

# **CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**IRINJALAKUDA, THRISSUR-PIN 680 125**



**DEGREE OF**

**Bachelor of Science in Mathematics**

**(CHOICE BASED CREDIT AND SEMESTER SYSTEM)**

**UNDER THE**

**FACULTY OF SCIENCE  
SYLLABUS**

**FOR THE STUDENTS ADMITTED FROM THE ACADEMIC**

**YEAR 2018 ONWARDS**

**BOARD OF STUDIES IN MATHEMATICS (UG)**

**IRINJALAKUDA, THRISSUR**

**PIN 680 125 KERALA**

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*B.Sc. DEGREE PROGRAMME*

*MATHEMATICS (CORE COURSE)*

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**DETAILS OF CORE COURSES**

Sl.No	Code	Name of the Course	Semester	No. of Teaching Hours/Week	Credits
1	MAT1B01	Foundations of Mathematics	I	4	4
2	MAT2B02	Calculus	II	4	4
3	MAT3B03	Calculus and Analytic Geometry	III	5	4
4	MAT4B04	Theory of Equations, Matrices and Vector Calculus	IV	5	4
5	MAT5B05	Vector Calculus	V	5	4
6	MAT5B06	Abstract Algebra	V	5	5
7	MAT5B07	Basic Mathematical analysis	V	6	5
8	MAT5B08	Differential equations	V	5	4
9		Open Course	V	2	2
10		Project/viva	V	2	
11	MAT6B09	Real analysis	VI	5	5
12	MAT6B10	Complex analysis	VI	5	5
13	MAT6B11	Numerical methods	VI	5	4
14	MAT6B12	Number Theory and Linear algebra	VI	5	4
15	MAT6B13	Elective Course	VI	3	2
16	MAT6P14(PR)	Project/viva	VI	2	2

### DETAILS OF OPEN COURSES

SI No	Code	Name Of The Course	Semester	No. of Contact Hours / Week	Credits	Max Marks			Duration of University Examinations
						Internal	External	Total	
1	MAT5D01	Mathematics For Physical Sciences	V	2	2	10	40	50	2 hrs
2	MAT5D01	Mathematics For Natural Sciences							
3	MAT5D01	Mathematics For Social Sciences							

### DETAILS OF ELECTIVE COURSES

SI No	Code	Name Of The Course	Semester	No. of Contact Hours / Week	Credits	Max Marks			Duration of University Examinations
						Internal	External	Total	
1	MAT6B13(E01)	Graph Theory	VI	3	2	20	80	100	3 hrs
2	MAT6B13(E02)	Linear Programming							
3	MAT6B13(E03)	C Programming For Mathematical Computing							
4	MAT6B13(E04)	Informatics and Mathematical Softwares							

\* Students who have chosen Mathematical Economics a Complementary Course first four semesters shall not choose Linear Programming M6B13(E02) as the elective course.

\* Students who have chosen Computer Science /Computer Applications as a Complementary Course during the first 4semsters shall not choose C Programming for Mathematical Computing (M6B13(E03) as the elective course.

## DETAILS OF COMPLEMENTARY COURSES

SI No.	Code	Name Of The Course	Semester	No. of Contact Hours / Week	Credits	Max Marks			Duration of University Examinations
						Internal	External	Total	
1	MAT1C01	Mathematics	I	4	3	20	80	100	3 hrs
2	MAT1C01	Mathematics	II	4	3	20	80	100	3 hrs
3	MAT1C01	Mathematics	III	5	3	20	80	100	3 hrs
4	MAT1C01	Mathematics	IV	5	3	20	80	100	3 hrs

### Credit and Mark Distribution of B.Sc Mathematics Programme

SI NO	Course	Credits	Marks
1	English	22	600
2	Additional Language	16	400
3	Core Course	12 Courses & 1 Elective	54
		Project	2
		56	1700
			50
			1750
4	Complementary course - I	12	400
5	Complementary course - II	12	400
6	Open Course	2	50
<b>Total</b>		<b>120</b>	<b>3600</b>

## SCHEME OF EVALUATION

The evaluation scheme for each course shall contain two parts: internal evaluation and external evaluation.

### Internal Evaluation:

20% of the total marks in each course are for internal evaluation.

### Components of Internal Evaluation\*

SI NO	Components	Marks (For Courses with Max. Marks 50)	Marks (For Courses with Max.Marks 100)	Marks (For Courses with Max. Marks 150)
1	Attendance	2.5	5	7.5
2	Assignment / Seminar/ Viva	2.5	5	7.5
3	Test paper: I	2.5	5	7.5
4	Test paper: II	2.5	5	7.5
<b>Total</b>		<b>10</b>	<b>20</b>	<b>30</b>

\* On Calculation of the Internal Marks, rounding off to the next digit has to be done only on the aggregate sum.

### a) Percentage of Attendance in a Semester and Eligible Internal Marks

% of Attendance	Marks (For Courses with Max. Marks 50)	Marks (For Courses with Max.Marks 100)	Marks (For Courses with Max. Marks 150)
90% to 100%	2.5	5	7.5
85% to 89%	2	4	6
80% to 84%	1.5	3	4.5

76% to 79%	1	2	3
75%	0.5	1	1.5

### b) Percentage of Marks in a Test Paper and Eligible Internal Marks

% of Marks in Test Paper	Marks (For Courses with Max. Marks 50)	Marks (For Courses with Max.Marks 100)	Marks (For Courses with Max. Marks 150)
90% to 100%	2.5	5	7.5
80% to 89%	2	4	6
65% to 79%	1.5	3	4.5
50% to 64%	1	2	3
35% to 49%	0.5	1	1.5

### EVALUATION OF PROJECT

The Internal to External components is to be taken in the ratio 1:4. Assessment of different components may be taken as below.

#### Internal assessment

(Supervising Teacher will assess the Project and award internal Marks)

Components	Internal Marks
Punctuality	2
Use of data	2
Scheme / Organization of Report	3
Viva Voce	3
<b>Total</b>	<b>10</b>

## External Evaluation

(To be done by the External Examiner)

Components	Internal Marks
Relevance of Topic, Statement of Objectives, Methodology (Reference / Bibliography)	8
Presentation, Quality of analysis/Use of statistical tools, Findings and recommendations	12
Viva Voce	20
<b>Total</b>	<b>40</b>

## PATTERN OF QUESTION PAPER FOR EXTERNAL EXAMINATIONS

	For Courses with Max. Marks 80		For Courses with Max. Marks 120		For Courses with Max. Marks 40 (Open Course)	
Part A	To Answer 12 out of 12	$12 \times 1 = 12$	To Answer 12 out of 12	$12 \times 1 = 12$	To Answer 6 out of 6	$6 \times 1 = 6$
Part B	To Answer 9 out of 12	$9 \times 2 = 18$	To Answer 10 out of 14	$10 \times 4 = 40$	To Answer 5 out of 7	$5 \times 2 = 10$
Part C	To Answer 6 out of 9	$6 \times 5 = 30$	To Answer 6 out of 9	$6 \times 7 = 42$	To Answer 3 out of 5	$4 \times 3 = 12$
Part D	To Answer 2 out of 3	$2 \times 10 = 20$	To Answer 2 out of 3	$2 \times 13 = 26$	To Answer 2 out of 3	$2 \times 6 = 12$
<b>Total</b>		<b>80</b>		<b>120</b>		<b>40</b>

**FIRST SEMESTER**  
**MAT1B01: FOUNDATIONS OF MATHEMATICS**

4 hours/week

4 credits

**Syllabus**

**Text Books:**

1. **S. Lipschutz** : Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi, 2009.
2. **Thomas /Finney** : Calculus and Analytic Geometry, 9th ed., LPE, Pearson Education, 2002
3. **K.H. Rosen**: Discrete Mathematics and its Applications (sixth edition), Tata McGraw Hill Publishing Company, New Delhi, 2007
4. **Arumugham and Ramachandran** : — Invitation to Graph Theory, Scitech Publications Chennai- 600 017, 2006.

**Module I** : Relations and Functions (17 hrs)

Relations: Types of relations, Partitions, Equivalence relations with example of Congruence modulo relation, Partial ordering relations, n-ary relations

(Sections from chapter 3 of Text 1)

Functions: (*Pre-requisites: Basic ideas such as domain, co-domain and range of functions.*

*Injection, Surjection and Bijection (Quick review)*)

Product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions

(Sections from chapter 4 of text book 1)

**Module II** : Limits and Continuity (20 hrs)

Function quick review, shifting graphs, Limit and continuity, The Sandwich theorem, Target values and formal definition of Limits, Extensions of limit concept, Continuity.

(Sections 3, 4, 1.1, 1.2, 1.3, 1.4 & 1.5 of Text 2)

**Module III**: Basic Logic (20 hrs)

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications,

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biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

(As in Chapter 1 of Text book 3).

### Module IV: Elements of Graph Theory (15 hrs)

Graphs and subgraphs: Definition and examples, Degrees, Subgraphs, Isomorphism, Matrices, Operations on graphs, Degree sequences, Graphic sequences, Definitions and examples of Walks, Trails Paths and Connectedness, Definition and Properties of Directed graphs

(sections 2.1 to 2.4 upto and including Definition of Automorphism, 2.8, 2.9, 3.1, 3.2, 4.1, 4.2

(upto Theorem 4.4) & 10.1 (upto and including Theorem 10.1) of text 4)

## References

1. P. R. Halmos: Naïve set Theory, Springer, 1974
2. Anton : Calculus, Wiley, 10<sup>th</sup> edition, 2012.
3. John Clark and D. A. Holton: A First look at Graph Theory, Allied Publishers Ltd, 1991.



**SECOND SEMESTER  
MAT2B02: CALCULUS**

4 hours/week

4 credits

Syllabus

### Text Books:

1. **Thomas /Finney** : Calculus and Analytic Geometry, 9th ed., LPE, Pearson Education, 2002

### Module I : (24 hrs)

Extreme value of functions, The mean value theorem, The first derivative test for local extreme values, Graphing with  $y'$  and  $y''$ , Limit as  $x \rightarrow \pm\infty$ , Asymptotes and dominant terms, Optimization, Linearization and differentials.

(Sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 & 3.7)

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### Module II : (16 hrs)

Riemann sums and definite integrals, Properties, Area and the mean value theorem, The fundamental theorem, Substitution in Definite Integrals.

(Sections 3.6, 3.7, 4.5, 4.6, 4.7 & 4.8)

### Module III : (20 hrs)

Areas between curves, Finding volumes by slicing, Volumes of solids of revolution (Disk method only), Lengths of plane curves, Areas of surface of revolution

(Sections 5.1, 5.2, 5.3, 5.5 & 5.6)

### Module IV : (12 hrs)

Moments and centres of mass, Work

(Sections 5.7 & 5.8)

## References:

1. Anton : Calculus, Wiley, 10<sup>th</sup> edn, 2012.
2. S.K. Stein : Calculus with Analytic Geometry, McGraw Hill, 1992.
3. S.S. Sastry, Engineering Mathematics, Volume I & II, 4th Edition PHI, 2008.
4. Murray R. Spiegel, Advanced Calculus, 3<sup>rd</sup> edition, Schaum's Outline Series, 2011

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## THIRD SEMESTER MAT3B03: CALCULUS AND ANALYTIC GEOMETRY

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5 hours/week

4 credits

### Syllabus

#### Text Books:

**Thomas /Finney** : Calculus and Analytic Geometry, 9th ed., LPE, Pearson Education, 2002

#### Module I : Transcendental functions (15 hrs)

Natural logarithms, The Exponential function,  $a^x$  and  $\log_a x$ , L'Hopital's Rule, Hyperbolic functions.

(Section 6.2, 6.3, 6.4, 6.6, 6.10)

**Module II** : Infinite Series (25 hrs)

Limits of sequence of numbers, Theorems for calculating limits of sequences, Infinite series, Integral test for series of non-negative terms, Comparison test for series of non negative terms, Ratio and root test for series of non negative terms, Alternating series, Absolute and conditional convergence.

(Section 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7)

**Module III** : Power Series (15hrs)

Power series, Taylor and Maclaurin's series, Convergence of Taylor series, Error estimate.

(Sections 8.8, 8.9, 8.10)

**Module IV** : Analytic Geometry (35 hrs)

Conic section and quadratic equations, Classifying conic section by eccentricity, Quadratic equations and rotations, Parametrisation of plane curves, Calculus with parametrised curves,

Polar coordinates, Graphing in polar co-ordinates, Polar equations for conic sections, Integration in polar coordinates.

(Section 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9)

**References:**

1. Anton : Calculus, Wiley, 10<sup>th</sup> edn, 2012
2. S.K. Stein : Calculus with Analytic Geometry, McGraw Hill, 1992.
3. S.S. Sastry, Engineering Mathematics, Volume I & II, 4th Edition PHI, 2008.
4. Murray R. Spiegel, Advanced Calculus, 3<sup>rd</sup> edition, Schaum's Outline Series, 2011

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**FOURTH SEMESTER**  
**MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS**

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**5 hours/week**

**4 credits**

**Syllabus**

**Text Books:**

1. **Bernard and Child**: Higher Algebra, Macmillan, 2003
2. **Shanti Narayanan & Mittal**: A Text book Matrices, Revised edn., S. Chand, 1953.

3. **Thomas /Finney** : Calculus and Analytic Geometry, 9th ed., LPE, Pearson Education, 2002

**Module I:** Theory of Equations (30 hrs)

Polynomial Equations and Fundamental Theorem of Algebra (without proof). Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and coefficients of a polynomial equation and computation of symmetric functions of roots. Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula. Cardano's method for solving cubic equations. Ferrari's method (for quadratic equations). Remarks about the insolubility of equations of degree five or more. Finding the nature of roots without solving Descartes' rule of signs.

(Sections from Text 1)

**Module II:** Matrices (16 hrs)

Rank of a matrix – Elementary transformation, reduction to normal form, row reduced echelon form. Computing the inverse of a non singular matrix using elementary row transformation.

(Section 4.1 to 4.13 of Text 2)

**Module III:** Matrices (20 hrs)

System of linear homogeneous equations. Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix. Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix. Cayley-Hamilton theorem.

(Sections 6.1 to 6.6 and 11.1 to 11.3 and 11.11 of Text 2)

**Module IV:** Vector Calculus (24 hrs)

(A quick review of sections 10.1 to 10.4)

Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector, Curvature, torsion and TNB frame.

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(Section 10.5, 10.6, 10.7, 11.1, 11.3, 11.4 of Text 3)

### References:

1. Kenneth Hoffman & Ray Kunze: Linear Algebra, Pearson Education, 1971
2. Manicavachagom Pillai, Natarajan & Ganapathy: Algebra, 2004
3. Dickson: First Course in Theory of Equation, 2011
4. Frank Ayres, Jr. : Matrices, Schaum's Outline series, Asian student edition, 1962.
5. Devi Prasad: Elementary Linear Algebra, Narosa Publishing House, 2012
6. Kreyszig: Advanced Engineering Mathematics, 8<sup>th</sup> ed., Wiley, 1999
7. H.F. Davis & A.D. Snider: Introduction to Vector Analysis, 6<sup>th</sup> ed., Universal Bookstall New Delhi, 1991.

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### FIFTH SEMESTER MAT5B05: VECTOR CALCULUS

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5 hours/week

4 credits

**Text Book:** Thomas / Finney : Calculus and Analytic Geometry, 9th ed., LPE, Pearson Education, 2002

**Module I :** (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables

(Section 12.1, 12.2, 12.3, 12.4, 12.5 & 12.6)

**Module II :** (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form,

(Sections 12.7, 12.8, 12.9, 12.10, 13.1 & 13.3)

**Module III :** (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals. Line integrals, Vector fields, work circulation

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and flux, Path independence, potential functions and conservative fields.

(Sections 13.4, 13.6, 13.7, 14.1, 14.2 & 14.3)

**Module IV** : (30 hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem.

(Section 14.4, 14.5, 14.6, 14.7 & 14.8)

## References

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley, 2015
2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6<sup>th</sup> ed., Universal Book Stall, New Delhi, 1991.
3. Shanti Narayan and P K Mittal: A Textbook of Vector Analysis, S Chand., 2013



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### FIFTH SEMESTER MAT5B06: ABSTRACT ALGEBRA

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5 hours/week

5 credits

#### Syllabus

**Text Book :**

**John B. Fraleigh** : A First Course in Abstract Algebra, 7th Ed., Pearson, 2003.

**Module I** : (25 hrs)

Binary operations; Isomorphic binary structures; Groups, Abelian Groups, Elementary properties of Groups; Sub groups, Cyclic subgroups, Cyclic Groups, Elementary properties of cyclic groups. The structure of cyclic groups, Subgroups of finite cyclic groups.

(Sections 2, 3, 4, 5 & 6).

**Module II** (20hrs)

Groups and permutations, Cayley's Theorem; Orbits, Cycles, even and odd permutations, The

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Alternating groups.

(Sections 8 & 9).

**Module III** : (15 hrs)

Cosets and Theorem of Lagrange; Homomorphisms, Properties of homomorphisms, Kernel of homomorphisms, Normal subgroups.

(Sections 10 & 13).

**Module IV**:(30 hrs)

Rings and Fields, Definitions and basic properties, Homomorphisms and isomorphisms, Fields; Integral Domains, Divisors of zero and Cancellation, Characteristic of a Ring

(Sections 18, 19, 21)

## References

1. Joseph A. Gallian : Contemporary Abstract Algebra, 4<sup>th</sup> Edition. Narosa Pub. House(2008).
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, 2<sup>nd</sup> Edition, Cambridge, University Press(1994).
3. Artin : Algebra, 2<sup>nd</sup> Edition, PHI(2011).
4. Durbin : Modern Algebra : An Introduction, 5th Edition, Wiley(2004).
5. I N Herstein: Topics in Algebra, 2<sup>nd</sup> Edition, Wiley Eastern LTD(1975).

### FIFTH SEMESTER

### MAT5B07: BASIC MATHEMATICAL ANALYSIS

6 hours/week

5 credits

### Syllabus

#### Text Books:

1. **Robert G. Bartle & Donald R. Sherbert** : Introduction to Real Analysis, 3<sup>rd</sup> Edition, Wiley(1999).
2. **J.W. Brown and Ruel V. Churchill** : Complex Variables and Applications, 8<sup>th</sup> Edition, McGraw Hill(2009).

**Module I:** (20 hrs)

Mathematical induction, Finite and infinite sets, Countable sets, Real numbers, Algebraic property of real numbers.

(Sec 1.2, 1.3 & 2.1 of text 1)

**Module II :**(24 hrs)

Absolute value and real line, The completeness property of  $\mathbb{R}$ , Applications of supremum property, Intervals, Nested interval property and uncountability of  $\mathbb{R}$

(Sec 2.2, 2.3, 2.4 & 2.5 of text 1)

**Module III :** (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterion, Properly divergent sequences. Open and closed sets.

(Sec. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 and 11.1 of text 1)

**Module IV :** (34 hrs)

Sums and Products; Basic Algebraic properties; Further properties, Vectors and Moduli; Complex conjugates; Exponential form; Product and powers in exponential form; Arguments of products and quotients; Roots of complex numbers; Regions in the complex plane.

Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity

(Sections 1 to 11 of Chapter 1; 12, 15 to 18 of Chapter 2 of Text 2)

**References :**

1. J.M. Howie, Real Analysis , 1<sup>st</sup> edition, Springer (2007).
2. Ghorpade and Limaye , A Course in Calculus and Real Analysis, 1<sup>st</sup> Edition, Springer (2006).
3. K.A. Ross, Elementary Real Analysis : The Theory of Calculus, 2<sup>nd</sup> Edition, Springer Indian Reprint(2004)
4. J.V. Deshpande, Mathematical Analysis and Applications, Narosa Publishing House(2004).

5. M.R. Spiegel, Complex Variables, Schaum's Outline Series, 2<sup>nd</sup> Edition, McGraw-Hill Education(2009).

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**FIFTH SEMESTER**  
**MAT5B08: DIFFERENTIAL EQUATIONS**

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5 hours/week

5 credits

**Syllabus**

**Text Book:**

**W.E. Boyce & R.C. Dippima**, Elementary Differential Equations and Boundary Value Problems, 7<sup>th</sup> Edn., John Wiley & Sons, 2001

**Module I:** (24 hrs)

(a) Introduction, Some Basic Mathematical Models; Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks.

(Chapter 1, Sec. 1.1.1.2, 1.3, 1.4)

(b) First order differential equations:

Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem (proof omitted)

(Chapter 2 – Sec. 2.1, 2.2, 2.3, 2.4, 2.6, 2.8)

**Module II :**(29 hrs)

(a) Second Order Linear Differential Equations

Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots; Reduction of order, Non homogeneous equations; Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations (upto and including e.g. 1)

(Chapter 3 – Sec. 3.1 to 3.8)

(b) Sysems of First Order Linear equations

Introduction, Basic theory of systems of first order Linear Equations

(Chapter 7 – Sec. 7.1, 7.4)

**Module III :** (17 hrs)

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Laplace Transforms, Definition of Laplace Transforms , Solution of Initial Value Problem ,  
Step functions , Impulse functions, The Convolution Integral  
(Chapter 6 – Sec. 6.1, 6.2, 6.3, 6.5, 6.6)

### Module IV - Partial Differential Equations and Fourier Series (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem Even  
and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation:

Vibrations of an elastic string

(Chapter 10 – Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.7)

## References

1. S.L. Ross, Differential Equations, 3rd Edition, Wiley , 2007
2. A.H. Siddiqi & P. Manchanda, A First Course in Differential Equation with Applications,  
1<sup>st</sup> Ed., Macmillan, 2006.
3. E.A. Coddington : An Introduction to Ordinary Differential Equation, Dover  
publications, 1989
4. G.F. Simmons, Differential Equation with Application and Historical Notes,  
2<sup>nd</sup> Edition, McGraw Hill Publications, 2003
5. M. Braun, Differential Equations and their Applications, 4<sup>th</sup> Edition, Springer, 1993

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## *B.Sc. DEGREE PROGRAMME MATHEMATICS (OPEN COURSE) FIFTH SEMESTER*

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**(For students not having Mathematics as Core Course)**

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### *MAT5D17: MATHEMATICS FOR PHYSICAL SCIENCES*

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2 hours/week

2 credits

#### Text Books:

1. **John B Fraleigh** : A First Course in Abstract Algebra, 7<sup>th</sup> edn., Pearson Ed.(2003).
2. **Devi Prasad**: Elementary Linear Algebra, 2<sup>nd</sup> Edn., Narosa Publishing House(2012).

### Module I (20 hrs)

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1. Binary operations
2. Isomorphic binary structures
3. Groups and subgroups - Sec. 2, 3, 4 and 5 of (1)
4. Groups of Permutations – Sec. 8 and 9 of (1)
5. Homomorphism – definition and simple examples – Sec. 13 of (1).
6. Rings and Fields – definition and simple examples.

### Module II : Linear Algebra (16 hrs)

Vector space, subspace, linear dependence and independence.

Basis and dimension – simple examples

Linear transformations and matrix of linear transformations – simple examples (Text 2)

### References:

1. Joseph A. Gallian, Contemporary Abstract Algebra , 4<sup>th</sup> Edition, Narosa Publishing House(2008).
2. K. Hoffman & R. Kunze, Linear Algebra, 2<sup>nd</sup> Edition , Pearson Education(1971).

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## MAT5D18: MATHEMATICS FOR NATURAL SCIENCES

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2 hours/week

2 credits

**Text Book: Murray R. Spiegel** : Statistics, 2nd Edn., Schaum's Outline Series, McGraw-Hill(1988).

### Module I (20 hrs)

The idea of sets. Operation on sets. Relations and functions. Variables and graphs (Chapter 1 of text 1).

Frequency distributions (Chapter 2 of text 1).

The Mean, Median, Mode and other measures of central tendency (Chapter 3 of text 1).

Dispersion or variation, The Range, The Mean deviation, The Semi-inter quartile range, Then 10-90 Percentile range; The standard deviation. Properties of standard deviation. The variance.

Short methods of computing standard deviation

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(Relevant section of Chapter 4 of text 1).

### Module II (16 hrs)

Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

(relevant sections of Chapter 5 from text 1).

Elements of Probability theory (Chapter 6 of text 1).

The Binomial distribution. The Normal distribution. Poisson distribution

(Relevant sections from Chapter 7 of text 1)).

### References:

1. Hogg & Craig: Introduction to Mathematical Statistics English, reprint, Pearson education Asia Ltd.& Higher education Press (2004).
2. Freund & Walpole: Mathematical Statistics, 4th edition, Longman Higher Edition(1986)
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### *BMAT5D19 : MATHEMATICS FOR SOCIAL SCIENCES*

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**2 hours/week**

**2 credits**

**Text Book: Edward T. Dowling** : Calculus for Business, Economics and Social Sciences, Schaum's Outline Series, TMH, 2005.

### **Module I** : Equations and Graphs (20 hrs)

Equations, Cartesian Coordinate System, Graphing linear equations, The slope of a line, Solving linear equations simultaneously, Solving quadratic equations, Practical applications

Functions: Concepts and definitions, Functions and graphs, The Algebra of Functions, Applications of linear functions, Facilitating non-linear graphs, Applications of non-linear functions

The derivative: Limits, Continuity, Slope of a Curvilinear function, Rates of change, The derivative, Differentiability and Continuity, Application

**Differentiation** : Derivative notation, Rules of differentiation, Derivation of the rules of

## B.Sc. Mathematics (Academic Year 2018 Onwards)

differentiation, Higher order derivatives, Higher order derivative notation, Implicit differentiation, Applications

(Sections: 2.1-2.7, 3.1- 3.6, 4.1-4.7, 5.1-5.7)

### Module II : Uses of Derivative (16 hrs)

Increasing and decreasing functions, Concavity, Extreme points, Inflexion points, Curve sketching.

Exponential and Logarithmic functions: Exponential functions, Logarithmic functions, Properties of exponents and logarithms, Natural exponential and Logarithmic functions, Solving natural exponential and logarithmic functions, Derivatives of natural exponential and logarithmic functions, Logarithmic differentiation, Applications of exponential functions, Application of Logarithmic functions

Integration: Anti differentiation, Rules for indefinite integrals

Multivariable Calculus: Functions of several variables, Partial derivatives, Rules of partial differentiation, Second order partial derivatives

More of Integration: Integration by substitution, Integration by parts

(Sections: 6.1-6.5, 7.1-7.9, 8.1-8.2, 9.1-9.4, 10.1-10.2)

## References

1. Srinath Baruah : Basic Mathematics and its Applications in Economics, Macmillan, 2000.
2. Taro Yamane: Mathematics for Economists, Second edition, PHI 2007.

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## SIXTH SEMESTER MAT6B09: REAL ANALYSIS

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5 hours/week

Syllabus

5 credits

### Text Books:

1. **Robert G. Bartle & Donald R. Sherbert** : Introduction to Real Analysis, 3<sup>rd</sup> ed., Wiley, 1993.

## B.Sc. Mathematics (Academic Year 2018 Onwards)

2. **R.R. Goldberg : Methods of Real Analysis**, John Wiley & Sons; 2nd Edition, 1976.
3. **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II, 2009.

### **Module I:** Continuous Functions (25 hrs)

Continuous functions (a quick review), Continuous functions on intervals, Uniform continuity

(Sec. 5.3, 5.4 of text 1)

### **Module II** : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions , The fundamental theorem, Substitution theorem and application, Approximate Integration

(Sec. 7.1, 7.2, 7.3, 7.4 of text 1)

### **Module III** : Sequence and series of functions (20 hrs)

Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions. (8.1, 8.2.1, 8.2.2, 9.4.1, 9.4.2, 9.4.5, 9.4.6 of text 1)

### **Module IV** (20 hrs)

Improper Integrals

Improper integrals of the first kind, Improper integrals of the second kind, Cauchy Principal value, Improper Integrals of the third kind.

(Sections: 7.9, 7.10 of text 2)

Beta and Gamma functions

Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

(Chapter IX, Sec: 2.1, 2.2, 2.3, 3, 4, 5 of text 3)

## References

1. J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House, 2004
2. Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency, 2014
3. K.A. Ross: Elementary Real Analysis : Theory of Calculus, 2<sup>nd</sup> Edition, Springer, 2013
4. K.G. Binmore: Mathematical Analysis, 2<sup>nd</sup> edn CUP, 1983

**SIXTH SEMESTER**  
**MAT6B10: COMPLEX ANALYSIS**

5 hours/week

5 credits

**Syllabus**

**Textbook :** James Ward Brown and Ruel V. Churchill : Complex Variables and Applications, 8<sup>th</sup> Edn, McGraw Hill(2009).

**Module I :** Analytic Functions and Elementary functions (25 hrs)

Derivatives, Differentiation formula, Cauchy-Riemann Equations, C-R equations in Polar coordinates. Analytic functions, Harmonic functions

The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse Trigonometric and Hyperbolic functions

(Sections 19 to 26 of chapter 2; 29 to 36 of Chapter 3)

**Module II :** Integrals (20 hrs)

Derivatives of functions  $\omega(t)$ ; Indefinite integral of  $\omega(t)$ ; Contours, Contour integrals, Antiderivatives, Cauchy-Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

(Sec: 37 to 54 excluding 42, 47 of Chapter 4)

**Module III :** Series (20 hrs)

A quick review of convergence of sequence and series of complex numbers. Taylor series, Laurents series (without proof), Applications. Power series: Absolute and uniform convergence. Continuity of sum of power series, Differentiation and integration of power series, Multiplication and division of power series.

(Sec: 55 to 60 & 62 to 67 of Chapter 5)

**Module IV :** Residues and Applications of residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles. Evaluation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving

sines and cosines.

(Sec: 68 to 76 of Chapter 6, 78, 79, 80 and 85 of Chapter 7).

## References :

1. Mark J. Ablowitz and Athanassios S. Fokas: Complex Variables, 2nd Edn, Cambridge University Press, 2003
2. S. Ponnusamy : Foundation of Complex Analysis, 2<sup>nd</sup> Edn, Narosa, 2006.
3. Murray R. Spiegel: Complex Variables, Schaum's Outline series, 2<sup>nd</sup> Edn, McGraw-Hill Education, 2009.
4. J.M. Howie: Complex Analysis, 1<sup>st</sup> Edition, Springer India Reprint, 2003
5. Stewart & Tall: Complex Analysis, Illustrated Edition, CUP, 1983
- 6.

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## SIXTH SEMESTER MAT6B11: NUMERICAL METHODS

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5 hours/week

4 credits

Syllabus

### Text Books :

1. S.S. Sastry : Introductory Methods of Numerical Analysis, Fourth Edition, PHI(2010).

### Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

2.1 Introduction, 2.2 Bisection Method, 2.3 Method of false position, 2.4 Iteration method, 2.5 Newton-Raphson Method, 2.6 Ramanujan's method , 2.7 The Secant Method

Finite Differences

3.1 Introduction, 3.3.1 Forward differences, 3.3.2 Backward differences, 3.3.3 Central differences, 3.3.4 Symbolic relations and separation of symbols, 3.5 Differences of a polynomial

### Module II: Interpolation (23 hrs)

3.6 Newton's formulae for interpolation, 3.7 Central difference interpolation formulae, 3.7.1 Gauss' Central Difference Formulae, 3.9 Interpolation with unevenly spaced points, 3.9.1 Lagrange's interpolation formula, 3.10 Divided differences and their properties, 3.10.1 Newton's General interpolation formula, 3.11 Inverse interpolation,

Numerical Differentiation and Integration

## B.Sc. Mathematics (Academic Year 2018 Onwards)

5.1 Introduction, 5.2 Numerical differentiation (using Newton's forward and backward formulae)  
5.4 Numerical Integration, 5.4.1 Trapezoidal Rule, 5.4.2 Simpson's 1/3-Rule, 5.4.3 Simpson's 3/8-Rule

### Module III : Matrices and Linear Systems of equations (22 hrs)

6.3 Solution of Linear Systems – Direct Methods, 6.3.2 Gauss elimination, 6.3.3 Gauss-Jordan Method, 6.3.4 Modification of Gauss method to compute the inverse, 6.3.6 LU Decomposition, 6.3.7 LU Decomposition from Gauss elimination, 6.4 Solution of Linear Systems – Iterative methods, 6.5 The eigen value problem, 6.5.1 Eigen values of Symmetric Trapezoidal matrix

### Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

7.1 Introduction, 7.2 Solution by Taylor's series, 7.3 Picard's method of successive approximations, 7.4 Euler's method, 7.4.2 Modified Euler's Method, 7.5 Runge-Kutta method, 7.6 Predictor-Corrector Methods, 7.6.1 Adams-Moulton Method, 7.6.2 Milne's method.

## References

1. S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.(2007).
2. F.B. Hidebrand : Introduction to Numerical Analysis, TMH. Tata McGraw-Hill Publishing Company Limited, 1956.
3. J.B. Scarborough : Numerical Mathematical Analysis, 6<sup>th</sup> ed., Oxford and IBH, 2011.

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## SIXTH SEMESTER

### *MAT6B12: NUMBER THEORY AND LINEAR ALGEBRA*

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5 hours/week

4 credits

## Syllabus

### Text Books:

1. **David M. Burton** : Elementary Number Theory, Sixth Edn., TMH, 2007
2. **T. S. Blynth and E.F. Robertson**: Basic Linear Algebra, second Edn springer under graduate mathematics series, 2009

## B.Sc. Mathematics (Academic Year 2018 Onwards)

### Module I : Theory of Numbers (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation  $ax + by = c$ . Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.

(Sections 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 4.2, 4.3 & 4.4 of Text 1).

### Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.

(Sections 5.2, 5.3, 6.1, 6.3, 7.2, 7.3 and 7.4 of Text 1) (Theorems 7.6 and 7.7 only).

### Module III (15 hrs)

Vectorspaces-examples, linear combinations, spanning, linear independence, base, finite dimensional vector spaces.

(All Sections in chapters 5 of text 2)

### Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism.

(All Sections in chapters 5 and 6 of text 2)

## References

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers, 1995
2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa Publishing House, 2006.
3. George E. Andrews : Number Theory, Dover Publications, 1994
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, 2<sup>nd</sup> Edn., Prentice-Hall of India, 1991
5. Frank Ayres, Jr. : Theory and problems in Matrices, Schaum's Outline Series, 1964
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House, 2006

## MATHEMATICS (ELECTIVE COURSE) SIXTH SEMESTER

**MAT6B13(E01) : GRAPH THEORY**

**3 hours/week**

**2 credits**

Text Book :

S. Arumugham & S. Ramachandran : Invitation to Graph Theory, Scitech Publications, Chennai-17.(2002)

**Module I (17 hrs)**

Isomorphic graphs, Ramsey numbers, Independent sets and Coverings, Intersection graphs and line graphs, Operation on graphs, Walks, Trails and Paths, Connected components,

Blocks, Connectivity

(Sections 2.4, 2.5, 2.6, 2.7, 2.9, 4.0, 4.1, 4.2, 4.3, 4.4.)

**Module II (10 hrs)**

Eulerian and Hamiltonian graphs (omit Fleury's Algorithm) Trees

(Sections : 5.0, 5.1, 5.2 (only upto and not including Theorem 5.5), 6.0, 6.1, 6.2.)

**Module III (10 hrs)**

Matchings and Planarity

(Sections 7.0, 7.1, 7.2, 8.0, 8.1, 8.2)

**Module IV (17 hrs)**

Colourability, Chromatic numbers, Five colour theorem, Chromatic polynomials, Directed graphs, Paths and Connectedness.

(Sections: 9.0, 9.1, 9.2, 9.4, 10.0, 10.1, 10.2.)

**References**

1. R.J. Wilson: Introduction to Graph Theory, 4th edn., LPE, Pearson Education, 1996
2. J.A. Bondy & U.S.R. Murty : Graph Theory with Applications, Macmillan, London 1976
3. J. Clark & D.A. Holton: A First Look at Graph Theory, Allied Publishers(World scientific), 1991
4. N. Deo : Graph Theory with Application to Engineering and Computer Science, PHI, 2014

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**MATHEMATICS (ELECTIVE COURSE) SIXTH SEMESTER  
MAT6B14 (E02): LINEAR PROGRAMMING**

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**3 hours/week**

**2 credits**

**Text Book:**

**Gupta and Manmohan** - Linear Programming and Theory of Games , Sultan Chand & Sons, 1979.

**Module I**

Formulation, convex sets, general LPP

( section 0.4, 1..6, 1.7 , 1..8, chapter 2, chapter 3 )

**Module II:**

Simplex method, duality

( section 4.6, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4 ( theorem 1 )

**Module III:**

The transportation problem, the assignment problems

( section 11.1 to 11-.11, 11.14, 12.1 to 12.4 )

**References**

1. K. V. Mital & Manmohan: optimization methods in operations research and systems Analysis, 3rd edn., new age international publishers, 1996
2. Dipak Chatterjee: linear programming and game theory, prentice hall of India, 2005

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**MATHEMATICS (ELECTIVE COURSE)  
SIXTH SEMESTER**

**MAT6B15.(E03) : C PROGRAMMING FOR MATHEMATICAL COMPUTING**

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**3 hours/week**

**2 credits**

**Course Requirements:**

## B.Sc. Mathematics (Academic Year 2018 Onwards)

Basic familiarity with computer.

A C compiler (Turbo C or Turbo C++) to do the Assignments in the course.

### Course Goals

Students who complete this course will:

1. Have the basic skills required for computer programming.
2. Learn to write, compile and debug a C program
3. Be able to solve Mathematical problems using C programs
4. Introduce how to use C for drawing graphs and use mathematical models.

### Course Contents

The course has Theory Part and Practical Part. The total periods for the course is 54 hrs of which 36 hrs for theory and 18 hrs for practical. Theory part focus on learning C Language to solve mathematical problems as listed in the Annexure 1. As and when various structures in C Language are discussed take examples from mathematics background as far as possible and conduct lab sessions to reinforce the idea. The Practical sessions are for testing the programs with the help of a C/C++ compiler. For entertaining free software, use Linux environment. A student must keep with the computer output obtained. He/She is expected to do a minimum of 12 programs selected from the list. (As shown in Annexure I) besides some other suitable sample programs to understand the style of C programming. The student has to maintain an observation note book and a practical record. Of the 3 periods per week 2 are for theory class and 1 is for practical session. The University will conduct only theory examination, but Practical examination should be conducted internally and this should be considered for internal mark. For internal assessment minimum three tests, of which one should be practical test, may be conducted.

### Theory Session (36 hrs)

#### Text Books

1. E. Balaguruswamy : Programming in Ansi C, Tata McGraw Hill.fifth edition 2010
2. Basavaraj S. Anami, Shanmughappa, A., Angadi S. &Sunilkumar S. Manvi : Computer Concepts and Programming (A Holistic Approach to Learning C), Prentice Hall of India.

### Module I (9 hrs)

Program Fundamentals: Computer Languages – Operating System – Compilation of Program – Different Types of Errors – Debugging of programs – Rewriting and Program Maintenance – Program Life Cycle (Text Book 2 – A quick review of Chapter 1 section 1.5).

Algorithms and Flow Charts: Algorithms and their characteristics – Flow Charts and their Uses – Advantages and Drawbacks of Flow Charts. (A quick view of Text Book 2 – Chapter 2 – All

## B.Sc. Mathematics (Academic Year 2018 Onwards)

sections).

Overview of C: History of C – Importance of C – Sample programs – Basic Structure of a C Program – Programming Style – Executing C Program – DOS System (Text Book 1 – Chapter 1 – Section 1.1 to 1.12).

Constants, Variables and Data Types: Introduction – Character set – Keywords and Identifiers – Constants – Variables – Data Types – Declaration of storage class – Declaration of variables (Primary and User defined) – Assigning Values to variables – Symbolic constants (Text Book 1 – Chapter 2 – Sections 2.1 to 2.13).

### Module II (9 hrs)

Operators and Expressions: Introduction – Arithmetic operators – Relational operators – Logical operators – Increment and Decrement operators – Conditional Operators – Arithmetic Expression – Evaluation of Expressions – Precedence of Operators – Some Computational Problems – Type Conversions in Expressions – Mathematical Functions (Text Book 1 – Chapter 3 – Sections 3.1 to 3.7 and 3.10 to 3.16).

Managing Output Operations: Introduction – Reading and writing a character and a string – Formatted Input – Formatted Output – Use of %c, %d, %e, %f, %s – (Text Book 1 – Chapter 4 – Sections 4.1 to 4.5).

### Module III (9 hrs)

Decision Making and Branching: Introduction – If Statements (Simple if, if-else, nested if, ladder if) – Switch Statement – Conditional Operator – Go to Statement (Text Book 1 – Chapter 5 – Sections 5.1 to 5.9).

Decision Making and Looping: Introduction – While Statement – Do-while Statement – For Statement – Use of break, goto, continue in control statements (Text Book 1 – Chapter 6 – Sections 6.1 to 6.5).

### Module IV (9 hrs)

Arrays: Introduction – One Dimensional Arrays – Two Dimensional Arrays – Initialization of arrays – Multi Dimensional Arrays (Text Book 1 – Chapter 7 – Sections 7.1 to 7.9).

User Defined Functions: Introduction – Need for user defined functions – The form of C functions – Return of values – Calling a function – category of functions – Recursion – Function with arrays (Text Book 1 – Chapter 9 – Sections 9.1 to 9.10 and 9.16, 9.17, 9.18).

### References

1. K.R. Venugopal & Sudeer R. Prasad : Programming with C, Tata McGraw Hill.
2. Yashant Kanetkar : Let us C, BPB Publication.ed14
3. Byron Gottfried : Programming with C, Tata McGraw Hill.ed:2 2006
4. V. Rajaraman : Computer Programming, Prentice Hall of India. Lab Sessions (18 hrs)

All the concepts in the theory sessions must be tested on a computer using a C compiler. A minimum of 12 problems from the list given in the Annexure I must be solved using C programming technique. A student should keep a practical record of the problem given by the teacher, algorithm, program and the output obtained in the lab session.

### Practical Examination

The practical examination of 1 hour duration is only for internal assessment.

## Annexure I

### List of Numerical Problems

#### Section A (minimum 4)

1. Find GCD / LCM of two numbers.
2. Find the factorial of a number using recursion.
3. Check whether a number is prime or not
4. Reverse a n-digit number.
5. Find the sum of a set of numbers.
6. Write First n multiple of 7.
7. Find the maximum of two numbers using a function program.
8. Add two matrices / transpose a matrix.

#### Section B (minimum 5)

1. Find the maximum and the minimum of n numbers
2. Find the sum of the squares of first n natural numbers using loop
3. Find the number of above average student based on their mathematics marks
4. Multiply two matrices
5. Find the sum of digits of a n-digit number
6. Find the first n Fibonacci numbers
7. Evaluate Trigonometric / logarithmic / exponential function for a given x using its infinite series
8. Solve a given quadratic equation
9. Find the mean and standard deviation of a set of marks
10. Arrange a set of numbers in ascending / descending order.

#### Section C (minimum 3)

1. Integrate a function using trapezoidal rule

2. Solve a first order differential equation using Euler's method
3. Find a real root, if any, of polynomial equation using Bisection method.
4. Solve a first order differential equation using by Rung-Kutta method
5. Newton-Raphson's Method
6. Integrate a function using Simpson's rule.

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### COMPLEMENTARY COURSE

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#### *B.Sc. DEGREE PROGRAMME MATHEMATICS (COMPLEMENTARY COURSE)* *FIRST SEMESTER* *MAT 1C01 : MATHEMATICS*

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4 hours/week

3 credits

**Textbook :** George B. Thomas Jr. and Ross L. Finney : Calculus and Analytic Geometry, LPE, Ninth edition, Pearson Education, 2002

#### **Module I (20 hrs)**

Limits and Continuity: Rules for finding limits. Target values and formal definitions of limits. Extensions of limit concept, Continuity, Tangent lines.  
(Section 1.2, 1.3, 1.4, 1.5 & 1.6 of the Text).

#### **Module II (12 hrs)**

Derivatives: The derivative of a function, a quick review of differentiation rules, rate of change.  
(Section 2.1, 2.2, 2.3 of the Text)

#### **Module III (24 hrs)**

Application of derivatives: Extreme values of a function. The mean value theorem, First derivative test, Graphing with  $y'$  and  $y''$ . Limits as  $x \rightarrow \pm \infty$ . Asymptotes and Dominant terms, Linearization and differentials. The L'Hopital's Rule  
(Section 3.1, 3.2, 3.3, 3.4, 3.5, 3.7 & 6.6 of the Text).

## Module IV (16hrs)

Integration: Riemann sums and Definite integrals; properties, areas and the Mean value theorem. The Fundamental theorem. Application of Integrals: Areas between curves, Finding Volumes by slicing.

(Section 4.5, 4.6, 4.7, 5.1 & 5.2 of the Text.)

### References

1. S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI(2008)
2. Murray R. Spiegel, Advanced Calculus, 3<sup>rd</sup> edition, Schaum's Outline Series,2011
3. Anton : Calculus, Wiley,10<sup>th</sup> edn, 2012.
4. S.K. Stein : Calculus with Analytic Geometry, McGraw Hill, 1992
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**B.Sc. DEGREE PROGRAMME MATHEMATICS (COMPLEMENTARY COURSE)**  
**SECOND SEMESTER**  
**MAT2C02 : MATHEMATICS**

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4 hours/week

3 credits

**Textbook:** George B Thomas, Jr and Ross L Finney: Calculus and Analytic Geometry, LPE, Ninth edition, Pearson Education, 2002

**Module I:** Hyperbolic functions, Application of Integrals and Improper Integrals, (20 hrs)

Hyperbolic Functions- Definitions and Identities, Derivatives and Integrals, Inverse Hyperbolic Functions- Derivatives and Integrals. Application of Integrals :, Volumes of Solids of Revolution (Disk method only), Lengths of plane curves. Areas of surfaces of revolution Improper Integrals- Convergence and Divergence, Tests for Convergence and Divergence- Direct Comparison Test and Limit Comparison Test

(Section: 5.3, 5.5, 5.6 , 6.10 & 7.6 of the Text)

**ModuleII:** Infinite Series (28 hrs)

Limit of Sequences of Number, Theorems for calculating limits of sequences ( Excluding Picard's Method), Infinite series, The ratio and root test for series of non negative terms, Alternating series, Absolute and conditional convergence, Power Series, Taylor and Maclaurin

Series.

(Sections 8.1, 8.2, 8.3, 8.6, 8.7, 8.8, 8.9 of the Text)

**Module III** : Polar Coordinates (10 hrs)

Polar coordinates, Graphing in Polar Coordinates, Polar equations for conic sections, Integration in Polar coordinates, Cylindrical and Spherical Coordinates.

(Sections 9.6, 9.7, 9.8, 9.9, 10.7 of the Text)

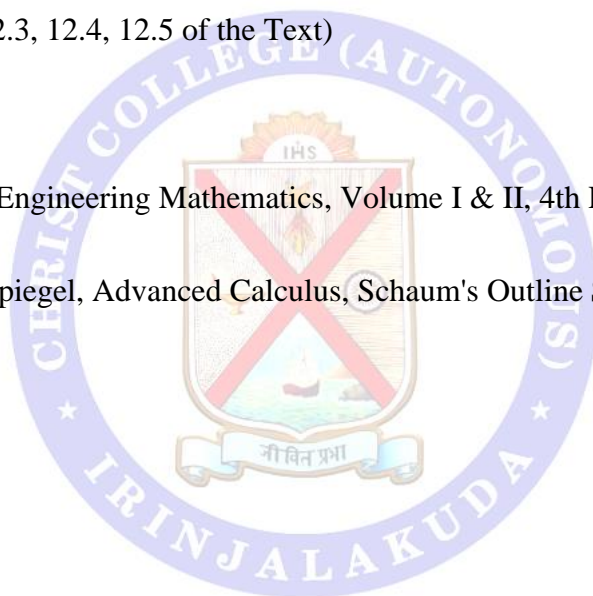
**Module IV** : Multivariable Functions and Partial Derivatives (14 hrs)

Functions of Several Variables, Limits and Continuity, Partial Derivatives, differentiability, Chain rule

(Sections 12.1, 12.2, 12.3, 12.4, 12.5 of the Text)

**References**

1. S.S. Sastry, Engineering Mathematics, Volume I & II, 4th Edition PHI(2008)
2. Murray R. Spiegel, Advanced Calculus, Schaum's Outline Series.



***B.Sc. DEGREE PROGRAMME MATHEMATICS  
(COMPLEMENTARY COURSE) THIRD SEMESTER  
MAT3C03 : MATHEMATICS***

**5 hours/week**

**3 credits**

**Text :** 1. **Erwin Kreyszig** : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.  
2. **Frank Ayres JR** : Matrices, Schaum's Outline Series, TMH Edition.

**Module I : Ordinary Differential Equations (20 hrs)**

Basic concepts and ideas, Geometrical meaning of  $y' = (x, y)$ . Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.  
(Sections 1.1, 1.2, 1.3, 1.5, 1.6, 1.8 of Text 1).

**Module II : Matrices (20 hrs)**

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogeneous Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications  
(relevant sections of Text 2).

**Module III : Vector Differential Calculus (25 hrs)**

A quick Review of vector algebra, Inner product and vector product in  $R^2$  and  $R^3$ . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

(Sections 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.9, 8.10, 8.11 of Text 1).

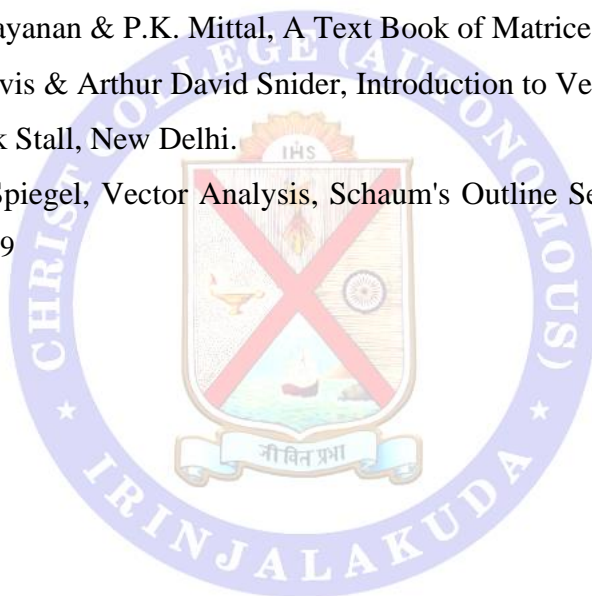
**Module IV : Vector Integral Calculus (25 hrs)**

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

(Sections 9.1, 9.2, 9.4, 9.5, 9.6, 9.7, 9.9, 9.10 of Text 1)

**References :**

1. S.S. Sastry, Engineering Mathematics, Volume II, 4th ed., PHI(2008)
2. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand.
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.  
1 December 1959



**B.Sc. DEGREE PROGRAMME MATHEMATICS  
(COMPLEMENTARY COURSE)  
FOURTH SEMESTER MAT4C04 : MATHEMATICS**

5 hours/week

3 credits

**Texts**

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. **George B. Thomas, Jr. and Ross L. Finney**, Calculus And Analytic Geometry, LPE, Ninth Edition, Pearson Education(2002)

**Module I: Linear Differential equations of Second and Higher order (20hrs)**

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian, Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

(Sections 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, 2.10 of Text 1).

**Module II: Laplace Transforms (20 hrs)**

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

(Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 of Text 1 – excluding Proofs).

**Module III : Fourier Series, Partial differential Equations(30 hrs)**

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions. (Excluding Proofs). Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series.

(Sections 10.1, 10.2, 10.4, 11.1, 11.2, 11.3 of Text 1).

**Module IV: Numerical Methods (20 hrs)**

Numerical Methods: Methods of First-order Differential Equations (Section 19.1 of Text 1). Picard's iteration for initial Value Problems.(Section 1.9 of Text 1). Numerical Integration: Trapezoidal Rule, Simpson's Rule.

(Section 4.9 of Text 2).

**References:**

1. S.S. Sastry, Engineering Mathematics, Vol. II, 4th ed., PHI, 2008
2. Murray R. Spiegel, Advanced Calculus, Schaum's Outline Series, 1963
3. Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series. McGraw Hill Professional, 1965
4. V Sundarapandian, Ordinary and Partial Differential Equations, Tata McGraw Hill Education Private Limited, 2013
5. B. S. Grewal, Higher Engineering Mathematics, 43<sup>rd</sup> Edn., Khanna Publishers, 2014.
6. S.L. Ross : Differential Equations, 3rd ed., Wiley, 2007
7. G.F. Simmons : Differential Equation with Application and Historical Notes, Second edn., Tata McGraw Hill Education Private Limited, 2003

