MADRAS CHRISTIAN COLLEGE (AUTONOMOUS)

DEPARTMENT OF MATHEMATICS -SELF FINANCED STREAM

Minutes of the Board of Studies Meeting

The board of studies meeting of the department was conducted on 12th April 2021 through the Google Meet platform from 2.30 p.m., Mrs. Hannah Blasiyus started the meeting with a prayer. The Assistant Professor In-charge of the Department Mrs. Asha Thomas welcomed and introduced the panel members. She explained the mode of operation followed for the revision of the syllabus based on TANSCHE guidelines. She also briefed on introducing MOOC courses as part of the revised syllabus.

The syllabi were presented for discussion and the following were resolved:

- Algebra and Trigonometry: To include hyperbolic and inverse trigonometric functions in place of roots of polynomial equations.
- Calculus: To add the topic multiple integrals.
- The course Programming in C is shifted from semester VI to semester IV.
- Number Theory and Infinite series: Shifted from semester IV to semester VI and renamed as Number Theory and Cryptography with required changes in syllabus.
- The course Fluid Dynamics in semester VI is removed. Students will undertake project work during this semester in its place.
- Introduced Python Programming in semester V. Panel members suggested including a list of programs for the practical session.
- The course Real Analysis is split into two papers Real Analysis I and Real Analysis II to be studied in semesters V and VI respectively. Relevant new topics are added to the existing syllabus.
- The Computer programming theory course in semester V is replaced with Computer training-LaTeX .
- Mathematical Programming Techniques and Resource Optimization Techniques are renamed as Operations Research I and II. To be offered as electives in semester V and VI.
- Mathematical Statistics-I and II has been slightly modified and Statistics with R software has been introduced.
- In courses Allied Mathematics I and II for B.Sc. Physics, content in the syllabus is rearranged to better the flow of topics among the two semester papers.
- General Elective: Space science is replaced with Discrete Mathematics.
- Web references has been added for all the courses.
- The Board has authorized the Chairperson to incorporate changes wherever required.
- The Board of studies meeting concluded at 5.30 p.m.

S.no	Names	Signature
	EXTERNAL MEMBERS	
1.	**University Nominee** Dr. V. Selvan, Associate Professor, Department of Mathematics, Ramakrishna Mission Vivekananda College, Ch-4	Dr. V. SELVAN, M.Sc.,M.Phil.,Ph.D. Associate Professor, Department of Mathematics, R.K.M. Vivekananda College, Mylapore, Chennai - 600 004.
2. i)	**Subject Experts** Dr. T. V. Sudharsan, Associate Professor & Head, Department of Mathematics, S.I.V.E.T College, Chennai -73.	Dr. T.V. SUDHARSAN, M.Sc., M.Phil., Ph.D., Associate Professor & Head, Department of Mathematics, S.I.V.E.T. College, Gowrivakkam, Chennai - 600 073.
ii)	Dr. V. Annamma, Assistant Professor, Department of Mathematics L.N. Govt . College, Ponneri, Chennai-601204.	Dr. V. ANNAMMA, M.Sc., M.Phil., B.Ed., Ph.D Assistant Professor, Department of Mathematics, L.N. Government College (Autonomous) PONNERI - 601 204.
iii)	Mrs. D. Sylvia Mary Associate Professor & Head Department of Computer Applications, Womens Christian College, Chennai-6.	
3.	**Industrial Expert** Ms. Priyanka Jayakumar, Software Engineer, Accenture, Shriram-the Gateway SEZ, 16, Rajaji Rd, New Perungalathur, Chennai-63.	J. Priyanka
4.	**Alumnus** Ms. Sindu Bharathi R. Advanced Math Expert Ms. Latriel Jackson, KOG, Mercer County, NJ. 126, Jawahar Nagar, Chemmancherry, Ch-119.	Sindu Bharathi
	INTERNAL MEMBERS	
5.	Mrs. Asha Thomas, Chairperson and Assistant Professor In-Charge	Asha Thomas
6.	Ms. S. Prathiba, Assistant Professor	S. Prathiba
7.	Dr. P. Deepa, Assistant Professor	P. Deepa
8.	Ms. L. Ancelin, Assistant Professor	
9.	Ms. Hannah Blasiyus, Assistant Professor	Hannah Blasiyus
10.	**Student Representative** Mr. A. Gurucharan, III B.Sc Mathematics	A. Gurucharan

DEPARTMENT OF MATHEMATICS - SFS

The B.Sc. Mathematics degree programme emphasis on motivating and training students towards higher education in the discipline giving employability. While the courses cover a wide spectrum of skills for specific corporate and creative sectors, the logic inbuilt in the courses helps in improved analytical skills. Computational techniques introduced through the courses trains students to solve problems with creative and critical thinking. The theoretical inputs to develop interest in Mathematical Communication.

PROGRAMME SPECIFIC OUTCOMES

On successful completion of B.Sc Mathematics degree programme, students will be able to

PSO Number	Program Specific Outcomes
PSO 1	Communicate the concepts of Mathematics effectively using various instructional strategies, both physically and geometrically.
PSO 2	Develop Mathematical ideas from basic axioms on Algebra and Calculus to analyze valid mathematical reasoning and logical thinking
PSO 3	Demonstrate proficiency in solving numerical problems, linear programming problems and networking models
PSO 4	Utilize Mathematical skills to solve theoretical and applied problems and identify applications of Mathematics in various disciplines.
PSO 5	Visualize elements of Analytics, theory of Computer Science and Cryptography as application of Mathematics
PSO 6	Use software and programming languages like LaTeX, C, Python and R to solve Mathematical and Statistical problems.

B.Sc. Mathematics, SFS Curriculum (Choice Based Credit System)

(Proposed to be with effect from the Academic year 2021-22)

SEMESTER I						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
		Language I	4	3	50	50
		English I	4	3	50	50
214MT1M01	Major	Algebra and Trigonometry	5	4	50	50
214MT1M02	Major	Calculus	5	4	50	50
214MT1A01	Allied	Allied Mathematics I	6	5	50	50
214UC1G08	General course	Basic Mathematics	4	2	50	50
		Value Education	2	1	50	50
		Total	**30**	**22**		
SEMESTER II						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
		Language II	4	3	50	50
		English II	4	3	50	50
214MT2M01	Major	Differential Equations and Laplace Transforms	5	4	50	50
214MT2M02	Major	Differential Geometry and Analytical Geometry of 3 - D	5	4	50	50
214MT2A01	Allied	Allied Mathematics II	6	5	50	50
214UC1G08	General course	Basic Mathematics	4	2	50	50
		Value Education	2	1	50	50
		Total	**30**	**22**		
SEMESTER III						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
		Language III	4	3	50	50
		English III	4	3	50	50
214MT3M01	Major	Abstract Algebra	5	4	50	50
214MT3M02	Major	Vector Calculus and Fourier series	5	4	50	50
214MT3A01	Allied	Mathematical Statistics with R -I	6	5	50	50
		Personality Development	2	-	25	-
214UC3I07	Inter - Disciplinary	Mathematics for Competitive Examinations	4	3	50	50
		Total	**30**	**22**		

SEMESTER IV						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
		Language IV	4	3	50	50
		English IV	4	3	50	50
214MT4M01	Major	Linear Algebra	5	4	50	50
214MT4M02	Major	Programming in C	5	4	50	50
214MT4A01	Allied	Mathematical Statistics with R - II	6	5	50	50
		Personality Development	2	3	25	50
		Environmental Studies	4	2	50	50
		Total	**30**	**24**		

SEMESTER V						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
214MT5M01	Major	Real Analysis -I	6	5	50	50
214MT5M02	Major	Mechanics	6	5	50	50
214MT5M03	Major	Introduction to Python	6	4	50	50
214MT5M04	Major-Elective	Numerical Methods	6	4	50	50
214MT5M05	Major-Elective	Operations Research -I	6	4	50	50
214UC5L07	General Elective	Discrete Mathematics	4	3	50	50
214MT5C01	Skill based	Computer Training (LaTeX)	2	3	50	50
		Total	**30**	**24**		

SEMESTER VI						
Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
214MT6M01	Major	Real Analysis -II	6	5	50	50
214MT6M02	Major	Complex Analysis			50	50
214MT6M03	Major	Number Theory and Cryptography	6	5	50	50
214MT6M04	Major-Elective	Formal Languages & Graph Theory	6	5	50	50
214MT6M05	Major-Elective	Operations Research-II	6	5	50	50
214MT6M06	Major	Project	6	5	50	50
		Total	**30**	**25**		

Course code	**Type**	**Course**	**Hours**	**Credits**	**Marks**	
					ICA	**ESE**
	Extension Activities	NCC/NSS/Sports/Scrub Soc./ Dept. Assn. Activities	-	1	-	-
		Grand Total		**140**		

Table of Contents

The Course Outcomes are given for every course offered by the department using the * **six Cognitive Levels (CL) of learning according to Bloom's Revised Taxonomy's for higher order thinking.**

R – Remembering, U – Understanding, Ap – Applying, An–Analyzing, E– Evaluating, C– Creating

ALGEBRA AND TRIGONOMETRY

(Core theory)

Code: 214MT1M01 **Hours: 75 Hours**

Semester: I **Credits: 4**

Learning Objective:

- To gain knowledge of basic concepts in Algebra and problem solving techniques in various summation of series.
- To learn the applications of De Moivre's theorem and the concepts of hyperbolic functions.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Apply summation of series using Binomial and logarithmic series	PSO 1	U, Ap
CO2	Find some results related to roots and apply transformations of equations and solve the equations	PSO 1, PSO 4	U, Ap
CO3	Recall expressions for trigonometric functions	PSO 2	R, U
CO4	Understanding the concepts of hyperbolic function and inverse hyperbolic functions	PSO 2	U, Ap
CO5	Understanding the concepts of summation of trigonometric series	PSO 2	U, Ap

Unit I **15 Hours**

Theory of Equations:

Summation of Series using Binomial, Exponential and Logarithmic series.

Unit II **15 Hours**

Sum of r^{th} powers of roots - Formation of Equation with given relation between the roots- Transformation of Equations- Reciprocal Equations and their solutions- Descartes's rule of sign- Solution by Newton and Horner's method.

Unit III **15 Hours**

Trigonometry:

Expansion of $sin\ x\ , cos\ x\ , tan\ x$ in terms of x- Expansion of $cos\ nx, sin\ nx, x\ , x$ – Solutions of Trigonometric Equations- Sums of sines and cosines of n angles which are in A.P.

Unit IV **15 Hours**

Hyperbolic function - Inverse hyperbolic functions

Unit V **15 Hours**

Logarithms of Complex numbers - Summation of trigonometric series using $C + iS$ method

Textbooks:

1. Manicavachagom Pillay. T. K., Natarajan. T. and Ganapathy. K. S., 2016, *Algebra*, Vol. 1, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.
Unit 1: Chapter 3: Sections 5, 10, Chapter 4: Sections 2, 3, 5, 6
Unit 2: Chapter 6: Section 13, 15.1, 15.2, 15.3, 16, 24, 30

2. Arumugam. S and Thangapandi Isaac. A., 2012, *Trigonometry*, New Gamma Publishing House, Palayamkottai.
Unit 3: Chapter 1
Unit 4: Chapter 2
Unit 5 : Chapter 3

References:

1. Arumugam. S. and Thangapandi Isaac. A., *Algebra: Theory of Equations, Theory of Numbers and Trigonometry*, New Gamma Publishing House, Palayamkottai, 2011.
2. Rawat, K.S., *Trigonometry*, First Edition, Sarup Book Publishers Pvt. Ltd., New Delhi, 2008.
3. Narayanan. S. and Manickavachagom Pillay. T. K., *Trigonometry*, S. Viswanathan Publishers (Printers and Publishers), Pvt., LTD., Chennai, 2001.

Web References:

1. https://ocw.mit.edu/
2. https://onlinecourses.nptel.ac.in/noc20_ma25/preview

CALCULUS

(Core theory)

Code: 214MT1M02 **Hours: 75 Hours**
Semester: I **Credits: 4**

Learning Objectives:

- To emphasize basic concepts in Calculus.
- To familiarize the applications of Integral Calculus.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Define and find the nth derivative & solve using Leibnitz theorem.	PSO 1	R, Ap
CO2	Solve maxima & minima using Lagrange Method.	PSO 1, PSO 2	Ap
CO3	To find length and surface area of the given curves.	PSO 1, PSO 2	U, Ap
CO4	To solve double & triple integral.	PSO 2	Ap
CO5	Apply Properties of Beta & Gamma Distribution and solve.	PSO 4	Ap, An

Unit I **12 Hours**

n^{th} derivative, standard results- Leibnitz theorem (without proof) and its applications.

Unit II **15 Hours**

Jacobians-Maxima and minima of functions of 2 and 3 independent variables - Necessary and sufficient conditions - Lagrange's method - simple problems.

Unit III **12 Hours**

To find length of the curve- Area of surface of revolution.

Unit IV **18 Hours**

Multiple Integral-Double Integral-change of order of Integration-Triple Integral.

Unit V **18 Hours**

Beta and Gamma integrals and their properties-simple problems.

Textbooks:

1. S. Narayanan, T. K. Manicavachagam Pillai & others, *Calculus*, Volume-I, S. Viswanathan (Printers and Publications) Pvt. Ltd. Reprint 2011.
Unit 1,2: Chapter 3: Sections 1.1-1.6 & section 2.1, 2.2, Chapter 8: Sections 4,4.1, 5

2. S. Narayanan, T. K. Manicavachagam Pillai & others, *Calculus*, Volume-II, S. Viswanathan (Printers and Publications) Pvt. Ltd. Reprint 2011.

Unit 3: Chapter 2 Section 1.1, 1.2, 1.3 &1.4
Unit 4: Chapter 5 Sections 1,2.1,2.2(problems only),3.1,3.2 & 4
Unit 5: Chapter 7 Section 2.1 - 2.5

References:

1. B.C. Das and B.N. Mukherjee, *Differential Calculus* 52nd Edition, Kolkata**:** U.N. Dhur and sons Pvt. Ltd., 2012.
2. G.C. Chaubey. S.K.D Dubey, M.U Khan, D.S Pandey, *A Textbook of Advanced Calculus*, New Delhi: Wisdom, 2012.
3. P. R. Vittal & V. Malini, *Calculus*, Margham Publications

Web References:

1. http://sydney.edu.au/stuserv/documents/maths_learning_centre/differentialcalculus.pdf
2. http://www.mathsisfun.com/calculus/
3. https://homepage.tudelft.nl/11r49/documents/wi4006/gammabeta.pdf

DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

(Core theory)

Code: 214MT2M01 **Hours: 75 Hours**
Semester: II **Credits: 4**
Learning Objectives:

- To help gain logical skills in the formulation and solving of differential equations.
- To expose students to different techniques of finding solutions to these equations.
- To give the application of Laplace transforms in differential equations.

Course Outcomes:
Upon completion of the course the student will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Define, Solving first order & second order ordinary differential equations	PSO 1	R, Ap
CO2	Solve using variation of Parameters	PSO 1	Ap
CO3	Define & Solve Partial differential equation. Solving various types of PDE	PSO 2, PSO 4	R, Ap
CO4	Find Laplace & Inverse Laplace transform	PSO 2, PSO 4	U, Ap
CO5	Solving differential equations using Laplace transform	PSO 4	Ap

Unit I **18 Hours**

First order but of higher degree equations - solvable for p, solvable for x, solvable for y - Clairaut's form - Simple Problems.
Second order equation with constant coefficient with particular integrals for $e^{ax}, x^m, e^{ax}\ sin\ sin\ mx$, $e^{ax}\ cos\ cos\ mx$.

Unit II **12 Hours**

Second order differential equation with variable coefficients $ax^2\frac{d^2y}{dx^2} + bx\frac{dy}{dx} + cy = g(x)$, - Method of variation of parameters - Simple Problems.

Unit III **15 Hours**

Formation of PDE by eliminating arbitrary constants and arbitrary functions - Complete integral - Singular integral - General integral –Charpit's method and the standard types $f(p,q) = 0$; $f(x,p,q) = 0$; $f(y,p,q) = 0$; $f(z,p,q) = 0$; $f(x,p) = f(y,q)$ - Clairaut's form and Lagrange's equation $Pp + Qq = R$ - Simple Problems.

Unit IV **15 Hours**

Laplace transforms - Inverse transform.

Unit V **15 Hours**

Application of Laplace to solution of first and second order linear differential equations with constant coefficients.

Textbook:

Narayanan, S. and Manicavachagom Pillay, T. K. *Calculus*, Vol III, Chennai: S. Viswanathan Printers & Publishers, 2006.

Unit 1: Chapter 1: Sections 5, 6, 7, Chapter 2: Sections 1 – 4
Unit 2: Chapter 2: Sections 8, 9, 10
Unit 3: Chapter 4
Unit 4: Chapter 5: Sections 1 – 7
Unit 5: Chapter 5: Section 8

References:

1. Narayan S. and T.K. Manicavachagom Pillay, *Differential Equations and its Applications*. Chennai: S. Viswanathan Printers & Publishers Pvt. Ltd., 2001.
2. Rai, B., D.P. Choudhury, and H.I. Freedman, *A Course in Ordinary Differential Equations.* New Delhi: Narosa Publishing House, 2002.
3. Sharma J.N. and Kehar Singh, *Partial Differential Equations for Engineers and Scientists*. New Delhi: Narosa Publishing House, 2000.
4. Amarnath. T, *An Elementary Course in Partial Differential Equation* (2nd Edition). New Delhi: Narosa Publishing House, 2003.
5. S. Sankarappan, S. Kalavathy, S. Santha, B. Praba, *Applied Mathematics*, Vijay Nicole Imprints Private Limited, Chennai, 2009.

Web References:

1. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
2. http://faculty.bard.edu/belk/math213s14/ApplicationsOfDifferentialEquations.pdf
3. www.ugrad.math.ubc.ca/coursedoc/math100/notes/.../intro.html
4. https://www.intmath.com/laplace-transformation/table-laplace-transforms.php

DIFFERENTIAL GEOMETRY AND ANALYTICAL GEOMETRY OF 3 - DIMENSIONS

(Core theory)

Code: 214MT2M02 **Hours: 75 Hours**

Semester: II **Credits: 4**

Learning Objectives:

- To review and extend the knowledge of differential geometry and applications of differentiation.
- To study planes, straight lines, spheres using their equations.

Course Outcomes:

Upon completion of the course the student will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Differentiate and apply curvature to model multidimensional systems	PSO 1, PSO 4	Ap
CO2	Apply the concepts of evolutes and create new family of curves	PSO 2	An
CO3	Recognize the type of conic sections and understand its properties	PSO 2	U
CO4	Familiarize concepts of planes, straight lines, and sphere in three - dimensional coordinate geometry	PSO 1	U
CO5	Demonstrate knowledge of geometry and its applications in the real world	PSO 4	Ap

Unit I **15 Hours**

Differential Geometry:

Curvature, radius of curvature in Cartesian coordinates – Polar coordinates – Radius of curvature in polar coordinates.

Unit II **12 Hours**

Differential Geometry contd.:

p – r equations – evolutes – envelopes.

Unit III **16 Hours**

Analytical Geometry of 3-Dimensions:

The Plane - General Equation- Intercept Form - Normal Form - Angle Between two Planes- Equation of Plane through the Line of Intersection of two Given Planes - Length of Perpendicular from a given Point to a Plane – Bisector planes.

Unit IV **16 Hours**

Analytical Geometry of 3-Dimensions contd.:

Lines – The straight line – reduction to symmetric form of a line given by a pair of planes, angle between a plane and a line – Coplanar lines, length and equation of the shortest distance between two skew lines.

Unit V **16 Hours**

Analytical Geometry of 3-Dimensions contd.:

Spheres - Equation of a Sphere with given Centre and Radius - General Form of the Equation of a Sphere - Plane Section of a Sphere - Intersection of Two Spheres - Equation of a Circle on a Sphere - Equation of Sphere Passing through given Circle - Tangent Plane to a Sphere.

Textbooks:

1. Manicavachagam Pillai T.K. and Narayanan S Calculus-volume I
Viswanathan, S., Printers & Publishers Pvt Ltd; 2013
Unit 1 & 2: Chapter 10 pg. 281 –323
2. Manicavachagam Pillai T.K. and Natarajan T., *Analytical Geometry – Part II (3- dimensions),*
Viswanathan, S., Printers & Publishers Pvt Ltd; 2009
Unit 3, 4: Chapter 1, 2 and 3; pg. 1-75
Unit 5: Chapter 4; pg. 92-114

References:

1. Singh, Shalini. *Two Dimensional Geometry*. New Delhi: Swarup, 2000.
2. Hari Krishnan. *Coordinate Geometry of Two Dimensions*. New Delhi: Atlantic, 2006.
3. Narayan, Shanti P.K., Mittal *Analytical Solid Geometry*, New Delhi: S Chand, 2016.
4. Balasubramanyam P., Subramaniam K. G., Venkataraman G R., *Coordinate Geometry of 2 & 3 dimensions*, Tata McGraw-Hill Publishing Company Ltd.

Web References:

1. https://www.askiitians.com/blog/co-ordinate-geometry-works-real-space-fivepractical-examples/
2. https://www3.ul.ie/~rynnet/swconics/applications_of_conic_sections.htm

ABSTRACT ALGEBRA

(Core theory)

Code: 214MT3M01 **Hours: 75 Hours**

Semester: III **Credits: 4**

Learning Objective:

- To introduce various Algebraic Structures to the undergraduate Mathematics Students.
- To make them understand the subject as a tool applicable to all other branches of Sciences and Engineering.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Learn about some basic algebraic structures such as group, ring and field, and their properties	PSO 1	R, U
CO2	Construct examples and counter-examples for the structures learnt and analyze their behaviors	PSO 2	Ap
CO3	Gain knowledge about homomorphism and isomorphism, isomorphic structures and their properties	PSO 2	R, U
CO4	Understand the properties of algebraic structures by means of some special examples like Permutation Groups, Polynomial Rings, Gaussian Integers, Field of Quotients	PSO 2	U
CO5	Gain experience in using various proof techniques to prove theorems	PSO 2	U, Ap

Unit I **18 Hours**

Groups: Definition and Examples - Simple Properties - Subgroups - Cyclic Groups - Cosets and Lagrange's Theorem - Normal Subgroups and Quotient Groups. (Only simple examples and problems on the above topics)

Unit II **15 Hours**

Homomorphisms - Isomorphism Theorem - Automorphisms - Permutation Groups. (Only simple examples and problems on the above topics)

Unit III **12 Hours**

Rings: Definition and Examples - Properties - Special Classes of Rings - Subrings and Subfields - Ideals and Quotient Rings. (Only simple examples and problems on the above topics)

Unit IV **18 Hours**

Homomorphisms - Maximal and Prime Ideals - The Characteristic of an Integral Domain - The Field of Quotients of an Integral Domain. (Only simple examples and problems on the above topics)

Unit V **12 Hours**

Euclidean Rings: Definition and Properties - The Unique Factorization Theorem - Gaussian Integers.

Textbook:

Santiago M.L., *Modern Algebra*, Tata McGraw Hill, 2001.
Unit 1: Chapter 2: Sections 2.1, 2.2, 2.4 - 2.7
Unit 2: Chapter 2: Sections 2.8 - 2.11
Unit 3: Chapter 3: Sections 3.1 – 3.5
Unit 4: Chapter 3: Sections 3.6 - 3.9
Unit 5: Chapter 4: Sections 4.1 - 4.3

References:

1. Herstein I. N., *Topics In Algebra*, Second Edition, Wiley Student Edition, 2014.
2. Fraleigh John B., *A First Course in Abstract Algebra*, 7th Edition, Pearson, 2003.
3. Arumugam S., Thangapandi Isaac A., *Modern Algebra*, Scitech, 2018.
4. Gallian Joseph A., Contemporary Abstract Algebra, 8th Edition, Cengage Learning, 2012.
5. Gopalakrishnan N S., *University Algebra*, New Age International Pvt. Ltd., 2018

Web References:

1. http://www.maths.qmul.ac.uk/~pjc/notes/algstr.pdf
2. https://nptel.ac.in/courses/111/106/111106113/
3.https://math.libretexts.org/Bookshelves/Linear_Algebra/Book%3A_Linear_Algebra_(Schilling_Nachtergaele_and_Lankham)/13%3A_Appendices/13.02%3A_Summary_of_Algebraic_Structures

VECTOR CALCULUS AND FOURIER SERIES

(Core theory)

Code: 214MT3M02 **Hours: 75 Hours**

Semester: III **Credits: 4**

Learning Objectives:

- To introduce vector differentiation, integration and some integral theorems.
- To study Fourier coefficients and its series.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Understand the basic concepts of Gradient, Divergence and Curl	PSO 1	U
CO2	Study about the Solenoidal and irrotational vectors and identities involving divergence and curl	PSO 2	R
CO3	Understand & apply the concept of the Line integrals	PSO 1, PSO 2	U, Ap
CO4	Analyze & solve the problems Using Green's Theorem**,** Stoke's theorem	PSO 1, PSO 3	An
CO5	Apply the basic concepts of Fourier series and Fourier expansion	PSO 3, PSO 4	Ap

Unit I **12 Hours**

Differentiation of vector functions-Vector functions, limit of a vector functions, derivative of a vector function, partial derivatives of vector functions.

Vector and scalar point functions - The vector operator del (only in Cartesians).

Unit II **16 Hours**

Gradient of a scalar point function - determination of unit normal vectors to given surfaces. Divergence and curl of a vector - definition of solenoidal and irrotational vectors.

Formulae involving the operator Del - Laplacian operator.

Unit III **16 Hours**

Multiple integrals-line, surface, and volume integrals. Integration of point functions- Conservative field and scalar potential.

Unit IV **15 Hours**

Gauss divergence theorem (no proof), Stoke's theorem (no proof), Green's theorem in two dimensions (no proof)- Verification of the theorems in simple cases.

Unit V **16 Hours**

Fourier series – definition, finding Fourier coefficients for a given periodic function with period 2π, odd and even functions, half range series.

Textbooks:

1. Duraipandian, P. and Kayalal Pachaiyappa (2014) *Vector Analysis*. S. Chand Publishing.
Unit 1: Chapter 1,2: Sections 1.1-1.6, 2.1-2.3
Unit 2: Chapter 2: Sections 2.4-2.13
Unit 3: Chapter 3: Sections 3.1-3.6,3.8
Unit 4: Chapter 4: Sections 4.2-4.5,4.8
2. Narayanan, S. and Manicavachagom Pillay, T.K. (2004) *Calculus* –Volume III Viswanathan Publishers, Chennai.
Unit 5: Chapter 6: Sections 1 to 5.

References:

1. Narayanan, S. and Manicavachagom Pillay, T.K. (1997) *Vector Calculus* 1st ed. Viswanathan Publishers, Chennai.
2. Vittal, P.R. (1999), Differential equations, *Fourier and Laplace transforms*, Probability. 2nd ed. Margham publishers, Chennai.

Web Referencess:

1. www.math.oregonstate.edu/.../CalculusQuestStudyGuides/.../vcalc.html
2. http://www.youtube.com/watch?v=9Qf1PIggBhA

LINEAR ALGEBRA

(Core theory)

Code: 214MT4M01 **Hours: 75 Hours**

Semester: IV **Credits: 4**

Learning Objective:

- To study about Vector spaces, another important Algebraic Structure and their properties.
- To highlight the importance of the area called Linear Algebra, that has widest applications in Sciences and Engineering.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Have a clear knowledge about the Vector spaces as another algebraic structure, and their highlighting properties like possession of Bases, Linear Independent vectors and so on	PSO 2	R, U
CO2	Work out simple problems on Linear Independence, Basis and Dimensions, Linear Transformations and Matrices and prove basic results on the same topics	PSO 2, PSO 4	R, Ap
CO3	Understand the relationship between the Linear Transformations and Matrices	PSO 2	U
CO4	Perform a deeper analysis on vector space like Inner product space and linear transformation like Hermitian and Unitary Transformations	PSO 2	U, Ap
CO5	Learn in detail about Matrices, their properties and applications	PSO 2, PSO 4	U, Ap

Unit I **15 Hours**

Vector Spaces: Definitions and Simple Properties, Subspaces and Quotient Spaces, Sums and Direct Sums, Linear Independence – Simple Problems.

Unit II **18 Hours**

Basis and Dimension, Homomorphisms, Inner Product Spaces – Simple Problems.

Unit III **12 Hours**

Linear Transformations and Matrices: The Algebra of Linear Transformations, Eigenvalues and Eigenvectors.

Unit IV **15 Hours**

Matrix Algebra, Trace and Transpose, The Rank of a Matrix.

Unit V **15 Hours**

Linear Equations, Determinants, Hermitian and Unitary Transformations.

Textbook:
Santiago M L., *Modern Algebra,* Tata McGraw Hill, 2001.
Unit 1: Chapter 6: Sections 6.1 – 6.4
Unit 2: Chapter 6: Sections 6.5, 6.6, 6.8
Unit 3: Chapter 7: Sections 7.1 – 7.2
Unit 4: Chapter 7: Sections 7.3, 7.5, 7.6
Unit 5: Chapter 7: Sections 7.7, 7.8 (Definitions, Statements of the theorems and Problems only), 7.9

References:
1. Herstein I. N., *Topics In Algebra,* Second Edition, Wiley Student Edition, 2014.
2. Arumugam S., Thangapandi Isaac A., *Modern Algebra,* Scitech, 2018.
3. Gopalakrishnan N S., *University Algebra,* New Age International Pvt. Ltd., 2018
4. Kumaresan S., *Linear Algebra – A Geometric Approach,* Prentice-Hall of India Pvt. Ltd., 2001.

Web References:
1. https://nptel.ac.in/courses/111/106/111106051/
2. https://nptel.ac.in/courses/111/108/111108098/
3. https://www.math.tamu.edu/~dallen/linear_algebra/chpt4.pdf
4.https://www.coursera.org/lecture/linear-algebra-machine-learning/summary-XIkYP?utm_source=link&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button

PROGRAMMING IN C

(Core theory with Practicals)

Code: 214MT4M02 **Hours: 75 Hours**

Semester: IV **Credits: 4**

Learning Objective:

- To gain insight about basic programming skills based on different data types, control statements, string functions, arrays, structures and unions in C programming.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Recall the basic concepts of constants, variables and data type	PSO 1, PSO 6	R
CO2	Demonstrate the different types of operators in C programming language	PSO 6	U
CO3	Develop programming skills using the fundamentals and basics	PSO 2, PSO 6	Ap
CO4	Design programs using Structures and unions	PSO 6	Ap
CO5	Design programs using pointers	PSO 6	Ap

Unit I **15 Hours**

Constants, Variables and Data Types – Operators and Expression – Managing Input and Output Operators.

Unit II **15 Hours**

Decision Making and Branching Decision Making and Looping.

Unit III **15 Hours**

Arrays – Handling of Character String.

Unit IV **15 Hours**

User Defined Functions – Structure and Unions.

Unit V **15 Hours**

Pointers – File Management in C.

List of Programs for Practical work.

1. Fahrenheit to Celsius
2. Simple interest and Compound interest
3. Largest of three numbers
4. Odd/Even Number
5. Reverse the Number
6. Sum of Digits
7. Number of Multiples of 7 between 1 and 100
8. Prime Number
9. Quadratic Equation using switch case
10. Fibonacci Series
11. Average of n values
12. nCr value
13. Multiplication table
14. Standard deviation
15. Median
16. Ascending order
17. Descending order
18. Sorting a list of Names
19. Matrix addition and subtraction
20. Matrix multiplication

Textbook:

Balagurusamy. E, 2019, *Programming in ANSI C*, McGraw Hill Education (India), Private Limited, New Delhi.

Unit 1: Chapter 2 , 3 &4
Unit 2: Chapter 5 &6
Unit 3: Chapter 7 & 8
Unit 4: Chapter 9 & 10
Unit 5: Chapter 11 &12

References:

1. Yashavant Kanetkar, 2016, *Let us C*, 14th Edition, BPB Publications, New Delhi.
2. Ashok N. Kamthane, 2009, *Programming with ANSI and Turbo C*, Pearson Education, New Delhi.
3. Pradip Dey, Manas Ghosh, 2008, *Fundamentals of Computers with Programming in C*, Oxford University press, New Delhi.

Web References:

1. https://www.programiz.com/c-programming
2. http://www.c4learn.com/c-programs/
3. https://www.edureka.co/blog/c-programming-tutorial/

REAL ANALYSIS-I

(Core theory)

Code: 214MT5M01 **Hours: 90 Hours**

Semester: V **Credits: 5**

Learning Objective:

- To gain insights about the real number system, limits and metric spaces.
- To learn intuitive ideas about continuity and connectedness in metric spaces.

Course Outcomes

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Define and analyze the properties of Sequences of real numbers	PSO 2	R, U
CO2	Define and analyze the series of real numbers	PSO 2	R, U
CO3	Demonstrate definitions and theorems concerning metric spaces	PSO 2	R, U
CO4	Develop simple proofs for some standard theorems of continuous functions on metric spaces	PSO 4	U, Ap
CO5	Explain the concepts of completeness and connectedness in metric spaces	PSO 4	U, Ap

Unit I **18 Hours**

Sequence of Real Numbers: Definition of sequences and subsequences – Limit of a sequence – Convergent sequences – Divergent sequence – Bounded sequence – Monotone sequences and Cauchy sequences.

Unit II **18 Hours**

Series of Real Numbers: Convergence and Divergence – Series with nonnegative terms – Alternating series – Conditional Convergence and Absolute Convergence – Tests for Absolute Convergence.

Unit III **16 Hours**

Equivalence, Countability - Limits and metric spaces: Limit of a function on the real line – Metric spaces – Limits in metric spaces.

Unit IV **18 Hours**

Continuous functions on metric spaces: Functions continuous at a point on the real line – Functions continuous on a metric space – Open sets – Closed sets – Discontinuous Functions R^1.

Unit V **20 Hours**

Connectedness and Completeness: More about open sets – Connected sets – Bounded sets and totally bounded sets – Complete metric spaces.

Textbook:

Richard R. Goldberg, *Methods of Real Analysis*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2019.
Unit 1: Chapter 2: Sections 2.1 – 2.10
Unit 2: Chapter 3: Sections 3.1 –3.4, 3.6
Unit 3: Chapter 1: Section 1.5, Chapter 4: Sections 4.1 – 4.3
Unit 4: Chapter 5: Sections 5.1, 5.3 - 5.6
Unit 5: Chapter 6: Sections 6.1 – 6.4

References:

1. Rudin W., *Principles of Mathematical Analysis*, McGraw-Hill Book Co.
2. Arumugam. S. and Thangapandi Isaac. A., 2012, *Modern Analysis*, New Gamma publishing house, Palayamkkottai
3. Somasundaram. D. and Choudary. B., 2011, *A first course in Mathematical Analysis*, Narosa Publishing House Pvt. Ltd., New Delhi.
4. Chandrasekara Rao. K. and Narayanan. K.S., 2008, *Real Analysis*, Vol - I, Second Edition, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.

Web References:

1. https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/
2. https://mathcs.org/analysis/reals/
3. https://onlinecourses.nptel.ac.in/noc20_ma51/preview

MECHANICS

(Core theory)

Code: 214MT5M02 **Hours: 90 Hours**

Semester: V **Credits: 5**

Learning Objectives:

- To familiarize students with the fundamentals and principles of mechanics.
- To understand and solve physical problems.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Study classical laws of physics governing the motion of particles. Determine the resultant force and calculate the motion parameters for a body subjected to a given force system	PSO 1, PSO 4	An
CO2	Study Varignon's theorem and determine moment for a given force system. Analyze and apply the concept and laws of friction to solving related problems	PSO 1, PSO 4	An
CO3	Solve problems involving work and energy of bodies at rest and in motion using conservation laws. Determine the trajectory of projectiles and motion of particles	PSO 4	An
CO4	Understand Simple harmonic motion and analyze the motion of simple and conical pendulums	PSO 4	An
CO5	Study and apply equations to determine central forces and central orbits	PSO 4	Ap

Unit I **18 Hours**

Statics:

Force**:** Newton's laws of motion – Resultant of two forces on a particle – Concurrent System of Forces – Triangle law of Forces – Lami's Theorem – Polygon Law of Forces.

Unit II **16 Hours**

Moment of a Force – Varignon's Theorem – Friction – Laws of Friction – Angle of Friction – Ladder Problems.

Unit III **20 Hours**

Dynamics:

Energy**:** Kinetic Energy, Conservation of Energy, Conservative Forces – Projectiles – Trajectory, Horizontal and Inclined Planes.

Unit IV **18 Hours**

Simple Harmonic Motion: General Solution, Elastic Strings, Composition of two S.H.M, Simple Pendulum – Conical Pendulum.

Unit V **18 Hours**

Central Orbits: Central Forces, Differential Equation of a Central Orbit, Pedal Equation, Apse, p-r Equation, Inverse Square Law.

Textbook:

Duraipandiyan P., Laxmi Duraipandiyan, Muthamizh Jayapragasam, *Mechanics*, S. Chand Publications, 2018.

Unit 1: Chapter 2 and Chapter 3 (Sections 3.1.1 &3.1.2)
Unit 2: Chapter 4 (sections 4.1-4.4) & Chapter5(sections5.2-ladder problems)
Unit 3: Chapter 11 & Chapter 13
Unit 4: Chapter 12 (Sections 12.1-12.1.2) & Chapter 15 (Sections 15.1 & 15.2)
Unit 5: Chapter 16

References:

1. Dharmapadam A.V. *Statics*, Chennai: S. Viswanathan, 2006.
2. Dharmapadam A.V. *Dynamics*, Chennai: S. Viswanathan, 2006
3. Raisinghania M.D., *Dynamics*, New Delhi: S. Chand, 2006.
4. Vittal P.R., *Statics*, Margham Publications, Chennai, 2008.

Web References:

1. https://physics.gurumuda.net/moment-of-force-problems-and-solutions.htm
2. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf
3. http://www.physicsclassroom.com/class/newtlaws/Lesson-2/Types-of-Forces

INTRODUCTION TO PYTHON

(Core Theory with Practicals)

Code: 214MT5M03 **Hours: 90 Hours**

Semester: V **Credits: 4**

Learning Objective:

- To impart knowledge and skill in getting started with Python basic concepts.
- To give the concepts of sequences, string and built-in-functions of python.
- To introduce the various control statements for decision making.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Analyze data and understand the basic concepts in Python	PSO 6	An
CO2	Apply the concept of sequences, string and built-in-functions of python for program development and execution	PSO 4, PSO 6	Ap
CO3	Identify the data and use correction control statements for executing the inputs	PSO 6	Ap
CO4	Apply the knowledge of error correction to execute the python program	PSO 4, PSO 6	Ap
CO5	Formulate the file management in Python Programming	PSO 6	C

Unit I **18 Hours**

Introduction to Python – Origins – Features – Downloading and Installing Python – Running Python – Python Documentation. Getting Started – Program Output statement – Program Input function – Python Basics – Statements and syntax –Variable Assignment – Identifiers – Numbers – Introduction – Integers – Double Precision Floating Point Numbers – Complex Numbers – Operators – Built-in functions for all numeric types.

Unit II **18 Hours**

Sequences: Strings, Lists and Tuples – Sequences – Strings – Strings and Operators – String-Only Operators – Built-in Functions – String Built-in Methods – Lists – Operators - Built-in Functions – List Type Built-in Methods – Tuples –Tuple Operators and Built-in Functions - Mapping and Set Types: Dictionaries –Mapping Type Operators – Mapping Type Built-in Functions and Built-in Methods– Dictionary Keys.

Unit III **18 Hours**

Conditionals and Loops – If statement – else statement – else-if statement – Conditional expressions – while statement – for statement – break statement – Continue statement – pass statement - Functions and Functional Programming – Calling Functions – Creating Functions – Passing Functions – Formal Arguments – Variable-Length Arguments.

Unit IV **18 Hours**

Errors and Exceptions – Exceptions in Python – Detecting and Handling Exceptions Context Management – with statement – Raising Exceptions – Modules – What are Modules? – Modules

and Files – Namespaces – Importing Modules – Features of Module - Import – Module Built-in Functions – Packages – Other Features of Modules

Unit V **18 Hours**

Files and Input / Output: File Objects – File Built-in Functions – File Built-in Methods – File Built-in Attributes – Command-Line Arguments - File System – Object-oriented Programming – Introduction – Classes – Class Attributes – Instances– Instance Attributes – Binding and Method Invocation – Subclassing Inheritance.

Textbook:

Wesley J. Chun, *Core Python Programming*, 2nd Edition, Pearson Education LPE, New Delhi, 2007.

References:

1. Mark Summerfield, *Programming in Python 3*, Pearson Education LPE, New Delhi, 1996.
2. *Python Programming*, Brain draper, Kindle unlimited Pvt. Ltd.
3. *Core Python Programming*, Dr. R. Nageswara Rao, Dreamtech Pvt. Ltd. Kindle.
4. Martin. C. Brown, *The complete References on Python,* McGraw Hill Pvt. Ltd.
5. Louie Stowell, *Coding for Beginners using Python*, Kindle Publishing Pvt. Ltd.

Journals:

Python to learning - IOP Science
Python – Fastest learning Programming Language - IRJET

Web Referencess:

1. www.udemy.com/Python/Online-Course
2. https://www.educba.com/python-programming-beginners-tutorial/
3. https://en.wikiversity.org/wiki/Python_Concepts
4. https://www.tutorialspoint.com/python/
5. https://www.w3resource.com/python-exercises/math/

NUMERICAL METHODS

(Core theory-Elective)

Code: 214MT5M04 **Hours: 90 Hours**

Semester: V **Credits: 5**

Learning Objective:

- To find numerical solutions to problems where the exact relationship between the variables were not known.

Course Outcomes:

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Define Errors & type of errors. Proving the finite difference problems	PSO 2, PSO 3	R, U
CO2	Solving Interpolation with equal & unequal intervals	PSO 3	Ap
CO3	State different methods of numerical differentiation and evaluate	PSO 4	U, E
CO4	Find the roots of a given equation using different methods	PSO 2, PSO 4	U, Ap
CO5	Compute the solutions of differential equations	PSO 2, PSO 3	An

Unit I **18 Hours**

Introduction, Numbers – approximation and rounding to significant figures. Errors – absolute and relative, General formula and classification of errors, Illustrations, Finite differences.

Unit II **18 Hours**

Interpolation with equal intervals, Lagrange's interpolation formula, Divided differences, General difference interpolation formula.

Unit III **18 Hours**

Numerical Differentiation, Numerical Integration – Trapezoidal rule, Simpson's $1/3\,rd$ rule, Simpson's $3/8\,th$ rule.

Unit IV **18 Hours**

Solution of Algebraic equations, Methods to find approximate values of roots, Regula Falsi method, Secant method, Muller's method, Newton – Raphson method, Bairstow method, Graffe's root squaring method.

Unit V **18 Hours**

Solution of Ordinary differential equation, Euler's method, Modification of Euler's method, Taylor's series method, Predictor – corrector method, Runga - Kutta method.

Textbook:

Gupta B.D., *Numerical Analysis*, New Delhi**:** Konark Publishers Pvt. Ltd, 2000.
Unit 1: Chapter 1: Sections 1.1 – 1.6, Chapter 2: Sections 2.1
Unit 2: Chapter 3: Sections 3.1- 3.3, 3.5, 3.6
Unit 3: Chapter 5: Sections 5.1, Chapter 6: Sections 6.1, 6.2

Unit 4: Chapter 15: Sections 15.4 – 15.8, 15.10, 15.11
Unit 5: Chapter 16: Sections 16.1 – 16.3, 16.5, 16.7

References:

1. Devi Prasad, *Introduction to Numerical Analysis*, Narosa Publishing House, 2003.
2. P. Kandasamy, K. Thilagavathy and K. Gunavathy, *Numerical Methods*, S. Chand & Company Ltd, 2001.
3. Veerarajan T. and Ramachandran T., *Numerical Methods*, New Delhi, McGraw Hill, 2019.

Web References:

1. https://numericalmethodstutorials.readthedocs.io/en/latest/
2. https://www.sanfoundry.com/c-program-solve-linear-equation-one-variable/
3. https://nptel.ac.in/courses/122106033/

OPERATIONS RESEARCH - I

(Core theory-Elective)

Code: 214MT5M05 **Hours: 90 Hours**

Semester: V **Credits: 5**

(Proofs of theorems and derivations not included unless specified)

Learning Objectives:

- To introduce Operations Research and its applications.
- To present methods of solving Linear Programming problems, Transportation problems, Assignment problems.

Course Outcomes:

Upon successful completion of this course, Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Understand the basic concepts of Operations Research and formulation of linear programming problems	PSO 1, PSO 3	U
CO2	Solve linear programming problems by using graphical method and simplex method	PSO 3, PSO 4	Ap, An
CO3	Understand the existence of Duality	PSO 3	U
CO4	Evaluate transportation using some mathematical techniques	PSO 4	Ap, An
CO5	Understand the solving method of Assignment problem and travelling salesman problem	PSO 4	U, Ap

Unit I **16 Hours**

Operations Research – Introduction, Characteristics of OR, Phases of OR, Scope of OR, Drawbacks and Difficulties of OR. Linear Programming – Introduction, Formulation, Graphical Method of Solution.

Unit II **20 Hours**

Simplex Method – Introduction, Simplex Method. Artificial Variables – Big M Method ,Two Phase Method.

Unit III **18 Hours**

Duality – Rules for Writing the Dual of a Primal, Duality Theorems (Statement only), Principle of Duality, Economic Interpretation of the Dual. Dual Simplex Method.

Unit IV **18 Hours**

Transportation Problem – Mathematical Formulation, Initial Basic Feasible Solution (North West Corner Rule, Matrix Minima Method, Vogel's Approximation Method), Testing for Optimality , Optimization – MODI Method, Degeneracy, Unbalanced Transportation Problem, Maximization Type.

Unit V **18 Hours**

Assignment Problem – Introduction, Mathematical Formulation, Method of Solving an AP - Hungarian Method (Minimization Problem), Maximization Assignment Problem, Unbalanced Assignment Problem.

Textbook:

Sankara Iyer, P.(2012) *Operations Research*. 5th ed. Tata McGraw Hill Education Private Limited.
Unit 1: Chapter 1: Sections 1.1 - 1.5, Chapter 2: Sections 2.1 - 2.3
Unit 2: Chapter 3: Sections 3.1 - 3.2, Chapter 4: Sections 4.1- 4.3
Unit 3: Chapter 5: Section 5.1, Chapter 6: Sections 6.1, 6.2 (Statement only), 6.3 - 6.4
Unit 4: Chapter 11: Sections 11.1 - 11.2 (11.2.2 and 11.2.3 omitted), 11.3 - 11.7
Unit 5: Chapter 12: Sections 12.1 – 12.6

References:

1. Kanti Swarup, Gupta, P.K. and Man Mohan (2014) *Operations Research*. 12th ed.
Sultan Chand and Sons, New Delhi.
2. Vittal P.R. and Malini, V. (2002) *Operations Research*. 1st ed. Margham Publications, Chennai.
3. Sharma S. D. (1996) *Operations Research*, 11th ed. Kedar Nath Ram Nath & Co., Meerut.

Web References:

1. http:// www.pitt.edu/~jrclass/or/or-intro.html
2. http://home.ubalt.edu/ntsbarsh/econ/graphical.doc

REAL ANALYSIS II

(Core theory)

Code: 214MT6M01 **Hours: 90 Hours**
Semester: VI **Credits: 5**

Learning Objective:

- To gain cognizance about Compactness in metric spaces.
- To gain knowledge about Riemann integral and convergence of sequences and series of functions.

Course Outcomes

Upon successful completion of this course, students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Explain the concepts of compactness in metric spaces	PSO 2	U, Ap
CO2	Define and analyze the properties of Riemann integral	PSO 1, PSO 2	U, Ap
CO3	Demonstrate some theorems in calculus	PSO 2	R, U
CO4	Demonstrate pointwise and uniform convergence of sequences of functions	PSO 2, PSO 4	R, U
CO5	Explain the concepts of integration and differentiation of series of functions	PSO 4	U, Ap

Unit I **18 Hours**

Compact Metric Spaces – Continuous functions on Compact Metric Spaces – Continuity of the Inverse Functions – Uniform Continuity.

Unit II **18 Hours**

Sets of Measure Zero – Definition of Riemann Integrals – Existence of Riemann Integral – Properties of Riemann Integral**.**

Unit III **18 Hours**

Derivatives- Rolle's Theorem – The law of the Mean – Fundamental Theorem of Calculus.

Unit IV **18 Hours**

Taylor's Theorem, Pointwise Convergence of sequence of Functions – Uniform Convergence of sequences of functions.

Unit V **18 Hours**

Consequence of Uniform Convergence – Convergence and Uniform Convergence of series of Functions – Integration and Differentiation of series of Functions.

Textbook:

Richard R. Goldberg, *Methods of Real Analysis,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2019.

Unit 1: Chapter 6: Sections 6.5 - 6.8.
Unit 2: Chapter 7: Sections 7.1 –7.4.
Unit 3: Chapter 7: Sections 7.5 - 7.8.
Unit 4: Chapter 8: Section 8.5, Chapter 9: Sections 9.1,9.2.
Unit 5: Chapter9: Sections 9.3 – 9.5.

References:

1. Rudin W., *Principles of Mathematical Analysis,* McGraw-Hill Book Co.
2. Somasundaram. D. and Choudary. B., 2011, *A first course in Mathematical Analysis,* Narosa Publishing House Pvt. Ltd., New Delhi.
3. Chandrasekara Rao. K. and Narayanan. K.S., 2008, *Real Analysis*, Vol - I, Second Edition, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.

Web References:

1. https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/
2. https://mathcs.org/analysis/reals/
3. https://onlinecourses.nptel.ac.in/noc20_ma51/preview

COMPLEX ANALYSIS

(Core theory)

Code: 214MT6M02 **Hours: 90 Hours**

Semester: VI **Credits: 5**

Learning Objective:

- To nourish the Undergraduate Mathematics students with the knowledge of Complex-valued functions and their Geometric Interpretation.

Course Outcomes:

Upon successful completion of this course, Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Develop knowledge about Analytic and Harmonic Functions, their properties, and give examples and counter examples using the theorems and special results	PSO 1, PSO 2	R, U, Ap
CO2	Perform contour integration on complex plane with the help of various standard theorems	PSO 2	Ap
CO3	Understand the Geometrical properties of complex valued functions	PSO 1	U
CO4	Have a clear picture about Taylor's theorem and Laurent's theorem, using them to expand complex functions as power series	PSO 4	U, Ap
CO5	Workout simple problems on finding poles and residues of a complex valued function	PSO 4	U, Ap

Unit I **20 Hours**

Complex Numbers: Regions in the complex plane.

Analytic Functions: Functions of a complex variable, Mappings, Limits, Theorems on Limits, Limits involving the Point at Infinity, Continuity, Derivatives, Differentiation Formulas, Cauchy – Riemann Equations, Sufficient Conditions for Differentiability, Polar Coordinates, Analytic Functions, Examples, Harmonic Functions. (Simple Problems on the above topics)

Unit II **16 Hours**

Integrals: Contours, Contour Integrals, Examples, Upper Bounds for Moduli of Contour Integrals, Antiderivatives, Examples, Cauchy – Goursat Theorem (Statement only), Simply and Multiply Connected Domains, Cauchy – Integral Formula. (Simple Problems on the above topics)

Unit III **18 Hours**

Derivatives of Analytic Functions, Liouville's Theorem and the Fundamental Theorem of Algebra, Maximum Modulus Principle.

Series: Convergence of Sequence, Convergence of Series, Taylor Series, Examples, Laurent Series, Examples. (Simple Problems on the above topics)

Unit IV **20 Hours**

Residues and Poles: Residues, Cauchy's Residue Theorem, Using a Single Residue, The three types of Isolated Singular Points, Residue at Poles, Examples, Zeros of Analytic Functions, Zeros and Poles. (Simple Problems on the above topics)

Applications of Residues: Evaluation of Improper Integrals, Example, Improper Integrals from Fourier Analysis, Jordan's Lemma, Definite integrals involving Sines and Cosines, Rouche's Theorem. (Simple Problems on the above topics)

Unit V **16 Hours**

Mapping By Elementary Functions: Linear Fractional Transformations, an implicit form, Mappings of the Upper Half Plane, The Transformation $w = sin\ z$, Mappings by z^2 and Branches of $z^{1/2}$,Mappings by the Exponential Function.

Conformal Mapping: Preservation of angles. (Simple Problems on the above topics)

Textbook:

Brown J. W., Churchill Ruel V., *Complex Variables and Applications*, 7th Edition, McGraw Hill Co., International Student Edition, 2003.

Unit 1: Chapter 1: Section 10, Chapter 2: Sections 11, 14 – 25
Unit 2: Chapter 4: Sections 38 – 44, 46, 47
Unit 3: Chapter 4: Sections 48 – 50, Chapter 5: Sections 51 – 56
Unit 4: Chapter 6: Sections 62 – 69, Chapter 7: Sections 71 – 74, 78, 80
Unit 5: Chapter 8: Sections 86 – 90, Chapter 2: Section 13, Chapter 9: Section 94

References:

1. Duraipandian P., Kayalal Pachaiyappa, *Complex Analysis*, S. Chand and Co., 2017.
2. Arumugam S., Thangapandi Isaac A., Somasundaram A., *Complex Analysis*, Scitech Publications, 2018.
3. Venkatachalapathy S G., *Real and Complex Analysis*, Margham Publications, 2009.
4. Spiegel Murray R., *Theory and Problems of Complex Variables*, Schaum Outline Series.
5. Ponnusamy S., *Foundations of Complex Analysis*, Narosa Publishing House, 2000.

Web References:

1. https://www.coursera.org/learn/complex-analysis
2. https://en.wikipedia.org/wiki/Bilinear_transform
3. https://digitalcommons.csumb.edu/cgi/viewcontent.cgi?article=1360&context=caps_thes

NUMBER THEORY AND INTRODUCTION TO CRYPTOGRAPHY

(Core theory)

Code: 214MT6M03 **Hours: 90 Hours**

Semester: VI **Credits: 5**

Learning Objectives:

- To develop an appreciation for some interesting properties of numbers that developed from ancient times.
- To understand applications of Number Theory with special References to cryptosystems.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Understand the basic concepts of numbers	PSO 1	U
CO2	Understand the concept of the Fermat numbers	PSO 3, PSO 5	U
CO3	Apply the concepts learnt in problems	PSO 4, PSO 5	Ap
CO4	Study about the basic concepts of cryptography	PSO 1	U
CO5	Knowledge to apply elementary Number theory to Cryptography	PSO 5	Ap

Unit I **18 Hours**

Principle of Mathematical Induction, Binomial Theorem, Division Algorithm, greatest common divisor, Euclidean Algorithm, Diophantine Equation $ax + by = c$.

Unit II **18 Hours**

Fundamental Theorem of Arithmetic, Euclid's theorem, Bounds for primes, Basic Properties of Congruence, Binary and Decimal representation of integers.

Unit III **18 Hours**

Linear congruences and Chinese Remainder theorem. Fermat's theorem, Wilson's theorem. The Sum and Number of Divisors. Mobius Inversion Formula (definition only).

Unit IV **18 Hours**

The Order of an Integer Modulo n. Primitive roots for primes, From Caesar Cipher to Public Key Cryptography, The Knapsack Cryptosystem.

Unit V **18 Hours**

Application of Primitive roots to Cryptography. Numbers of Special form- Perfect numbers, Fermat Numbers, Fibonacci sequence.

Textbook:

David M. Burton, (2007), *Elementary Number Theory*, Tata McGraw-Hill Education Company.
Unit 1: Chapter 1:1.1, 1.2 Chapter 2: Sections 2.2- 2.5
Unit 2: Chapter 3: Sections 3.1, 3.2, Chapter 4: Section 4.2, 4.3
Unit 3: Chapter 4: Section 4.4, Chapter 5: 5.2, 5.3, Chapter 6: Section 6.1, 6.2(definition only)
Unit 4: Chapter 8: Section 8.1, 8.2, Chapter 10: Sections 10.1-10.2
Unit 5: Chapter 10: Section 10.3,Chapter 11: Sections 11.2,11.4 Chapter 14: Section 14.2

References:

1. George E. Andrews, (1984), *Number Theory*, Hindustan Publishing Company.
2. S. B. Malik, (1996), *Basic Number Theory*, Vikas Publishing House.

Web References:

1. http://www.math.niu.edu/~rusin/known-math/index/11-
2. http://marauder.millersville.edu/~bikenaga/numbertheory/numb

FORMAL LANGUAGES AND GRAPH THEORY

(Core theory- Elective)

Code: 214MT6M04 **Hours: 90 Hours**

Semester: VI **Credits: 5**

Learning Objective:

- To study Formal Languages and Automata and establish some of the properties of such systems.
- To familiarize the students with some theories of mathematics in computer science.
- To translate real life situations to diagrammatic representations.
- To develop problem solving skills and thereby solve real life problems.

Course Outcomes:

No.	Course Outcomes	PSO addressed	CL*
CO1	Define and prove the closure properties of PSL, CSL, CFL & RL	PSO 4	R, Ap
CO2	Define and explain about derivation tree, Ambiguous & unambiguous grammar	PSO 2, PSO 4	R, U
CO3	Analyzing the different properties of CFL and study about automata theory	PSO 4, PSO 5	An, Ap
CO4	Defining the various concepts of Graph theory	PSO 5	R
CO5	Defining and examining the concepts of trees	PSO 3, PSO 4	R, An

Unit I **18 Hours**

Phrase - Structure grammars and languages – Chomsky hierarchy.

Unit II **18 Hours**

Context-free languages: Derivation tree Ambiguity.

Unit III **18 Hours**

Context-free languages: Reduced grammar – Chomsky normal form – uvwxy Theorem – Finite state automata and regular sets – Kleen's Theorem.

Unit IV **18 Hours**

Graphs – Incidence and degree of a vertex – Paths and circuits – Euler's graph – Hamiltonian paths and circuits.

Unit V **18 Hours**

Tree – Spanning trees – Cut-trees and Cut-vertices.

Textbooks:

1. Formal Languages by Rani Siromoney CLS Publishers.
Unit 1: Chapters 2, 3, 4 (Sections 4.1, 4.2)
Unit 2: Chapter 4 (Sections 4.3, 4.4(Upto Theorem 4.1 and Examples 4.10, 4.11, 4.12), 4.5(Upto Theorem 4.3 and Example 4.15))
Unit 3: Chapter 5 (5.1, 5.2, 5.3 5.4 (Upto Theorem 5.7 and example under it)).
2. Graph Theory with application to Engineering and Computer Science by Narasingh Deo, Prentice Hall, 1974.

Unit 4: Chapters 1, 2
Unit 5: Chapters 3, 4 (Sections 4.1 – 4.5 only).

References:

1. Hopcroft and Ullman, *Introduction to Automata Theory, Languages and Computation* , Narosa Publishing House,1987.
2. Peter Linz, *An Introduction to Formal Languages and Automata*, 3rd Edition. New Delhi: Narosa Publishing House, 2005.
3. Arumugam S. & Ramachandran S., *Invitation to Graph Theory*. Chennai: Scitech, 2013.
4. Balakrishnan B, *Textbook of Graph Theory*, Springer, 2000.

Web Resources:

1. http://www.iitg.ernet.in/dgoswami/Flat-Notes.pdf
2. https://www.ics.uci.edu/~goodrich/teach/cs162/notes/
3. https://cs.stanford.edu/people/eroberts/courses/soco/projects/2004-05/automata-theory/apps.html
4. http://www.sti.uniurb.it/aldini/publications/lfga.pdf
5. http://www.open-graphtheory.org/
6. https://www.britannica.com/topic/graph-theory
7. http://mathforum.org/library/topics/graph_theory/

OPERATIONS RESEARCH - II

(Core theory- Elective)

Code: 214MT6M05 **Hours: 90 Hours**

Semester: VI **Credits: 5**

(Proofs of theorems and derivations not included unless specified)

Learning Objectives:

- To introduce sequencing models, replacement problem, inventory control.
- To study different techniques of solving problems in network scheduling and game theory.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Apply sequencing concepts to solve real time problems.	PSO 1, PSO 4	Ap
CO2	Analyze the network by PERT and CPM	PSO3, PSO 4	An
CO3	Apply the concept of strategies in games	PSO 4	Ap
CO4	Analyze the type of replacement to be made in real time.	PSO 4, PSO 5	An
CO5	Understand the different inventory systems and evaluate the cost.	PSO 4	U

Unit I **18 Hours**

Sequencing Problem- Introduction, Notations, Terminology and Assumptions, Processing *n* Jobs Through Two Machines, Processing *n* Jobs Through Three Machines, Processing *n* Jobs Through *m* Machines.

Unit II **18 Hours**

Project Scheduling (PERT and CPM) – Introduction, Network Diagrams, Critical Path Method, PERT Calculations (CPM and PERT, Time Calculations and Critical Path, Probability of completion within a specified time).

Unit III **18 Hours**

Theory of Games – Introduction, Two-Person Zero Sum Games, Games with Saddle Point (Pure Strategy), Games without Saddle Points (Mixed Strategy), Formula for Finding the Value of the Game in Case of 2 x 2 Games without Saddle Point, Dominance Property, Algebraic Method, Graphical Method.

Unit IV **18 Hours**

Replacement Models – Introduction, Replacement of items which Deteriorate in Efficiency with Time, Replacement of Items that Fail Completely.

Unit V **18 Hours**

Inventory Models – Introduction, Costs Involved in Inventory Control, Characteristics of Inventory System, Deterministic Inventory Models with no Shortage (Economic Lot Size Model with constant demand, Manufacturing Model), Model with shortages (production instantaneous).

Textbook:

Sankara Iyer, P. (2012) *Operations Research,* 5th ed. Tata McGraw Hill Education Private Limited.
Unit 1: Chapter 16: Sections 16.1 – 16.3
Unit 2: Chapter 20: 20.1 – 20.3, 20.4 (20.4.4 omitted)
Unit 3: Chapter 14: Sections 14.1 – 14.8
Unit 4: Chapter 19: 19.1 – 19.3
Unit 5: Chapter 18: 18.1 – 18.3, 18.4 (18.4.3 omitted)

References:

1.Kanti Swarup, Gupta, P.K. and Man Mohan (2014) *Operations Research,* 12th ed. Sultan Chand and Sons, New Delhi.
2.Vittal P.R. and Malini, V. (2002) *Operations Research*, 1st ed. Margham Publications, Chennai.
3.Sharma S. D. (1996) *Operations Research*, 11th ed. Kedar Nath Ram Nath & Co., Meerut

Web References:

1. www.pitt.edu/~jrclass/or/or-intro.html
2. www.me.utexas.edu/~jensen/ORMM/supplements/models/inventory/

ALLIED MATHEMATICS - I
(For First year Physics Major students)

Code: 214MT1A01 **Hours: 90 Hours**
Semester: I **Credits: 5**

Learning Objectives:

- To present the different methods in solving problems in differentiation and transforms.
- To introduce the fundamental concepts of theory of equations and Fourier series.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Solve problems in physics and applied mathematics using ordinary differential equations.	PSO 1, PSO 2	Ap
CO2	Study the importance and applications of differential calculus in Physics	PSO 2	U
CO3	Determine partial derivatives and obtain maxima and minima for functions of several variables.	PSO 1, PSO 2	Ap
CO4	Analyze a periodic function and obtain its Fourier components and find the surface areas and lengths of unknown curves	PSO 2, PSO 4	An
CO5	Analyze and apply polynomial and reciprocal equations to solve problems in physics and the applications of characteristic equations.	PSO 2, PSO 4	Ap

Unit I **14 Hours**

Ordinary Differential Equations

Second order differential equations with constants coefficients – Particular integral of polynomial $e^{mx}$and v, where v is a polynomial or $sin\ x$ or $cos\ x$.

Unit II **18 Hours**

Differential Calculus

Curvature and radius of curvature in rectangular coordinates-p-r equations.

Unit III **18 Hours**

Partial Differentiation

Partial derivatives of functions of several variables – Jacobian of three variables - Maxima and Minima for functions of several variables.

Unit IV **20 Hours**

Fourier Series and Applications of Integrals

Bernoulli's formula for integration by parts (simple problems) – Fourier series of periodic function on interval (0,2π) (without deduction) - Length of a Plane curve – Surface area of solid of revolution in rectangular coordinates.

Unit V **20 Hours**

Theory of Equations and Matrices

Polynomial equations – irrational roots – Complex roots – Reciprocal equations.
Characteristic equation of a matrix - Eigen values, Eigen vectors- Cayley-Hamilton Theorem

Textbook:

Vittal P. R, *Allied Mathematics*, Margham Publications, Chennai, Reprint 2013.
Unit 1: Chapter 23, pp. 23.1 - 23.25
Unit 2: Chapter 11, pp. 11.1 - 11.34
Unit 3: Chapter 9, pp. 9.1 - 9.62
Unit 4: Chapter 18, 19 and 21, pp. 18.1, 18.25, 19.1 - 19.15, 21.1 - 21.23
Unit 5: Chapter 5 and 6, pp. 5.50 - 5.82, 6.1 - 6.37

References:

1. Manicavachagom Pillay T K., T. Natarajan T. and Ganapathy K S., *Algebra* (Vol - II), S. Viswanathan Pvt. Ltd, Reprint,2004.
2. Narayanan S. and T.K. Manicavachagom Pillay T K., *Calculus* (Vol-I, II), S. Viswanathan Printers and Publishers, Reprint, 2003.
3. Narayanan S., Manicavachagom Pillay T K., *Ancillary Mathematics*, S. Viswanathan Printers and Publishers, Reprint, 2003.
4. M.K. Venkataraman, Engineering Mathematics, National Publishing Company.

Web References:

1. http://sydney.edu.au/stuserv/documents/maths_learning_centre/differentialcalculus.pdf
2. http://www.mathsisfun.com/calculus/
3. http://www.edurite.com/kbase/application-of-matrices-in-real-life

ALLIED MATHEMATICS - II
(For First year Physics Major Students)

Code: 214MT2A01 **Hours: 90 Hours**
Semester: II **Credits: 5**

Learning Objectives:

- To present the different methods in solving problems involving partial differential equations and to apply transform techniques to solve ordinary differential equations.
- To introduce the methods of solving multiple and vector integrals.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Solving ordinary differential equations using Laplace and inverse Laplace transforms	PSO 1, PSO 2	Ap
CO2	Apply partial differential equations to model multidimensional systems.	PSO 2	An
CO3	Apply concept of multiple integrals to solve simple mathematical problems.	PSO 2	Ap
CO4	Use vector calculus and related theorems to solve problems in field of physics	PSO 2, PSO 4	Ap
CO5	Apply the concepts Curl and Divergence in physical situations	PSO 2, PSO 4	An

Unit I **18 Hours**

Laplace transforms

Laplace transforms of standard functions and simple properties – Inverse Laplace Transform (partial fractions method) – solving ordinary differential equation using Laplace transforms – simple problems.

Unit II **18 Hours**

Partial Differential Equations

Formation of Equations by Elimination of Constants and an Arbitrary Function-Definition of General, Particular, Complete and Singular Integral- Solutions of First Order Equations in their Standard Forms - Lagrange's Method of Solving of Linear Equations $Pp + Qq = R$

Unit III **18 Hours**

Multiple Integrals

Evaluation of double and triple integrals – changing the order of integration – simple applications in finding area and volume.

Unit IV **18 Hours**

Vector Differentiation

Gradient of a Scalar field – Divergence of a Vector function - Solenoidal and irrotational vectors -Curl of a vector function and its physical significance -Vector identities

Unit V **18 Hours**

Vector integration

Line, surface and volume Integrals- Gauss divergence theorem - Stoke's theorem - Green's theorem (without proof) and simple problems.

Text Book:

Vittal P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2013.
Unit 1: Chapter 27, pp. 27.1 - 27.62
Unit 2: Chapter 26, pp. 26.1 - 26.63
Unit 3: Chapter 20, pp. 20.1 - 20.44
Unit 4: Chapter 28, pp. 28.1 - 28.53
Unit 5: Chapter 28, pp. 28.54 - 24.142

References:

1. Manicavachagom Pillay T K., T. Natarajan T. and Ganapathy K S., *Algebra* (Vol - II), S. Viswanathan Pvt. Ltd, Reprint,2004.
2. Narayanan S. and T.K. Manicavachagom Pillay T K., *Calculus* (Vol-I, II), S. Viswanathan Printers and Publishers, Reprint, 2003.
3. Narayanan S., Manicavachagom Pillay T K., *Ancillary Mathematics*, S. Viswanathan Printers and Publishers, Reprint, 2003.
4. M.K. Venkataraman, Engineering Mathematics, National Publishing Company.

Web References:

1. http://faculty.bard.edu/belk/math213s14/ApplicationsOfDifferentialEquations.pdf
2. http://www.javaquant.net/papers/Laplacetransform.pdf
3. http://www.intmath.com/laplace-transformation/10-applications.php

MATHEMATICAL STATISTICS WITH R – I

(Allied Theory with Practicals)

Code: 214MT3A01 **Hours: 90 Hours**

Semester: III **Credits: 5**

Learning Objective:

- To gain understanding about the basic concepts of Data Analysis, Statistical Computations and Theoretical Distributions.
- To gain insights about Statistical Computations using R

Course Outcomes

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Understanding the ideas of probability and random variables	PSO 3	R, U
CO2	Understanding the concepts of variance and moment generating function	PSO 3	R, U
CO3	Examine the correlation and regression concepts	PSO 3, PSO 4	U, Ap
CO4	Analyze the probability distributions	PSO 5	U, Ap
CO5	Applying the statistical ideas using R	PSO 6	Ap

Unit I **15 Hours**

Probability, Random Variables, Mathematical Expectations

Unit II **15 Hours**

Variance, Moments and Moment Generating Function, Characteristic Functions,

Unit III **15 Hours**

Correlation, Regression

Unit IV **15 Hours**

Binomial, Poisson, Normal, Exponential Distributions.

Unit V **30 Hours**

Problems in units II and III to be done in R

(Internal Practical only No questions for the End of Semester Examination)

Textbooks:

1. S.C.Gupta and V.K. Kapoor, *Elements of Mathematical Statistics*, Third Edition(2015), Sultan Chand & Sons, New Delhi.

Unit 1: Chapters 4.3-4.4,4.6-4.8,5.1-5.4.1,5.4.3-5.5.5,6.1

Unit 2: Chapter 6.2 - 6.13.1

Unit 3: Chapters 10.1-10.7.7

Unit 4: Chapters 7.2- 7.2.11, 7.3-7.3.9, 8.2-8.2.13, 8.6,8.6.1

2. Mark Gardener- Beginning R: The Statistical Programming Language, 2013
Unit 5:

References:

1. Murrey Spiegel, John Schiller R., Alu Srinivasan, *Probability and Statistics* (Schaum's Outline Series), 2017
2. Garrett Grolemund- Hands on Programming With R: Write Your Own Functions and Simulations, 2014.
3.. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani - An Introduction to Statistical Learning: with Applications in R , Springer, 2017
4. W. John Braun and Duncan J. Murdoch, *A First Course in Statistical Programming with R*, Cambridge University Press, 2007.

Web References:

1. https://ocw.mit.edu/courses/sloan-school-of-management/15-075j-statistical-thinking-and-data-analysis-fall-2011/index.html
2. https://stattrek.com/
3. https://nptel.ac.in/courses/111/105/111105041/
4.http://scholar.harvard.edu/dromney/online-resources-learning-r

MATHEMATICAL STATISTICS WITH R – II

(Allied Theory with Practicals)

Code: 214MT4A01 **Hours: 90 Hours**

Semester: IV **Credits: 5**

Learning Objective:

- To understand the concepts of t, F distributions and its applications
- To demonstrate the use of Chi – Square distribution
- To analyze the concepts of sampling techniques and procedure for testing of hypothesis

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Derive the pdf, mgf of chi-square, t, F-distribution	PSO 2	Ap
CO2	Define and explain the methods of estimation. Test statistic & critical region.	PSO 3, PSO 4	R, Ap
CO3	Understand, apply and compute sample test of hypothetic problem.	PSO 4	Ap
CO4	Apply and examine the t-test, Chi-square test, F-test.	PSO 4, PSO 5	Ap, An
CO5	Effectively use R software to solve problems in Unit-III, Unit-IV.	PSO 6	Ap, An

Unit I **15 Hours**

Sampling Distribution – Chi Square, t, F Distributions.

Unit II **15 Hours**

Estimation – Point Estimation – Unbiased Estimator-Cramer-Rao Inequality-Rao Blackwell theorem-Consistent Estimator-Method of Maximum Likelihood-Testing of Hypothesis – Null and Alternative Hypothesis-Critical Region-Errors-Significance level of the test.

Unit III **15 Hours**

Large Samples.

Unit IV **15 Hours**

Small Samples – t Test, F Test and Chi Square Test.

Unit V **30 Hours**

Problems of Unit-III & Unit-IV to be done using R.

(Internal Practical only No questions for the End of Semester Examination)

Textbooks:

1. S.C.Gupta and V.K. Kapoor, *Fundamentals of Mathematical Statistics*,, Third Edition(2015), Sultan Chand & Sons, New Delhi.

Unit 1: Chapters 12 Section 12.1,12,2, Chapter 13 Section 13.1-13.4(Theorem 13.1 &13.2 only), Chapter 14 Section 14.1,14.2,14.2.1-14.2.5, 14.5, 14.5.1-14.5.3

Unit 2: Chapters 12 Section 12.3-12.7, Chapter 15 Section 15.1-15.5.1,15.7, 15.9,15.11

Unit 3: Chapters 12 Section 12.8 -12.9.2, 12.13-12.15

Unit 4: Chapters 11 Section 11.7-11.8, Chapter 13 Section 13.7.1 -13.7.3, Chapter 14 Section 14.2.9-14.2.10, 14.5.5,14.5.7,

2. Mark Gardener- Beginning R: The Statistical Programming Language, 2013
Unit 5

References:

1. S. P. Gupta, *Statistical Methods*, S. Chand & sons 2002.
2. Veerarajan. T. Yes Dee, *Fundamentals of Mathematical Statistics*, 2017.
3. Pillai R. S. N. and Bagavathi V., *Statistics*, New Delhi: S. Chand & Company Ltd, Reprint 2007.
4. Sancheti D.C. and Kapoor V. K., *Statistics: Theory, Methods & Application*, New Delhi: S. Chand & Company Ltd, 2014.
5.Vittal P R., *Mathematical Statistics*, Margham Publications, 2002
6. Garrett Grolemund- Hands on Programming With R: Write Your Own Functions and Simulations, 2014.
7. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani - An Introduction to Statistical Learning: with Applications in R , Springer, 2017
8.. W. John Braun and Duncan J. Murdoch, *A First Course in Statistical Programming with R*, Cambridge University Press, 2007.

Web References:

1. https://statistics.laerd.com/statistical-guides/hypothesis-testing.php
2. https://www.spss-tutorials.com/anova-what-is-it/
3. http://www.statsoft.com/textbook/time-series-analysis
4. http://scholar.harvard.edu/dromney/online-resources-learning-r

GENERAL COURSE – BASIC MATHEMATICS
(Offered to ONLY other department Students)

Code: 214UC1G08 **Hours: 60 Hours**
Semester: I or II **Credits: 2**

Learning Objective:

- To equip the Undergraduate students from various Disciplines with Basic Mathematics knowledge.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Revise the Basic concepts on Classic Algebra, Sequences and Series that was learnt by him/her in Secondary School level	PSO 1	R, U
CO2	Gain knowledge about various types of matrices and various operations performed on them.	PSO 1	R
CO3	Solve simple polynomials using some simple techniques	PSO 2	U, Ap
CO4	Learn about interpolation and find the missing data	PSO 4	U, Ap
CO5	Differentiate and integrate basic real valued functions by means of simple formulae and simple derivations	PSO 4	R, U, Ap

Unit I **12 Hours**

Partial Fractions - Binomial Series - Exponential Series - Logarithmic Series (Simple Problems only)

Unit II **14 Hours**

Matrices - Theory of Equations (Simple Problems only)

Unit III **12 Hours**

Successive Differentiation - nth Derivatives (Simple Problems only)

Unit IV **10 Hours**

Integration

Unit V **12 Hours**

Reduction Formula - Finite Differences (Newton Forward and Backward Difference Formulae only) (Simple Problems only)

Textbook:

Vittal P. R., *Allied Mathematics,* Margham Publications, Chennai, Reprint 2016
Unit 1: Chapters 1 - 4
Unit 2: Chapter 5: pp 5.1 - 5.7 (till determinants), Chapter 6: pp 6.1 - 6.19
Unit 3: Chapter 8: pp 8.1 - 8.23
Unit 4: Chapter 15: pp 15.1 - 15.32,
Unit 5: Chapter 16: pp 16.1 - 16.4 (Bernoulli's Formula only), Chapter 7

Reference:

1. Manicavachagom Pillay T K., Natarajan T. and Ganapathy K S., *Algebra*, Volume I, S. Vishwanathan Printers and Publishers, 2012
2. Narayanan S., Manicavachagom Pillay T K., *Calculus*, Volumes I, II, S. Vishwanathan Printers and Publishers, 2012
3. Venkataraman M K., *Engineering Mathematics*, Volume 1, National Publishing Co., 1994

Web Reference:

1. https://onlinecourses.nptel.ac.in/noc21_ma16/preview
2. https://study.com/academy/lesson/interpolation-in-statistics-definition-formula-example.html
3.https://www.onlinemath4all.com/questions-on-binomial-expansion-exponential-functions-and-logarithmic-function.html
4.https://www.khanacademy.org/math/ap-calculus-bc/bc-integration-new/bc-6-11/v/deriving-integration-by-parts-formula

INTERDISCIPLINARY ELECTIVE – MATHEMATICS FOR COMPETITIVE EXAMINATIONS (Offered to ALL department Students)

Code: 214UC3I07 **Hours: 60 Hours**
Semester: III or IV **Credits: 3**

Learning Objective:

- To equip the student to concentrate on basic concepts of Arithmetic
- To help in developing the skills required to succeed in any Competitive Examinations.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Revise the Basic concepts in Mathematics that was learnt by him/her in Secondary School level	PSO 1	R
CO2	Develop knowledge on remembering few basic formulae to do problems faster	PSO 1	R, Ap
CO3	Appear for any kind of Quantitative Aptitude Tests as we cover almost every topic under Aptitude	PSO 3, PSO 4	Ap
CO4	Gain knowledge in certain higher concepts like Permutation, Combination, Probability, that might help him/her in their Disciplines too	PSO 4	U, Ap
CO5	Interpret pictorially represented data (by means of bar graphs, Pie charts, graphs) into words	PSO 1, PSO 4	Ap

Unit I **12 Hours**

Numbers – H.C.F and L.C.M of Numbers – Square Roots and Cube Roots – Average – Problems on Numbers – Problems on Ages – Surds and Indices.

Unit II **12 Hours**

Percentage – Profit and Loss – Ratio and Proportion – Logarithms – Calendars – Clocks – Odd man Out and Series.

Unit III **12 Hours**

Time and Work – Pipes and Cistern – Time and Distance – Problems on Trains – Boats and Streams – Permutations and Combinations – Probability

Unit IV **12 Hours**

Area – Volume and Surface Areas – Simple Interest – Compound Interest – True Discount

Unit V **12 Hours**

Tabulation – Bar Graphs – Pie Charts – Line Graphs

Textbook:

Aggarwal R.S., *Quantitative Aptitude*, S. Chand & Company Ltd., 2017
Unit 1: Section 1: Topics 1, 2, 5 - 9
Unit 2: Section 1: Topics 10 - 12, 23, 27, 28, 20, 35

Unit 3: Section 1: Topics 15 - 19, 30, 31
Unit 4: Section 1: Topics 21, 22, 24, 25, 32
Unit 5: Section 2

References:

1. Comdex M.B.A., *All-in-One Study Kit* Published by Dream Tech, New Delhi, 2004
2. Guha Abhijit, *Quantitative Aptitude For Competitive Examinations,* Standard Book Distributing House, Third Edition, 2005
3. Serre J.P., *A Course In Arithmetic,* Springer, 1973
4. Dinesh Khattar, *The Peareson Guide to Quantitative Aptitude,* Pearson Education (Singapore), 2005

Web Reference:

https://play.google.com/store/apps/details?id=co.gradeup.android – Gradeup Application For Competitive Examinations

GENERAL ELECTIVE – DISCRETE MATHEMATICS

(Offered to ALL department Students)

Code: 214UC5L07 **Hours: 60 Hours**
Semester: V **Credits: 3**
Learning Objective:

- To gain knowledge about discrete structures, mathematical logic and graphs
- To learn about the discrete structures for computer-based applications.

Course Outcomes:
Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Define and analyze the concepts of Logic and its applications	PSO 1, PSO 2	R, U
CO2	Demonstrate the posets and Lattices	PSO 2, PSO 3	R, U
CO3	Define and analyze the concepts of integers	PSO 2	R, U
CO4	Develop simple proofs for some standard theorems of concepts of Graph structures	PSO 5	U, Ap
CO5	Explain the concepts of trees and Traversability	PSO 3, PSO 5	U, Ap

Unit I **12 Hours**
Mathematical Logic: Propositions - connectives- conditional and Biconditional propositions- Tautology and contradiction - Equivalence of Propositions - Duality Theorem - Algebra of Propositions - Tautological implication- Normal forms

Unit II **12 Hours**
Ordered Sets and Lattices: Ordered pairs and cartesian products - Relations - Equivalence classes - Hasse Diagrams for Partially Orderings - Lattices - Principal of Duality - Properties of lattices - Sublattices.

Unit III **12 Hours**
Properties of Integers: Divisibility, Prime Numbers- Fundamental Theorem of Arithmetic - Greatest common Divisor - least common multiple - Congruence - The Chinese Remainder Theorem

Unit IV **12 Hours**
Introduction to Graph Theory: Graphs and Graph models- degrees - subgraphs - Isomorphism - independent sets and covering - Matrices - Operations on Graphs- Degree sequence.
Unit V **12 Hours**
Connectedness and Trees : Walks**,** Trails and paths - connectedness and components - Eulerian Graphs - Hamiltonian Graphs - characterisation Trees-

Textbooks:

1. Veerarajan T- Discrete Mathematics, with Graph Theory and Combinatorics - With Graph Theory and Combinatorics, McGraw Hill Publication.
   Unit 1 Sections 1.1- 1.12
   Unit 2 Sections 2.3, 2.6-2.11, 2.16, 2.18-2.22
   Unit 3 Section 3.2- 3.4, 3.7,3.9,3.10, 3.13
2. S. Arumugam - Invitation to Graph Theory, 2006 by Scitech Publications
   Unit 4 Section 2.2-2.4, 2.6, 2.8, 2.9, 3.1
   Unit 5 Section 4.1, 4.2, 5.1, 5.2, 6.1

References:

1. Kenneth H. Rosen, *Discrete Mathematics and Its Applications,* 7th Edition
2. Seymour Lipschutz, Marc Lipson, Schaum's Outlines, *Discrete Mathematics,* III Edition
3. Gary Chartrand & Ping Zhang, *A First course in Graph Theory,* CRC Press- 2012

Web References:

1. http://research.engineering.nyu.edu/~greg/discrete/resources.html
2. https://onlinecourses.nptel.ac.in/noc19_cs67/preview
3. https://ocw.mit.edu/

COMPUTER TRAINING – LaTeX

(Practicals)

Code: 214MT5C01 **Hours: 30 Hours**

Semester: V **Credits: 3**

Learning Objective:

- To gain aesthetic typesetting technique to type mathematical expressions, bibliography, inserting images and tables.

Course Outcomes

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Understand to do typeset basic document and formatting	PSO 6	R, U
CO2	Understand and apply to do typeset in Mathematical expression	PSO 2	U, Ap
CO3	Understand to customize the bibliography and table of contents	PSO 4, PSO 6	U, Ap
CO4	Understand to insert images and referencing	PSO 6	U, Ap
CO5	Understand to create various tables and positioning tables with caption	PSO 6	U, Ap

Unit I **6 Hours**

First document in LATEX

The preamble of a document - Displaying the title of your document - Basic formatting: abstract, paragraphs and newlines - Bold, italics and underlining – Lists

Unit II **6 Hours**

Mathematical expressions

Subscripts and superscripts - Brackets and Parentheses- Fractions and Binomials- Aligning Equations- Operators- Spacing in math mode- Integrals, sums and limits- Display style in math mode- List of Greek letters and math symbols- Mathematical fonts

Unit III **6 Hours**

Bibliography management in LaTeX

Basic usage - The bibliography file- Customizing the bibliography- Adding the bibliography in the table of contents

Unit IV **6 Hours**

Inserting Images

The folder path to images - Changing the image size and rotating the picture- Positioning- Captioning, labelling and referencing - Captions- Labels and cross-References

Unit V **6 Hours**

Tables

Creating a simple table in LaTeX - Tables with fixed length - Combining rows and columns - Multi-page tables - Positioning tables - Captions, labels and References

Textbooks:

1. Frank Mittelbach, Michel Goossens, Johannes Braams, David Carlisle, Chris Rowley, *The LaTeX Companion*, Second Edition
2. George Grätzer, *More Math Into LATEX*, 5th Edition.

References:

1.Dilip Datta-LaTeX in 24 Hours: A Practical Guide for Scientific Writing, Springer, 2017
2.Leslie Lamport-LATEX: A Document Preparation System, Addison-Wesley Publishing Company, 1986

Web References:

https://www.overleaf.com/

PROJECT WORK

Code: 214MT6M06 **Hours: 90 Hours**
Semester: VI **Credits: 5**
Course Objective:

- To give conceptual knowledge on the topic selected by the students related to Mathematics
- To inculcate Research interest among students

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

No.	Course Outcomes	PSO addressed	CL*
CO1	Exposure of the knowledge gained in the classroom	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	E
CO2	Experience in preparing Research Report	PSO 6	C

Methodology

PREPARATION OF PROJECT (Using LaTeX)

The project shall contain around 25 pages and shall be typed with double spacing. The format is as follows:

1. Cover page shall contain
   a) Title of the project
   b) Project submitted for the B.Sc. Degree course in the VI semester
   c) Name of the Candidate
      Register number
   d) Department of Mathematics- SFS
      Madras Christian College (Autonomous), Chennai-600 059
   e) Month, Year
2. The project shall contain
   a) Contents page
   b) At least 2 chapters including an introductory chapter (comprising motivation, basic concepts needed / used in the project and outline of the project)
   c) Conclusions / interpretations arrived at may be given at the end of each problem in the chapter concerned
   d) List of figures / list of abbreviations (if needed) shall be given as an appendix
   e) Bibliography shall be given in alphabetical order at the end in MLA format

3. Each candidate may prepare 3 copies of the project, one copy for her and submit 2 copies to the Head of the department before the commencement of the SIXTH semester examination.

4 The candidate may be advised that the project will be valued based on the criteria of

a) Motivation towards the chosen area

b) formulation of the problem
c) Methodology, analysis, logic and reasoning
d) Capacity to interpret the results obtained

5. Internal Assessment will be based on Drafts I and II during the semester

6. For the valuation of the Project as well as the conduct of the Viva Voce, the panel of examiners will consist of an internal-external examiner and the Supervisor.

The guidelines for the Viva-Voce examiners would be that

a) They will satisfy themselves that this is a work of the candidate as certified by the department

b) The project is in the given format and

c) The candidate has clear understanding of the concepts, discussed in the project.

The department should certify as follows:

This is to certify that the project in the broad area_____ __titled_____

is submitted by_____ for the degree of Bachelor of Science (Mathematics) during the year _____

sd/ sd/

Head of the Department Supervisor

PATTERN OF ASSESSMENT:

Total marks: 100 marks

Continuous Assessment: Project : 50 marks Draft I, Drafts II

External Evaluation: Project (Final) : 25 marks, Viva-Voce: 25 marks