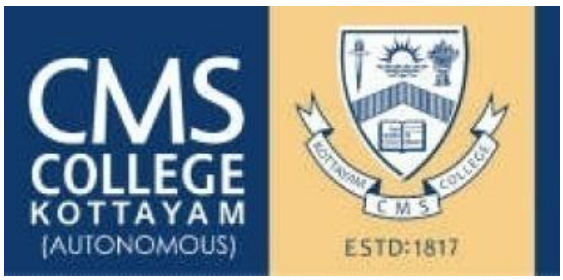

CMS COLLEGE KOTTAYAM

(AUTONOMOUS)

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR

UNDER GRADUATE PROGRAMME

BACHELOR OF SCIENCE IN

MATHEMATICS

UNDER CHOICE BASED CREDIT SYSTEM 2018
(With effect from 2018)

Approved by the Board of Studies

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9. Mr. Siby Chandy, DGM, State Bank of India.

CONTENTS

ACKNOWLEDGEMENT

The Board of Studies in Mathematics (Under Graduate), would like to express our gratitude to Prof.(Dr.)N. J. Rao, Former Professor, Indian Institute of Science, Dr.T P. Sasi Kumar, Former Space Scientist ISRO, Dr.C.James, Associate Professor, Department of Physics, Scott Christian College for their timely guidance in the curriculum revision process.

We would also like to thank the Principal, the IQAC and the Curriculum Revision Committee for the excellent stewardship.

We take this opportunity to thank our colleagues, academicians from other institutions, representatives from industry and representatives of other stakeholders for their cooperation, valuable suggestions and collective efforts which have enabled us to achieve important progress on our agenda

Chairman

Board of Studies

PREFACE

"Neglect of Mathematics work injury to all knowledge, since he who is ignorant of it cannot know the other sciences or things of this world".

Roger Bacon (1214-1294)

"Mathematics is the language in which God has written the world."

Galileo Galilee (1564-1642)

At the time of inception of CMS College, there were no colleges and universities pioneering higher education in India. Mathematics was a part of the curriculum right from the beginning of the college and has a legacy of being one of the very few arenas were Euclid's 'Elements' was taught to usher the age of modernity.

Mathematics runs in the veins of natural sciences. It is inextricably incorporated with world and with the natural phenomena. Exposure to Mathematics helps in developing an analytic mind helps in better organization of ideas and accurate expression of thoughts. At a general level, far away from dealing with the higher mathematical concepts, the importance of Mathematics for a common man is underpinned. A common man is increasingly dependent on the application of Mathematics in day to day life.

Mathematics can be personally empowering in everyday life. Mathematics is one of the greatest cultural and intellectual achievements of humankind and every citizen ought to develop an appreciation and understanding of that achievement, including its aesthetic aspect. All careers require a foundation of mathematical knowledge.

This is an era of rapid change and development. New knowledge, ideas, tools and ways of doing and communicating Mathematics continue to emerge and evolve. The level of mathematical thinking needed for problem solving in workplace has increased dramatically.

This curriculum identifies the key role of Mathematics in shaping the scientific society. May more students pursue an educational path that will prepare them for lifelong work as mathematicians and scientists.

CURRICULUM
GRADUATE PROGRAMME OUTCOMES (GPO)

At the completion of the under graduate programme, the student will be able to accomplish the following programme outcomes.

GPO No.	Graduate Programme Outcomes
GPO.1	**Critical Thinking**: Take an informed and analytical approach to learning and demonstrate in-depth knowledge of the subject and give opinion(s) supported by logical reasoning that one have judged to be appropriate and understanding different approaches and using them
GPO.2	**Effective Communication:** Demonstrate proficiency in communicating competently in groups and organizations, competence in interpersonal communication; possess skills to effectively deliver formal and informal presentations to a variety of audiences in multiple contexts
GPO.3	**Social Interaction:** Foster social skills and peer interaction enabling them to make all people feel valued and respect their differences by being responsible citizens for creating a socially inclusive society
GPO.4	**Ethical Standards:** Recognize values such as justice, trust, equity, fairness, kindness and develop a commitment to meeting and upholding standards of ethical behaviour in all walks of life and comprehending the moral dimensions of decisions and actions
GPO.5	**Environmental Consciousness:** Discern the issues of environmental contexts and engages in promoting values and attitudes that claim coexistence and sustainable living with reduced, minimal, or no harm upon ecosystems
GPO.6	**Lifelong Learning:** Acquire the skill to be an independent lifelong learner embracing real-time changes in the socio-technological context, promoting continuous development and improvement of the knowledge and skills needed for employment and personal fulfilment.

PROGRAMME SPECIFIC OUTCOMES (PSO)

IO No.	Intended Programme Specific Outcomes *Upon completion of B.Sc Mathematics Programme, the graduates will be able to:*	GPO No.
PSO-1	Provide a systematic understanding of the fundamental concepts and theories of mathematics.	**1,2,3,6**
PSO-2	Learn mathematics as a language for all sciences.	**2,3,5,6**
PSO-3	Enhance problem solving and computing skills for wide variety of areas of employment.	**1,6**
PSO-4	Application of theories of mathematics in the physical world and enhance career prospects.	**5,6**
PSO-5	Recognize the need to engage lifelong learning of mathematics through continuing education and research.	**4,6**
PSO-6	Strengthen the mathematical ability and abstract intelligence of students and equip them for higher mathematics and research.	**1,6**
PSO-7	Learning mathematization of physical problems as the initial step of mathematical research.	**5,6**
PSO-8	Recognise, appreciate and learn the physical laws which governs then universe	**1,2,5**
PSO-9	Acquire fundamental knowledge in statistical methods and techniques.	**1,2**
PSO-LG	Organize and deliver relevant applications of knowledge through effective written, verbal, graphical/virtual communications and interact productively with people from diverse backgrounds	**2,3,6**

PROGRAMME DESIGN

B.Sc. MATHEMATICS PROGRAMME

The U.G. programme in Mathematics includes (a) Common courses, (b) Core courses, (c) Complementary courses; (d) Choice based course, (e) Open course and (f) Project. No course shall carry more than 4 credits. The student shall select any one Open course in Semester 5 offered by the various departments depending on the availability of infrastructure facilities in the institution. The number of Courses for the programme should contain 12 compulsory core courses, 1 open course, 1 choice based course from the frontier area of the core courses, 1 project in the area of core and 8 complementary courses from the relevant subjects for complementing the core of study. There should be 10 common courses, which includes English and Additional language of study. For the successful completion of this UG programme, a student shall acquire minimum 120 credits.

Sl. No	**Course type**	**No. of courses**	**Total credits**
1	Common course I-English	**6**	**22**
3	Common course II– Additional language	**4**	**16**
4	Core	**12**	**46**
6	Complementary I	**4**	**14**
7	Complementary II	**4**	**14**
8	Open course	**1**	**3**
9	Choice Based Course	**1**	**4**
	Project work	**1**	**1**
Total		**33**	**120**

PROGRAMME STRUCTURE

B.SC. MATHEMATICS

(Semester wise)

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
SEMESTER I					
EN1811501	Fine-tune Your English	Common I-English 1	5	90	4
EN1811502	Pearls from the Deep	Common I-English 2	4	72	3
	Additional Language	Common Course	4	72	4
HN1811501	Prose and One Act Plays	Common II - Hindi 1			
ML1811501	*Kathasahithyam*	Common II - Malayalam 1			
SC1811501	Poetry/ Grammar & History of Syriac Language & Literature	Common II – Syriac 1			
MT1811101	Foundation of Mathematics	Core 1	4	72	3
ST1811201	Descriptive statistics	Complementary Statistics1	4	72	3
PH1811201	Properties of Matter &Error Analysis	Complementary Physics 1	2	36	2
PH1811701	Properties of Matter &Error Analysis(P)	Complementary Physics Practical	2	36	1
		Total	**25**	**450**	**20**
SEMESTER II					
EN1812503	Issues that Matter	Common I-English 3	5	90	4
EN1812504	Savouring the Classics	Common I-English 4	4	72	3

	Additional Language	Common Course	4	72	4
HN1812503	Short stories and Novel	Common II - Hindi 2			
ML1812504	*Kavitha*	Common II- Malayalam 2			
SC1812503	Poetry/ Grammar & History of Syriac Literature	Common II – Syriac 2			
MT1812102	Analytic Geometry, Trigonometry and Differential Calculus	Core 2	4	72	3
ST1812203	Probability Theory	Complementary Statistics2	4	72	3
PH1812203	Mechanics and Astrophysics	Complementary Physics 2	2	36	2
PH1812703	Mechanics and Astrophysics(P)	Complementary Physics Practical 2	2	36	1
		Total	**25**	**450**	**20**
SEMESTER III					
EN1813505	Literature and/ as Identity	Common I- English 5	5	90	4
	Additional Language	Common Course	5	90	4
HN1813505	Poetry Grammar and Translation	Common II - Hindi 3			
ML1813507	*Drishyakalasahithyam*	Common II- Malayalam 3			
SC1813505	Prose, Grammar & Literature	Common II- Syriac 3			
MT1813103	Calculus	Core 3	5	90	4
ST1813204	Probability Distribution	Complementary Statistics3	5	90	4
PH1813205	Modern Physics and	Complementar	3(T)	90	3

	Electronics	y Physics 3			
PH1813705	Modern Physics and Electronics	Complementary Practical Physics 3	2(p)		1
		Total	**25**	**450**	**20**
SEMESTER IV					
EN1814507	Illuminations	Common I - English 6	5	90	4
	Additional Language	Common Course	5	90	4
HN1814506	Drama and Long Poem	Common II- Hindi 4			
ML1814508	*Malayala Gadyarachanakal*	Common II- Malayalam 4			
SC1814506	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4			
MT1814104	Vector Calculus, Theory of Numbers and Laplace transforms	Core 4	5	90	4
ST1814206	Statistical Inference	Complementary Statistics4	5	90	4
PH1814207	Optics and Electricity	Complementary Physics 4	3(T)	54	3
PH1814707	Optics and Electricity	Complementary Physics Practical 4	2(P)	36	1
		Total	**25**	**450**	**20**
SEMESTER V					
MT1815105	Mathematical Analysis	Core 5	6	108	4
MT1815106	Differential Equations	Core 6	6	108	4
MT1815107	Abstract Algebra	Core 7	5	90	4
MT1815108	Human Rights and Mathematics for	Core 8	4	72	4

	Environmental Studies.				
MT1815401	History of Indian Mathematics	Open Course	4	72	3
MT1815402	Applicable Mathematics				
MT1815403	Mathematical Economics				
		Total	**25**	**450**	**19**
SEMESTER VI					
MT1816109	Real Analysis	Core 9	5	90	4
MT1816110	Graph Theory and metric spaces	Core 10	6	108	4
MT1816111	Complex Analysis	Core 11	5	90	4
MT1816112	Linear Algebra	Core 12	5	90	4
MT1816301	Operations Research	Choice Based Course (Elective)	4	54	4
MT1816302	Basic Python Programming & Typesetting in La Tex				
MT1816303	Numerical Analysis				
MT1816801	Project				1
		Total	**25**	**450**	**21**

PROGRAMME STRUCTURE – B.SC. MATHEMATICS
(Category wise)
COMMON COURSES

Sl.No	Course Name		Credit	Hrs/W	Semester
1	Common I -English 1 Fine-tune Your English		4	5	1
2	Common I- English 2 Pearls from the Deep		3	4	1
3	Common I -English 3 Issues that Matter		4	5	2
4	Common I- English 4 Savouring the Classics		3	4	2
5	Common I – English 5 Literature and/ as Identity		4	5	3
6	Common I – English 6 Illuminations		4	5	4
7	Additional language –1		4	4	1
	Prose and One Act Plays	Common II - Hindi 1			
	Kathasahithyam	Common II - Malayalam 1			
	Poetry/ Grammar & History of Syriac Language & Literature	Common II – Syriac 1			
8	Additional language –1		4	4	2
	Short stories and Novel	Common II - Hindi 2			
	Kavitha	Common II- Malayalam 2			
	Poetry/ Grammar & History of Syriac Literature	Common II – Syriac 2			
9	Additional Language - 1		4	4	3
	Poetry Grammar and Translation	Common II - Hindi 3			
	Drishyakalasahithyam	Common II- Malayalam 3			
	Prose, Grammar & Literature	Common II- Syriac 3			
10	Additional Language – 1		4	4	4
	Drama and Long Poem	Common II- Hindi 4			
	Malayala Gadyarachanakal	Common II- Malayalam 4			
	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4			
Total			**38**		

CORE COURSES

Sl.No	Course Name	Credit	Hrs/W	Semester
1	Foundation of Mathematics	3	4	1
2	Analytic Geometry, Trigonometry and Differential Calculus	3	4	2
3	Calculus	4	5	3
4	Vector Calculus, Theory of Numbers and Laplace transforms	4	5	4
5	Mathematical Analysis	4	6	5
6	Differential Equations	4	6	5
7	Abstract Algebra	4	5	5
8	Human Rights and Mathematics for Environmental Studies.	4	4	5
9	Real Analysis	4	5	6
10	Graph Theory and metric spaces	4	6	6
11	Complex Analysis	4	5	6
12	Linear Algebra	4	5	6

COMPLEMENTARY COURSES

Sl.No	Course Name	Credit	Hrs/W	Semester
1	Complementary 1 - Statistics 1 Descriptive statistics	3	4	1
2	Complementary 1 - Statistics 2 Probability Theory	3	4	2
3	Complementary 1- Statistics 3 Probability Distribution	4	5	3
4	Complementary 1 - Statistics 4 Statistical Inference	4	5	4
5	Complementary II- Physics 1 Properties of Matter and Error Analysis	2	2	1
6	Complementary II - Physics Practical 1 Properties of Matter and Error Analysis(P)	1	2	1
7	Complementary II - Physics 2 Mechanics and Astrophysics	2	2	2
8	Complementary II - Physics 2 Mechanics and Astrophysics(P)	1	2	2
9	Complementary II - Physics 3 Modern Physics and Electronics	3	3	3
10	Complementary II - Physics 3 Modern Physics and Electronics(P)	1	2	3
11	Complementary II – Physics 4 Optics and Electricity	3	3	4
12	Complementary II – Physics 4 Optics and Electricity(P)	1	2	4
Total		**28**		

Choice Based Open Course

Sl.No	Course Name	Credit	Hrs/Wk	Semester
1	History of Indian Mathematics	**3**	4	5
2	Applicable Mathematics			
3	Mathematical Economics			

Choice Based Elective Course

Sl.No	Course Name	Credit	Hrs/Wk	Semester
1	Operations Research	3	4	6
2	Basic Python Programming and Typesetting in LaTeX			
3	Numerical Analysis			

DETAILED SYLLABUS OF THE COURSES
OFFERED BY THE DEPARTMENT

SEMESTER I				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
EN1811501	Fine-tune Your English	Common I - English 1	5	4
EN1811502	Pearls from the Deep	Common I - English 2	4	3
	Additional Language	Common Course	4	4
HN1811501	Prose and One Act Plays	Common II - Hindi 1		
ML1811501	*Kathasahithyam*	Common II - Malayalam 1		
SC1811501	Poetry/ Grammar & History of Syriac Language & Literature	Common II –Syriac 1		
MT1811101	Foundation of Mathematics	Core 1	4	3
ST1811201	Descriptive statistics	Complementary I Statistics 1	4	3
PH1811201	Properties of Matter and Error Analysis	Complementary I Physics 1	2	2
PH1811701	Properties of Matter and Error Analysis(P)	Complementary Practical Physics 1	2	1
		Total	**25**	**20**

Course	Details				
Code	MT1811101				
Title	**FOUNDATION OF MATHEMATICS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	I/I				
Type	Core				
Credits	4	Hrs/Week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To learn a mathematical topic, a person needs to actively construct mathematical arguments on this topic, a major goal of this course is to teach the students how to understand and how to construct correct mathematical arguments.	**C**	1,2,5,6
2	understand what makes up a correct mathematical argument, that is, a proof	**U**	1,5,6
3	distinguish between valid and invalid mathematical arguments.	**E**	1,5,6
4	study the fundamental discrete structure on which all other discrete structures are built, namely, the set. Identify sets, different properties of sets, set operation and Set identities.	**U**	1,2,5,6
5	Understand the different method for representing the relationship between sets.	**Ap**	1,2,6
6	Apply the different properties of injections, surjections, bijections, compositions, and inverse functions	**A**	1,6
7	Understand howthe equivalence classes of an equivalence relation partition a set into disjoint nonempty subsets.	**A**	1,6
8	obtain a relation that is reflexive, anti symmetric, and transitive. These are properties that characterize relations used to order the elements of sets.	**C**	1,6
9	'Solving equations' was an important problem from the beginning of study of Mathematics itself. We shall look at polynomials in detail and will discuss various methods for solving polynomial equations.	**C**	3
10	Solve the problems using what they studied.	**C**	3

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1	**BASIC LOGIC**		
1.1	Propositional Logic	2	1
1.2	Truth table of Compound Propositions	1	2, 10
1.3	Logic and Bit Operations, Problems	1	2
1.4	Propositional equivalence	1	3
1.5	Constructing New Logical Equivalences, Problems	1	3, 10
1.6	Predicates and Quantifiers- Introduction, Predicates	1	3
1.7	Quantifiers	1	3
1.8	Rules of Inference- Valid Arguments in Propositional Logic	3	3, 10
1.9	Using Rules of Inference to Build Arguments	1	3
1.10	Rules of Inference for Quantified statements	1	3
1.11	Introduction to Proofs- Introduction	1	1, 2
1.12	Direct Proofs, Proof by Contraposition	1	1, 2, 10
1.13	Proof by Contradiction	2	1, 2, 10
1.14	Mistakes in Proofs, Problems	1	2, 3
2	**SET THEORY**		
2.01	Sets – Introduction	1	4
2.02	Definitions, Examples	1	4, 5
2.03	set operations – Introduction	1	2, 4, 5
2.04	Set Identities	1	2, 4
2.05	Generalized Union and Intersections	1	2, 4
2.06	Problems	1	10
2.07	Functions – Introduction, One-to-One and Onto functions	1	6
2.08	Inverse Functions and Compositions of Functions	1	6
2.09	The Graphs of Functions	1	5, 6
2.10	Problems	1	10
3	**RELATIONS**		
3.01	Relations and their properties – Introduction, Relations on a set	1	2, 4
3.02	Properties of Relations	1	2, 4, 8
3.03	Combining Relations	2	8, 10
3.04	representing relations – Introduction	1	5
3.05	Representing Relations using Matrices	1	5
3.06	Representing Relations using Digraphs	1	5
3.07	equivalence relations – Introduction	1	7, 8
3.08	Equivalence relations	1	2, 7, 8,10
3.09	Equivalence Classes	1	2, 7, 8,

			10
3.10	Equivalence Classes and Partitions	2	2, 7, 8, 10
3.11	partial orderings – Introduction	1	8
3.12	Lexicographic Order	1	8, 10
3.13	Hasse Diagrams	1	5, 10
3.14	Maximal and Minimal Elements	1	2, 5, 8, 10
3.15	Lattices	2	5, 8, 10
4	**THEORY OF EQUATIONS**		
4.01	Roots of Equations – Introduction	2	9, 10
4.02	Relation Connecting the roots and coefficients of an equation,	2	2, 9, 10
4.03	Transformation of equations	2	2, 9, 10
4.04	Special Cases	2	9, 10
4.05	The Cubic equation, The Biquadratic Equation	2	9, 10
4.06	Character and Position of the Roots of an Equation	2	9, 10
4.07	Some General Theorems	2	2, 9, 10
4.08	Descartes's Rule of Signs, Corollaries	2	2, 9, 10
4.09	Reciprocal Equations	2	2, 9, 10

Text Books:

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

Module 1: Basic Logic (20 hours)
Text 1: Chapter – 1excluding sections 1.4 & 1.7

Module 2: Set theory (12 hours)
Text 1: Chapter – 2 excluding section 2.4

Module 3: Relations (20hours)
Text 1: Chapter 7 excluding Sections 7.2 & 7.4

Module 4: Theory of Equations (20 hours)
Text 2: Chapter VI Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, Chapter XI Section 1

Text Books for Reference

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

2. Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata
   McGraw-Hill Publishing Company, New Delhi(Reprint 2009).
3. P.R. Halmos : Naive Set Theory, Springer.
4. Richard Johnsonbaugh; Discrete Mathematics; Pearson Education; Dorling KindersleyIndia Pvt. Ltd
5. Clifford Stien, Robert L Drysdale, KennethBogart ; Discrete Mathematics for ComputerScientists; Pearson Education; Dorling Kindersley India Pvt. Ltd

Text Books for Enrichment

1. Kenneth A Ross; Charles R.B. Wright ; Discrete Mathematics; Pearson Education;Dorling Kindersley India Pvt. Ltd
2. Ralph P. Grimaldi, B.V.Ramana; Discrete And Combinatorial Mathematics ; PearsonEducation; Dorling Kindersley India Pvt. Ltd
3. Lipschutz:Set Theory And Related Topics (2ndEdition), SchaumOutlineSeries, Tata
   McGraw-Hill Publishing Company, New Delhi
4. H.S.Hall, S.R. Knight: Higher Algebra, Surjit Publications, Delhi
5. Winfried Karl Grassman, Jean-Paul Tremblay; Logic And Discrete Mathematics A
   Computer Science Perspective ; Pearson Education; Dorling Kindersley India Pvt. Ltd

SEMESTER II				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
EN1812503	Issues that Matter	Common I -English 3	5	4
EN1812504	Savouring the Classics	Common I - English 4	4	3
	Additional Language	Common Course	4	4
HN1812503	Short stories and Novel	Common II - Hindi 2		
ML1812504	*Kavitha*	Common II- Malayalam 2		
SC1812503	Poetry/ Grammar & History of Syriac Literature	Common II –Syriac 2		
MT1812102	Analytic Geometry, Trigonometry And Differential Calculus	Core 2	4	3
ST1812203	Probability Theory	Complementary I Statistics 2	4	3
PH1812203	Mechanics & Astrophysics	Complementary II Physics 2	2	2
PH1812703	Mechanics & Astrophysics(P)	Complementary II Practical Physics 2	2	1
		Total	**25**	**20**

Course	Details				
Code	MT1812102				
Title	**ANALYTIC GEOMETRY,TRIGOMETRY AND DIFFERENTIAL CALCULUS**				
Degree	BSc				
Branch(s)	Mathematics				
Year/Semester	I/II				
Type	Core				
Credits	3	Hours /week	4	Total Hours	72

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	establishes a correspondence between geometric curves and algebraic equations	**U**	1,2
2	Recognize the equation, vertex, focus, directrix and sketch the graph of corresponding equation	**E**	1,2
3	Understand the different terms like Chord, Tangent, Normal, Othoptic locus, pole, Polar...etc and analyse the relation between this terms and different conic sections	**A**	1
4	Eliminate parameters to identify curve defined by parametric equations.	**Ap**	1
5	Understand the different terms in a given question, sketch a rough figure of corresponding problems and solve the problem in given coordinates system	**Ap**	1,2,3
6	Understand and analyze the Relations connecting Circular and hyperbolic functions	**A**	1
7	Factorization of $x^n - 1$,$x^n + 1$,$x^{2n} - 2x^n a^n cosn\theta + a^{2n}$	**Ap**	1,3
8	Summation of infinite series by $C + iS$ method	**Ap**	3
9	Find the higher order derivatives	**Ap**	3
10	Find the limit of a function which are in indeterminate form	**E**	3
11	Solve the problems using what they study.	**C**	3

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1	**CONIC SECTIONS**		
1.1	Conic Sections – Introduction	2	1, 2
1.2	Tangent and Normals of a Conic- Tangents in terms of slope of a line	2	1, 3, 5
1.3	Orthoptic Locus	1	1, 3, 5
1.4	Parametric Coordinates – Parabola	1	1, 4, 5
1.5	Parametric Coordinates – Ellipse	2	1, 4, 5
1.6	Parametric Coordinates – Hyperbola	1	1, 4, 5
1.7	Chords in terms of given points – Chord of Contact	1	1, 3, 5
1.8	Chord with a given Mid-Point	3	1, 3, 5
1.9	Equation of the polar of a given point	1	1, 3, 5
1.10	Pole of a given line	2	1, 3, 5
1.11	Conjugate lines	2	1, 3, 5
1.12	Conjugate diameters of Ellipse	2	1, 3, 5
2	**POLAR CO-ORDINATES**		
2.01	Polar Co-ordinates – Introduction	2	3
2.02	Polar Equation of a line	2	3, 4, 5
2.03	Polar Equation of Circle	2	3, 4, 5
2.04	Polar Equation of Conic	2	3, 4, 5
2.05	Polar Equations of tangents and Normals	2	3, 5
2.06	Chords of Conic Sections	3	3, 5
3	**TRIGONOMETRY**		
3.01	Circular functions of complex variables	1	6, 11
3.02	Hyperbolic functions of complex variables	1	6, 11
3.03	Relations connecting Circular and hyperbolic functions	1	6, 11
3.04	Inverse of hyperbolic functions	1	6, 11
3.05	Separation of functions of complex variables into real and imaginary parts	2	7, 11
3.06	Factorization of $x^n - 1$	2	7, 11
3.07	Factorization of$x^n + 1$	1	7, 11
3.08	Factorization of$x^{2n} - 2x^n a^n cosn\theta + a^{2n}$	2	7, 11
3.09	Summation of infinite series by $C + iS$ method – based on geometric series	1	8, 11
3.10	Summation based on binomial series	1	8, 11
3.11	Summation based on exponential series	2	8, 11
4	**DIFFERENTIAL CALCULUS**		
4.01	Higher order derivative	2	9, 11

4.02	Calculation of nth derivative. Some standard results	2	9, 11
4.03	Determination of nthderivative of rational functions	2	9, 11
4.04	The nth derivative of the product of the power of sines band cosines	2	9, 11
4.05	Leibnitz's theorem. The nth derivative of the production of two function	2	9, 11
4.06	The Indeterminate Forms 0/0	2	10, 11
4.07	The Indeterminate Forms ∞/∞	2	10, 11
4.08	The Indeterminate Forms $0.\infty$	1	10, 11
4.09	The Indeterminate Forms $\infty - \infty$	1	10, 11
4.10	The Indeterminate Forms $0^o, 1^\infty, \infty^0$	2	10, 11

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 (22 hrs)
Relevant Sections of Text 1

MODULE II: Polar Co-ordinates (15 hrs)
Relevant Sections of Text 1

MODULE III: Trigonometry (17 hrs)
Relevant Section of Text Chapter V, VI, VIII, IX

MODULE IV: Differential Calculus
(18hrs)
Text 3: Chapter 5 and Chapter 10

Text Books for Reference

1. S. K. Stein : Calculus And Analytic Geometry, McGraw Hill
2. P. K. Jain , Khalil Ahmad : Analytic Geometry of Two Dimensions ,(2ndEdition) NewAgeInternational (P) Limited Publishers
3. Thomas and Finney : Calculus and Analytic Geometry , Addison Wesley

SEMESTER III				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
EN1813505	Literature and/ as Identity	Common I-English 5	5	4
	Additional Language	Common Course	5	4
HN1813505	Poetry/Grammar and Translation	Common II -Hindi 3	3	3
ML1813507	*Drishyakalasahithyam*	Common II- Malayalam 3		
SC1813505	Prose, Grammar & Literature	Common II- Syriac 3		
MT1813103	Calcus	Core 3		
ST1813204	Probability Distribution	Complementary I Statistics 3	5	4
PH1813205	Modern Physics and Electronics	Complementary II Physics 3	3	3
PH1813705	Modern Physics and Electronics(P)	Complementary II Practical Physics 3	2	1
		Total	**25**	**20**

Course	Details				
Code	MT1813103				
Title	**CALCULUS**				
Degree	BSc				
Branch(s)	Mathematics				
Year/Semester	II/III				
Type	Core				
Credits	4	Hours/week	5	Total hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Expand a function using Taylor's and Maclaurin's series	U, A	1,3
2	Determine the length of an arc	E	1,3
3	Learn about concavity, points of inflexion, curvature, evolutes and involutes	U	1,3,6
4	Conceive the concept of asymptotes and obtain their equations and learn about envelopes	U, C	1,6
5	Learn about partial derivatives and its applications	R, U	1,3
6	Calculate the extreme values of the function by examining the functions partial derivatives	Ap, An	3,4
7	Evaluate the volumes of solids using cross-sections	E	3,4,6
8	Calculate the length of an arc of a curve when whose equations are given in parametric and polar form	Ap	3,4
9	Evaluate the area of surfaces of revolution	E	3,4
10	Determine the area and volume by applying the techniques of double and triple integrals	Ap, E	3,6,7

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Differential Calculus**		
1.1	Expansion of functions using Maclaurin's theorem	2	1
1.2	Expansion of functions using Taylor's theorem	3	1
1.3	Concavity and points of inflexion	2	3
1.4	Length of arc as a function derivatives of arc with problems	2	2
1.5	Radius of curvature - Cartesian equations - definition, formula and problems	3	3
1.6	Centre of curvature - definition, concept and problems	2	3
1.7	Evolutes - concepts and problems	2	3
1.8	Properties of evolutes	2	3
1.9	Involutes - explanations with problems	2	3
1.10	Asymptotes	2	4
1.11	Envelopes	2	4
1.12	Problems related with the above areas	3	1,2,3,4
2.0	**Partial Differentiation**		
2.1	Partial derivatives of a function of two variables	1	5
2.2	Partial derivatives of a function of more than two variables	1	5
2.3	Partial derivatives and continuity	1	5
2.4	Partial derivatives of higher order	1	5
2.5	Differentiability	1	5
2.6	The chain rule for functions of two variables	1	5
2.7	The chain rule for functions of three variables	1	5
2.8	The chain rule for functions defined on surfaces	1	5
2.9	Implicit differentiation	1	5
2.10	Derivative tests for local extreme values	2	6
2.11	Absolute maxima and minima on closed bounded regions	2	6
2.12	Constrained maxima and minima	1	6
2.13	The method of Lagrange multipliers	1	6
2.14	Lagrange multipliers with two constraints	1	6
2.15	Problems related to above concepts	2	5, 6
3.0	**Integral Calculus**		
3.1	Volumes by slicing and rotation about an axis	2	7
3.2	The Disk method	2	7

3.3	The Washer method	2	7
3.4	Volumes by cylindrical shells	2	7
3.5	Length of a parametrically defined curve	2	8
3.6	Length of a curve $y = f(x)$	2	8
3.7	Surface area of revolution	2	9
3.8	Surface area of revolution for parametrized curves	2	9
3.9	Problems to find volumes	2	7
3.10	Problems to find surface area	2	9
4.0	**Multiple Integrals**		
4.1	Double integrals over rectangles	2	10
4.2	Fubini's theorem for calculating double integrals	2	10
4.3	Double integrals over bounded non rectangular regions	2	10
4.4	Properties of double integrals	1	10
4.5	Area by double integration	2	10
4.6	Double integrals in polar form	2	10
4.7	Changing Cartesian integrals into polar integrals	2	10

Text Books

1. Shanti Narayan, P.K.Mittal: Differential Calculus, SChand and Company
2. George B Thomas Jr: Thomas' Calculus (12thEdition), Pearson.

Module I: Differential Calculus (27 hrs)

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)

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)

Text 2: Chapter 6 (Section 6.1 to 6.4 only (Pappus Theorem excluded)

Module IV: Multiple Integrals (25 hrs)

Text 2: Chapter 15 (Sections 15.4 and 15.6 are excluded)

Text Books for Reference

1. T.M Apostol- Calculus Volume I & II(Wiley India)
2. .Widder-Advanced Calculus, 2nd edition
3. Shanti Narayan, P.K. Mittal- Integral Calculus- (S. Chand & Co.)

Text Books for Enrichment

1. Howard Anton et. Al. Calculus, Seventh Edition, John Wiley
2. K.C. Maity& R.K Ghosh- Differential Calculus(New Central Books Agency)
3. K.C. Maity& R.K Ghosh- Integral Calculus(New Central Books Agency)

SEMESTER IV				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
EN1814507	Illuminations	Common I -English 6	5	4
	Additional Language	Common Course	5	4
HN1814506	Drama and Long Poem	Common II- Hindi 4	3	3
ML1814508	*Malayala Gadyarachanakal*	Common II- Malayalam 4		
SC1814506	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4		
MT1814104	Vector Calculus,Theory of Numbers and Laplace Transforms	Core 4		
ST1814206	Statistical Inference	Complementary I Statistics 4	5	4
PH1814207	Optics and Electricity	Complementary II Physics 4	3	3
PH1814707	Optics and Electricity(P)	Complementary II Physics practical 4	2	1
		Total	**25**	**20**

Course	Details				
	MT1814104				
Title	**VECTOR CALCULUS, THEORY OF NUMBERS AND LAPLACE TRANSFORMS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	II/IV				
Type	Core				
Credits	4	Hours/week	5	Total Hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be*	Cognitive Level	PSO No.
1	Define vector equation for lines and planes	R	1
2	Analyze vector functions to find limits, derivatives, tangent lines, integrals, arc length, curvature, torsion	An	1,3,6
3	Compute limits and derivatives of functions of two and three variables	Ap	1,3
4	Differentiate vector fields	An	1,3
5	Determine gradient vector fields and find potential functions	E	1,3,6
6	Calculate work, circulation, flux and verify path independenc	Ap, E	3,6
7	Evaluate line integrals, surface area and surface integrals	E	3,6
8	Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and	R, U	1,3,4
9	Produce rigorous arguments (proofs) centered on the material of number theory, most notably in the use of	C	2,4,6
10	Discuss Laplace transforms, its properties and analyze transforms of derivatives, integrals to solve	U, Ap, An	3,4,6

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0			
1.1	A vector equation and Parametric equations for lines	2	1
1.2	Equation for a plane in space	2	1
1.3	Vector functions	1	2
1.4	Limits and continuity	2	2, 3
1.5	Derivatives and motion	1	2, 3
1.6	Vector functions of constant length	1	2
1.7	Integrals of vector functions	2	2
1.8	Arc length along a space curve	2	2
1.9	Unit tangent vector	2	2
1.10	Curvature and unit normal vector	2	2
1.11	Curvature and normal vectors for space curves	2	2
1.12	Torsion and the unit binormal vector	2	2
1.13	Tangential and normal components of acceleration	1	2
1.14	Directional derivatives and gradient vectors	2	2, 3
1.15	Tangent planes and normal lines	1	2
2.0	**Vector Integration**		
2.1	Line integrals	2	7
2.2	Vector Fields	1	4
2.3	Gradient fields	1	4
2.4	Work	2	6
2.5	Circulation and Flux	2	6
2.6	Path Independence	2	6
2.7	Conservative Fields (Proofs of theorems excluded)	2	4
2.8	Potential Functions (Proofs of theorems excluded)	2	5
2.9	Exact differential forms	1	5
2.10	Green's theorem in the plane (Statement & problems only)	2	7
2.11	Divergence	1	7
2.12	Surface Area	1	7
2.13	Surface Integrals	1	7
2.14	Parameterisations of surfaces	2	7
2.15	Stokes' theorem (Statement & simple problems only)	3	7
2.16	Divergence theorem (Statement & problems only)	3	7
2.17	Problems	2	6, 7
3.0	**Theory of Numbers**		
3.1	Basic properties of congruence	2	8
3.2	Fermat's theorem - proof and problems	3	8, 9
3.3	Wilson's theorem - proof and problems	3	8, 9
3.4	Euler's phi function	3	8
3.5	Problems	2	8
4.0	**Laplace Transforms**		
4.1	Laplace transform - definition and transforms	2	10

	simple functions		
4.2	Linearity of Laplace transform	1	10
4.3	First shifting theorem	2	10
4.4	Existence of Laplacetransform	1	10
4.5	Transforms of derivatives	2	10
4.6	Solution of ordinary differential equation	2	10
4.7	Solution of initial value Problem	2	10
4.8	Laplace transform of the integral of a function	2	10
4.9	Convolution and Integral equations	2	10
4.10	Problems	2	10

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)

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)

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

Module III: Theory of Numbers (15 hrs)

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)

Text 3 (Sections 6.1, 6.2 and 6.5

Text Books for Reference

1. Anton, Bivens and Davis, Calculus (10th Edition) International Student Version, John Wiley & sons 2015
2. David M. Burton, Elementary Number Theory (7th Edition), Mc Graw Hill Education
3. Shanti Narayan, P.K Mittal – Vector Calculus (S. Chand)
4. Merle C. Potter, J. L. Goldberg, E. F. Aboufadel – Advanced Engineering Mathematics (Oxford)
5. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi
6. **Ghosh, Maity – Vector Analysis (New Central books)**

SEMESTER V				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
MT1815105	Mathematical Analysis	Core 5	6	4
MT1815106	Differential Equations	Core 6	6	4
MT1815107	Abstract Algebra	Core 7	5	4
MT1815108	Human Rights and Mathematics for Environmental Studies.	Core 8	4	4
MT1815401	History of Indian mathematics	Open Course	4	3
MT1815402	Applicable Mathematics			
MT1815403	Mathematical Economics			
		Total	**25**	**19**

Course	Details				
Code	MT1815105				
Title	**MATHEMATICAL ANALYSIS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Core				
Credits	4	Hours/week	6	Total Hours	108

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Determine the basic topological properties of subsets of the real numbers	An	1,3
2	Describe the real line as a complete, ordered field	R, U	1
3	Learn and discuss about intervals and its characterizations	R, U	1,3
4	Describe about sequences, limit of a sequence and its applications	U	1,3,4
5	Classify some types of sequences and properties	Ap	2,3
6	Identify the nature of sequences such as convergence, divergence, etc.	An	1,3
7	Explain about infinite series and its nature	U	1
8	Choose tests and analyze the convergence of a series	Ap, An	3,6
9	Discuss about the absolute convergence of a series	U	1,6
10	Demonstrate limit of functions, its properties and types	U	3,6

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Real Numbers**		
1.1	Finite and infinite sets	1	1
1.2	Countable sets	1	1
1.3	Cantor's set	1	1
1.4	Algebraic properties of R	2	1
1.5	The order properties of R	2	2
1.6	Inequalities	2	1
1.7	Absolute value and real line	2	1
1.8	The completeness property of R	2	2
1.9	Applications of supremum property	1	1
1.10	The Archimedean property	2	1
1.11	The existence of $\sqrt{2}$	1	1
1.12	Density of Rational numbers in R	1	1
1.13	Intervals	2	3
1.14	Characterization of Intervals	1	3
1.15	Nested Intervals	2	3
1.16	The uncountability of R	1	1
2.0	**Sequences**		
2.1	Sequences - Introduction	2	4
2.2	The limit of a sequence	2	4
2.3	Tails of sequences	1	4
2.4	Limit theorems	3	4
2.5	Monotone sequences	2	5
2.6	The calculation of square roots	1	4
2.7	Euler's number	1	4
2.8	Subsequences	2	5
2.9	The existence of monotone subsequences	1	5
2.10	The Bolzano-Weierstrass theorem	2	5
2.11	Limit superior and limit inferior	2	5
2.12	The Cauchy criterian	2	6
2.13	Properly divergent sequences	2	6
3.0	Series		
3.1	Introduction to infinite series	1	7
3.2	Comparison tests	2	8
3.3	Absolute convergence	1	9
3.4	Grouping of series	1	7
3.5	Rearrangements of series	1	7
3.6	Tests for absolute convergence	2	8
3.7	The root and ratio tests	3	8
3.8	The integral test	1	8
3.9	Raabe's test	2	8
3.10	Test for non absolute convergence	1	8
3.11	Alternating series	2	7
3.12	The Dirichlet and Abel tests	3	8

4.0	Limits		
4.1	Limits of functions	2	10
4.2	The definition of the limit	1	10
4.3	Sequential criterian for limits	2	10
4.4	Divergence criteria	3	10
4.5	Limit theorems	3	10
4.6	Some extensions of the limit concept	3	10
4.7	Infinite limits	2	10
4.8	Limits at infinity	2	10

Text Books

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

MODULE I: REAL NUMBERS **30hours**

Chapter 1: Section 1.3 and Chapter 2 : Sections 2.1, 2.2,2.3,2.4,2.5

MODULE II: SEQUENCES **30 hours**

Chapter 3 : Sections 3.1,3.2,3.3,3.4, 3.5,3.6

MODULE III: SERIES **24 hours**

Chapter 3 : Section 3.7, Chapter 9 : Sections 9.1,9.2,9.3

MODULE IV: LIMITS **24 hours**

Chapter 4 : Sections 4.1,4.2,4.3

Text Books for Reference

1. Richard R Goldberg - Methods of real Analysis, 3rd edition , Oxford and IBM Publishing Company (1964) 2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)
3. Elias Zako - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)

Text Books for Enrichment

1. J.M Howie - Real Analysis, Springer 2007.
2. K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.
3. S.C Malik, Savitha Arora - Mathematical Analysis, Revised Second Edition

Course	Details				
Code	MT1815106				
Title	**DIFFERENTIAL EQUATIONS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Core				
Credits	4	Hours/week	6	Total Hours	108

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Understands different types of differential equations	U	1
2	Solve first order linear differential equation	Ap	3
3	Calculate Orthogonal trajectories of families of curves	Ap	3,4
4	Solve linear differential equations of second order (and higher)	Ap	3,4
5	Find power series solutions of differential equations	Ap	3
6	Origin of first order partial differential equations	U	1,3
7	Solve pde Linear equations of the first order	Ap	3,4,7

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**What is a differential equation**		
1.1	The nature of solutions of differential equation	2	1
1.2	Separable equations	3	2
1.3	First order linear equations	3	2
1.4	Exact equations,	3	2
1.5	Orthogonal trajectories and families of curves	3	3
1.6	Homogeneous equations	3	2
1.7	Integrating factors	3	2
1.8	Reduction of order-dependent variable missing	3	2

1.9	Reduction of order-independent variable missing	3	2
2.0	**Second order linear equations**		
2.1	Second order linear equations with constant coefficients	3	4
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	4
2.5	The use of a known solution to find another	4	4
2.6	Vibrations and oscillations	3	4
2.7	Higher order linear equations	4	4
3.0	**Power Series solutions and special functions**		
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
4.0	**Partial Differential equations**		
4.1	Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	4	7
4.2	Pfaffian differential forms and equations	4	7
4.3	Solution of Pfaffian differential equations in three variables : variables separable	4	7
4.4	Solution of Pfaffian differential equations in three variables : one variable separable	4	7
4.5	Solution of Pfaffian differential equations in three variables : homogeneous Equations	4	7
4.6	Origin of first order partial differential equations	5	6
4.7	Linear equations of the first order	5	7

Text Books

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

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

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

Text 1: Chapter 1 (Sections 1.2 to 1.9)

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

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

Method IV: Partial Differential equations (30 hrs.)
Text 2: Chapter 1 (Section 3, 5 (no proof of theorem-5) & section 6 (a, b, c and d only) and Chapter 2 (Section 1, 2 and 4 (no proof of theorem 2 and theorem 3)

Course	Details				
Code	MT1815107				
Title	**ABSTRACT ALGEBRA**				
Degree	B. Sc				
Branch(s)	Mathematics				
Year/Semester	III/ V				
Type	Core				
Credits	4	Hours/week	5	Total Hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Analyze properties implied by the definitions of groups and rings,	E	1,2
2	Use various canonical types of groups (including cyclic groups and groups of permutations) and canonical types of rings	E	1
3	Analyze and demonstrate examples of subgroups, normal subgroups and quotient groups,	A	1,3
4	Analyze and demonstrate examples of ideals and quotient rings	Ap	1,3,6
5	Solve problems from the Algebra related to Group Theory and basic Ring Theory.	C	3
6	Solve problems in Group Theory including permutation groups, abelian groups, homomorphism theorems and in Ring Theory including ideals, factor rings, and isomorphism theorems.	C	3,4,5
7	Use the concepts of isomorphism and homomorphism for groups and rings	Ap	6,7
8	Produce rigorous proofs of propositions arising in the context of abstract algebra.	A	6,7

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1	**GROUPS AND SUBGROUPS**		
1.1	Groups and subgroups-Binary operations	3	1, 5, 8
1.2	Isomorphic binary structures	3	6, 7
1.3	Groups-definition and examples	2	1, 5, 8
1.4	elementary properties of groups	3	8
1.5	finite groups and group tables	2	1, 3
1.6	Subgroups	2	1, 3
1.7	cyclic subgroups	3	2, 5
1.8	cyclic groups	2	2, 5
1.9	elementary properties of cyclic groups	3	2, 5, 6, 8
2	**GROUPS OF PERMUTATIONS AND THEOREM OF LAGRANGE**		
2.1	Permutations	3	2, 6, 8
2.2	Cosets and direct products	4	1,2, 6, 8
2.3	groups of permutations	3	2, 6, 8
2.4	Cayley's theorem	3	2, 6, 8
2.5	Orbits	3	1, 8
2.6	cycles and the alternating groups	3	1, 6
2.7	cosets and the theorem of Lagrange	4	1, 2, 6, 8
3	**HOMOMORPHISMS AND FACTOR GROUPS**		
3.1	Homomorphisms,	2	2, 3, 6
3.2	properties of homomorphisms	3	1, 8
3.3	Factor groups	2	3, 8
3.4	The Fundamental Homomorphism theorem	2	1, 8
3.5	normal subgroups	3	2, 3, 7
3.6	Inner automorphisms	3	2, 3, 7
3.7	simple groups	3	2, 3, 7, 8
4.0	**RINGS AND FIELDS, INTEGRAL DOMAINS**		
4.1	definitions and basic properties of Ring and Field	3	1, 2
4.2	Homomorphisms of Ring	2	4, 5, 7, 8
4.3	Isomorphisms of Ring	2	4, 5, 7, 8
4.4	divisors of zero and cancellation	2	4, 5, 7, 8
4.5	Integral domains	2	2, 4, 5, 7, 8
4.6	characteristic of a ring	2	4, 5, 7, 8
4.7	Ideals and factor rings	2	4, 5, 7, 8
4.8	Homomorphisms and factor rings	3	2, 4, 5, 7, 8

Text Books

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

Module I **(25 hrs)**

Part I: Sections 2, 3, 4, 5 and 6

Module II: **(25 hrs)**

Part II: Sections 8, 9, 10, 11.1 and 11.2

Module III **(20 hrs)**

Part III: Sections 13, 14, 15.14 to 15.18

Module IV **(20 hrs)**

Part IV: Sections 18 and 19 and Part V: Section 26.

Text Books forReferences

1. I.N. Herstein - Topics in Algebra
2. Joseph A Gallian - Contemporary Abstract Algebra, Narosa Pub. House
3. Artin – Algebra , PHI

Course	Details				
Code	MT1815108				
Title	**HUMAN RIGHTS AND MATHEMATICS FOR ENVIRONMENTAL STUDIES**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Core				
Credits	4	Hours/week	4	Total hrs	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To define the scope and importance of Multidisciplinary nature of environmental studies, the natural resources and ecosystem.	U	4
2	Draw the attention on Biodiversity, Environmental pollution, social issues and environmental acts. Extend the necessity of Environmental Education and to understand how their decisions and actions affect the environment.	R	5
3	To find mathematical patterns from the nature	An	1,4
4	To understand the basic concepts related to Fibonacci numbers &Golden Ratio	U	1,4
5	Illustrate the above concepts with the help of real life examples	Ap	4
6	Concepts of human rights, its development, its contribution, human right related organisations, human right in India	R	5
7	Draw the attention of different types of Environmental pollution	U	5
8	Explain the necessity of environmental education and actions to protect environment .	Ap	5
9	Implementing the sense of awareness among the students about the environment and its various problems.	C	5
10	Identify the issues related to society due to environmental pollution	An	5
11	Organising environmental protection awareness classes and programmes in the society	E	5

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Multidisciplinary nature of environmental studies** Definition, scope and importance Need for public awareness.	2	1
1.1	**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	1
1.2	**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	1
2.0	**Biodiversity and its conservation** • 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	2,7,8,9
2.1	**Environmental Pollution** Definition	8	2,3

	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.		
2.2	**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	3,4
3.0	**Fibonacci Numbers in nature**	**10**	
3.1	The rabbit problem	1	3,5
3.2	Fibonacci numbers	1	3,5
3.3	Recursive definition	1	3,5
3.4	Lucas numbers	1	3
3.5	Different types of Fibonacci and Lucas numbers	1	3
3.6	Fibonacci numbers in nature : Fibonacci and the earth • Fibonacci 29 and flowers • Fibonacci and sunflower • Fibonacci, pinecones, artichokes and pineapples • Fibonacci and bees	1	5
3.7	Fibonacci and subsets	1	3
3.8	Fibonacci and sewage treatment	1	3
3.9	Fibonacci and atoms	1	3

3.10	Fibonacci and reflections Fibonacci, paraffins and cycloparaffins Fibonacci and music Fibonacci and compositions with 1's and 2's	1	5
4.0	**Golden Ratio**	**10**	
4.1	The golden ratio	1	4
4.2	Mean proportional	1	4
4.3	A geometric interpretation	1	4,5
4.4	Ruler and compass construction	1	4,5
4.5	Euler construction Generation by Newton's method	1	4
4.6	The golden ratio revisited	1	4
4.7	Golden ratio by origami	1	4
4.8	The golden ratio and human body	1	4,5
4.9	Differential equations	1	4
4.10	Gattei's discovery of golden ratio ,Centroids of circles	1	4,5
5.0	**Human rights**	**8**	
5.1	**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).	2	6
5.2	**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	3	6
5.3	**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 fisheries,Sand mining etc.	3	6

Text Book

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

Books for Reference

1. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press,IInd Edition 2013 (TB)
2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001Environmental Encyclopedia, Jaico Publ.
4. . Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb(Ref)
7. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
8. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
12. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
13. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
14. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
15. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
16. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)
17. (M) Magazine (R) Reference (TB) Textbook

Text Books for Enrichment

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)
3. Law Relating to Human Rights, Asia Law House,2001.
4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
5. S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998.2011.
6. Sudhir Kapoor, Human Rights in 21st Century,Mangal Deep Publications,Jaipur,2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004

Course	Details				
Code	MT1815401				
Title	**HISTORY OF INDIAN MATHEMATICS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Open Course				
Credits	3	Hours/week	4	Total Hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To introduce the students the history of ancient Indian Mathematics	U	1,2
2	Development of Mathematical knowledge	U	2,4
3	To aquire knowledge of Ancient Indian Mathematics	Ap,Ev	1,3
4	Developing the passion towards Mathematics	Ap	3,4,5,6
5	Enrich the students with mathematical concepts	Ev	1,3
6	Motivate students to develop interest in Mathematics through notable contributions to our nation	R,Ap	4,5
7	Understand transmission of Kerala through Mathematics	Ap	1,3

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Introduction**	12	
1.1	The History of Mathematics	2	1,2
1.2	Alternative perspectives and justification	5	2, 3
1.3	Development of Mathematical knowledge	2	1,2
1.4	Mathematical signposts and transmissions across the ages	4	1,2,3,7
2.0	**Ancient Indian Mathematics**	24	
2.1	A restatement of intent and a brief historical sketch	5	2,3,4
2.2	Maths from bricks: Evidence from the Harappan culture	5	5,6
2.3	Mathematics from the Vedas Early Indian Numerals and their development	4	1,2,3,4
2.4	Jaina Mathematics	4	1,2,3,4,6,7
2.5	Mathematics on the eve of the classical period	6	1,2,3,4,6,7
3.0	**Indian Mathematics: The Classical Period and After**	20	
3.1	Major Indian mathematician-Astronomers	4	1,4,
3.2	Indian Algebra	5	1,5,
3.3	Indian Trigonometry	6	1,2,3,5
3.4	Contributionsof Mathematics	5	1,2,3,4,6,7
4.0	**A Passage to Infinity: The Kerala Episode**	16	
4.1	The actors	7	1,6,7
4.2	Transmission of Kerala Mathematics	9	1,6,7

Text Book:

1 The Crest of the Peacock - 3rd Edition, George Geeverghese Joseph. Princeton University Press, Princeton & Oxford.

Module I: Introduction (12 hrs.)
Chapter 1.

Module II: Ancient Indian Mathematics (24 hrs.)
Chapter 8

Module III: Indian Mathematics: The Classical Period and After (20 hrs.)
Chapter 9.

Module IV: A Passage to Infinity: The Kerala Episode (16 hrs.)
Chapter 10
Text Books for Reference

1. Kim Plofker ; Mathematics In India ; Hndustan Book Agency

2. History of Science and Technology in ancient India: the beginnings, D.
3. History of Hindu Mathematics, B. Datta and A.N. Singh, Bharatiya Kala,Prakashan N.Delhi 2001 (reprint**)**
4. Studies in the History of Indian Mathematics (Culture and History of Indian Mathematics) C. S. Seshadri (Editor), Hindustan Book Agency (15 August 2010)
5. An introduction to the history of Mathematics 5th Edn, H. Eves. Saunders,Philadelphia 1983.
6. A history of Mathematics, C.B. Boyer. Princeton University Press, NJ, 1985.

Course	Details				
Code	MT1815402				
Title	**APPLICABLE MATHEMATICS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Open Course				
Credits	3	Hours/week	4	Total Hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To understand types of numbers and to improve arithmetic skill	Ap	2,3
2	Understands basic mathematics. With emphasis on algebra	U	2,3
3	Familiar with short cut methods to solve problems.	Ap,Ev	2,3
4	To calculate percentage	Ap	2,3
5	To calculate interest	Ev	2,3
6	To deal with problems that requires the idea of permutation and combination	An	2,3
7	Acquire knowledge in trigonometry	Ap	2,3
8	To differentiate simple functions	U	2,3
9	Learns elementary mensuration.	Ev	2,3
10	Equip the students with mathematical concepts so that they can perform well in different competitive examinations	C	2,3,4

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0		18	
1.1	Types of numbers	2	1,10
1.2	HCF of integers LCM of integers	2	2, 10
1.3	Fractions	3	1,2,10
1.4	Simplifications(VBODMAS)	2	1,2,3,10
1.5	Squares and square roots	1	1,2, 10
1.6	Ratio and proportion	2	1,2,3, 10
1.7	Percentage	3	1, 3,4,10
1.8	Profit and loss	2	1,3 ,10
2.0		18	
2.1	Quadratic Equations	3	2,3,10
2.2	Permutation and combination-simple application	4	6,10
2.3	Introduction to trigonometry	2	7,10
2.4	Values of trigonometric ratios	2	3,7,10
2.5	Heights and distances	4	3,7,10
3.0		18	
3.1	Simple interst	2	1,5,10
3.2	Compound interest	3	1,5,10
3.3	Time and work	3	1,2,3,10
3.4	Work and wages	2	1,2,3,10
3.5	Time and distance	2	1,2,3,10
3.6	Exponential series	2	10
3.7	Logarithmic series	2	10
4.0		18	
4.1	Area and perimeter of polygons	2	9,10
4.2	Elementary algebra	2	2,10
4.3	Monomial	1	2,10
4.4	binomial	1	2,10
4.5	polynomial	1	2,10
4.6	Simple factorization of quadratic and cubic polynomial	2	2,10
4.7	Differentiation – standard results	3	8,10
4.8	Product rule	2	8,10
4.9	Quotient rule	2	8,10

Text Books for Reference

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)44
4. Calculus Volume I, S. Narayanan & T.K. Manikavachagam Pillai – S. Viswanathan (Printers & Publications) Pvt.Ltd
5. S Narayaynan, TK Manikavachagam Pillai : Calculus Volume I, S Viswanathan Printers and publications Pvt. Ltd.

Course	Details				
Code	MT1815403				
Title	**MATHEMATICAL ECONOMICS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/V				
Type	Open Course				
Credits	3	Hours/week	4	Total Hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To understand the meaning of demand and quantity	U	1,2,3
2	To acquire the relativity between Demand and Supply	U	2,3
3	Develop skill to draw Demand-Supply curve	Ap,C	3,4
4	To calculate market equilibrium	Ap	3,4,6
5	To measure price elasticity	Ap,Ev	3,4,
6	To deal with problems of Cost and Revenue Functions	Ap,Ev,An	2,3,4
7	Expertising in the Theory of Consumer Behaviour	Ap	3,4,5
8	Applications of Derivatives	Ap	3,4,5
9	To acquire concepts of optimization	U,Ap,Ev	2,3
10	To enhance partial Differentiation and Total Derivatives	U,Ap,C	4,6,7
11	To evaluate Marginal productivity and Income determination	Ev,Ap,An	3,4,5

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Demand and Supply Analysis**	16	
1.1	Utility and demand	4	1,2
1.2	market demand curve	3	2, 3
1.3	demand function and demand curve	5	1,2,3
1.4	Supply functions and supply curve	4	1,2,3
2.0	**Cost and Revenue Functions**	15	
2.1	Cost function	8	6
2.2	Marginal and Average Revenue Functions	7	6
3.0	**Theory of Consumer Behaviour**	15	
3.1	Cardinal utility analysis	4	6,7
3.2	Law of diminishing marginal utility	4	6,7
3.3	Law of equi-marginal utility	1	6,7
3.4	Indifference curves and Maps	4	3,6,7
3.5	Properties of indifference curves	2	3,6,7
4.0	**Economic Applications of Derivatives**	26	
4.1	Economic Applications of Derivatives	5	9,10
4.2	Optimizationof multivariable functions	6	8, 9,10
4.3	Constrained optimization with Lagrange multipliers	5	8, 9
4.4	Marginal productivity	6	9,10,11
4.5	Optimization of multivariable function in Economics	4	8,10

Text books:

1. H.L. Ahuja : Principles of Micro Economics, 15th Revised Edition, S. Chand

2. Edward T. Dowling: Introduction to Mathematical Economics, Schaum's Outline Series, Third edition, TMH.

Module I : Demand and Supply Analysis **(16 hrs)**

Relevant sections chapters 5 and 7 of Text -1

Module II: Cost and Revenue Functions **(15 hrs)**

Relevant sections of chapter 19 & 21 of Text - 1

Module III: Theory of Consumer Behaviour **(15 hrs)**

Relevant sections of chapters 9 and 11 of Text -1

Module IV: Economic Applications of Derivatives **(26 hrs)**

Chapter 4 – Sections 4.7 and 4.8; chapter 5 and chapter 6 sections 6. 1 to 6.5 – of text 2

Text Books for Reference

1. Singh, Parashar, Singh --Econometrics & Mathematical Economics, S. Chand & Co. 1997.
2. R.G.D. Allen - Mathematical Analysis for Economists, Macmillan, ELBS.
3. Edward T. Dowling - Introduction to Mathematical Economics, Third edition, Schaum's

Outline Series, TMH.

4. Henderson & Quandt - Microeconomic Theory: A Mathematical Approach, 3rdEdition, TMH.
5. Taro Yamane - Mathematics for Economists: An elementary survey. Second Edition, PHI.
6. Srinath Baruah - Basic Mathematics and its Application in Economics, Macmillan.

SEMESTER VI				
Course Code	**Title of the Course**	**Course Category**	**Hours / week**	**Credits**
MT1816109	Real Analysis	Core 9	5	4
MT1816110	Graph Theory and Metric spaces	Core 10	6	4
MT1816111	Complex Analysis	Core 11	5	4
MT1816112	Linear Algebra	Core 12	5	4
MT1816301	Operations Research	Choice Based Course (Elective)	4	3
MT1816302	Basic Programming in Python & typesetting in La TeX			
MT1816303	Numerical Analysis			
MT1816801	Project		1	2
		Total	**25**	**21**

Course	Details				
Code	MT1816109				
Title	**REAL ANALYSIS**				
Degree	B. Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Core				
Credits	4	Hours/week	5	Total Hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To understand the concept of continuity and uniform continuity of functions	u	1,4,6,
2	To analyze the various properties of continuous functions	An	6,7
3	To understand the definition, meaning and significance of derivatives	U	1,6,7
4	To apply theorems on differentiation	Ap	3,4,6
5	Define Reimann Integrals and understand its geometric interpretation	U,An	6,7
6	Evaluate Reimann Integrals	E	3,6,7
7	Define sequence and series of functions	U	6
8	To apply the properties of uniformly convergent sequences and series	Ap	3,6,7

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Continuous Functions**	**30**	**1,2,3,4, 5,6,7,8**
1.1	Continuous Functions	7	1,2
1.2	Combinations of continuous functions	3	2
1.3	Continuous functions on Intervals	5	2
1.4	Uniform continuity	9	1,2
1.5	Monotone Functions	3	2
1.6	Inverse Functions	3	2
2.0	**Differentiation**	**30**	**3,4**
2.1	The Derivative	10	1,2
2.2	The Mean Value Theorem	5	2
2.3	L'Hospital Rules	9	2
2.4	Taylor's Theorem	6	2
3.0	**The Reimann Integral**	**24**	**5,6**
3.1	The Reimann integral	11	5,6
3.2	ReimannIntegrable Functions	9	5,6
3.3	The Fundamental Theorem	4	6
4.0	**Sequences and Series of Functions**	**24**	**7,8**
4.1	Point-wise convergence	6	7,8
4.2	Uniform convergence	8	7,8
4.3	Interchange of Limits	4	8
4.4	Series of Functions	6	8

Text Book

1. Introduction to Real analysis-Robert G.Bartle and Donald R.Sherbert(3rd edition)John Wiley & Sons
2.

MODULE I: CONTINUOUS FUNCTIONS **30 hours**

Chapter 5: Sections 5.1,5.2,5.3,5.4,5.6

MODULE II: DIFFERENTIATION **30 hours**

Chapter 6: Sections 6.1,6.2,6.3,6.4

MODULE III: THE REIMANN INTEGRAL **24 hours**

Chapter 7: Sections 7.1,7.2,7.3

MODULE IV: SEQUENCES AND SERIES OF FUNCTIONS **24 hours**

Chapter 8: Sections 8.1,8.2, Chapter 9: Section 9.4

Text Books for Reference

1. Richard R.Goldberg-Methods of Real Analysis,3rdedition,Oxford and IBM Publishing company(1964)
2. Shanti Narayan-A Course of Mathematical Analysis-S.Chand and Co.Ltd(2004)
3. Elias Zako-Mathematical Analysis,Vol 1,Overseas Press,New Delhi(2006)
4. J.M Howie-Real analysis,Springer(2007)
5. K.A Ross-Elementary Real Analysis,Springer,Indian Reprints
6. S.C Malik,Savitha Arora,-Mathematical Analysis,Revised Second Edition

Course	Details				
Code	MT1816110				
Title	**GRAPH THEORY AND METRIC SPACES**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Core				
Credits	4	Hours/week	6	Total Hours	108

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Describe various aspects related to graphs	R	1
2	Recognize properties of graphs	R	1
3	Model and solve real-world problems using graphs and trees, both quantitatively and qualitatively	Ap	3,4,7
4	Deal with various examples of metric spaces	U	1,3
5	Examine that a function is a metric or not	An	1,3
6	Show that a set in a metric space is open and/or closed	Ap	1,3
7	Learn about Cantor's set	U	1,6
8	Analyze a sequence in a metric space is convergent or not	An	1,3
9	Examine the completeness of a metric space	Ap	1,3
10	Investigate a function between metric spaces is continuous or not	An	1,3,6

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Graph Theory**		
1.1	An introduction to graphs	2	1
1.2	Definition of a graph	3	1
1.3	More definitions	4	1
1.4	Vertex degrees	4	1
1.5	Subgraphs	5	1
1.6	Paths and cycles	5	1
1.7	The matrix representation of graphs	5	1
2.0	**Graph Theory**		
2.1	Trees - Definitions	3	1
2.2	Simple properties	3	2
2.3	Bridges	3	1
2.4	Spanning trees	5	2
2.5	Cut vertices and Connectivity	5	2
2.6	Euler's Tours	3	2
2.7	The Chinese postman problem	2	3
2.8	Hamiltonian graphs	4	2
2.9	The travelling salesman problem	2	3
3.0	**Metric Spaces**		
3.1	Metric Spaces - definition and some examples	4	4, 5
3.2	Open sets	4	6
3.3	Closed sets	4	6
3.4	antor set	3	7
4.0	**Metric Spaces**		
4.1	Convergence	5	8
4.2	Completeness	5	9
4.3	Continuous mappings	5	10

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)**

Text 1: Chapter 1 (Sections 1.1, 1.3 to 1.7)

Module II: Graph Theory **(30 Hrs)**

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)**

Text 2: Chapter 2 (sections 9, 10 and 11).

Module IV: Metric spaces **(24 Hrs)**

Text 2: Chapter 2 (Sections 12 and 13).

Text Books for Reference

1. Douglas B West Peter Grossman - Introduction to Graph Theory
2. S. Bernard and J.M Child - Higher Algebra, AITBS Publishers, India,2009

Text Books for Enrichment

1. R. Balakrishnan, K. Ranganathan - A textbook of Graph Theory, Springer International Edition
2. S. Arumugham, S. Ramachandran - Invitation to Graph Theory, Scitech. Peter Grossman,

Course	Details				
Code	MT1816111				
Title	**COMPLEX ANALYSIS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Core				
Credits	4	Hours/week	5	Total Hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Identify analytic functions, harmonic functions and elementary functions	U	1
2	Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations	U,R	1
3	Evaluate integrals along a path in the complex plane	R,U,Ap	3
4	Understand the statement of Cauchy's Theorem	U	1,6
5	Determining the nature of singularities and calculating residues	R,U,An	3,6
6	Compute the Taylor and Laurent expansions of simple functions	U,Ap,E	6,7
7	Use the Cauchy-Residue Theorem to evaluate integrals and sum series	U,Ap,E	3,6,7
8	Analyze the continuity of a function and explain limit of a complex valued function	An,U	6,7
9	Explain the convergence of sequences and series	R	6,7

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**ANALYTIC FUNCTIONS**	**28**	
1.1	Functions of a complex variable	1	8
1.2	Limits Theorems on limits	2	8
1.3	Continuity	2	8
1.4	Derivatives , Differentiation formulas	2	2
1.5	Cauchy-Riemann equation	3	2
1.6	Sufficient condition for differentiability	2	2
1.7	Analytic functions Examples	4	1
1.8	Harmonic functions	4	1
1.9	Elementary functions	2	1
1.10	The exponential function	1	1
1.11	Logarithmic function Complex exponents	3	1
1.12	Trigonometric functions Hyperbolic functions Inverse trigonometric and hyperbolic functions	2	1
2.0	**INTEGRALS**	**25**	
2.1	Derivative of functions	1	3
2.2	Definite integrals of functions	1	3
2.3	Contours Contour integrals Some examples	4	3
2.4	Antiderivates	1	3
2.5	Cauchy-Goursat theorem(without proof)	1	3
2.6	Simply and multiply connected domains	5	3
2.7	Cauchy's integral formula	3	4
2.8	An extension of Cauchy's integral formula	3	4
2.9	Liouville's theorem and fundamental theorem of algebra	4	3,4
2.10	Maximum modulus principle	2	4
3.0	**SERIES**	**15**	
3.1	Convergence of sequences	2	9
3.2	Convergence of series	2	9
3.3	Taylors series	2	6
3.4	Proof of Taylor's series	2	6
3.5	Examples	3	6
3.6	Laurent's series (without proof)	1	6

3.7	Examples	3	6
4.0	**RESIDUES AND POLES**	**18**	
4.1	Isolated singular points	2	5
4.2	Residues	3	5
4.3	Cauchy's residue theorem	2	5
4.4	Three types of isolated singular points	2	5
4.5	Residues at poles	3	5
4.6	Examples	2	5
4.7	Applications of residues	2	7,5
4.8	Evaluation of improper integrals	1	7,5
4.9	Examples	1	7,5

Text book:

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

Module I: Analytic functions (28 hours)

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)

.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)

Chapter 5 (Sections 55 to 60 and 62)

Module IV: Residues and poles (18 hours)

Chapter 6 (Sections 68 to 70 and 72 to 74);
Chapter 7 (Section 78)

Text Books for Reference

1. Lars V. Ahlfors – Complex Analysis – An Introduction to the Theory of Analytic Functions of one Complex Variables (4th edition), (McGRAW-HILL)
2. J M Howie : Complex Analysis, Springer
3. Shanti Narayan – Theory of functions of a complex variable

Text Books for Enrichment

1. Steven G Krantz - Complex Variables – A Physical approach with applications and MATLAB, Chapman & Hall/CRC (2007)
2. Kasana – Complex Variables: Theory and Applications, 2nd edition
3. B. Choudhary – The Elements of Complex Variables

Course	Details				
Code	MT1816112				
Title	**LINEAR ALGEBRA**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Core				
Credits	4	Hours/week	5	Total Hours	90

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Solve systems of linear equations	**Ap**	3
2	Analyze vectors in R^n geometrically and algebraically	**A**	6
3	Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces,	**Ap**	1,3,6
4	Use matrix algebra and the related matrices to linear transformations,	**Ap**	3,6
5	Compute and use determinants,	**Ap**	3
6	Compute and use eigenvectors and eigenvalues	**Ap**	7
7	Find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial and will know how to diagonalize a matrix when this is possible;	**C**	3,6
8	Understand the basic ideas of vector algebra: linear dependence and independence and spanning;	**U**	3,6
9	Familiar with the notion of a linear transformation and its matrix.	**U**	1
10	Find the change-of-basis matrix with respect to two bases of a vector space	**C**	3

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1	**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	4
1.2	Systems of linear equations and difference equations	2	4
1.3	Elementary matrices	2	4
1.4	The process of Gaussian elimination	2	4
1.5	Hermite or reduced row-echelon matrices	2	4
1.6	Linear combinations of rows (columns)	2	4
1.7	Linear independence of columns	2	4
1.8	Row equivalent matrices	2	4
1.9	Rank of a matrix	1	4
1.10	Column rank	2	4
1.11	Normal form	2	4
1.12	Consistent systems of equations.	2	4
2	**INVERTIBLE MATRICES AND VECTOR SPACES**		
2.1	Invertible matrices	2	4, 5
2.2	Left and right inverse of a matrix	2	4, 5
2.3	Orthogonal matrix	2	4, 5
2.4	Vector spaces	3	3, 8
2.5	Subspaces	2	3
2.6	Linear combination of vectors	2	2, 3
2.7	Spanning set	2	2, 3, 8
2.8	Linear independence and basis	3	2, 3, 8
3	**LINEAR MAPPINGS AND MATRIX CONNECTION**		
3.1	Linear transformations	3	3
3.2	Kernel and range	3	3
3.3	Rank and Nullity	2	3
3.4	Linear isomorphism	3	3
3.5	Ordered basis	2	3
3.6	Matrix of f relative to a fixed ordered basis	3	3, 4, 9
3.7	Transition matrix from a basis to another	4	3, 4, 10
3.8	Nilpotent and index of nilpotency	3	3, 4
4	**EIGENVALUES AND EIGENVECTORS**		
4.1	Characteristic equation	3	4, 5, 6, 7

4.2	Algebraic multiplicities	2	4, 5, 6
4.3	Eigen space	3	4, 5, 6
4.4	Geometric multiplicities	2	4, 5, 6
4.5	Eigenvector	3	4, 5, 6
4.6	Diagonalisation	3	4, 5, 6, 7
4.7	Tri-diagonal matrix	2	4, 5, 6

Text Books

1. S. Blyth and E. F. Robertson : Basic Linear Algebra, Springer, Second Ed.(2002)

Module 1

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

Module 2

Text 1: Chapter 4 and Chapter 5.

Module 3

Text 1: Chapter 6 and Chapter 7.

Module 4

Text 1: Chapter 9**.**

Text Books for Reference

1. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (SecondEdition), Academic Press 2009, an imprint of Elsevier.
2. David C Lay: Linear Algebra, Pearson
3. Sheldon Axler - Linear Algebra Done Right (Third Edition, Undergraduate text inMathematics), Springer 2015.
4. S. H. Friedberg, Arnold J. Insel and Lawrence E. Spence, - Linear Algebra, 2^{nd}Edition, PH Inc.

Text Books for Enrichment

1. S. Kumaresan - Linear Algebra: A Geometric Approach, Prentice Hall IndiaLearning Private Limited; New title edition (2000)
2. Gilbert Strang – Linear Algebra and its applications, Thomson Learning,

Course	Details				
Code	MT1816301				
Title	**OPERATIONS RESEARCH**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Choice Based				
Credits	3	Hours/week	4	Total Hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Learns to solve LPP using Graphical method,Simplex method and Big M method	Ap	3,4,7
2	Learns to form dual of an LPP and theorems of duality with proof	Ap	3,4
3	Learns to solve Transportation and Assignment problems	Ap	3,4,7
4	Learns different solution methods :Games without saddle point	Ap	3,4

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Linear Programming		
1.1	General Mathematical Model Of Linear Programming Problem	1	1
1.2	Guidelines on Linear Programming Model Formulation	1	1
1.3	Examples of LP Model Formulation	1	1
1.4	Introduction to Graphical method	1	1
1.5	Graphical Solution nMethods of LP problem	2	1
1.6	Special Cases of Linear Programming	1	1
1.7	Introduction to Simplex method,std form of LPP	2	1
1.8	Simplex algorithm-Maximization and Minimization case	6	1
1.9	Big M method	3	1
1.10	Types of Linear Programming Solutions,some complication and their resolutions	2	1
2.0	Duality in Linear Programming		

2.1	Introduction	1	2
2.2	Formulation of Dual LPP	5	2
2.3	Standard results in Duality	2	2
2.4	Theorems of duality with Proof	4	2
3.0	Transportation and Assignment Problem		
3.1	Introduction	1	3
3.2	Mathematical model of Transportation Problem	2	3
3.3	The Transportation Algorithm	2	3
3.4	Methods for finding Initial solution	3	3
3.5	Test for Optimality	2	3
3.6	Variations in Transportation Problem	3	3
3.7	Maximization Transportation Problem	4	3
3.8	Assignment Problem	4	3
3.9	Variations of Assignment Problem	1	3
4.0	Theory of Games		
4.1	Introduction	1	4
4.2	Two-person zero sum games	1	4
4.3	Pure Strategic(Minimax and Maximin principles)	2	4
4.4	Games without saddle point	2	4
4.5	The rules of dominance	1	4
4.6	Solution methods :Games without saddlepoint: Arithmetic method	2	4
4.7	Matrix Method	3	4
4.8	Graphical Method	3	4
4.9	Linear programming Method	3	4

Text Book:

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. J.K Sharma –Operations Research-Theory and Applications,Macmillan Publishers,India

Text Books for Enrichment

1. Kanthi Swarup, P.K Gupta and Man Mohan-Operations Research(Sultan Chand and sons)
2. Frederick S Hillar and Gerald Jn Liberman- Introduction to operations research(seventh edition),Mc Graw Hill Edition
3. Hamdy A Taha-Operations Research-An Introduction(seventh edition),Prentice Hall of India Pvt Ltd

Course	Details				
Code	MT1816302				
Title	**BASIC PYTHON PROGRAMMING AND TYPESETTING IN LATEX**				
Degree	B Sc				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Choice Based Course				
Credits	3	Hours/week	4	Total Hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Understand the fundamentals of Python Language	U	2,3,4
2	acquire the basic skills required for Python programming.	Ap	3,4
3	be able to solve Mathematical problems using Python programs	Ap,E	3,4,6
4	Understand the basics of La TeX	U	1,2,6
5	Learn to prepare a LaTeX document, article and a project report.	Ap,C	2,3,4
6	be able to include figures and tables in a LaTeX document.	Ap,C	3,4

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Beginning Python Programming** .	**16**	
1.1	Introduction of Python	1	1
1.2	Installation of Python	1	1
1.3	IDLE and file name	1	2,3
1.4	Output function	1	2,3
1.5	Arithmetic Operators	2	2,3
1.6	Input and variables	2	2,3
1.7	assignment statement	2	2,3
1.8	simple string operations	2	2,3

1.9	while loops, if statement	2	2,3
1.10	relational operators, For loops	2	2,3
2.0	Advanced Features	**20**	
2.1	Defining functions	1	1
2.2	Variables in functions	1	1
2.3	Advanced functions	2	2,3
2.4	Recursion	2	2,3
2.5	Lists, More features of lists, More on lists	5	2,3
2.6	Revenge of the strings	2	2,3
2.7	Slicing of strings	3	2,3
2.8	File input or output	4	2,3
3.0	Beginning typesetting with using LaTeX	**16**	
3.1	The Basics: What is LATEX, Simple typesetting, Fonts, Type size.	3	4,5,6
3.2	The Document: Documentclass, page style, page numbering, formatting lengths, parts of a document, dividing the document.	3	5,6
3.3	Bibliography: Introduction.	2	5,6
3.4	Displayed Text: Borrowed words, poetry in typesetting, making lists.	3	5,6
3.5	Table of Contents: Table of Contents, Index, Glossary.	3	5,6
3.6	Rows and Columns:Tables.	2	5,6
4.0	Typesetting Mathematics	**20**	
4.1	Typesetting Mathematics: The basics, custom commands	3	4
4.2	more on mathematics, mathematics miscellany	3	5
4.3	And that is not all, symbols.	2	5
4.4	Typesetting Theorems: Theorems in LaTeX	3	5,6
4.5	designer theorems- the amsthm package	2	5,6
4.6	Housekeeping.	2	6
4.7	Floats : creating floating figures	3	5,6
4.8	Cross References in LaTeX: Why cross references? Let LaTeX do it.	2	5,6

Text Books

1 . The online Wiki book "Non-Programmer's Tutorial for Python 3" (A free PDF book from the URL https://en.wikibooks.org/wiki/Non-Programmer's_Tutorial_for_Python_3)

2. LATEX Tutorials : A PREMIER by Indian TEX Users Group, Edited by E. Krishnan, 2003. A free PDF document from the URL

https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

Module I : Beginning Python Programming (16 hours)

Text 1: Chapters 2, 3, 4, 5, 6 and 11

Module II: Advanced features (20 hours)

Text 1: Chapters 8, 9, 10, 15, 16 and 17.

Module III: Beginning typesetting with using LaTeX (16 hours)

Text 2 : Tutorial I (Sections I.1 to I.4),
Tutorial II (Sections II.1 to II.7)
Tutorial III (Section III.1) and
Tutorial V (Sections V.1 to V.3)
Tutorial VI (Sections VI.1 to VI.3) ,
Tutorial VII (Section VII. 2 [deleting VII.2.1 to VII.2.6])

Module IV: Typesetting Mathematics (20 hours)

Text 2 :- Tutorial VIII (Sections VIII.1 to VIII.7 [deleting VIII.5 and VIII.6])
Tutorial IX ([deleting IX.2.3])
Tutorial XI (Section XI.1.1 only) and Tutorial XII (Section XII.1 and XII.2)

Text Books for Reference

1. Dive Into Python by Mark Pilgrim, Free to download from the URL http://www.diveintopython.net/
2. The free to download book "Formatting inform action: A beginner's introduction to typesetting with LaTeX" by Peter Flynn. This can be downloaded free from the URL https://www.ctan.org/pkg/beginlatex
3. Dive Into Python by Mark Pilgrim, Free to download from URL http://www.diveintopython.net/
4. LATEX , a Document Preparation System by Leslie Lamport (second edition, Addison Wesley, 1994).
5. The Not So Short Introduction to LaTeX2e by Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl. Free to download from
https://www.ctan.org/pkg/lshort-english

Course	Details				
Code	MT1816303				
Title	**NUMERICAL ANALYSIS**				
Degree	B.Sc.				
Branch(s)	Mathematics				
Year/Semester	III/VI				
Type	Choice based				
Credits	3	Hours/week	4	Total Hours	72

Module	Course Description	Hrs	CO.No.
1.0	**Solution of Equations**	**20**	**1,2,3**
1.1	(A quick review mathematical preliminaries, errors, algebraic and transcendental equations)	3	1
1.2	Bisection Method	2	2,3
1.3	Method of False Position	2	2,3
1.4	Iteration Method	2	2,3
1.5	Aitken'sΔ_ process	2	2,3
1.6	Newton– Raphson Method, Generalised Newton's Method	6	2,3
1.7	Ramanujan's Method	3	2,3
2.0	**Interpolation**	**18**	**2,3**
2.1	Errors in Polynomial Interpolation	2	2
2.2	Forward Differences, Backward Differences	2	2,3
2.3	CentralDifferences	3	2,3
2.4	Symbolic Relations	4	2,3
2.5	Difference of a Polynomial and Newton's Formulae for Interpolation	7	2,3
3.0	**Fourier Approximations**	**14**	**4,5**
3.1	Fourier series	4	4,5,
3.2	Fourier transform,	4	4,5
3.3	Discrete Fourier transform (DFT) and inverse Discrete Fourier transform (IDFT).	6	4,5
4.0	**Numerical Differentiation and Integration**	**20**	**6,7,8**
4.1	Introduction	3	6
4.2	numerical differentiation and errors in numerical differentiation.	4	6,7
4.3	NumericalIntegration	2	6,7

4.4	Trapezoidal Rule	2	7,8
4.5	Simpson's 1/3 Rule, Simpson's 3/8 Rule	5	7,8
4.6	Boole's and Weddle's Rules.	4	7,8

Use of Non Programmable Scientific Calculator is Permitted

Text Books :

1. S. S. Sastry - Introductory Methods of Numerical Analysis , PHI Learning Private Limited Fifth Edition

2 .Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition Wiley New Delhi, 2015**.**

Module I: Solution of Equations **(20 hrs)**

Text 1: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6)

Module II: Interpolation **(18 hrs)**

Text 1: Chapter 3 (Sections 3.1, 3.2, 3.3, 3.5 and 3.6)

Module III: Fourier Approximations **(14 hrs)**

Text 1: Chapter 4 (Section 4.6 : 4.6.1 and 4.6.2).

Module IV : Numerical Differentiation and Integration **(20 Hrs)**

Text 1 : Chapter 6 (Sections 6.1, 6.2 : 6.2.1. Sections 6.4 : 6.4.1, 6.4.2, 6.4.3 and 6.4.4)

Text Books for Reference

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. Scarborough : Numerical Mathematical Analysis
3. Francis Shield (Schaum's Series) : Numerical Analysis
4. Hilderbrand : Introduction to Numerical Analysis

COMPLEMENTARY COURSES FOR B.Sc. PHYSICS & B.Sc. CHEMISTRY

Sl.No	Course Code	Course Name	Credit	Hrs/W	Semester
1	MT1811201	Partial Differentiation, Matrices, Trignometry	4	72	I
2	MT1812203	Integral Calculus and Differentaial Equations	4	72	II
3	MT1813205	Vector Calculus, analytic Geometry and Abstract Algebra	5	90	III
4	MT1814206	Fourier Series, Laplace Transform and complex Analysis	5	90	IV

Course	Details				
Code	MT1811201				
Title	**PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICAL METHODS**				
Degree	B. Sc.				
Branch(s)	Physics & Chemistry				
Year/Semester	I/I				
Type	Complementary Mathematics for Physics & Chemistry				
Credits	3	Hours/week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Recognize Functions of different variable and acquire knowledge in partial differentiation	Ap	PH -6, CH-7
2	Get an idea about Rank,Transformation(Row/column) of Matrices,Able to find solutions of homogenous and non homogeneous linear equations,Get an idea about Characterstic roots and vectors of a matrix and Cayley Hamilton Theorem and application of theorem in different problems	Ap	
3	Learns the expansion using de Movier's theorem,in powers of sines and cosines,recognize hyperbolic and circular functions also learns the summation of different types of series	An	
4	Able to find solution of algebraic and transcendental equations using different methods	An	

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Functions of several variable		
1.1	Open disk, Closed disk, Closed Ball, Open Ball,	1	1
1.2	Interior point,boundary point, Bounded region,unbounded region	1	1
1.3	Functions of two variables- Domain,Range and level curve	1	1
1.4	Functions of three variables- Domain,Range and level surface	2	1
1.5	Partial Derivatives	2	1
1.6	Partial Derivatives and continuity	1	1
1.7	Partial Derivatives of higher order	1	1
1.8	The chain rule	2	1
1.9	The tree Diagram	1	1
1.10	Implicit Differentiation	2	1
2.0	Matrices		
2.1	Rank of a matrix, Equivalent matrices	2	2
2.2	Elementary Transformation- row	2	2
2.3	Elementary Transformation-column	2	2
2.4	Determination of Rank using Transformations	2	2
2.5	Employment of only row(column) transformation	4	2
2.6	Solution of homogeneous system of linear equations	2	2
2.7	Solution of nonhomogeneous system of linear equations	2	2
2.8	Characteristic Roots	1	2
2.9	Characteristic Vectors	2	2
2.10	Cayley-Hamilton Theorem	2	2
3.0	Trigonometry		
3.1	Expansion using de Moivre's theorem	2	3
3.2	Expansion of powers of Sines	2	3
3.3	Expansion of powers of Cosines	2	3
3.4	Expansion of $\sin^m\theta \cos^n\theta$ in terms of cosines or sines of multiples of θ	4	3
3.5	Circular functions of complex angles	1	3
3.6	Hyperbolic Functions and identities in hyperbolic functions	2	3
3.7	Expansion and periods of hyperbolic functions	2	3
3.8	Separation into real and imaginary parts	2	3
3.9	Inverse Circular functiona	1	3
3.10	Summation of series	5	3

4.0	Solutions of Algebraic and Transcendental Equations		
4.1	Bisection method	3	4
4.2	Regula Falsi method	3	4
4.3	Fixed Point Iteration Method	3	4
4.4	Newton _Raphson method	3	4
4.5	Generalized Newton's method	2	4

Text Books

1. George B Thomas,Jr:Thomas Calculus 12 th edition ,Pearson
2. Shanthi Narayan &P.K Mittal, A text book of Matrices,S.Chand
3. S.L.Loney-Plane Trigonometry Part-II,AITBS Publishers India,2009
4. S.S Sastry:Introductory methods of Numerical Analysis,4^{Th} Edition(Prentice Hall)

Module I: Partial Differentiation(14hrs)

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

Module II: Matrices(21hrs)

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) (Proofs of all Theorems in Module II are excluded.)

Module III: Trigonometry(23hrs)

Text3 (RelevantSectionsofChapters3to5and8)

Module IV: Numerical Methods (14Hrs)

Text 4,Chapter2 (Sections2.1, 2.2,2.3,2.4 and 2.5)

Text Books for Enrichment

1. Shanthi Narayan :Differential Calculus(S Chand)
2. George B Thomas,Jr. And Ross L Finney:Calculus,LPE,Ninth Edition,Pearson Education
3. S.S Sastry,Engineering Mathematics,Volume I,4^{th} edition PHI
4. Muray R Spiegel.Advanced Calculus,schaum's Outline series
5. Frank Ayres Jr:Matrices,Schaum's Outline series,TMH Edition(Allied)
6. David W Lewis- Matix Theory

Course	Details				
Code	MT1812203				
Title	**INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS**				
Degree	B. Sc.				
Branch(s)	Physics & Chemistry				
Year/Semester	I/II				
Type	Complementary Mathematics for Physics & Chemistry				
Credits	3	Hours/week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	**Cognitive Level**	**PSO No.**
1	Evaluate the volumes of solids using cross-sections	E	PH-6, CH-7
2	Calculate the length of an arc of a curve when whose equations are given in parametric and polar form	Ap	
3	Evaluate the area of surfaces of revolution	E	
4	Determine the area and volume by applying the techniques of double and triple integrals	Ap, E	
5	Identify different types of differential equations and solve them	U	
6	Obtain equations for surfaces and curves in three dimension	U	
7	Apply different methods to solve the equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	Ap,E	
8	Form the partial differential equations by elimination of constants and elimination of functions	Ap,C	
9	Solve the partial differential equation using Lagrange's method	Ap, An ,C	

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**INTEGRAL CALCULUS**	**15**	
1.1	Volumes using Cross-Section	6	1
1.2	Volumes using Cylindrical shells	4	1
1.3	Arc lengths	2	2
1.4	Areas of surfaces of Revolution	3	3
2.0	**MULTIPLE INTGRALS**	**17**	
2.1	Double and iterated integrals over rectangles	5	4
2.2	Double integrals over general regions	4	4
2.3	Area by double integration	5	4
2.4	Triple integrals in rectangular co-ordinates	3	4
3.0	**ORDINARY DIFFEREENTIAL EQUATION**	**20**	
3.1	Separable Variables	3	5
3.2	Exact Differential Equation	3	5
3.3	Equations reducible to exact form	4	5
3.4	Linear Equations	4	5
3.5	Solutions by Substitution	2	5
3.6	Homogeneous equations	2	5
3.7	Bernoulli's Equations	2	5
4.0	**PARTIAL DIFFERENTIAL EQUATIONS**	**20**	
4.1	Surfaces and Curves in three dimension	5	6
4.2	Solutions of equations of the form$\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	4	7
4.3	Origin of first order and second order partial differential equations	4	8
4.4	Linear equations of the first order	2	8
4.5	Lagrange's method	5	9

Text Books

1. George B Thomas,Jr.:Thomas Calculus 12th Edition
2. A.H. Siddiqi,P.Manchanada : A first course in Differential Equations with Applications
3. Ian Sneddon : Elememnts of Partial Differential Equations

Module I: Integral Calculus **(15 hrs)**

.Text 1: Chapter 6 (Sections 6.1 to 6.4)

Module II: Multiple Integrals **(17 hrs)**

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

Module III: Ordinary Differential Equations (20 Hrs)

Text 2 : Chapter 2

Module IV: Partial Differential Equations (20 Hrs)

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

Text Books for Reference

1. Shanti Narayan, P K Mital : Integral Calculus
2. Differential Equations, E. Rukmangadachari
3. R.K. Ghosh, K.C. Maity- An Introduction to Differential Equations,New Central Books

Course	Details				
Code	MT1813205				
Title	**VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA**				
Degree	B. Sc.				
Branch(s)	Physics & Chemistry				
Year/Semester	II/III				
Type	Complementary Mathematics for Physics & Chemistry				
Credits	4	Hours/week	5	Total hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Getting an idea of curves in space and associated concepts.	Ap	PH-6, CH-7
2	Able to calculate directional derivatives and to find gradient vectors	Ap	
3	Understands the importance of line integral and will be able to identify where it can be applied and how it is evaluated	Ap,An	
4	Able to calculate surface area and surface integral	Ap,An	
5	Can interpret the concepts of work , potential function, circulation, flux etc mathematically by the help of greens theorem, stokes theorem	Ap,An	
6	Able to convert polar coordinates to Cartesian coordinates and learns the techniques to graphing equation in polar coordinates	Ap	
7	Identifies conic sections and their properties	U	
8	Get an understanding in basic concepts in group theory	R, U	

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Vector value functions	15	1
1.1	Vector functions – curves in space	1	1
1.2	Properties of vector functions	1	1
1.3	Velocity and acceleration in space	2	1
1.4	Integrating vector valued functions	2	1
1.5	Tangent lines to smooth curves	2	1
1.6	Features of a curve's shape (a) Arc length (b) speed (c) unit tangent vector	2	1
1.7	Curvature and the unit normal vector	2	1
1.8	Directional derivatives	1	2
1.9	Gradient vectors	1	2
2.0	Integration in vector fields		
2.1	Introduction to Line integrals and evaluating line integrals	3	3
2.2	Vector fields and line integral - (a) work (b) circulation (c) flux	4	3,5
2.3	Path independence	1	3,5
2.4	Conservation field and potential function	3	3,5
2.5	Green's theorem in plane (tangential form and normal form) verification and problems	3	3,5
2.6	Surface area	3	4
2.7	Surface integral	2	4
2.8	Stokes theorem (statement and problems)	3	3,4,5
2.9	The Divergence theorem and a unified theory (statement and simple problem only)	2	3,4,5
3.0	Analytic Geometry		
3.1	Definition of polar coordinates	1	6,7
3.2	Polar equation and graphs	3	6,7
3.3	Relating polar and Cartesian coordinates	3	6,7
3.4	Introduction to Conic section in polar coordinates and graphing	3	6,7
3.5	Conic section in polar coordinates: lines	2	6,7
3.6	Conic section in polar coordinates : circles	3	6,7
3.7	Conic section in polar coordinates: ellipses	3	6,7
3.8	Conic section in polar coordinates : parabola	3	6,7
3.9	Conic section in polar coordinates : hyperbolas	2	6,7
4.0	Abstract Algebra		
4.1	Groups – Definition and examples	3	8
4.2	Groups- elementary properties	3	8

4.3	Finite groups and group tables	3	8
4.4	Subgroups	3	8
4.5	Cyclic subgroups	3	8
4.6	Cyclic groups and their elementary properties	3	8
4.7	Groups of permutation	3	8
4.8	Homomorphisms –definition and examples	1	8
4.9	Properties of homomorphisms	1	8

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

Text Books for Reference

1. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6th ed.,
2. Universal Book Stall, New Delhi.
3. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
4. I.N. Herstein - Topics in Algebra
5. Joseph A Gallian - A Contemporary Abstract Algebra, Narosa Publishing House.

Course	Details				
Code	MT1814206				
Title	**FOURIER SERIES,LAPLACE TRANSFORM AND COMPLEX ANALYSIS**				
Degree	B. Sc.				
Branch(s)	Physics & Chemistry				
Year/Semester	II/IV				
Type	Complementary Mathematics for Physics & Chemistry				
Credits	4	Hours/week	5	Total hours	90

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	TO represent periodic functions using Fourier series	U, Ap	PH-6, CH-7
2	Get an idea of power series method to solve differential equations Familiar with Legendre equation and Legendre polynomial	R, Ap	
3	Understands laplace transforms	U, Ap	
4	Learns complex numbers and their properties	U, Ap	
5	Learns about analytic function and how to check analyticity based on Cauchy – Riemann equation	R, U, Ap	
6	To evaluate complex integral by various methods	R, An	
7	Knowing basic difference between real and complex calculus	U, Ap	

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Fourier series and Legendre polynomials		
1.1	Periodic functions – (a) period of functions (b) graphical representation	3	1
1.2	Trigonometric series and orthogonality condition	1	1
1.3	Fourier series-(a)condition for convergence (b) Euler formula for fourier coefficients with period 2π	4	1
1.4	Fourier series for functions with arbitrary period p=2L	4	1
1.5	Even and odd function and their graphical representation	2	1
1.6	Half range expansion – (a) sine series (b) cosine series	4	1
1.7	Power series method to solve differential equation	2	2
1.8	Legendre's equation and Legendre polynomial	3	2
2.0	Laplace Transform		
2.1	Laplace transform-(a) inverse laplace transform (b) linearity	3	3
2.2	Shifting: replacement of s by s-a	3	3
2.3	Existence of laplace transform	2	3
2.4	Transform of derivatives - (a) transform of the derivative of a function (b)solving differential equation by laplace transform method	3	3
2.5	Transform of integral of a function	3	3
2.6	Differentiation of transforms Integration of transforms	3	3
2.7	Laplace transform method to solve differential equation with variable coefficients	1	3
3.0	Complex numbers and functions		
3.1	Introduction to complex numbers- basic properties	2	4
3.2	Complex plane	2	4
3.3	Polar form , argument and principle value	2	4
3.4	Powers and roots-(a) De moivers formula (b) n^{th} root of unity	3	4
3.5	Complex functions	2	4
3.6	Limit and derivative of complex functions.	3	7
3.7	Analytic functions (a) Cauchy Riemann equation (b) laplace equation and harmonic function	4	5
3.8	Elementary complex functions and their properties (a) Exponential function (b) trigonometric	4	7

	function (c) hyperbolic functions		
3.9	An introduction to complex logarithm	1	7
4.0	Complex integration		
4.1	Line integral in the complex plane	2	6
4.2	Basic properties of complex integration	2	6
4.3	Indefinite integration and substitution of limits Integration by the use of representation of path	4	6
4.4	Estimation of absolute value of complex line integral	1	6
4.5	Cauchy integral theorem Cauchy theorem for multiply connected domain	3	6
4.6	Cauchy's integral formula	3	6
4.7	Derivative of analytic function	2	5
4.8	Cauchy's inequality, Liouville's theorem, Morera's theorem	1	5

Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth edition, Wiley India.

Module I : Fourier Series and Legendre Polynomials (25 hours)

Sections 10.1 to 10.4, 4.1 and 4.3 (Proofs of all theorems in this module are excluded.)

Module II: Laplace Transforms (20 hours)

Sections 5.1, 5.2, 5.4. 5.8 and 5.9 (Proofs of all theorems in this module are excluded.)

Module III : Complex Numbers and Functions (25 hours)

Sections 12.1 to 12.4 and 12.6 to 12.8 (Proofs of all theorems in this module are excluded.)

Module IV: Complex Integration (20 hours)

Sections 13.1 to 13.4 (Proofs of all theorems in this module are excluded.)

Text Books for Reference

1. Michael D Greenberg Advanced Engineering Mathematics, Pearson Education, 2002
2. B.S Grewal, Higher Engineering Mathematics, 42 nd Edition, Khanna Publishers
3. Brown and Churchill, Complex Variables and Applications, McGraw-Hill Higher education, Edition 8, 2008

COMPLEMENTARY COURSES FOR B.C.A

Sl.No	Course Code	Course Name	Credit	Hrs/W	Semester
1	MT1811202	Discrete Mathematics I	4	72	I
2	MT1812204	Discrete Mathematics II	4	72	II
3	MT1814207	Operations Research	4	72	IV

Course	Details				
Code	MT1811202				
Title	**DISCRETE MATHEMATICS -I**				
Degree	BCA				
Branch(s)	Computer Application				
Year/Semester	I/I				
Type	Complementary Mathematics for BCA				
Credits	4	Hours/week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	To learn a mathematical topic, a person needs to actively construct mathematical arguments on this topic. A major goal of this course is to teach the students how to understand and construct correct mathematical arguments.	An	1,2
2	Identify sets, different properties of sets, set operations and set identities.	R	1,6
3	Explain the different methods for representing the relationship between sets.	U	1,6
4	The basic concepts involving functions needed in discrete mathematics.		1
5	Discuss how the equivalence classes of an equivalence relation partition a set into disjoint nonempty subsets.	U	5,6,7
6	Find a relation that is reflexive, anti-symmetric and transitive. These are the properties that characterize relations used to order the elements of sets.	R	1,6
7	Solve the problems using what they studied.	Ap	3
8	Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime and prime factorization.	R, Ap	3,4,6

PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Logic	18	1
1.1	Propositional Logic	5	1
1.2	Propositional Equivalence	5	1
1.3	Predicates and Quatifiers	4	1
1.4	Rules of Inference	4	1
2.0	Basic Structures	15	2
2.1	Sets	3	2
2.2	Set Operations	4	2,3
2.3	Functions	4	2,3
2.4	Sequences and Summations	4	2,3
3.0	Number Theory and Cryptosystem	20	4,7
3.1	The integer and Division	7	4,7
3.2	Primes and Greatest Common Divisors	7	4,7
3.3	Applications of Number Theory	6	5,7
4.0	Relations	19	4,6,7
4.1	Relations and Their Properties	5	4,7
4.2	Representing Relations	5	4,7
4.3	Equivalence Relations	4	4,6,7
4.4	Partial Ordering	5	4,6,7

Text Books

1. Kenneth H Rosen; Discrete Mathematics and its applications; 6th Edition; Tata McGraw-Hill Publishing Company Limited

Module 1: Logic **(18 hrs)**
Chapter 1 (Sections 1.1, 1.2, 1.3 and 1.5only)
Module II: Basic Structur **(15 hrs)**
Chapter 2 (Sections 2.1, 2.2, 2.3 and 2.4)

Module III: Number Theory and Cryptosystem **(20 hrs)**
Chapter 3 (Sections 3.4, 3.5 and 3.7 Only)

Module IV: Relations **(19 hrs)**
Chapter 7 (Sections 7.1, 7.3, 7.5 and 7.6)

Text Books for References

1. Clifford Stien, Robert L Drysdale, KennethBogart ; Discrete Mathematics for Computer Scientists; Pearson Education; Dorling Kindersley India Pvt. Ltd

2. Kenneth A Ross; Charles R.B. Wright ; Discrete Mathematics; Pearson Education; Dorling Kindersley India Pvt.Ltd
3. Ralph P. Grimaldi, B.V.Ramana; Discrete And Combinatorial Mathematics ; Pearson Education; Dorling Kindersley India Pvt. Ltd
4. Richard Johnsonbaugh; Discrete Mathematics; Pearson Education; Dorling Kindersley India Pvt.Ltd
5. Winfried Karl Grassman, Jean-Paul Tremblay; Logic And Discrete Mathematics A Computer Science Perspective ; Pearson Education; Dorling Kindersley India Pvt. Ltd

Course	Details				
Code	MT1812204				
Title	**DISCRETE MATHEMATICS -II**				
Degree	BCA				
Branch(s)	Computer Application				
Year/Semester	I/II				
Type	Complementary Mathematics for BCA				
Credits	4	Hours/week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Solve real world problems using graphs and trees, both quantitatively and qualitatively	Ap	1,3,4
2	Explain the combination of logic gates	U	3,4

*PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Graphs	18	1
1.1	Graphs and Graph models	3	1
1.2	Graph Terminology and Special type of Graphs	4	1
1.3	Representing Graphs and Graph Isomorphism	4	1
1.4	Connectivity	3	1
1.5	Euler and Hamilton Paths	4	1
2.0	Trees	17	1
2.1	Introduction to Trees	4	1
2.2	Application of Trees	3	1
2.3	Tree Traversal	5	1
2.4	Spanning Trees	5	1
3.0	Boolean Algebra	17	2
3.1	Boolean Function	7	2
3.2	Representing Boolean Functions	3	2
3.3	Logic Gates	6	2
4.0	Matrices	20	2

4.1	Definition and examples of Matrices	4	2
4.2	Rank of Matrix	2	2
4.3	Determination of Rank by Row Canonical form and Normal form	4	2
4.4	Linear Equations	2	2
4.5	Solution of non-homogenous equations	2	2
4.6	Homogenous Equations	2	2
4.7	Characteristic roots and Charaacteristic vectors of matrix	2	2
4.8	Cayley Hamilton theorem and applications	2	2

Text Books

1. Kenneth H Rosen; Discrete Mathematics and its applications; 6th Edition; Tata McGraw-Hill Publishing Company Limited
2. Frank Ayres Jr: Matrices, Schaum's Outline Series ,TMH Edition

Module I: Graphs **(18 hrs)**
Text 1 Chapter 8 (Sections 8.1, 8.2, 8.3, 8.4 and 8.5 only)

Module II: Trees **(17 hrs)**
Text 1 Chapter 9 (Sections 9.1, 9.2, 9.3 and 9.4 only)

Module III: Boolean Algebra **(17 hrs)**
Text 1 Chapter 10 (Sections 10.1, 10.2 and 10.3 only)
Module IV: Matrices **(20 hrs)**

Text 2. Relevant Sections of Chapters 2, 5 , 10 , 19 and 23 (Proofs of all Theorems in Module IV are Excluded)

Text Books for References

1. Clifford Stien, Robert L Drysdale, KennethBogart ; Discrete Mathematics for Computer Scientists; Pearson Education; Dorling Kindersley India Pvt. Ltd
2. Kenneth A Ross; Charles R.B. Wright ; Discrete Mathematics; Pearson Education; Dorling Kindersley India Pvt.Ltd
3. Ralph P. Grimaldi, B.V.Ramana; Discrete And Combinatorial Mathematics ; Pearson Education; Dorling Kindersley India Pvt. Ltd
4. Richard Johnsonbaugh; Discrete Mathematics; Pearson Education; Dorling Kindersley India Pvt.Ltd
5. Winfried Karl Grassman, Jean-Paul Tremblay; Logic And Discrete Mathematics A Computer Science Perspective ; Pearson Education; Dorling Kindersley India Pvt. Ltd

Course	Details				
Code	MT1814207				
Title	**OPERATIONS RESEARCH**				
Degree	BCA				
Branch(s)	Computer Application				
Year/Semester	II/IV				
Type	Complementary Mathematics for BCA				
Credits	4	Hours/week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Formulate and model a linear programming	C	3
2	Solve L.P.P graphically, simplex method, Big-M-method	Ap	3,4,7
3	Solve transportation problem	Ap	3,4,7
4	Solve assignment problem	Ap	3,4,7
5	Define game	R	3,4
6	Solve payoff matrix without saddle point using different methods	Ap	3,4

*PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	Basics of O.R	10	1
1.1	The nature and uses of O.R	3	1
1.2	Math concepts and approaches of O.R	3	1
1.3	Models in O.R	4	1
2.0	Linear Programming Problems	25	
2.1	Mathematical formulation of a L.P.P	2	1
2.2	General linear programming problems	3	1
2.3	Solution of a L.P.P	3	2
2.4	Graphical method for solving a L.P.P	5	2
2.5	Simplex method	6	2
2.6	Big M method	6	2
3.0	Transportation and assignment Problems	**20**	**3,4**

3.1	Transportation model	2	3,4
3.2	Solution by north west corner rule	2	3,4
3.3	Lowest cost entry method	2	3,4
3.4	Vogel method	4	3,4
3.5	MODI method	4	3,4
3.6	Degeneracy	2	3,4
3.7	Assignment problems	4	3,4
4.0	Game Theory	**17**	**5,6**
4.1	Two person zero sum games	3	5,6
4.2	Pure and mixed strategy with saddle point	3	5,6
4.3	Solution of pure strategy games	4	5,6
4.4	Solution of mixed strategy problems by arithmetic method	4	5,6
4.5	Principle of dominance	3	5,6

Text Book:

1 Belly E Gillet – Introduction to Operations Research (A Computer Oriented Arithmetic Approach) (Tata Mc. GrawHill)

MODULE I: Basics of O.R. (10hrs)
MODULE II: Linear programming problems (25 hrs)
MODULE III: Transportation & assignment Problems (20 hrs)
MODULE IV: Game Theory (17 hrs)

Text books for Reference :

1. V.K Kapoor – OperationsResearch
2. Kanti Swarup , P.K Gupta and Man Mohan – Operations Research, Sultan Chand &Sons
3. K.V Mital and C. Mohan – Optimization Methods in Operations Research and SystemAnalysis
4 J. K Sharma – Operations Research Theory and Applications , Macmillan
5 B. N. Mishra, B. K. Mishra – OptimizationLinear Programming Ane Book