, Chapter 13, Chapter 14 , Chapter 15 (Section 15.1 to 15.4 only), Chapter 18 (Section 18.1 to 18.8 only).

Module II: Partial Differentiation (18 hrs)

Partial derivatives, The Chain rule, Extreme values and saddle points, Lagrange multipliers.
Text 2 Chapter 14 (Sections 14.3, 14.4, 14.7 and 14.8 only) All other sections are excluded

Module III: Integral Calculus (20 hrs)

Volumes using Cross-sections, Volumes using cylindrical shells, Arc lengths, Areas of surfaces of
Revolution.
Text 2: Chapter 6 (Section 6.1 to 6.4 only (Pappus Theorem excluded)

Module IV: Multiple Integrals (25 hrs)

Double and iterated integrals over rectangles, Double integrals over general regions, Area by double
integration, Triple integrals in rectangular coordinates, Triple integrals in cylindrical and spherical
coordinates, Substitutions in multiple integrals.
Text 2: Chapter 15 (Sections 15.4 and 15.6 are excluded)

COURSE OUTCOMES

MM4CRT04:VECTOR CALCULUS, THEORY OF NUMBERS AND LAPLACE TRANSFORM

COURSE OUTCOME 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 theorem	Un, Ap	PSO 1,4
CO 5	To understand fundamental concepts of congruence and learn Fermat's theorem and Wilson's theorem	Un	PSO 1
CO 6	To get an idea about Euler's phi function.	Un	PSO 1
CO 7	To understand fundamental concepts of Laplace transforms and get an idea about convolution and integral equations	Un	PSO 1

- Ap – Apply, Un- Understand

FOURTH SEMESTER

MM4CRT04 : VECTOR CALCULUS, THEORY OF NUMBERS AND LAPLACE

Module		**Course Description**	**Hrs.**	**Co No.**
I	1.0	**MODULE I - VECTOR DIFFERENTIATION**	**25**	
	1.1	A vector equation for lines and planes	3	1
	1.2	Parametric equation for lines and planes	3	1
	1.3	Vector functions	1	1
	1.4	Arc length and Unit tangent vector	3	1
	1.5	Curvature and Unit normal vector	3	2
	1.6	Tangential components of acceleration	3	2
	1.7	Normal components of acceleration	3	2
	1.8	Directional derivatives and Gradient vectors	3	2
	1.9	Tangent planes and Normal lines	3	2
II	2.0	**MODULE II – VECTOR INTEGRATION**	**30**	
	2.1	Line integrals	3	3
	2.2	Vector fields and line integrals	3	3
	2.3	Conservative fields and potential functions	3	3
	2.4	Green's theorem in the plane	4	4
	2.5	Surfaces and area	3	4
	2.6	Parametrisations of surfaces	3	4
	2.7	Implicit surfaces and Surface integral	3	4
	2.8	Stoke's theorem	4	4
	2.9	Divergence theorem	4	4
III	3.0	**MODULE III - THEORY OF NUMBERS**	**15**	
	3.1	Basic properties of congruences	3	5
	3.2	Fermat's theorem	4	5
	3.3	Wilson's theorem	4	5
	3.4	Euler's phi functions	4	6
IV	4.0	**MODULE IV – LAPLACE TRANSFORMS**	**20**	

TRANSFORM

	4.1	Laplace transforms	2	7
	4.2	Linearity of laplace transforms	2	7
	4.3	First shifting theorem	2	7
	4.4	Existence of laplace transforms	2	7
	4.5	Transforms of derivatives	3	7
	4.6	Solution of ordinary differential equation and initial value problem	3	7
	4.7	Laplace transform of the integral of a function	3	7
	4.8	Covolution and integral equation	3	7

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

Syllabus

Text Books:

1. Thomas Jr., Weir M.D, Hass J.R – Thomas' Calculus (12th Edition) Pearson, 2008.

2. David M Burton - Elementary Number Theory, 7thEdition,McGraw Hill Education(India) Private Ltd.

3. Erwin Kreyszig : Advanced Engineering Mathematics, Ninth Edition, Wiley, India.

Module I: Vector Differentiation (25 hrs)

(A quick review of vectors), A vector equation and Parametric equations for lines and equation for a plane in space only (the distance from a point to a line and a plane and angle between planes are excluded) Vector functions, Arc length and Unit tangent vector, Curvature and the Unit normal vector, Tangential and Normal Components of Acceleration, Directional derivatives and Gradient vectors, tangent planes and Normal lines only.

Relevant sections from 12.5, 13.1, 13.3, 13.4, 13.5, 14.5, 14.6 (tangent planes and normal lines only) of Text 1

Module II: Vector Integration (30 hrs)

Line integrals, Vector fields and line integrals: Work, Circulation and Flux, Path Independence, Conservative Fields and Potential Functions (Proofs of theorems excluded), Green's theorem in the plane (Statement and problems only), Surfaces and Area: Parameterisations of surfaces, Implicit surfaces, Surface integrals, Stokes' theorem (Statement and simple Problems only), Divergence theorem only (Statement and Problems only) Gauss' law onwards are excluded.

Sections 16.1 to 16.6 and relevant portions from 16.7 & 16.8 of Text 1

Module III: Theory of Numbers (15 hrs)

Basic properties of congruence, Fermat's theorem, Wilson's theorem, Euler's phi function.

Text 2 : Chapter 4: section 4.2, Chapter 5: sections 5.2, 5.3 and Chapter 7: section 7.2.

Module IV: Laplace transforms (20 hrs)

Laplace transform, Linearity of Laplace transform, First shifting theorem, Existence of Laplace transform, Transforms of derivatives, Solution of ordinary differential equation & initial value problem, Laplace transform of the integral of a function, Convolution and Integral equations.

Text 3 (Sections 6.1, 6.2 and 6.5)

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 identify different forms of numerical representation of real numbers and to characterize different types of intervals.	An	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 basic concepts about infinite series and Apply different types of tests to establish the convergence or divergence of infinite series.	Un, Ap	PSO 3,5
CO 7	To categorize different classes of convergent series and learn the techniques to establish the convergence.	An	PSO 4,5
CO 8	To understand limit of a function at a point and Apply theories to find the limit of a function at a point.	Un	PSO 1,4

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

COURSE DESCRIPTION

MM5CRT05 - MATHEMATICAL ANALYSIS

SEMESTER : FIFTH

MODULE	SECTION	COURSE DESCRIPTION	HOURS	CO.NO.
I	**MODULE I: REAL NUMBERS**		30	
	1.1	Introduction to Real number system	1	1,2
	1.1	Countability- Introduction	2	1,2
		Classification of sets according to its countability	1	1,2
		Discussion of examples	2	1,2
	1.1	Characterization of countable sets	1	1,2
		Cantors Theorem	2	1,2
	1.2	Real numbers as a Field structure	3	1,2
		Some Properties of sets of rational numbers	2	1,2
		Ordering Property	2	1,2
		Absolute Value Function	2	1,2
	1.2	Some inequalities related to absolute value function	2	1,2
		Supremum, Infemum of Bounded sets	1	1,2
		Problems in Supremum and infemum	2	1,2
		Completeness property of reals	1	1,2
	1.3	Characterisation of Intervals	2	1,2
		Decimals – Periodic, Terminating	2	1,2
		Problems discussion	2	1,2
2	**MODULE II: SEQUENCES**		**30**	
	2.1	Introduction to Sequence	1	3,4

2		Definition, Basic Properties of Sequence	2	3,4
		Limit Theorems	2	3,4
	2.2	Limit Theorems – Continuation	3	3,4
		Problems in Limit Theorems Introduction to Monotone sequences	3	3,4
		Definition, Elementary Properties of Monotone sequences	3	3,4
		Properties of Monotone sequences	2	3,4
	2.2	Monotone Convergence theorem	2	3,4
		Monotone Subsequence theorem	2	3,4
		Bolzano Weierstrass Theorem	3	3,4
	2.3	The Cauchy Criterion of convergence	2	3,4
		Divergent sequences definition, classification	3	3,4
		Discussion of examples	3	3,4
3	**MODULE III: SERIES**		**24**	
3	3.1	Introduction to series	1	5,6
		Definition of Convergent series	1	5,6
		Examples of convergent series, divergent series	1	5,6
		Necessary condition for convergence	1	5,6
	3.2	Tests for convergence	1	5,6
		Limit Comparison test, Comparison test	1	5,6
		Problems sessions Cauchys Condensation test	1	5,6
		Alternating Series	1	5,6
	3.3	Absolute convergence	2	5,6

		Leibnits Tests- Problems	1	5,6
		Rearrangement of series, Grouping of series	1	5,6
		Tests for Absolute Convergence,Ratio Test, Root Test	2	5,6
	3.3	Raabes Test	1	5,6
		Integral test	1	5,6
		Tests for non absolute convergence	2	5,6
		Problems of various tests	2	5,6
	3.4	Abels Theorem	1	5,6
		Abels Test	2	5,6
		Dirichlet's Test	2	5,6
4	**MODULE IV: LIMITS**		**18**	
4	4.1	Definition and Introduction to limits	2	7,8
		Limit Theorems	2	7,8
		Examples discussion	3	7,8
	4.1	Extension of Limit concepts	3	7,8
	4.2	Limits at infinity	4	7,8
	4.3	Infinite Limits	4	7,8

FIFTH SEMESTER

MM5CRT05 : MATHEMATICAL ANALYSIS

6 Hrs/Week (Total Hours : 108) 4 Credits

SYLLABUS

Text Book : Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, In. 2007

MODULE I: REAL NUMBERS 30 hours

Finite and Infinite Sets, The Algebraic and Order Properties of R, Absolute Value and Real Line, The Completeness Property of R, Applications of the Supremum Property, Intervals.
Chapter 1: Section 1.3 and Chapter 2 : Sections 2.1, 2.2,2.3,2.4,2.5

MODULE II: SEQUENCES 30 hours

Sequences and their Limits, Limit Theorems, Monotone Sequences, Subsequences and the Bolzano- Weierstrass Theorem, The Cauchy Criterion, Properly Divergent Sequences.
Chapter 3 : Sections 3.1,3.2,3.3,3.4, 3.5,3.6

MODULE III: SERIES 24 hours

Introduction to Series, Absolute Convergence, Tests for Absolute convergence, Tests for nonabsoute Convergence
Chapter 3 : Section 3.7, Chapter 9 : Sections 9.1,9.2,9.3

MODULE IV: LIMITS 24 hours

Limits of Functions, Limit Theorems, Some Extensions of the Limit Concept.
Chapter 4 : Sections 4.1,4.2,4.3

Reference Texts

- Richard R Goldberg - Methods of real Analysis, 3rd edition , Oxford and IBM Publishing Company (1964)
- Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)
- J.M Howie - Real Analysis, Springer 2007.
- K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.
- S.C Malik, Savitha Arora - Mathematical Analysis, Revised Second Edition

COURSE OUTCOMES

SEMESTER 5 CORE COURSE MM5CRT06: 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

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

Module	Course Description	Hours	CO No
1	**WHAT IS A DIFFERENTIAL EQUATION?**	**26**	
1.1	The nature of solutions of differential equation	2	1,2
1.2	Separable equations	3	1,2
1.3	First order linear equations	3	1,2
1.4	Exact equations,	3	1,2
1.5	Orthogonal trajectories and families of curves	3	3
1.6	Homogeneous equations	3	4
1.7	Integrating factors	3	4
1.8	Reduction of order-dependent variable missing	3	4
1.9	Reduction of order-independent variable missing	3	4
2	**Second order linear equations**	**23**	
2.1	Second order linear equations with constant coefficients	3	1
2.2	Euler's equidimensional equations	4	4
2.3	The method of undetermined coefficients	4	4
2.4	The method of variation of parameters	4	1
2.5	The use of a known solution to find another	4	4
2.6	Higher order linear equations	4	4
3	**Power Series solutions and special functions**	**26**	
3.1	Series solutions of first order differential equations	6	5
3.2	Second order linear equations: ordinary points	5	5
3.3	Legendre's equations	5	5
3.4	Regular singular points	5	5
3.5	More on regular singular points	5	5
4	**Partial Differential equations**	**28**	
4.1	Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	8	6,7
4.2	Origin of first order partial differential equations	10	6,7
4.3	Linear equations of the first order	10	6,7

MM5CRT06 : DIFFERENTIAL EQUATIONS
6 hours/week (Total: 108 hours) 4 credits
Syllabus

Text Book:

1. G.F. Simmons, S.G. Krantz - Differential Equations, (Tata McGraw Hill-New Delhi). (Walter Rudin Student Series)

2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)

Module I: What is a differential equation (26 hrs.)

The nature of solutions, Separable equations, First order linear equations, Exact equations, Orthogonal trajectories and families of curves, Homogeneous equations, Integrating factors, Reduction of order-dependent variable missing-independent variable missing

Text 1: Chapter 1 (Sections 1.2 to 1.9)

Module II: Second order linear equations (26 hrs.)

Second order linear equations with constant coefficients (which includes Euler's equidimensional equations given as exercise 5 in page 63 of Text 1), The method of undetermined coefficients, The method of variation of parameters, The use of a known solution to find another, Vibrations and oscillations (first two subsections), Higher order linear equations

Text 1: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4, 2.5 (2.5.3 and 2.5.4 are excluded) and 2.7 (example 2.17 is excluded).

Module III: Power Series solutions and special functions (26 hrs.)

Series solutions of first order differential equations, Second order linear equations: ordinary points (specially note Legendre's equations given as example 4.7), Regular singular points, More on regular singular points.

Text 1: Chapter 4 (Sections 4.2, 4.3, 4.4 and 4.5).

Method IV: Partial Differential equations (30 hrs.)

Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

Pfaffian differential forms and equations, proof of theorem 5 on condition for integrability is excluded). Solution of Pfaffian differential equations in three variables (By inspection, variables separable, one variable separable and homogeneous equations only). Origin of first order partial differential equations, Linear equations of the first order (proof of theorem 2 and theorem 3 are excluded)

Text 2: Chapter 1 (Section 3, 5 (no proof of theorem-5) & section 6 (a, b, c and d only)

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	3	1,2
1.2	Isomorphic Binary structures	3	1,2
1.3	Groups-definition and examples	2	1,2
1.4	Elementary properties of groups	3	1,2,3
1.5	Finite group and group tables	2	1,3
1.6	Subgroups	3	1,2,3
1.7	Cyclic subgroups	3	1,2,3
1.8	Cyclic groups	3	1,2,3
1.9	Elementary properties of cyclic groups	3	1,2
2	**PERMUTATIONS,COSETS AND DIRECT PRODUCTS**	**23**	
2.1	Functions and permutations	3	1,2
2.2	Groups of permutations	3	1,2
2.3	Cayley's theorem	3	1,2
2.4	Orbits, cycles	4	1,2
2.5	Alternating groups	3	1,2
2.6	Cosets and theorem of Lagrange	4	1,2
2.7	Direct Product	3	1,2
3	**HOMOMORPHISMS AND FACTOR GROUPS**	**18**	
3.1	Homomorphism	2	1,2,3,4
3.2	Properties of homomorphism	3	1,2
3.3	Factor group	2	1,2
3.4	Fundamental homomorphism theorem	2	1,2,3,4
3.5	Normal subgroup	3	1,2,4
3.6	Inner automorphism	3	1,2,4

3.7	Simple groups	3	1,2,4
4	**RINGS AND FIELDS, INTEGRAL DOMAINS**	**18**	
4.1	Ring and Fields-definitions and basic properties	3	5,6
4.2	Homomorphism of rings	2	4,5,6
4.3	Isomorphism of rings	2	4,5,6
4.4	Divisors of zero and cancellation	2	5,6
4.5	Integral domains	2	5,6
4.6	The characteristic of a ring.	2	5,6
4.7	Factor ring and ideals	2	5,6
4.8	Homomorphism and factor rings	3	4,5,6

MM5CRT07 : ABSTRACT ALGEBRA
5 hours/week (Total Hrs: 90) 4 credits
Syllabus

Text book :John B. Fraleigh : A First Course in Abstract Algebra (7th Edition) (Pearson)

Module I (25 hrs)

Groups and subgroups-Binary operations, Isomorphic binary structures, Groups-definition and examples, elementary properties of groups, finite groups and group tables, subgroups, cyclic subgroups, cyclic groups, elementary properties of cyclic groups.
Part I: Sections 2, 3, 4, 5 and 6

Module II: (25 hrs)

Permutations, cosets, and direct products-groups of permutations, Cayley's theorem, orbits, cycles and the alternating groups, cosets and the theorem of Lagrange, direct products.
Part II: Sections 8, 9, 10, 11.1 and 11.2

Module III (20 hrs)

Homomorphisms and Factor groups - Homomorphisms, properties of homomorphisms, factor groups, The Fundamental Homomorphism theorem, normal subgroups and inner automorphisms, simple groups.
Part III: Sections 13, 14, 15.14 to 15.18

Module IV (20 hrs)

Rings and fields-definitions and basic properties, homomorphisms and isomorphisms, Integral domains- divisors of zero and cancellation, integral domains, the characteristic of a ring. Ideals and factor rings. Homomorphisms and factor rings.
Part IV: Sections 18 and 19 and Part V: Section 26.

Course Outcomes

SEMESTER 5 CORE COURSE Environmental Mathematics and Human Rights

Course Outcomes	Outcomes	Cognitive level	PSO No
CO1	To understand the human rights for an Indian citizen, women, children, prisoners etc.	Un	PSO 1,2
CO 2	To understand the applications of mathematics in nature.	Un	PSO 3,4
CO 3	To understand the role of mathematics in the beauty of nature, architecture etc.	Un	PSO 2,3,4
CO 4	To understand the issues that pollute or disturb the environment that cause the natural disasters.	Un	
CO 5	To understand how to reduce environmental disasters that are man made.	Un	

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

Module	Course Description	Hours	CO No.
1	**Environment and its Resources**	**13**	
1.1	Definition - Scope and need	1	1,2
1.2	Renewable and non-renewable resources	2	1,2
1.3	Forest and Water resources	2	1,2
1.4	Mineral resources	1	1,2,3
1.5	Food resources, Energy resources	2	1,3
1.6	Land resources, Role of individual in conservation of natural resources.	3	1,2,3
1.7	Equitable use of resources for sustainable lifestyles.	2	1,2,3
2	**Environmental Pollution and Social Issues**	**12**	
2.1	Air, Water and soil pollution	1	1,2
2.2	Marine, noise and thermal pollution, nuclear hazards	2	1,2
2.3	Soil waste management, role of individuals in prevention of pollution	2	1,2
2.4	Disaster management, Urban problems related to energy	2	1,2
2.5	Water conservation, rehabilitation and resettlement of people	2	1,2
2.6	Environmental ethics, climate change , etc.	1	1,2
2.7	Consumerism and waste products, public awareness	2	1,2
3	**Fibonacci Numbers in Nature**	**13**	
3.1	The rabbit problem, Fibonacci numbers - recursive definition	2	1,2,3,4
3.2	Lucas numbers, Types of Fibonacci and Lucas numbers	1	
3.3	Fibonacci and earth, flowers, sunflower	1	
3.4	Fibonacci and pinecones, arthichokes , pineapple	1	1,2
3.5	Fibonacci and trees, subsets, sewage treatment	2	1,2

3.6	Fibonacci and atoms, reflections	2	1,2,3,4
3.7	Fibonacci and paraffins, cycloparaffins, music	1	1,2,4
3.8	Compositions with 1's and 2's, Euclidean algorithm and Luca's formula.	2	1,2,4
3.9	Linear homogeneous recurrence relations	1	1,2,4
4	**Golden Ratio**	**11**	
4.1	Golden ratio, mean proportional geometric interpretation	1	5,6
4.2	Golden ratio - Ruler and compass construction.	2	5,6
4.3	Euler construction, Newton's method	3	5,6
4.4	Golden ratio and human body, origami, differential equations	2	5,6
4.5	Gattei's discovery of golden ratio	2	5,6
4.6	Centroids of circles	1	4,5,6
5	**Human Rights**	**14**	
5.1	Human rights- Introduction, history, Universality of human rights, basic human rights documents, Value dimensions of human rights	3	5,6
5.2	Human rights co-ordination within UN system- UN secretariat, Economic and social council	2	5,6
5.3	Commission of human rights, security council and human rights, the commission for elimination of racial discrimination, discrimination against women	2	5,6
5.4	Committee on Economic, social and cultural rights, human rights committee, critical appraisal of UN human rights regime	2	5,6
5.5	Human rights in Indian constitution, fundamental rights , constitutional context of human rights, state policy and human rights	3	5,6
5.6	Human rights for women, children, minorities , prisoners, Science and technology, National and state human rights commissions, human rights education	2	4,5,6

SYLLABUS

Text Book :

1. Thomas Koshy : Fibonacci and Lucas numbers with applications, John Wiley & Sons, Inc (2001).

Unit 1 :Multidisciplinary nature of environmental studies

Definition, scope and importance (**2 hrs**)

Need for public awareness.

Unit 2 : Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) **Forest resources** : Use and over-exploitation, deforestation, case studies.
Timber extraction, mining, dams and their effects on forest and tribal people.

b) **Water resources** : Use and over-utilization of surface and ground water,
floods, drought, conflicts over water, dams-benefits and problems.

c) **Mineral resources** : Use and exploitation, environmental effects of extracting
and using mineral resources, case studies.

d) **Food resources** : World food problems, changes caused by agriculture and
overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water
logging, salinity, case studies.

e) **Energy resources**: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.

f) **Land resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

Role of individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles. (**10 hrs**)

Unit 3: Ecosystems

Concept of an ecosystem

Structure and function of an ecosystem

Producers, consumers and decomposers

Energy flow in the ecosystem

Ecological succession

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given ecosystem:-
Forest ecosystem

(**6 hrs**)

ModuleII

Introduction

Biogeograhical classification of India

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

India as a mega-diversity nation

Hot-sports of biodiversity

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

Endangered and endemic species of India

(**8 hrs**)

Unit 2: Environmental Pollution

Definition

Causes, effects and control measures of: -

a. Air pollution

b. Water pollution

c. Soil pollution

d. Marine pollution

e. Noise pollution

f. Thermal pollution

g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and

industrial wastes.
Role of an individual in prevention of pollution
Pollution case studies
Disaster management: floods, earthquake, cyclone and landslides. (**8hrs**)

Unit 3: Social Issues and the Environment

Urban problems related to energy
Water conservation, rain water harvesting, watershed management
Resettlement and rehabilitation of people: its problems and concerns, Case studies
Environmental ethics: Issues and possible solutions
Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and holocaust, Case studies
Consumerism and waste products
Environment Protection Act
Air (Prevention and Control of Pollution) Act
Water (Prevention and control of Pollution) Act
Wildlife Protection Act
Forest Conservation Act
Issues involved in enforcement of environmental legislation
Public awareness (**10 hrs**)

Module III : Fibonacci Numbers in nature

The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Different types of Fibonacci and Lucas numbers. Fibonacci numbers in nature : Fibonacci and the earth, Fibonacci and flowers, Fibonacci and sunflower, Fibonacci, pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets, Fibonacci and sewage treatment, Fibonacci and

Unit 1: Biodiversity and its conservationatoms, Fibonacci and reflections, Fibonacci, paraffins and cycloparaffins, Fibonacci and music,
Fibonacci and compositions with 1's and 2's.

Text 1 : Chapters 2 & 3 (excluding Fibonacci and poetry, Fibonacci and electrical networks)

Module IV : Golden Ratio (10 Hrs)

The golden ratio, mean proportional, a geometric interpretation, ruler and compass construction, Euler construction, generation by Newton's method. The golden ratio revisited, the golden ratio and human body, golden ratio by origami, Differential equations, Gattei's discovery of golden ratio, centroids of circles,
Text 1 : Chapters 20, 21

Module V : Human rights

Unit1-Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2 Human Rights and United Nations – contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3 EnvironmentandHuman Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine

COURSE OUTCOMES

SEMESTER 5 OPEN COURSE MM5GET02: 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

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

COURSE DESCRIPTION

MM5GET02: APPLICABLE MATHEMATICS

Module		Course Description	Hrs	Co. No.
1	**1.0**	**Module I**	**18**	
	1.1	Types of numbers	1	1,2,3,4
	1.2	HCF & LCM of integers	2	1,2,3,4
	1.3	Fractions & Simplifications	3	1,2,3,4
	1.4	Squares & Square roots	3	1,2,3,4
	1.5	Ratio & Proportion	3	1,2,3,4
	1.6	Percentage	3	1,2,3,4
	1.7	Profit & Loss	3	1,2,3,4
2	**2.0**	**Module II**	**18**	
	2.1	Quadratic Equations	1	2,3,5,6
	2.2	Permutations and Combinations	3	2,3,5,6
	2.3	Applications of Permutations	3	2,3,5,6
	2.4	Trigonometry- introduction	3	2,3,5,6
	2.5	Values of trigonometric ratios	3	2,3,5,6
	2.6	Heights& Distances	5	2,3,5,6
3	**3.0**	**Module III**	**18**	
	3.1	Simple interest	2	1,2,3,4
	3.2	Compound interest	3	1,2,3,4
	3.3	Time & Work	3	1,2,3,4
	3.4	Work& wages	3	1,2,3,4
	3.5	Time & distance	3	1,2,3,4
	3.6	Exponential series	2	1,2,3,4
	3.7	Logarithmic series	2	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	Monomial, binomial, polynomial	3	7,2,3,4
	4.5	Simple factorization of quadratic and cubic polynomials	3	7,2,3,4
	4.6	Differential Calculus	3	7,2,3,4

FIFTH SEMESTER (OPEN COURSE)
MM5GET02 : APPLICABLE MATHEMATICS
4 hours/week 4 credits

The objective is to prepare students of all streams, particularly those with arts and commerce back ground for their higher studies and 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.. All questions asked to be of arts students' standard.

Module – I (18 hours)

Types of numbers, HCF & LCM of integers, Fractions, Simplifications (VBODMAS rule), squares and square roots, ratio and proportion, percentage, profit & loss.

Module – II (18 hours)

Quadratic equations (Solution of quadratic equations with real roots only), 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.

Module – III (18 hours)

Simple interest, Compound interest, Time and work, Work and wages, Time and distance, exponential series and logarithmic series.

Module – IV (18 hours)

Elementary mensuration – Area and perimeter of polygons, Elementary Algebra, monomial , binomial, polynomial (linear, quadratic & cubic), simple factorization of quadratic and cubic polynomials.

Differential Calculus - Differentiation – Standard results (derivatives), Product rule, Quotient rule and function of function rule (with out proof) and simple probles),

References –

1 M. Tyra, & K. Kundan- CONCEPTS OF ARITHMETIC, BSC PUBLISHING COMPANY PVT.LTD, C – 37, GANESH NAGAR, PANDAV NAGAR COMPLEX
2 GRE Math review (pdf)
3 Joseph Edward : Differential Calculus for beginners. Nabu Press (2011)

B.Sc MATHEMATICS

SIXTH SEMESTER CORE COURSE

COURSE OUTCOMES

MM5CRT05–REAL ANALYSIS

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To understand the concept of continuous functions and its properties.	Un	PSO 1,4
CO 2	To get an idea of uniform continuity and compare it with continuity.	Un, An	PSO 1
CO 3	To understand the concept of differentiation.	Un	PSO 1
CO 4	To get an idea of mean value theorem and L'hospital rules.	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

- An: Analyse Ap:Apply Un: Understand

COURSE DESCRIPTION

MM5CRT05: REAL ANALYSIS

Module		Course Description	Hrs.	CO. No.
I	**1.0**	**Module I - Continuous Functions**	**30**	
	1.1	Continuous functions	6	1
	1.2	Combinations of continuous functions	6	1
	1.3	Continuous functions on intervals	6	1
	1.4	Uniform continuity	6	2
	1.5	Monotone and inverse functions	6	2
II	**2.0**	**Module II- Diferentiation**	**30**	
	2.1	The derivative	7	3
	2.2	The mean value theorem	8	4
	2.3	L'Hospital rules	8	3,4
	2.4	Taylor's theorem	7	4
III	**3.0**	**Module III- The Riemann Integral**	**24**	
	3.1	The Riemann integral	8	5
	3.2	Riemann integrable functions	8	5,6
	3.3	The fundamental theorem	8	6
IV	**4.0**	**Module IV- Sequences And Series Of Functions**	**24**	
	4.1	Pointwise convergence	6	7
	4.2	Uniform convergence	6	7
	4.3	Interchange of limits	6	8
	4.4	Series of functions	6	8

MM5CRT05 : REAL ANALYSIS
5 Hrs/Week (Total Hours : 90) 4 Credits
SYLLABUS

Text Book : Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, In

MODULE I: CONTINUOUS FUNCTIONS 30 hours

Continuous Functions, Combinations of Continuous Functions, Continuous Functions on Intervals, Uniform continuity, Monotone and Inverse Functions.
Chapter 5: Sections 5.1,5.2,5.3,5.4,5.6

MODULE II: DIFFERENTIATION 30 hours

The Derivative, The Mean Value Theorem, L' Hospital Rules, Taylor's Theorem
Chapter 6: Sections 6.1,6.2,6.3,6.4

MODULE III: THE REIMANN INTEGRAL 24 hours

The Riemann Integral, Riemann Integrable Functions, The Fundamental Theorem
Chapter 7: Sections 7.1,7.2,7.3

MODULE IV: SEQUENCES AND SERIES OF FUNCTIONS 24 hours

Point wise and Uniform Convergence, Interchange of Limits, Series of Functions.
Chapter 8: Sections 8.1,8.2, Chapter 9: Section 9.4

COURSE OUTCOMES

B.Sc MATHEMATICS

SIXTH SEMESTER CORE COURSE: MM6CRT10–GRAPH THEORY AND METRIC SPACES

Course Outcomes No.	Course Outcomes	Cognitive Level	PSO No.
CO 1	To understand fundamental concepts of graphs and get an idea about its matrix representation.	Un, An	PSO 1
CO 2	To understand fundamental concepts of trees and their properties.	An	PSO 1,2
CO 3	To explain Chinese Postman problem and Travelling Salesman problem	Re	PSO 2,3,5
CO 4	To understand the concept of distance in an arbitrary space.	Un, Ap	PSO 4,5
CO 5	To understand the concepts open sets , closed sets, cantor sets.	Un	PSO 7
CO 6	To understand the concept of convergence and completeness	Un	PSO 3,5
CO 7	To understand Baire's Theorem and continuous mapping	Un	PSO 4,5
CO 8	To understand the fundamental properties of continuous functions and its characteristics	Un	PSO 1,4

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

COURSE DESCRIPTION

MM6CRT10 - GRAPH THEORY AND METRIC SPACES

Module		Course Description	Hrs.	Co no.
I	**1.0**	**MODULE I - GRAPH THEORY**	**36**	
	1.1	An introduction to graph	5	9
	1.2	Definition of a graph	5	9
	1.3	More definition	5	9
	1.4	Vertex degrees	5	9
	1.5	Sub graphs	5	9
	1.6	Paths and cycles	5	9
	1.7	The matrix representation of graphs	6	9
II	**2.0**	**MODULE II - GRAPH THEORY**	**30**	
	2.1	Trees	3	10
	2.2	Definition and simple properties	3	10
	2.3	Bridges	3	10
	2.4	Spanning trees	3	10
	2.5	Cut vertices and connectivity	3	10
	2.6	Euler's tours	3	10
	2.7	The Chinese postman problem	4	11
	2.8	Hamiltonian graphs	4	11
	2.9	The travelling salesman problem	4	11
III	**3.0**	**MODULE III- METRIC SPACES**	**18**	
	3.1	Metric spaces	3	1,2,5
	3.2	Definition and examples	3	1,2,5
	3.3	Open sets	4	5,6
	3.4	Closed sets	4	5,6
	3.5	Cantor set	4	5,6
IV	**4.0**	**MODULE IV – METRIC SPACES**	**24**	
	4.1	Convergence	8	3,4,7

	4.2	Completeness	8	7
	4.3	Continuous mapping	8	8

MM6CRT10 : GRAPH THEORY AND METRIC SPACES
6 hours/week (Total Hrs : 108) 4 credits
Text books:

1. John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers
2. G. F. Simmons -- Introduction to Topology and Modern analysis
(Tata McGraw Hill)

Module I : Graph Theory (36 Hrs)

An introduction to graph. Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, the matrix representation of graphs,
Text 1: Chapter 1 (Sections 1.1, 1.3 to 1.7)

Module II: Graph Theory (30 Hrs)

Trees. Definitions and Simple properties, Bridges, Spanning trees. Cut vertices and Connectivity. Euler's Tours, the Chinese postman problem. Hamiltonian graphs & the travelling salesman problem.
Text 1: Chapter 2 (Sections 2.1, 2.2 & 2.3, 2.6); Chapter 3 (Sections 3.1 (algorithm deleted), 3.2 (algorithm deleted), 3.3, and 3.4 (algorithm deleted)).

Module III: Metric Spaces (18 Hrs)

Metric Spaces – Definition and Examples, Open sets, Closed Sets, Cantor set.
Text 2: Chapter 2 (sections 9, 10 and 11).

Module IV: Metric spaces (24 Hrs)

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

COURSE OUTCOMES

Complex Analysis MM6CRT11

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

MM6CRT11: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)

COURSE OUTCOMES

MM6CRT12 :LINEAR ALGEBRA

COURSE OUTCOME NO.	**COURSE OUTCOMES**	**Cognitive Level**	**PSO NO.**
CO 1	To understand fundamental concepts of system of linear equations and difference equation	Un	PSO 1
CO 2	To apply various method to solve system of linear equations.	Un, Ap	PSO 1, 4
CO 3	To apply various method to find rank of the matrices.	Un, Ap	PSO 1,4
CO 4	To understand fundamental concepts of vectorspace.	Un	PSO 1
CO 5	To understand the basic concepts of linear mapping and its matrix representation.	Un,Ap	PSO 1,4
CO 6	To get an idea about eigen values and eigen vectors	Un	PSO 1

- Ap – Apply, Un- Understand

COURSE DESCRIPTION

MM6CRT12: LINEAR ALGEBRA

Module		Course Description	Hrs.(90)	Co No.
I	**1.0**	**The Algebra Of Matrices, Some Application Of Matrices And System Of Linear Equations**		
	1.1	A review of algebra of matrices is followed by some applications of matrices	2	1
	1.2	Systems of linear equations and difference equations	2	2
	1.3	Elementary matrices	2	1
	1.4	The process of Gaussian elimination	2	3
	1.5	Hermite or reduced row-echelon matrices	2	3
	1.6	Linear combinations of rows (columns)	2	1
	1.7	Linear independence of columns	2	1
	1.8	Row equivalent matrices	2	1
	1.9	Rank of a matrix	1	3
	1.10	Column rank	2	3
	1.11	Normal form	2	3
	1.12	Consistent systems of equations.	2	2
II	**2.0**	**Invertible Matrices And Vector Spaces**		
	2.1	Invertible matrices	2	3
	2.2	Left and right inverse of a matrix	2	3
	2.3	Orthogonal matrix	2	1
	2.4	Vector spaces	2	4
	2.5	Subspaces	2	4
	2.6	Linear combination of vectors	2	4
	2.7	Spanning set	2	4
	2.8	Linear independence and basis	3	4
III	**3.0**	**Linear Mappings And Matrix Connection**		
	3.1	Linear transformations	3	5
	3.2	Kernel and range	3	5
	3.3	Rank and Nullity	2	5
	3.4	Linear isomorphism	3	5

	3.5	Ordered basis	3	5
	3.6	Matrix of f relative to a fixed ordered basis	3	5
	3.7	Transition matrix from a basis to another	4	5
	3.8	Nilpotent and index of nilpotency	3	5
I V	**4.0**	**Eigenvalues And Eigenvectors**		
	4.1	Characteristic equation	3	6
	4.2	Algebraic multiplicities	3	6
	4.3	Eigen space	4	6
	4.4	Geometric multiplicities	4	6
	4.5	Eigenvector	4	6
	4.6	Diagonalisation	4	6
	4.7	Tri-diagonal matrix	4	6

MM6CRT12 : LINEAR ALGEBRA
5 hours/week (Total Hrs: 90) 4 credits
SYLLABUS
Text Book :
1. S. Blyth and E. F. Robertson : Basic Linear Algebra, Springer, Second Ed. (2002)
Module 1
A review of algebra of matrices is followed by some applications of matrices, analytic geometry, systems of linear equations and difference equations. Systems of linear equations: elementary matrices, the process of Gaussian elimination, Hermite or reduced row-echelon matrices. Linear combinations of rows (columns), linear independence of columns, row equivalent matrices, rank of a matrix, column rank, normal form, consistent systems of equations.
Text 1: Chapter 1 ; Chapter 2 (Sections 1, 2 and 4) and Chapter 3.
Module 2
Invertible matrices, left and right inverse of a matrix, orthogonal matrix, vector spaces, subspaces, linear combination of vectors, spanning set, linear independence and basis.
Text 1: Chapter 4 and Chapter 5.
Module 3
Linear mappings: Linear transformations, Kernel and range, Rank and Nullity, Linear isomorphism. Matrix connection: Ordered basis, Matrix of f relative to a fixed ordered basis, Transition matrix from a basis to another, Nilpotent and index of nilpotency.
Text 1: Chapter 6 and Chapter 7.
Module 4
Eigenvalues and eigenvectors: Characteristic equation, Algebraic multiplicities, Eigen space, Geometric multiplicities, Eigenvector, diagonalisation, Tri-diagonal matrix.
Text 1: Chapter 9**.**

COURSE OUTCOME

MM6CBT01 OPERATION 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	Learn Theory of games and different methods like Arithmetic method , Matrix method ,graphical method and linear and apply various methods to solve problems.	Un	PSO 1, 3

Ap – Apply, Un- Understand

Module	Course Description	Hours	CO No
1	**Linear Programming**	**20**	
1.1	General Mathematical Model Of Linear Programming Problem	1	1
1.2	Guidelines on Linear Programming Model Formulation	1	2
1.3	Examples of LP Model Formulation	1	2
1.4	Introduction to Graphical method	1	3
1.5	Graphical Solution and Methods of LP problem	2	3,5
1.6	Special Cases of Linear Programming	1	4
1.7	Introduction to Simplex method,std form of LPP	2	1,3,5
1.8	Simplex algorithm-Maximization and Minimization case	6	5
1.9	Big M method	3	5
1.10	Types of Linear Programming Solutions,some complication and their resolutions	2	5
2	**Duality in Linear Programming**	**12**	
2.1	Introduction	1	6
2.2	Formulation of Dual LPP	5	6
2.3	Standard results in Duality	2	6
2.4	Advantages of Duality	2	6
2.5	Theorems of duality with Proof	2	6
3	**Transportation and Assignment Problem**		
3.1	Introduction	1	7
3.2	Mathematical model of Transportation Problem	2	7
3.3	The Transportation Algorithm	2	7
3.4	Methods for finding Initial solution	3	7
3.5	Test for Optimality	2	7
3.6	Variations in Transportation Problem	3	7
3.7	Maximization Transportation Problem	4	7

3.8	Introduction, mathematical models and solution methods of Assignment Problem	4	7
3.9	Variations of Assignment Problem	1	7
4	**Theory of Games**		
4.1	Introduction	1	8
4.2	Two-person zero sum games	1	8
4.3	Pure Strategic(Minimax and Maximin principles)	2	8
4.4	Games with saddle point	2	
4.5	Games without saddle point	2	8
4.6	The rules of dominance	1	8
4.7	Solution methods :Games without saddlepoint: Arithmetic method	2	8
4.8	Matrix Method	3	8
4.9	Graphical Method	2	8
4.10	Linear programming Method	2	8

Text Books

1. J.K SHARMA-OPERATIONS RESEARCH- THEORY AND APPLICATIONS, MACMILLAN PUBLISHERS, INDIA Ltd

Module I: Linear Programming:- Model formulation and solution by the Graphical Method and the Simplex method (20Hrs.)

Chapter 2: Sections 2.6 to 2.8
Chapter 3: Sections 3.1 to 3.4
Chapter 4: Sections 4.1 to 4.6

Module II: Duality in Linear Programming (12 Hrs.)

Chapter 5: Sections: 5.1 to 5.3, 5.5 with appendix.

Module III: Transportation and Assignment Problems (22 Hrs.)

Chapter9: Sections 9.1 to 9.7
Chapter 10 : Sections 10.1 to 10.4

Module IV: Theory of Games (18 Hrs.)

Chapter 12: Section 12.1 to 12.6

Text Books for Reference

1. KanthiSwarup, P.K Gupta and Man Mohan-Operations Research (Sultan Chand and sons)
2. Frederick S Hillar and Gerald JnLiberman- Introduction to operations research (seventh edition),McGraw Hill Edition
3. Hamdy A Taha-Operations Research-An Introduction(7th edtn), Prentice Hall of India Pvt Ltd

COMPLEMENTARY COURSE FOR PHYSICS, CHEMISTRY

COURSE OUTCOMES

SEMESTER 1 MM1CMT01- PARTIAL DIFFERENTAIATION, MATRICES, TRIGNOMETRY AND NUMERICAL METHODS

COURSE OUTCOME NO.	COURSE OUTCOMES	Cognitive Level	PSO NO.
CO 1	To understand the fundamentals of partial differentiation and to distinguish various types partial differential equations.	Un	PSO 1
CO 2	To identify various solution techniques to solve some class of partial differential equations	Re	PSO 3,4
CO 3	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 4	To get an idea about characteristic roots and characteristic vectors of a matrix and	Un	PSO 1
CO 5	To understand Cayley Hamilton Theorem and application of theorem in different problems.	Un,Ap	PSO 1,3,7
CO 6	To understand and simplify various types of trigonometric expressions and express them in C+iS form to sum trigonometric series.	Un	PSO 1,3
CO 7	To apply numerical methods to solve algebraic as well as transcendental expressions.	Ap	PSO 3,4

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

COURSE DESCRIPRTION

MM1CMT01: PARTIAL DIFFERENTIATION, MATRICES, TRIGNOMETRY AND NUMERICAL METHOD

Module		Course Descriprtion	Hrs.	Co No.
I	**1.0**	**Module I :Partial Differentiation**	**14**	
	1.1	Functions of Several Variables	1	1,2
	1.2	Partial derivatives	1	1,2
	1.3	Partial derivatives of higher derivatives	2	1,2
	1.4	Functions of more than two variables	2	1,2
	1.5	The Chain rule for functions of one variable	2	1,2
	1.6	The chain rule for functions of three variables	2	1,2
	1.7	The chain rule for functions of many variables	2	1,2
	1.8	Implicit differentiation	2	1,2
II	**2.0**	**Module II: Matrices**	**21**	
	2.1	Rank of a matrix	2	3
	2.2	Elementary transformations of a matrix	3	3
	2.3	Reduction to normal form	3	3
	2.4	R0w reduced method for finding rank of a matrix	2	3
	2.5	Solution of homogenous system of linear equations	3	3
	2.6	Solution of non-homogenous system of linear equations	2	3
	2.7	Characteristic roots and characteristic vectors of a matrix	2	4
	2.8	Cayley Hamilton theorem	2	5
	2.9	Expressing of the inverse of a non-singular matrix a as a polynomial in a with scalar coefficients	1	5
III	**3.0**	**Module III: Trigonometry**	**23**	
	3.1	" Basic Concepts about Trigonometry - Review"	1	6
	3.2	Circular Functions and Exponential Functions – Relationship Expansion of Powers of Sin x	2	6
	3.3	Expansion of Powers of Cos x Expansion of Sin nx	3	6
	3.4	Expansion of cosnx Expansion of Tan nx	2	6

	3.5	Circular and Hyperbolic Functions	1	6
	3.6	Inverse Hyperbolic Functions	1	6
	3.7	Problems of Circular and Hyperbolic Functions	2	6
	3.8	Separation of Real and Imaginary Parts	1	6
	3.9	Separation of Real and Imaginary Parts- Problems	3	6
	3.10	Summation of Series , C+iS Method	2	6
	3.11	Problems in separating real and imaginary parts of series of the Form C+iS	4	6
IV	**4.0**	**Module IV: Numerical Methods**	**14**	
	4.1	The concept of solution of an algebraic equation	1	7
	4.2	Introduction to Numerical Method, Bisection Method	2	7
	4.3	Regula – Falsi Method	1	7
	4.4	Regula – Falsi Method -Problems	2	7
	4.5	Iteration Method	1	7
	4.6	Iteration Method -Problems	2	7
	4.7	Newton- Raphson Method	1	7
	4.8	Newton- Raphson Method- -Problems	3	7

Syllabus

TextBooks:-

1. GeorgeB.Thomas,Jr: Thomas'Calculus12thEdition,Pearson.
2. ShanthiNarayanan&P.K. Mittal,AText BookofMatrices,S.Chand.
3. S. L.Loney–PlaneTrigonometryPart–II,AITBSPublishersIndia,2009.
4. S. S.Sastry:IntroductorymethodsofNumericalAnalysis, 4th edition(PrenticeHall)

ModuleI: PartialDifferentiation (14hrs)

Functionsofseveralvariables(Definitions and simple graphs only),Partialderivatives,TheChainRule.
Text1Chapter14(Sections14.1(Definitions and simple graphs only), 14.3and14.4)

ModuleII:Matrices (21hrs)

Rankof aMatrix, Elementary transformations of a matrix, Reduction toNormalform, Employment of only row (column) transformations, System of Linear Homogeneous Equations,Systems of linear nonhomogenousequations, Characteristic roots and characteristic vectors of a square matrix,Characteristic matrix andCharacteristicequation of a matrix, CayleyHamiltontheorem, Expression of the inverse of a nonsingular matrix A as a polynomial in A with scalar coefficients
Text2 Chapter4 (Sections4.1 to 4.8 and 4.11)
Chapter6 (Sections 6.1, 6.2 and 6.6)
Chapter11 (Sections 11.1 and 11.11)
(ProofsofallTheoremsin ModuleIIare excluded.)

ModuleIII:Trigonometry (23hrs)

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,inversecircularandhyperbolicfunction,Separationintorealandimaginaryparts,Summationof infiniteseriesbasedonC+iSmethod.
Text3(RelevantSectionsofChapters3to5and8)

ModuleIV:NumericalMethods (14Hrs)

BisectionMethod,MethodofFalseposition,IterationMethod,Newton-RaphsonMethod.
Text4,Chapter2(Sections2.1, 2.2,2.3,2.4and2.5)

MM2CMT02– INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

CO NO.	COURSE OUTSOMES	COGNITIVE LEVEL	PSO NO.
CO 1	To identify ordinary differential equations and solve them.	Un	PSO 1,4
CO 2	To study the theory of partial differential equations.	Un	PSO 1
CO 3	To study the method of obtaining partial differential 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

COURSE DESCRIPTION

MM2CMT02:INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

Module		Course Description	Hrs.	CO. No.
I	**1.0**	**Module I – Integral Calculus**	**15**	
	1.1	Volumes using cross sections	3	4
	1.2	Volumes using Cylindrical shells	4	5
	1.3	Arc lengths	4	6
	1.4	Areas of surface of revolution	4	6
II	**2.0**	**Module II–Multiple Integrals**	**17**	
	2.1	Double integrals over rectangles	5	7
	2.2	Double integrals over general regions	4	7
	2.3	Area by double integration	4	7
	2.4	Triple integrals over rectangular regions	4	8
III	**3.0**	**Module III–Ordinary Differential Equations**	**20**	
	3.1	Separable variables	2	1
	3.2	Exact differential equation	3	2
	3.3	Equations reducible to exact forms	3	1,2
	3.4	Linear equations	3	1
	3.5	Solutions by substitutions	3	2
	3.6	Homogeneous equations	3	2
	3.7	Bernoull’s equations	3	1,2
IV	**4.0**	**Module IV – Partial Differential Equations**	**20**	
	4.1	Surfaces and curves in three dimensions	4	2
	4.2	Solutions of first order partial differential equations	4	2
	4.3	Solutions of second order partial differential equations	4	3
	4.4	Linear equations of first order	4	2,3
	4.5	Lagrange’s method	4	3

MM2CMT02 : INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS
4 hours/week (Total Hrs : 72) 3 Credits

Syllabus

Text Books:-

1. George B. Thomas, Jr.: Thomas' Calculus 12th Edition,(Pearson).

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

3. Ian Sneddon : Elements of Partial Differential Equations (Tata Mc Graw Hill)

Module I: Integral Calculus (15 hrs)

Volumes using Cross-Sections, Volumes using Cylindrical shells, Arc lengths, Areas of surfaces of
Revolution.

Text 1: Chapter 6 (Sections 6.1 to 6.4)

Module II: Multiple Integrals (17 hrs)

Double and iterated integrals over rectangles, Double integrals over general regions, Area by double integration, Triple integrals in rectangular co-ordinates.

Text 1: Chapter 15 (Sections 15.1, 15.2,15.3, 15.5)

Module III: Ordinary Differential Equations (20 Hrs)

Separable Variables, Exact Differential Equation, Equations reducible to exact form, Linear Equations, Solutions by Substitutions, Homogeneous equations and Bernoulli's Equations.

Text 2 : Chapter 2

Module IV: Partial Differential Equations (20 Hrs)

Surfaces and Curves in three dimensions, Solution of equations of the form
Origin of first order and second order partial differential equations, Linear equations of the first order,
Lagrange's method.

Text 3: Chapter 1 (Sections 1 and 3), Chapter 2 (Sections 1, 2 and 4)

COURSE OUTCOMES

SEMESTER 3 MM32CMT03 VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA

Course outcome number	Course outcomes	Cognitive level	PSO No:
CO1	To understand the basics of vector differentiation and integration .	U	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.	U, 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.	U, Ap	PSO 1,3,4
CO 4	To identify different conics and its properties	Re	PSO 1,4
CO 5	To solve and graph problems related to conic	Ap	PSO 4
CO 6	To understand the basic concepts in Group theory.	U	PSO 1
CO 7	To solve problems related to Group theory	Ap	PSO 3,4

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

Module	Course Description	Hours	CO No
1	**Vector Differentiation**	**15**	
1.1	Vector calculus introduction	1	CO 1
1.2	Curves in space	2	CO 1
1.3	Tangents in space	2	CO 2
1.4	Arc length in space	2	CO 2
1.5	Curvature	1	CO 2
1.6	Normal vectors	2	CO 2
1.7	Directional derivatives	3	CO 2
1.8	Gradient vector	2	CO 2
2	**Vector Integration**	**22**	
2.1	Line integral	3	CO 3
2.2	Line integrals, work and circulation	2	CO 3
2.3	Flux and path independence	3	CO 3
2.4	Conservation fields and Potential function	4	CO 3
2.5	Green's theorem	4	CO 3
2.6	Stoke's theorem	3	CO 3
2.7	Divergence Theorem	3	CO 3
3	**ANALYTIC GEOMETRY**	**18**	
3.1	Polar coordinates	5	CO 4, CO 5
3.2	Conic sections	8	CO 4, CO 5
3.3	Conic section in polar coordinates	5	CO 5
4	**ABSTRACT ALGEBRA**	**20**	
4.1	Groups – Definition and examples,properties	4	CO 6

4.2	Finite groups and group tables	2	CO 6, CO 7
4.3	Subgroups	3	CO 6
4.4	Cyclic groups	2	CO 6, CO 7
4.5	Cyclic subgroups and their elementary properties	3	CO 6, CO 7
4.6	Groups of permutation	3	CO 6, CO 7
4.7	Homomorphisms –definition and examples,properties	3	CO 6, CO 7

Text Books

1. George B Thomas , Thomas‟ Calculus Twelfth edition, Pearson
2. John B Fraleigh- A First course in Abstract Algebra (7 th edition)

Module I: Vector valued Functions (15 hrs)
Text 1: Chapter 13 (Sections 13.1, 13.3 and 13.4), Chapter 14 (Section 14.5 only)

Module II: Integration in Vector Fields (25hrs)
Text 1: Chapter 16 (Sections 16.1 to 16.8)

Module III: Analytic Geometry (25 hrs)
Text 1: Chapter 11 (Sections 11.3, 11.6 and 11.7)

Module IV: Abstract algebra (25 hrs)
Text 2: Chapter 1 Sections 4, 5 and 6 (Proofs of Theorems/ Corollary 5.17, 6.3, 6.7, 6.10, 6.14, 6.16 are excluded) Chapter 2: Section 8 (Proofs of theorems 8.15 and 8.16 are excluded)
Chapter 3, Sections 13.1, 13.2 and 13.3, 13.11, 13.12 only

COURSE OUTCOMES

MM4CMT04 : FOURIER SERIES, LAPLACE TRANSFORMS AND COMPLEX ANALYSIS

COURSE OUTCOME NO.	COURSE OUTCOMES	Cognitive Level	PSO NO.
CO 1	To understand fundamental concepts of periodic functions,trigonometricseries,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 Laplace transforms.	Un	PSO 1
CO 4	To apply various method to find Laplace transforms of different functions.	Un, Ap	PSO 1,4
CO 5	To understand the fundamental concepts of complex numbers and functions.	Un	PSO 1
CO 6	To apply CR equations to find differentiable functions.	Un,Ap	PSO 1,4
CO 7	To understand various method to find complex integration.	Un	PSO 1

- Ap – Apply, Un- Understand

COURSE DESCRIPTION

MM4CMT04: FOURIER SERIES,LAPLACE TRANSFORM AND COMPLEX ANALYSIS

Module		Course Description	Hrs.	Co No.
I	**1.0**	**MODULE I : Fourier Series And Legendre Polynomials**	**25**	
	1.1	Periodic functions	2	1
	1.2	Trigonometric series	2	1
	1.3	Fourier series	3	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	3	2
	1.9	Legendre equations	3	2
	1.10	Legendre polynomials $P_n(x)$	3	2
II	**2.0**	**Module II : Laplace Transforms**	**20**	
	2.1	Laplace transform	2	3,4
	2.2	Inverse Laplace transform	2	3,4
	2.3	Linearity	2	3,4
	2.4	Shifting	2	3,4
	2.5	Transforms of derivatives and integrals	2	3,4
	2.6	Differential equations	2	3,4
	2.7	Differentiation and integration of transforms	2	3,4
	2.8	Laplace transform general formula	3	3,4
	2.9	Table of Laplace transforms	3	3,4
III	**3.0**	**Module III: Complex Numbers And Functions**	**25**	
	3.1	Introduction to complex numbers- basic properties	2	5
	3.2	COMPLEX plane	2	5
	3.3	Polar form of complex numbers	3	5
	3.4	Powers and roots	2	5

	3.5	Derivatives	2	6
	3.6	Analytic functions	3	6
	3.7	Cauchy- Riemann equations	3	6
	3.8	Laplace's equation	2	6
	3.9	Exponential function	2	6
	3.10	Trigonometric functions	2	6
	3.11	Hyperbolic function	2	6
IV	**4.0**	**Module IV: Complex Integration**	**18**	
	4.1	Line integral in the complex plane	6	7
	4.2	Cauchy's integral formula	6	7
	4.3	Derivatives of analytic function	6	7

FOURTH SEMESTER
MM4CMT04 : FOURIER SERIES, LAPLACE TRANSFORM AND COMPLEX ANALYSIS

5 hours/ week (Total 90 hours) 4 credits

Syllabus

Text: Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

Module_: Fourier Series and Legendre Polynomials (25 hours)

Periodic Functions, Trigonometric Series, Fourier Series, Functions of any period p = 2L, Even and Odd functions, Half range Expansions.

A brief introduction to power series and power series method for solving Differential equations, Legendre equation and Legendre polynomials _(_).

(Proofs of all theorems in this module are excluded.)

(Sections 10.1 to 10.4, 4.1 and 4.3)

Module__: Laplace Transforms (20 hours)

Laplace Transform, Inverse Laplace transform, Linearity, Shifting, transforms of Derivatives and Integrals, Differential Equations, Differentiation and Integration of Transforms, Laplace transform general Formula(relevant formulae only), Table of Laplace Transforms(relevant part only)

(Proofs of all theorems in this module are excluded.)

(Sections 5.1, 5.2, 5.4. 5.8 and 5.9)

Module___: Complex Numbers and Functions (25 hours)

Complex Numbers, Complex Plane, Polar form of Complex Numbers, Powers and Roots, Derivative, Analytic

Functions, Cauchy-Riemann Equations, Laplace's Equation, Exponential Function, Trigonometric Functions,

Hyperbolic Functions, Logarithm, General Power.

(Proofs of all theorems in this module are excluded.)

(Sections 12.1 to 12.4 and 12.6 to 12.8)

Module__: Complex Integration (20 hours)

Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of

Analytic functions.

(Proofs of all theorems in this module are excluded.)

(Sections 13.1 to 13.4)

Reference:

1. Michael D.Greenberg Advanced Engineering Mathematics, Pearson Education, 2002.

2. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers

3. Brown and Churchill, Complex Variables and Applications, McGraw-Hill Higher Education, Edition 8, 2008.