ALAGAPPA UNIVERSITY

(A State University Established in 1985)
Karaikudi - 630003, Tamil Nadu, India

2017 — Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 — MHRD Govt. of India; UGC University Grants Commission — Graded as Category - 1 & Granted Autonomy

2018 — MHRD Government of India — Swachh Campus Rank : 4

2019 — nirf National Institutional Ranking Framework — Rank : 28

2019 — QS — India Rank : 20; BRICS Rank : 104; Asia Rank : 216

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

[Choice Based Credit System (CBCS)]

[For the candidates admitted from the academic year 2019 -2020]

Panel of Members-Broad Based Board of Studies

Chairperson

Dr. N. Anbazhagan, Professor & Head, Department of Mathematics, Alagappa University, Karaikudi. Teaching Experience: 17 years, Research experience: 17 years, Area of Research: Stochastic Modeling, Data mining.

Foreign Experts

Prof. Wan Ainun Binti Mior Othman, University of Malaysia (UM), wanainun@um.edu.my. Working Experience: 26 Years, Research Experience: 26 Years, Area of Research: Algorithms and Cryptology [Cryptography and Computer Aided Geometric Design (CAGD)].

Indian Experts

Dr. D. Arivudainambi, Professor,Department of Mathematics (CEG Campus), Anna University, Chennai. Teaching Experience: 19 years, Research experience: 19 Years, Area of Research: Computer Networks, Queuing theory, Stochastic Processes and its applications, Operations Research, Cloud Computing, Wireless Sensor Networks Evolutionary Algorithms and Adhoc Networks.

Dr. V. Lakshmana Gomathi Vinayagam, Department of Mathematics, National Institute of Technology, Tirchirapalli. Teaching Experience: 18 Years, Research experience: 18 Years, Area of Research: Fuzzy Topological Structures, Fuzzy Algebraic Structures, Fuzzy Mathematical Modelling: Theory and Applications.

Members

Dr. C. Ganesa Moorthy, Professor, Department of Mathematics, Alagappa University, Karaikudi. Teaching Experience: 34 years, Research Experience: 29 years, Area of Research: Graph Theory, Topology and Functional Analysis.

Dr. J. Vimala, Assistant Professor, Department of Mathematics, Alagappa University, Karaikudi. Teaching Experience: 15 years, Research Experience: 12 years, Area of Research: Algebra –Lattice Theory, Fuzzy Algebra, Decision Theory and Soft computing.

Dr. R. Raja, Assistant Professor, Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi. Teaching Experience: 8 Years, Research Experience: 7 years, Area of Research: Abstract& Fractional Differential Equations, Stability Analysis of Dynamical Systems, Neural Networks, Synchronization Theory, Mathematical Modeling and Population Systems, Genetic Regulatory Networks, Complex Dynamical Networks and Multi-Agent S ystems.

Dr. B. Sundaravadivoo, Assistant Professor, Department of Mathematics, Alagappa University, Karaikudi. Teaching Experience:16 years, Research Experience: 1year, Area of Research: Abstract &Fractional Differential Equations Control Theory, Mathematical Modelling and Perturbation Theory.

Dr. S. Amutha, Assistant Professor, Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi. Teaching Experience: 10 years, Research Experience: 10 years, Area of Research: Graph Theory, Domination Theory, Algorithmic Graph theory, Discrete Mathematics, Cryptography.

Dr. R. Jeyabalan, Assistant Professor, Department of Mathematics, Alagappa University, Karaikudi. Teaching Experience: 4 years, Research Experience: 4 years, Area of Research: Magic Labeling Graph Theory, Fuzzy Topology and Fuzzy Magic Labeling Graph Theory.

Dr. M. Mullai, Assistant Professor, Directorate of Distance Education, Alagappa University, Karaikudi. Teaching Experience:15 years,Research Experience: 12 years, Area of Research: Algebra & Fuzzy Algebra, Operations Research, Mathematical Modelling, Neutrosophic sets (Neutrosophic Inventory, Neutrosophic Graph theory, Neutrosophic Optimization, Neutrosophic Adhoc networks)

Co opted Member from the Industry:

Mr. N.S. Babu, BITS Pilani_V2A, Total Experience: 23 Years, developing Finacle Core Banking product that includes Retail banking, Retail Lending, Corporate Lending, Loan origination systems Liquidity Management Systems, Payment systems, Trade Finance and Islamic Banking Compliance and Regulations for various markets.

Alumni

Dr. A. Tamilselvan, Professor & Head, Department of Mathematics, Bharathidasan University, Tirchirapalli. Teaching Experience: 18 years, Research Experience: 18 years, Area of Research: Differential Equations, Numerical Analysis, Fractional Differential Equations, Finite Difference Methods, Finite Volume Methods.

Ex-officio Member

Dr. E. Kannapiran, Professor and Co-ordinator, Curriculum Development Cell, DistanceEducation, Alagappa University, Karaikudi Teaching Experience: 18 years, ResearchExperience: 20 years, Area of Research: Marine Biology: Marine Microbiology, Coral Reef and Marine Fouling.

REGULATIONS & SYLLABUS

For the candidates admitted from the academic year 2019 onwards]

1. Programme general objectives

The general objective of the M.Sc. program in Mathematics is to flourish strong-minded graduates with high level of analytic and technical skills required for the program. Moreover this program will furnish them with the necessary background for further study in Mathematics and enhance their research capabilities. Also it enables them to function effectively as teachers by giving seminar sessions in the related subjects. Hence the curriculum is designed to assist the students in understanding the vital concept of Algebra, Differential Equations, Analytical Number Theory, as well as C++, IP. At the end of the program, the student will gain in-depth knowledge in Mathematics subjects and play an active role in Mathematician research, government or non-government organization and private sectors.

2. Programme specific objectives

- To provide the student with pertinent information in the field of Mathematics.
- To teach the student with a broad understanding of Mathematical and their interactions with the Equations.
- To include methods of facilitating learning such as projects, group work and participative learning.
- To establish inter-disciplinarily between mathematics and other subjects from Humanities and the Social Sciences.
- To learn to apply mathematics to real life situations and help in problem solving.

3. Programme outcomes

On successful completion of the programme:

- The students will learn functions of real and complex variables, different types of integration.
- They knew the Introduction of Linear Algebra and study linear transformation on n-dimensional vector spaces.
- The students can solve various constrained and unconstrained problems in single variable as well as multivariables.
- They will Formulate simple stochastic process models and provide qualitative and quantitative analyses of some models.
- Also by the understanding of Numerical Analysis they will ready to develop computational skill to solve science and engineering problems.

4. Eligibility and Duration of the Programme

A candidate who has passed the undergraduate course like B.Sc., Mathematics / B.Sc., Mathematics (Computer Applications) degree of this University or any of the above degree of any other University shall be eligible for admission in Master of Science (M.Sc.,) Degree in Mathematics of this University. The duration of this program is two years. Students will be admitted to the M.Sc. program either directly (Mode I) or through an entrance test (Mode II).

5. Teaching and Learning Methods

The method of teaching is by giving lectures, tutorials, seminars and supervised research projects. Moreover, extensive use is made of IT and a wide range of materials is available to enable students to study at their own place and in their own time to enhance and extend the material taught formally.

6. Examinations

The examinations shall be conducted for theory to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II). The internal assessment shall comprise of maximum 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

6.1. Internal Assessment

Average marks of two CIA test	10 marks
Attendance	5 marks
Seminar/group discussion/quiz	5 marks
Assignment/field trip report/case study report.	5 marks
Total	**25 marks**

6.2. External Examinations

The external examinations of theory shall be conducted for three hours duration to each paper at the end of each semester. The external examinations shall comprise of a maximum of 75 marks for each subject. The candidate failing in any subject will be permitted to appear for each failed subject in the subsequent examination. At the end of the fourth semester, the project work viva-voce examination will be held based on the dissertation report submitted by the student. Two examiners (one internal and one external) will jointly conduct the viva-voce examination for evaluation.

6.2.1 Scheme of External examination

Section	**No. of questions**	**Choices if any**	**Marks per questions**	**Total (75)**
A	10	Answer all questions	2	20
B	5 (either (a) or (b) type)	Answer (a) or (b) in each question	5	25
C	5	Answer any three questions	10	30

7. Passing minimum

a) For Internal and External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
b) In the aggregate (External + Internal), the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
c) Grading shall be based on overall marks obtained (internal + external).

8. Dissertation Work (Maximum Marks: 100)

The duration of the Dissertation Work shall be a minimum of three months in the fourth semester.

a) Plan of work

The candidate shall undergo Dissertation Work during the fourth semester. The candidate should prepare a scheme of work for the dissertation and should get approval from the guide. The candidate, after completing the dissertation work, shall be allowed to submit to the university at the end of the fourth semester. If the candidate is desirous of availing the facility from other universities/laboratory, they will be permitted only after getting approval from the guide. In such a case, the candidate shall acknowledge the same in their dissertation.

b) No. of copies of dissertation

The candidate should prepare three copies of the dissertation and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, and the student shall hold one copy.

c) Format to be followed for dissertation

The format /certificate for dissertation to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows:

Chapter No	Title	Page No
1	Introduction	
2	Review of Literature	
3	Materials and Methods	
4	Results	
5	Discussion	
6	Summary	
7	References	

d) Format of the title page

Title of Dissertation

Dissertation submitted in partial fulfillment of the requirement for the degree of Master of Science in Mathematics to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of Mathematics

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003

(Year)

Format of certificate

Certificate

This is to certify that the dissertation entitled _____ submitted in partial fulfillment for the requirement of the Degree of Master of Science in Mathematics to the Alagappa University, Karaikudi is a bonafide record of research work done by Mr./Mrs_____ under my supervision and guidance and that no part of the dissertation has been submitted for the award of degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or in full in any scientific journal or magazines.

e) Dissertation evaluation

Dissertation Work	:	50 Marks
Internal Assessment	:	25 Marks
Viva –voce	:	25 Marks
Total	**:**	**100 Marks**

9. Village Extension Programme (VEP)

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three days.

1. Environmental awareness
2. Hygiene and Health

A minimum of two faculty members can accompany the students and guide them.

10. Important Instructions

Attendance: Attendance and participation are vital to the student's success in this course. Students are expected to attend class every day.

Punctuality: Punctuality is an essential element in achieving success. Therefore, anyone arriving after daily roll-call (about 5 minutes after the class begins) will be marked absent. A valid excuse for being absent from class shall be a medical or a personal emergency acceptable at the discretion of the Dean/Chairman/Head of the Dept.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignments: When submitting any assignments, **student name, student register number, course number and date of submission** should be clearly written on every page and all pages should be stapled together. The timely submission of assignments is an essence of personal discipline and will contribute towards forming a person's professional responsibility.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic work produced using dishonest methods has no value. Academic dishonesty also includes copying - verbatim or otherwise, and plagiarism i.e., the use of an author's ideas, statements, or approaches without crediting the source. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Candidates who passed all the examinations prescribed for the course in the first instance and within two academic years from the year of admission to the course are alone eligible for university ranking.

A candidate is deemed to have secured the first rank provided if he/she should have passed all the papers in the first attempt itself and should have secured the highest Cumulative grade point average (CGPA).

Each student should have taken credits as a core course**, credits as a major elective; credits as non-major elective, credits as dissertation work, in addition, MOOCs courses as extra credits**, thus totaling**at least 90 + extra credits required to complete M.Sc. Mathematics degree course**. Each paper carries **4 /3/ 2** credits with 50% marks in the university examination and 50% marks in CIA.

Raw score	Letter Grade	Description	Grade point
91 and above	S	First Class-Exemplary	9.01-10
76-90	D	First Class-Distinction	7.51-9.00
61-75	A	First Class	6.01-7.50
56-60	B	Second Class	5.51-6.00
50-55	C	Second Class	5.00-5.50
Below 50	RA	Re-appear	-
I - inadequate attendance; W-withdrawal from the course			

M. Sc., Mathematics

Semes	Course/ Title	Course Code	No. Credits	Teaching Hours per week	Marks		Total
					I	E	
I	Groups & Rings	511101	5	6	25	75	100
	Real Analysis - I	511102	5	6	25	75	100
	Differential Equations	511103	5	6	25	75	100
	Analytic Number Theory	511104	5	6	25	75	100
	Elective Course – I	--	5	6	25	75	100
	Library			1	--	--	--
	Total		**25**	**31**	**--**	**--**	**500**
II	Linear Algebra	511201	5	6	25	75	100
	Real Analysis – II	511202	5	6	25	75	100
	Complex Analysis	511203	5	6	25	75	100
	Elective Course – II	--	5	6	25	75	100
	Non Major Electives Course – I	--	2	3	25	75	100
	*Self Learning Courses	MOOC's	Extra Credit	--	--	--	--
	Library, Yoga and Career Guidance			3	--	--	--
	Total		**22+ Extra Credit**	**30**	**--**	**--**	**500**
III	Mechanics	511301	5	6	25	75	100
	Topology	511302	5	6	25	75	100
	Optimization Techniques	511303	5	6	25	75	100
	Elective Course – III	--	5	6	25	75	100
	Non Major Electives Course – II	--	2	3	25	75	100
	*Self Learning Course	MOOC's	Extra Credit	--	--	--	--
	Library, Yoga and Career Guidance			3	--	--	--
	Total	**22+ Extra Credit**		**30**	**--**	**--**	**500**
IV	Functional Analysis	511401	5	6	25	75	100
	Probability and Statistics	511402	5	6	25	75	100
	Graph Theory	511403	5	6	25	75	100
	Project Work	511999	6	12	25	75	100
	Total	**21**		**30**	**--**	**--**	**400**
Grand Total		**90+ Extra Credits**		**--**	**--**	**--**	**1900**

Major Elective –Courses offered to the other Department to other Departments

S. No	Paper Code	Semester	Title of the paper	Credits	Hours/ Week	Marks		
						I	E	T
1	511501	II	Differential Geometry	5	6	25	75	100
2	511502	II	Numerical Analysis	5	6	25	75	100
3	511503	III	Multivariate Calculus	5	6	25	75	100
4	511504	III	Stochastic Processes	5	6	25	75	100
5	511505	I	Combinatorics	5	6	25	75	100
6	511506	III	Algebraic Number theory	5	6	25	75	100
7	511507	III	Theory of Operators	5	6	25	75	100
8	511508	I	Theory of Automata and Formal Languages	5	6	25	75	100
9	511509	I	Algorithmic Graph Theory	5	6	25	75	100
10	511510	III	Coding Theory	5	6	25	75	100
11	511511	I	Fluid Dynamics	5	6	25	75	100
12	511512	I	Object oriented programming and C++	5	6	25	75	100
13	511513	I	Skills in Latex	5	6	25	75	100
14	511514	II	Measure and Integration	5	6	25	75	100
15	511515	III	Calculus of Variations & Integral Equations	5	6	25	75	100
16	511516	II	MATLAB	5	6	25	75	100
17	511517	II	Financial Mathematics	5	6	25	75	100
18	511704	II	Effective Communication and Soft Skills	5	6	25	75	100

Non-Major Elective –Courses offered to the other Department to other Departments

S. No	Paper Code	Semester	Title of the paper	Credits	Hours/ Week	Marks		
						I	E	T
1		III	Image Processing & Pattern Recognition	2	3	25	75	100
2		I	Discrete Mathematics	2	3	25	75	100
3		III	Methods of Mathematical Physics	2	3	25	75	100
4		III	Classical Mechanics	2	3	25	75	100
5		III	Resource Management Techniques	2	3	25	75	100
6		I	Descriptive Statistics	2	3	25	75	100
7		III	Biostatistics	2	3	25	75	100

Courses:

I	Semester	=	25 Credits	(Core: 20; Major Elective: 5)
II	Semester	=	22 Credits	(Core: 15; Major Elective: 5; Non-Major Elective: 2)
III	Semester	=	22 Credits	(Core: 15; Major Elective: 5; Non-Major Elective: 2)
IV	Semester	=	21 Credits	(Core: 15; Dissertation Work: 6)
Total credits		**=**	**90+ Extra credits**	**(Core: 65; Major Elective: 15; Non-Major Elective: 4; Dissertation Work: 6 + MOOCs extra credits)**

Semester – I			
Course Code: 511101	**Groups and Rings**	**Credits: 5**	**Hours: 6**
Objectives	➢ Introduce and study the basic properties of Groups, Normal sub groups and Quotient groups. ➢ Derive the notion of Homomorphism, Automorphism on groups and Permutation groups. ➢ Introduce the above mentioned concepts in Sylow's Theorems, Direct products and Finite Abelian groups. ➢ Study the basic concepts of rings and some types of rings and ideals.		
Unit – I	**Definition of a group** – Some examples of groups – Some preliminary lemmas. Subgroups – A counting principle – Normal subgroups and Quotient groups.		
Unit – II	**Homomorphisms** – Automorphisms – Cayley's theorem - Permutation groups – Another counting principle.		
Unit – III	**Sylow's theorem** – Direct products – Finite abelian groups.		
Unit – IV	**Definition and Examples of Rings** – Some Special Classes of Rings - Homomorphisms – Ideals and Quotient Rings – More Ideals and Quotient Rings.		
Unit – V	**The Field of Quotients of an Integral Domain** – Euclidean Rings – A particular Euclidean Ring – Polynomial Rings - Polynomials over the Rational Field – Polynomial Rings over Commutative Rings.		
Reference & Text books: Artin, M. (1991). *Algebra.* Prentice Hall of India, New Delhi. Bhattacharaya, P.B., Jain S.K.,Nagpaul. S.R.(1995).*Basic Abstract Algebra.* Cambridge University Press. Herstein, I. N. (2017). *Topics in Algebra* (2nd ed.). John Wiley & Sons. John Fraleigh, B. (1982).*A first course in Abstract Algebra.* Addison Wesley, MA.			
Outcomes	After the successful completion of this course, students will be able to: ➢ Understand the concepts of groups, normal subgroups and quotient groups. ➢ Explain the concepts of homomorphism, automorphism on groups and permutation groups. ➢ Analyze basic concepts about rings, ideals and quotient rings. ➢ Demonstrate the examples of Euclidean rings, polynomial rings over Commutative rings.		

Name of the Course Teacher
Dr. J. Vimala
Assistant Professor
Department of Mathematics

Semester – I			
Course Code: 511102	**Real Analysis– I**	**Credits: 5**	**Hours: 6**
Objectives	➢ Deal primarily with sequences and series of complex numbers. The basic facts about convergence. ➢ Discuss vector valued functions (i.e. functions with values in R^K) and functions with values in an arbitrary metric space. ➢ Confine our attention to real functions defined on intervals or segments. ➢ The genuine differences appear when we pass from real functions to vector valued ones.		
Unit - I	**Basic Topology:** Finite, Countable and uncountable sets – Metric spaces – compact spaces – Perfect sets – Connected sets.		
Unit - II	**Numerical sequences and series:** Convergent sequences – Subsequences – Cauchy sequences – Upper and lower limits – Some special sequences – Series – Series of nonnegative terms.		
Unit - III	**Numerical sequences and series (Conti):** The number 'e' – The root and ratio tests – Power series – Summation by parts – Absolute convergence – Addition and multiplication of series – Rearrangements.		
Unit - IV	**Continuity** – Limits of functions – Continuous functions – Continuity and compactness – Continuity and connectedness – Discontinuities – Monotonic functions – Infinite limits and limits at infinity.		
Unit - V	**Differentiation** – Derivative of a real function – Mean value theorems – Continuity of derivatives – L'Hospital rule – Derivatives of higher order – Taylor's theorem – Differentiation of vector valued functions.		
Reference & Text books: Apostol, T.M. (1985).*Mathematical Analysis (2nd ed.)*.New Delhi: Narosa Publ. House. Donald Sherbert, R., Robert Bartle, G. (2014). *Introduction to Real Analysis* (4th ed.). Wiley. Edward Gaughan, D.(2010).*Introduction to Analysis* (5th ed.). American Mathematical Society. Walter Rudin. (2016). *Principles of Mathematical Analysis* (3rd ed.). New York : McGraw-Hill.			
Outcomes	After the successful completion of this course, students will be able to: ➢ Define and recognize the series of real numbers and convergence shown the ability of working independently and with groups. ➢ Define and recognize Bolzano- Weirstrass theorem. Ability to apply the theorem in a correct mathematical way. ➢ Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.		

Name of the Course Teacher
Dr. S. Amutha
Assistant Professor
Ramanujan Centre for Higher Mathematics

Semester – I			
Course Code: 511103	**Differential Equations**	**Credits: 5**	**Hours: 6**

Objectives	➢ Formulate ordinary differential equations (ODEs) and seek understandingof their solutions, either obtained exactly or approximately by analytic or numerical methods. ➢ Understand the concept of a solution to an initial value problem and the guarantee of its existence and uniqueness under specific conditions.
Unit – I	**Linear equations with constant coefficients:** Linear dependence and independence - A formula for the Wronskian – The non-homogeneous equation of order two - Homogeneous equation of order n-initial value problems for n^{th} order equations- Equations with real constants - Non-homogeneous equation of order n.
Unit – II	**Linear equations with variable coefficients:** Reduction of the order of homogeneous equation – The non homogeneous equation - Homogeneous equations with analytic coefficients- Legendre equation.
Unit – III	**Partial differential equations of the first order:** Partial differential equations – Origins of first order partial differential equations – Cauchy's problem for first order equations – Linear equations of the first order – Integral surfaces passing through a given curve – Charpit's method – Special types of first order equations – Solutions satisfying given conditions – Jacobi's method.
Unit – IV	**Partial differential equations of the second order:** The origin of second order equations – Linear partial differential equations with constant coefficients. equations with variable coefficients – Separation of variables.
Unit – V	**Laplace's equation:** Elementary solutions of Laplace's equation – Boundary value problems – The Wave equation: Elementary solutions of the one dimensional Wave equation.

Reference &Textbooks:

Earl Coddington, A. (2011).*An Introduction to Ordinary Differential Equations*. Prentice Hall of India.

Ian Sneddon, (1986).*Elements of Partial Differential Equations*. McGraw Hill Book Company.

James Robinson, B.(2004). An *Introduction to Ordinary Differential Equations*. Cambridge University Press.

Raj, D., Choudhury, D.P., Freedman, H.I. (2004).*A Course in Ordinary Differential Equations*, Chennai: Narosa Publ. House.

Outcomes	After the successful completion of this course, students will be able to: ➢ Understand the difficulty of solving problems analytically and need to use numerical approximations for their resolution. ➢ Use computational tools to solve problems and applications of ordinary differential equations and partial differential equations.

Name of the Course Teacher
Dr. B. Yasodara
Department of Mathematics

Semester – I			
Course Code: 511104	**Analytic Number Theory**	**Credits: 5**	**Hours: 6**
Objectives	➢ Gain an understanding and appreciation of Analytic Number Theory and some of its important applications. ➢ Focus on the properties of prime numbers and to understand Prime number Theorem. ➢ Understand the partitions of numbers and learn techniques to relate the subject with Combinatorics.		
Unit - I	The fundamental theorem of Arithmetic – Arithmetic Function and Dirichlet multiplication.		
Unit - II	Averages of Arithmetic Functions.		
Unit - III	Some elementary theorems on the distributions of prime numbers.		
Unit - IV	Congruence's.		
Unit - V	Quadratic residues and the quadratic reciprocity law.		

Reference &Textbooks:

Burton, D.M.(2001).*Elementary Number Theory* (7th ed.).New Delhi: Universal Book Stall.

Davenport, H. (2000).*Multiplicative Number Theory* (3rd ed.). Springer.

Ireland, K., Rosen, M. (1972).*A Classical Introduction to Modern Number Theory*. New York: Springer Verlag.

Ivan Niven, Zuckerman, H.S.(1989).*An Introduction to the Theory of Numbers*(5th ed.). New Delhi: Wiley Eastern Ltd..

Montgomery, H.L. Vaughan, R.C.,(2012).*Multiplicative Number Theory. I. Classical Theory*. Cambridge University Press.

Tom Apostol, M. (2010). *Introduction to Analytic Number Theory*. New Delhi: Narosa.

Outcomes	After the successful completion of this course, students will be able to: ➢ Prove results similar to the ones presented in the course and apply the basic techniques, results and concepts of the course to concrete examples and exercises. ➢ Understand the interdisciplinary nature with other mathematical branches. ➢ Understand theoretical physics and Combinatorics with the knowledgeof partition theory.

Name of the Course Teacher
Dr. M. S. Anitha
Department of Mathematics

Semester – II			
Course Code: 511201	**Linear Algebra**	**Credits: 5**	**Hours: 6**

Objectives	➢ Introduce the basic concepts of vector spaces, subspaces, bases and dimension, coordinates and Summary of Row-Equivalence. ➢ Study linear transformation on n-dimensional vector spaces. ➢ Establish a few of the basic properties of algebra of polynomial over a field.
Unit - I	**Vector spaces** - Subspaces - Bases and dimension - Coordinates - Summary of row-equivalence - Computations concerning subspaces
Unit - II	**Linear transformations** - The algebra of linear transformations – Isomorphism's - Representation of transformations by matrices - Linear functionals - The double dual - The transpose of a linear transformation.
Unit - III	**Polynomials:** Algebras - The algebra of polynomials - Lagrange interpolation - Polynomial ideals - The prime factorization of a polynomial.
Unit - IV	**Determinants:** Commutative rings - Determinant functions - Permutations and the uniqueness of determinants - Additional properties of determinants Elementary Canonical Forms: Introduction - Characteristic values - Annihilating polynomials - Invariant subspaces.
Unit - V	**Simultaneous triangulation:** Simultaneous diagnolization - Direct-sum Decompositions - Invariant direct sums - The primary decomposition theorem. The rational and Jordan forms: Cyclic subspaces and annihilators - Cyclic decompositions and the rational form - The Jordan Form.

Reference & Textbooks:

Artin, M. (1991).*Algebra*. New Delhi: Prentice Hall of India.

David Lay, C.(2003).*Linear Algebra and its Applications* (3rd ed.). Pearson Education, Inc..

Hoffman, K., Kunze, R. (2015). *Linear Algebra* (2nd ed.). Pearson Education Inc., Prentice Hall Sons.

Lang, S.(1971).*Algebra* (3rd ed.). Addison Wesley, Reading, MA.

Strang, G. (2009).*Introduction to Linear Algebra* (4th ed.).Wellesley Cambridge Press.

Outcomes	Students who successfully complete this course should be able to: ➢ Assign a dimension to certain vector spaces and illustrate examples of vector spaces and subspaces. ➢ Access properties implied by linear transformations, linear functional, Double dual. ➢ Classify and determine the polynomial ideals and prime factorization of a polynomial.

Name of the Course Teacher
Dr. J. Vimala
Assistant Professor
Department of Mathematics

Semester – II			
Course Code: 511202	**Real Analysis – II**	**Credits: 5**	**Hours: 6**
Objectives	➢ Deals with the definition of the Riemann integral which depends very explicitly on the order structure of the real line. ➢ Discuss an integration of real valued functions on intervals. ➢ Deals with many theorems and proofs extend without difficulty to vector valued functions and even to mappings into general metric spaces.		
Unit - I	**The Riemann – Stieltjes integral:** Definition and existence of the integral - Properties of the integral – Integration and differentiation – Integration of vector – valued functions – Rectifiable curves.		
Unit - II	**Sequences and series of functions:** Discussion on main problem – Uniform convergence – Uniform convergence and continuity – Uniform convergence and integration.		
Unit - III	**Sequences and series of functions (Conti):** Uniform convergence and differentiation – Equicontinuous families of functions – Weierstrass theorem.		
Unit - IV	**Some special functions:** Power series – The exponential and logarithmic functions – The trigonometric functions.		
Unit - V	The algebraic completeness of the complex field – Fourier series – The gamma function.		
Reference &Textbooks: Apostol, T.M.(1985).*Mathematical Analysis* (2nd ed.).New Delhi: Narosa Publ. House. Ganapathy Iyer, V.(1970).*Mathematical Analysis*. New Delhi: Tata McGraw Hill. Royden, H.L. (1993).*Real Analysis* (4th ed.).New York: Macmillan Publ. Co. Inc. Russel Gorden, A.(2011). Real Analysis. A First Course, Pearson. Walter Rudin, (2016). *Principles of Mathematical Analysis* (3rd ed.). New Yor: McGraw-Hill.			
Outcomes	After the successful completion of this course, the student will be able to ➢ Define and recognize the series of real numbers and convergence shown the ability of working independently and with groups. ➢ Define and recognize Bolzano- Weirstrass theorem. Ability to apply the theorem in a correct mathematical way.		

Name of the Course Teacher
Dr. B. Sundaravadivoo
Assistant Professor
Department of Mathematics

Semester – II			
Course Code: 511203	**Complex Analysis**	**Credits: 5**	**Hours: 6**

Objectives	➢ The concepts of *Analysis*, Cauchy-Riemann relations and harmonic functions are then introduced. ➢ The notion of the Riemann sheet is presented to help student visualize multi-valued complex functions. Complex integration and complex power series are presented. Students will be equipped with the understanding of the fundamental concepts of complex variable theory. ➢ The skill of contour integration to evaluate complicated real integrals via residue calculus.
Unit - I	**Analytic functions** – Polynomials – Rational functions – Power series – Abel's limit theorem – Bi-linear transformations.
Unit - II	**Complex integration** - line integrals - Fundamental theorems– Cauchy's theorem for rectangle- Cauchy's theorem for disk - Cauchy's integral formula – index of a point with respect to a closed curve, Higher derivatives.
Unit - III	**Local properties of analytic functions:** Removable singularities, Taylor's theorem, zeroes and poles, the local mapping, maximum principle, the general form of Cauchy's theorem.
Unit - IV	**The calculus of residues:** The residue theorem – The argument principle – Evaluation of definite integrals.
Unit - V	**Weierstrass theorem**, Taylor's series, Laurent series.

Reference &Textbooks:

Conway, J.B.(1980).*Functions of one Complex variable*. New Delhi: Narosa Publ. House.

Lang, S.(1977).*Complex-Analysis*. Addison Wesley Mass.

Lars Ahlfors, V. (2016). *Complex Analysis* (3rd ed.)., McGraw Hill.

McMullen, C. (1893).*Complex Analysis*. USA: Harvard University.

Ponnusamy, S. (2004).*Foundations of Complex Analysis*. New Delhi: Narosa Publ. House.

Stein and Shakarchi, (2003).*Complex Analysis.* Princeton University Press.

Outcomes	After the successful completion of this course, the student will be able to: ➢ Apply the fundamental concepts of complex numbers and variables. ➢ Solve the problem using Cauchy's integral formula and Cauchy's residue theorem, Residue theorem. ➢ Formulate and solve differential equation problem in the field of industrial organization engineering.

Name of the Course Teacher
Dr. R. Jeyabalan
Assistant Professor
Department of Mathematics

Semester – III			
Course Code: 511301	**Mechanics**	**Credits: 5**	**Hours: 6**

Objectives	➢ The understand the fundamental concepts in mechanics such as force, energy, momentum etc. more rigorously as needed for further studies in physics, engineering and technology. ➢ The student's physical intuition and thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems. ➢ An advanced mathematical techniques and methods of use to physicists in solving problems. Develop some capabilities for numerical/computational methods, in order to obtain solutions to problems too difficult or impossible to solve analytically.
Unit - I	**Mechanical system** – Generalized coordinates – Constraints – Virtual work – Energy and momentum
Unit - II	Derivation of Lagrange's equations – Examples – Integrals of motion.
Unit - III	**Hamilton's principle** – Hamilton's equation – Other variations principle.
Unit - IV	**Hamilton principle function** – Hamilton-Jacobi equation – Separability.
Unit - V	**Differential forms and generating functions** – Special transformations – Lagrange and Poisson brackets.

Reference &Textbooks:

Chandra, S.(2009).*Classical Mechanics: A Textbook.* UK: Alpha Science International.

Goldstein, H. (2001).*Classical Mechanics*. New Delhi: Narosa Publishing House.

Greenwood, D. T. (1985). *Classical Dynamics*. New Delhi: Prentice Hall of India.

John Taylor, R. (2005).*Classical Mechanics*(2nd ed.).California: University Science Books, Sausalito.

Rane N.C.,Joag, P.S.C. (1991).*Classical Mechanics*. New Delhi: Tata McGraw Hill.

Synge J.L.,Griffth, B.A. (1970).*Principles of Mechanics*. New York: McGraw Hill Book Co..

Outcomes	After the successful completion of this course, students will be able to: ➢ Have a deep understanding of Newton's laws. ➢ Solve the Newton equations for simple configurations using various methods. ➢ Understand the foundations of chaotic motion.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Semester – III			
Course Code: 511302	**Topology**	**Credits: 5**	**Hours: 6**
Objectives	➢ Explain how to distinguish spaces by means of simple topological invariants, compactness, connectedness and the fundamental group. ➢ Explain how to construct spaces by gluing and to prove that in certain cases that the result is homeomorphic to a standard space. ➢ Construct simple examples of spaces with given properties.		
Unit - I	**Topological spaces** – Bases for a topology – The order topology – The product topology on X x Y – The subspace topology – Closed sets and limit points – Continuous functions.		
Unit - II	**The product topology** – The metric topology – The metric topology (continued) - Connected spaces – Connected subspaces of the real line.		
Unit - III	**Compact Spaces** – Compact subspaces of the real line–Limit point compactness– Local compactness.		
Unit - IV	**The countability axioms** – The separation axioms – Normal Spaces - The Urysohn's Lemma – The Urysohn's Metrization theorem.		
Unit - V	**The Tietze extension theorem** – Imbedding of manifolds - The Tychonoff theorem – The Stone-Cech compactification.		
Reference &Textbooks: Dugundji, J. (1975)*Topology*. New Delhi: Prentice Hall of India. Hocking, J.G., Young, G.S.(1961).*Topology*. Addison-Wesley Publishing Company, Inc, Reading Mass. Hu, S.T.(1965)*Elements of General Topology*. New York: Holden Day, Inc. James Munkres, R. (2018). *Topology: A First Course* (2^{nd} ed.). New Delhi: Prentice Hall of India. Simmons, G.F. (1963).*Introduction to Topology and Modern Analysis*. New York: McGraw Hill Co. Stephen Willard.(1970).*General Topology*. Addition Wesley, Publishing Company.			
Outcomes	After the successful completion of this course, students will be able to ➢ Define and illustrate the concept of topological spaces and continuous functions. ➢ Define and illustrate the concept of product topology and quotient topology. ➢ Prove a selection of theorems concerning topological spaces, continuous functions, product topologies, and quotient topologies.		

Name of the Course Teacher
Dr. R. Jeyabalan
Assistant Professor
Department of Mathematics

Semester – III			
Course Code: 511303	**Optimization Techniques**	**Credits: 5**	**Hours: 6**
Objectives	➢ Introduce the fundamental concepts of optimization techniques. ➢ Make the learners aware of the importance of optimizations in real scenarios. ➢ Provide the concepts of various classical and modern methods for constrained and unconstrained problems in both single and multivariable.		
Unit - I	**Network models:** Minimal spanning tree algorithm - Shortest route algorithms – Maximal flow problems - Critical path calculations - Tree and total floats.		
Unit - II	**Advanced linear programming:** Simplex method using the restricted basis - Bounded variables algorithm - Revised Simplex method.		
Unit - III	**Game theory:** Optimal solution of two person zero Sum Games - Solution of mixed strategy games - Linear programming solution of games.		
Unit - IV	**Classical optimization theory:** Jacobian method - Lagrangian method - The Newton Raphson method - Kuhn- Tucker conditions.		
Unit - V	Unconstrained algorithms - Non linear programming algorithms: Separable programming – Quadratic programming.		

Reference &Textbooks:

Gillett, B.E. (1976). Operations research, A Computer Oriented Algorithmic Approach (TMH ed.). New Delhi.

Hillier, F.S., Lieberman, G.J. (1989).*Introduction to Operation Research* (4th ed.). New York: Mc Graw Hill Book Company.

Kanti Swarp, Gupta, P.K., Mohan, M. (1994).*Operations Research* (9th ed.). Sultan Chand and Sons.

Philips, D.T., Ravindra, A., Solbery, J. (1999). Operations Research. New York: Principles and Practice John Wiley and Sons.

Taha, H.A. (2018). *Operations Research* (9th ed.). New Delhi: Pearson Education.

Outcomes	After the successful completion of this course, students will be able to ➢ Understand and apply the concept of optimality criteria for various types of optimization problems. ➢ Solve various constrained and unconstrained problems in single variable as well as multivariables. ➢ Apply the methods of optimization in real life situations. ➢ Develop and promote research interest in applying optimization techniques in various problems.

Name of the Course Teacher
Dr. M. Mullai
Assistant Professor
Directorate of Distance Education

Semester – IV			
Course Code: 511401	**Functional Analysis**	**Credits: 5**	**Hours: 6**

Objectives	➢ Study the spaces of functions. ➢ Introduce the basic concepts and theorems of functional analysis and its applications.
Unit - I	**Normed space** - Banach space – Properties of normed spaces – Finite dimensional normed spaces and subspaces – Compactness and finite dimension – Linear operators – Bounded linear operators – Linear functional – Normed spaces of operators – Dual space.
Unit - II	**Inner product space** – Hilbert space – Properties – Orthogonal complements and direct sums – Orthonormal sets and sequences – Total orthonormal sets and sequences.
Unit - III	**Riesz's theorem** – Hilbert adjoint operator – Self-adjoint, unitary and normal operators.
Unit - IV	**Hahn – Banach theorem** - Adjoint operator – Reflexive spaces – Category theorem - Uniform boundedness theorem.
Unit - V	**Strong and weak convergence** – Convergence of sequences of operators and functionals – Open mapping theorem -Closed graph theorem.

Reference &Textbooks:

Goffman H.C.,Fedrick, G.(1987).*First Course in Functional Analysis*.New Delhi: Prentice Hall of India.

Kreyszig, E. (2019). Introductory Functional Analysis with Applications. John Wiely.

Rudin, W. (1991).*Functional Analysis*. New Delhi: Tata McGraw Hill Publ. Co.

Simmons, G.F. (1963).*Introduction to Topology and Modern Analysis*. New York: McGraw Hill Inter. Book Co.

Somasundaram, D.(1994).*Functional Analysis*. Chennai: S. Viswanathan Pvt. Ltd.

Outcomes	After the successful completion of this course, students will be able to: ➢ Describe the properties of normed linear spaces and construct examples of such spaces. ➢ Extend basic notions from calculus to metric spaces and normed vector spaces. ➢ State and prove theorems about finite dimensionality in normed vector spaces. ➢ State and prove the Cauchy-Schwartz inequality and apply it to the derivation of other inequalities. ➢ Describe the properties of normed linear spaces and construct examples of such spaces.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Semester – IV			
Course Code: 511402	**Probability and Statistics**	**Credits: 5**	**Hours: 6**

Objectives	➢ Study the key concepts of probability, including discrete and continuous random variables, probability distributions, conditional probability , independence, expectations, and moments. ➢ Apply the basic rules and theorems in probability including Bayes's theorem and the Central Limit Theorem (CLT).
Unit - I	**Probability set function** - Conditional probability and independence – Random variables of discrete-type and continuous type- Distribution function and its properties - Expectation of a random variable - Moment generating function - Chebychev's inequality.
Unit - II	**Two random variables** - Joint density - Marginal probability density – Conditional distribution - Expectation and variance - Independence of two random variables - Mutual independence and pair-wise independence.
Unit - III	**Discrete distributions** - Bernoulli, binomial and related distributions - Poisson distribution - Continuous distributions - Experimental, gamma and chi square normal and bivariate normal distributions.
Unit - IV	**Sample, Statistics and parameter** concepts - Transformation of variables of discrete and continuous types- t and F distributions – Change of variable (and its extension), Order statistics- Distributions of order statistics and Moment generating function.
Unit - V	**Distributions of sample mean and sample variance** - Expectation of function of random variables - Limiting distributions - Convergence in probability and in distribution - Limiting M.G.F- Central limit theorem - Important results on limiting distributions.

Reference &Textbooks:

Chow Y.S. Teicher, H.(1988).*Probability Theory*. Berlin: Springer Verlag.

Chung, K.L. (1974).*A course in Probability*. New York: Academic Press.

Durrett, R.(1996). Probability: *Theory and Examples* (2nd ed.). New York: Duxbury Press.

Hogg, Craig, Mckean, J. (2018). *Introduction to Mathematical Statistics* (7th ed.). Pearson Education.

Outcomes	After the successful completion of this course, students will be able to ➢ Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions. ➢ Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables. ➢ Know the distributions of sample mean, variance and central limit theorem.

Name of the Course Teacher
Dr. N. Anbazhagan
Professor& Head
Department of Mathematics

Semester – IV			
Course Code: 511403	**Graph Theory**	**Credits: 5**	**Hours: 6**

Objectives	➢ Introduce the fundamental concepts in graph theory, in a sense of some its modern applications. ➢ Use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems. ➢ Cover a variety of different problems in graph theory. ➢ Prove theorems which will be stated formally using various techniques.
Unit - I	**Graphs** – Subgraphs – Graph isomorphisms – Incidence and Adjacency matrices – Vertex degrees – Paths –Cycles – Trees- Cut edge – Cut vertices – Cayley's Formula.
Unit - II	**Connectivity** – Blocks – Euler tours – Hamiltonian cycles.
Unit - III	**Matchings** - Matchings and coverings in Bipartite graphs – Perfect matchings – Independent sets – Ramsey's theorem – Taurn's theorem.
Unit - IV	**Edge chromatic number** – Vizing's theorem – Chromatic number – Brook's theorem – Hajo's theorem – Chromatic polynomials.
Unit - V	**Plane and planar graphs** – Dual graphs – Euler's formula – The five colour theorem – Non Hamiltonian planar graphs.

Reference &Textbooks:

Bela Bollobas.(1998).*Modern Graph Theory*. Springer, Science & Business Media.

Bondy J. A. Murthy U.S.R. (2013).*Graph Theory with Applications*. Elsevier Science Publishing Co., Inc..

Dougles West, B.(2000).*Introduction to Graph Theory* (2nd ed.). Pearson Publication.

Foulds, L. R.(1933).*Graph Theory Application*. Chennai: Narosa Publ. House.

Harary, F. (1969).*Graph Theory*. Addison Wesely Pub. Co. The Mass.

Jean Calude Fournier.(2009). Graph Theory and Applications: With exercises and Problems. Wiley-ISTE.

Jonathan Gross, L., Jay Yellen, (1998).*Graph Theory and its Applications* (2nd ed.). CRC Press.

Outcomes	After the successful completion of this course, students will be able to ➢ Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices. ➢ Understand the properties of trees and able to find a minimal spanning tree for a given weighted graph. ➢ Understand Eulerian and Hamiltonian graphs.

Name of the Course Teacher
Dr. S. Amutha
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511 501	**Differential Geometry**	**Credits: 5**	**Hours: 6**

Objectives	➢ To introduce the concepts -What is a curve? Arc-Length, Curvature, Plane curves, Space Curves, Frenet –Serret Equations. ➢ To make the knowledge about Surfaces, Smooth surfaces, Tangents, Normals, Quadric Surfaces. ➢ To introduce the concepts of Lengths of Curves on Surfaces, Isometries of Surfaces, Conformal Mappings of Surfaces.
Unit - I	**Introductory remark about space curves** – Definitions – Arc length – Tangent, normal and binormal – Curvature and torsion of a curve given as the intersection of two surfaces.
Unit - II	**Contact between curves and surfaces** – Tangent surface, involutes and evolutes – Intrinsic equations – Fundamental existence theorem for space curves – Helices.
Unit - III	**Definition of a surface** – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients.
Unit - IV	**Families of curves** – Isometric correspondence – Intrinsic properties - Geodesics – Canonical Geodesic equations – Normal property of Geodesics.
Unit - V	**Existence theorem**– Geodesic parallels – Geodesic curvature – Gauss – Bonnet theorem - Gaussian curvature.

Reference &Textbooks:

Rao, S.S.(2009).*Engineering Optimization: Theory and Practice* (4th ed.). John Wiley and Sons.

Somasundaram, D.(2005).*Differential Geometry*. Chennai: Alpha Science International Ltd.

Struik, D.T.(1950).*Lectures on Classical Differential Geometry*. Addison Wesely, Mass.

Thorpe, J.A.(1979).*Elementary Topics in Differential Geometry*. New York: Springer – Verlag.

Willmore T.G. (2018). *An Introduction to Differential Geometry*. Twenty Ninth, Oxford University press.

Outcomes	After the successful completion of this course, students will be able to ➢ Understand the curvature and torsion of a space curve, how to compute them, and how they suffice to determine the shape of the curve. ➢ Understand the definition of a smooth surface, and the means by which many examples may be constructed. ➢ Understand the various different types of curvature associated to a surface, and how to compute them.

Name of the Course Teacher
Dr. M. Mullai
Assistant Professor
Directorate of Distance Education

<table>
<tr><th colspan="4">Elective Course</th></tr>
<tr><td>Course Code: 511502</td><td>Numerical Analysis</td><td>Credits: 5</td><td>Hours: 6</td></tr>
<tr><td>Objectives</td><td colspan="3">➢ Derive appropriate numerical methods to solve algebraic and transcendental equations.
➢ Develop appropriate numerical methods to approximate a function.
➢ Develop appropriate numerical methods to solve a differential equation.</td></tr>
<tr><td>Unit – I</td><td colspan="3">Systems of equations and unconstrained optimization: Optimization and steepest descent – Newton's method – Fixed point iteration and Relaxation method.</td></tr>
<tr><td>Unit - II</td><td colspan="3">Approximation: Uniform approximation by polynomials – Data fitting – Orthogonal polynomials – Least square approximation by polynomials.</td></tr>
<tr><td>Unit - III</td><td colspan="3">Differentiation and integration: Numerical differentiation – Numerical integration: Some basic rules – Numerical integration: Gaussian rules – Numerical integration: Composite rules.</td></tr>
<tr><td>Unit - IV</td><td colspan="3">The solution of differential equations: Mathematical preliminaries – simple difference equations – Numerical integration by Taylor series – Error estimates and convergence of Euler's method – Runge – Kutta methods.</td></tr>
<tr><td>Unit - V</td><td colspan="3">Multi- step formulas – Predictor – Corrector methods – Boundary valueProblems:Finite difference methods – Shooting methods.</td></tr>
<tr><td colspan="4">Reference &Textbooks:
Conte, S.D. Carl de Boor, (1981).Elementary Numerical Analysis: An Algorithmic Approach (3rd ed.).McGraw - Hill.
Gerald, C.F., Wheathy, P.O. (1998).Applied Numerical Analysis. (5th ed.). Addison Wesley.
Kandasamy, P., Thilagavathy, K., Gunavathy, K.(2003).Numerical Methods. S. Chand & Company.
Sastry, S.S.(1995). Introductory methods of Numerical Analysis. Prentice of India.
Vedamurthy, V.N.,Iyengar, Ch. S.N.(1998).Numerical Methods. Vikas Publishing House Pvt Ltd.</td></tr>
<tr><td>Outcomes</td><td colspan="3">The students will become proficient in:
➢ Understanding the theoretical and practical aspects of the use of numerical methods.
➢ Implementing numerical methods for a variety of multidisciplinary applications.
➢ Establishing the limitations, advantages, and disadvantages of numerical methods.
➢ Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.</td></tr>
</table>

Name of the Course Teacher
Dr. S. Amutha
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511503	**Multivariate Calculus**	**Credits: 5**	**Hours: 6**

Objectives	➢ Examine functions of several variables, define and compute limits of functions at points and determine continuity. ➢ Use rectangular, cylindrical and spherical coordinates systems to define space curves and surfaces in Cartesian and parametric forms. ➢ Define and compute the curl and divergence of vector fields and apply Green's Theorem, Stokes's Theorem and the Divergence Theorem to evaluate line integrals, surface integrals and flux integrals.
Unit - I	**Differentiation** – Partial derivatives – Directional derivatives – Contractionprinciple – Inverse function theorem.
Unit - II	**Implicit function theorem** - Rank theorem – Determinants – Jacobians – Derivatives of higher order – Differentiation of integrals.
Unit - III	**Primitive mappings** – Partitions of unity – Change of variables – Differential forms – Elementary properties – Products of basic k-forms – Multiplication.
Unit - IV	**Differentiation** – Change of variables– Affine simplex – Affine chain – Differentiable simplex and chains – Positively oriented boundaries.
Unit - V	**Stokes theorem** – Closed forms and Exact forms – Vector fields – Volume elements – Green's theorem – Arc elements – Stokes formula.

Reference &Textbooks:

Edwards, C.H.(1973).*Advanced Calculus of Several Variables*. New York: Academic Press Inc.

Francis Calrke, (2013). Functional Analysis. Calculus of Variations and Optimal Control. Springer.

Loomis, L. H.,Sternberg, S.(1968).*Advanced Calculus*, Addison-Wesley Publishing Company, Inc.

Michael Spivak, (1995).*Calculus on Manifolds*. Addison-Wesley Publication Company.

Rudin, W. (2016). *Principles of Mathematical Analysis* (3rd ed.). McGraw Hill.

Stewart, J. (2008).*Multivariable Calculus*. USA: Brooks/Cole.

Outcomes	After the successful completion of this course, students will be able to ➢ Draw graphically and analytically synthesize and apply multivariable and vector-valued functions and their derivatives. ➢ Use double triple and line integrals in applications, including Green's Theorem, Stokes' Theorem and Divergence Theorem. ➢ Synthesize the key concepts of differential, integral and multivariate calculus.

Name of the Course Teacher
Dr. B. Sundaravadivoo
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511504	**Stochastic Processes**	**Credits: 5**	**Hours: 6**

Objectives	➢ To provide the fundamentals and advanced concepts of probability theory and random process to support graduate coursework and research in electrical, electronic and computer engineering. ➢ The required mathematical foundations will be studied at a fairly rigorous level and the applications of the probability theory and random processes to engineering problems will be emphasized.
Unit - I	**Definition of stochastic processes** – Markov chains: definition, order of a Markov chain – Higher transition probabilities – Classification of states and chains – denumerable number of states and reducible chains.
Unit - II	**Markov process with discretestate space:** Poisson process and related distributions – Properties of Poisson process, Generalizations of Poisson processes – Birth and death processes – Continuous time Markov chains.
Unit - III	**Markov processes with continuous state space:** Introduction - Brownian motion **-** Weiner process and differential equations for it, Kolmogrov equations – first passage time distribution for Weiner process – Ornstein – Uhlenbech process.
Unit - IV	**Branching processes:** Introduction – properties of generating functions of Branching process – Probability of extinction – Distribution of the total number of progency conditional limit laws due to Kolmogrov and due to Yaglom - classical Galton and Watson process – Bellman Hari's process.
Unit - V	**Stochastic processes in Queueing Systems:** Concepts – Queueing model M/M/1 – transient behaviour of M/M/1 model – Birth and death process in Queueing theory: M/M/1 model and related distributions – M/M/ ∞/ - M/M/S/S – loss system – M/M/S/M – Non Markovian queues – P-K formula.

Reference &Textbooks:

Cinlar, E. (1975).*Introduction to Stochastic Processes*. New Jersey: Prentice Hall, Inc.

James Melsa, L., Andrew Sage, P.(1973).*An Introduction to Probability and Stochastic Processes*.New Jersey: Prentice Hall, Inc.

Medhi, J. (2017). *Stochastic Processes* (4th ed.). New age international Private limited.

Robert Gallager, G., (2013).*Stochastic Processes: Theory for Applications*. Cambridge University Press.

Outcomes	After successful completion of this course, students will be able to ➢ Acquire more detailed knowledge about Markov processes with a discrete state space, including Markov chains, Poisson processes & birth and death processes.

Name of the Course Teacher
Dr. N. Anbazhagan
Professor & Head
Department of Mathematics

Elective Course			
Course Code: 511505	**Combinatorics**	**Credits: 5**	**Hours: 6**

Objectives	➢ Make the students familiar with fundamental combinatorial structures that naturally appear in various other fields of Mathematics and Computer Science. ➢ Give the structures to represent mathematical and applied questions, and they will become comfortable with the combinatorial tools commonly used to analyze such structures. ➢ Provide the existence or non-existence of the object, compute the number of such objects, and understand their underlying structure.
Unit - I	**Permutations and combinations** – Distributions of distinct objects – Distributions of non distinct objects – Stirling's formula.
Unit - II	**Generating functions** – Generating function for combinations – Enumerators for permutations distributions of distinct objects into non distinct cells – partitions of integers – Ferrers graphs – Elementary relations.
Unit - III	**Recurrence relation** – Linear recurrence relations with constant coefficients- solutions by the technique of generating functions – A special class of nonlinear difference equations – Recurrence relations with two indices
Unit - IV	**The principle of inclusion and exclusion** – General formula – Permutations with restriction on relative positions – Derangements – Rook polynomials – permutations with forbidden positions
Unit - V	**Polya's theory of counting** – Equivalence classes under a permutation group – Burnside theorem – Equivalence classes of functions – Weights and inventories of functions – Polya's fundamental theorem – Generalization of Polya's theorem.

Reference &Textbooks:

Cameron, P.J.(1998).*Combinatorics: Topics, Techniques, Algorithms*. Cambridge: Cambridge University Press.

Liu, C.L., Eddberg, M. (1968).*Solutions to problems in Introduction to Combinatorial mathematics*. New York: MC Graw-Hill Book & Co.

Liu, C.L. (1968). *Introduction of Combinatorial Mathematics*. New York: McGraw Hill Book Co.

Stanley, R.P.(1997). Enumerative Combinatorics, Volume I, Cambridge Studies in Advanced Mathematics, Volume 49. Cambridge University Press.

Outcomes	After successful completion of this course, students will be able to ➢ Utilize Mathematics and Computer Applications to solve practical problems in Mathematics. ➢ Practice problem solving techniques that they know, and learn new ones, such as non-constructive existence proofs and the probabilistic method.

Name of the Course Teacher
Dr. J. Vimala
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511506	**Algebraic Number Theory**	**Credits: 5**	**Hours: 6**

Objectives	➢ Gain an understanding and appreciation of algebraic number theory andfamiliarity with the basic objects of study, namely number fields and their rings of integers. ➢ Enable them to become comfortable working with the basic algebraic concepts involved, to appreciate the failure of unique factorization in general, and to see applications of the theory to Diophantine equations.
Unit - I	**Algebraic numbers** – Conjugates and discriminants – Algebraic integers – Integral bases – Norms and traces – Quadratic fields – Cyclotomic fields.
Unit - II	**Factorization into irreducibles** – Example of non-unique factorization into irreducibles – Prime factorization – Euclidean domains – Euclidean quadratic fields – Consequences of unique factorization – Ramanujan-Nagell theorem.
Unit - III	**Ideals** – Prime factorization of fields – Norm of an ideal.
Unit - IV	**Lattices** – Quotient torus – Minkowski's theorem – the two-square theorem – the four-square theorem –The space L.
Unit - V	**Fermat's last theorem**– Historical background –Elementary considerations– Kummer's lemma – Kummer's theorem.

Reference &Textbooks:

Robert Ash, B.(2003).*A Course in Algebraic Number Theory*. USA: Dover Publications.

Samuel, P.(1970).*Algebraic Theory of Numbers*. New York: Dover Publications, Mineola.

Stewart, I., Tall, D. (2002). *Algebraic Number Theory and Fermat's Last Theorem* (3rd ed.). Chapman and Hall Mathematics Series.

Weiss, E.(1963).*Algebraic Number theory*. New York: Mc Graw Hill.

Outcomes	At the end of this module students should be able to understand: ➢ The concept (definition and significance) of algebraic numbers and algebraic integers. ➢ How to factorize an algebraic integer into irreducible. ➢ The ideals of a ring of integers in an algebraic number field. ➢ The class group, and find the class order in some cases.

Name of the Course Teacher
Dr. J. Vimala
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511507	**Theory of Operators**	**Credits: 5**	**Hours: 6**

Objectives	➢ Examine the basic techniques for the spectral analysis of linear operators. ➢ Focus on applications of the theory to the study of the Laplace operator.
Unit - I	**Spectral theory of linear operators in normed spaces** – Spectral theory on finite dimensional normed spaces – Basic concepts – Spectral properties of bounded linear operators – Properties of resolvent and spectrum – Banach algebra.
Unit - II	**Compact linear operators on normed spaces** – Properties – Spectral properties of compact linear operators on normed spaces.
Unit - III	Operator equations involving compact linear operators – Theorems of Fredholm type – Fredholm alternative.
Unit - IV	Spectral properties of bounded self adjoint linear operator – Positive operators – Square roots of a positive operator.
Unit - V	**Projection operators and their properties** – Spectral family – Spectral family of bounded self adjoint linear operators.

Reference &Textbooks:

Ahiezer, N.I., Glazman, I.M.(1961).*Theory of Linear Operators in Hilbert Spaces*. New York: Ungar.

Conway, J. B. (1985).*Course in Functional Analysis*. New York: Springer-Verlag.

Kreyszig, E. (2019). Introductory Functional Analysis with its Applications. John Wiley.

Peter Lax, D.(2002).*Functional Analysis*. Warszawa, Wiley- Inder Science.

Outcomes	By the end of the course, students should be able to: ➢ Grasp the fundamental language of spectral theory. ➢ Manipulate the elements of the theory of compact linear self-adjoint operators on Hilbert spaces. ➢ Understand the Dirichlet Laplacian as an operator with a compact resolvent. ➢ Describe the basic spectral properties of the Dirichlet Laplace operator on a segment and on polygons. ➢ Understand the fundamental idea behind the concepts of isospectrality and transplantation.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

<table>
<tr><th colspan="4">Elective Course</th></tr>
<tr><td>Course Code: 511508</td><td>Theory of Automata and Formal Languages</td><td>Credits: 5</td><td>Hours: 6</td></tr>
<tr><td>Objectives</td><td colspan="3">➢ Introduce the concepts in automata theory and theory of computation.
➢ Identity different formal language classes and their relationships.
➢ Design grammars and recognizers for different formal languages
➢ Prove or disprove theorems in automata theory using its properties.</td></tr>
<tr><td>Unit – I</td><td colspan="3">The theory of automata</td></tr>
<tr><td>Unit – II</td><td colspan="3">Formal languages</td></tr>
<tr><td>Unit – III</td><td colspan="3">Regular sets and regular grammars</td></tr>
<tr><td>Unit – IV</td><td colspan="3">Context free languages</td></tr>
<tr><td>Unit – V</td><td colspan="3">Push down automata and Turing machines</td></tr>
<tr><td colspan="4">Reference &Textbooks:
John Hopcroft, E., Motwani, R., Ullman, J.D.(2011).Introduction to Automata Theory, Languages and Computation (3rd ed.). Pearson Education, India.
Linz, P.(2012).Introduction to Formal Languages and Automata. Jones and Barlett Learning, LLC.
Mishra, K.L.P., Chandrasekaran, N. (2018). Theory of Computer Science (Automata, Languages and Computation) (3rd ed.)., Prentice Hall Of India.
Sipser, M.(2013).Introduction to the Theory of Computation. USA: Cengage Learning.</td></tr>
<tr><td>Outcomes</td><td colspan="3">After the successful completion of this course, the student will be able to
➢ Classify machines by their power to recognize languages.
➢ Employ finite state machines to solve problems in computing.
➢ Explain deterministic and non-deterministic machines.
➢ Comprehend the hierarchy of problems arising in the computer sciences.</td></tr>
</table>

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511509	**Algorithmic Graph Theory**	**Credits: 5**	**Hours: 6**
Objectives	➢ Theorems will be stated and proved formally using various techniques. ➢ Various graphs algorithms will also be taught along with its analysis.		
Unit – I	Adjacency matrices and adjacency lists, Depth First Search, Spanning trees, branching and connectivity.		
Unit – II	Planar graphs – Genus, Crossing Number and Thickness, Dual Graphs, Planarity Testing Algorithm.		
Unit – III	Matchings and Eulerian graph, The Chinese Postman problem for directed and undirected graphs.		
Unit – IV	Graph Colourings – Vertex and Edge Colourings, Chromatic polynomials, Four colour and Five colour theorems, Dominating and Independent sets.		
Unit – V	Complexity of graph problems - P and NP classes, Cook's theorem, NP-complete problems.		
Reference &Textbooks: Berge, C. (1991). *Graphs*. First Edition, North Holland. Bollabas, B. (1979). *Graph Theory: An Introductory Course*. Springer Verlag. Gary Chartrand, Ortrud R. (1992). *Applied and Algorithmic Graph Theory*. Mc Graw Gill. Gibbons, A. (1985). *Algorithmic graph theory*. Cambridge University Press. Golumbic, M.C. (1980). Algorithmic Graph Theory and Perfect Graphs. Academic Press. Rosan, K. H. (2005). *Graphs, Algorithms and Optimization*. CRC Press, Florida, USA.			
Outcomes	After the successful completion of this course, the student will have: ➢ A strong background of graph theory which has diverse applications in the areas of computer science, biology, chemistry, physics, sociology, and engineering.		

Name of the Course Teacher
Dr. S. Amutha
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511510	**Coding Theory**	**Credits: 5**	**Hours: 6**

Objectives	➢ Learn the principles of the theory of information. ➢ Code the channels without interference. ➢ Study the principles of the algebraic theory of coding and the importance of those theories in contemporary communication.
Unit – I	**Basic definitions** – Weight – Maximum – Likelihood decoding – Syndrome decoding – Perfect codes – Hamming codes – Sphere – Packing bound – Self-dual codes.
Unit – II	**Double-error**-coding, B.C.H. code – Finite fields.
Unit – III	**Cyclic codes** – The generator polynomial of the dual code – Idempotents and minimal ideas for binary cyclic codes.
Unit – IV	**The group of a code** – Quadratic residue codes – Groups of quadratic residue codes – Permutation decoding – Cyclic codes given in terms of roots – properties of B.C.H. codes.
Unit – V	**Weight distributions** – Weights in homogeneous codes – The Mac Williams equations – Pless power moments – Gleason polynomials.

Reference &Textbooks:

Ling, S. and Xing, C. (2004). *Coding Theory - A First Course*. Cambridge University Press.

Pless, V. (1981). Introduction to The Theory of Error-Coding Codes. John Wiley and Sons.

Roman, S. (1997). Introduction to Coding and Information Theory. Springer-Verlag.

Ron Roth, M. (2006).*Introduction to Coding Theory*. Cambridge University Press.

Van Lint, J.H. (1992). *Introduction to Coding Theory*. Springer-Verlag, Berlin, Heidelberg.

Outcomes	After the successful completion of this course, the student will be able to ➢ Understand the concept and importance of the amount of information, the system of communication, developing the ability of solving typical tasks from coding theory. ➢ Understanding and implementing codes and source of information and solving optimization problems. ➢ Understand the principles of binary block-codes, solving problems on linear codes.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511511	**Fluid Dynamics**	**Credits: 5**	**Hours: 6**

Objectives	➢ Develop an understanding of fluid dynamics in aerospace engineering as well as a variety of other fields. ➢ Learn to use control volume analysis, to develop basic equations and to solve problems. ➢ Understand and use differential equations to determine pressure and velocity variations in internal and external flows.
Unit – I	**Real fluids and ideal fluids** – Velocity – Stream lines – Steady and unsteady flows – Velocity potential
Unit – II	**Vorticity vector** – Equation of continuity – Euler's equation of motion – Bernouli's equation – Some three dimensional flows.
Unit – III	**Sources** – Doubles – Images in a rigid infinite plane – Images in solid spheres – Anti symmetric flows.
Unit – IV	**Irrational motions** – Use of cylindrical polar coordinates – Stream functions – Complex potential for two dimensional.
Unit – V	**Irrational incompressible flow** – Complex velocity potentials – Two dimensional image – Systems of conformal transformation.

Reference &Textbooks:

Chorlton, F. (1985). *Text Book of Fluid Dynamics*. New Delhi: CBS Publications.

Batchaelor, G.K. (2005). *An Introduction to Fluid Dynamics*. New Delhi: Foundation Books.

Rathy, R.K. (1976). *An Introduction to Fluid Dynamics*. New Delhi: IBH Publ. Comp.

Yuan, S.W. (1976). *Foundations of Fluid Mechanics*. New Delhi: Prentice Hall of India Pvt. Ltd.

Outcomes	After completing this course students will apply the: ➢ Bernoulli equation to solve problems in fluid mechanics. ➢ Control volume analysis to problems in fluid mechanics. ➢ Potential flow theory to solve problems in fluid mechanics. ➢ Performance dimensional analysis for problems in fluid mechanics. ➢ Knowledge of laminar and turbulent boundary layer fundamentals.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

<table>
<tr><th colspan="4">Elective Course</th></tr>
<tr><td>Course Code: 511512</td><td>Object Oriented Programming And C++</td><td>Credits: 5</td><td>Hours: 6</td></tr>
<tr><td>Objectives</td><td colspan="3">➢ Perform object oriented programming to develop solutions to problems demonstrating usage of control structures, modularity, I/O. and other standard language constructs.
➢ Demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation, and inheritance.</td></tr>
<tr><td>Unit - I</td><td colspan="3">Introduction to C++ - Object Oriented Programming – Principles – Basic concepts – Benefits – Languages of OOP. C++ data types – operators – Cin and Cout streams – Manipulators – Functions.</td></tr>
<tr><td>Unit - II</td><td colspan="3">Object and classes – Messages – Access specifier – Data encapsulation – Definition and declaration of member functions – Constructor and destructor – Inline function – Friend function – Static data and member function.</td></tr>
<tr><td>Unit - III</td><td colspan="3">Pointers: Pointers and references – This pointer – Strings – New and delete operators - Dynamic constructors – Problems with pointer reference Copy constructor.</td></tr>
<tr><td>Unit - IV</td><td colspan="3">Polymorphism: Compile time polymorphism – Function overloading – Operator overloading – Overloading unary operators – Overloading binary operators – Pitfalls of operator overloading.</td></tr>
<tr><td>Unit - V</td><td colspan="3">Reusability: Inheritance – Types of inheritance – Inheritance access specifier – Derived and base classes – Runtime polymorphism – Static and dynamic binding – Virtual function – Pure virtual function – Virtual base class – Abstract class.</td></tr>
<tr><td colspan="4">Reference &Textbooks:
Ashok Kamthane, N. (2006). Object Oriented Programming with ANSI and Turbo C++. Pearson Education Pvt. Ltd, Singapore.
Balagurusamy, E. (2018). Object oriented programming in C++ (7th ed.). Tata McGraw Hill publications Ltd.
Janna, D. (2014). C++ and Object Oriented Programming Paradigm, PHI Pvt. Ltd, Delhi.
Lafore, R. (1998). Object Oriented Programming In Turbo C++. Galgotia Publication Pvt. Ltd.</td></tr>
<tr><td>Outcomes</td><td colspan="3">After the completion of the course, students will be able to
➢ Understand object oriented programming and advanced C++ concepts.
➢ Be able to explain the difference between object oriented programming and procedural programming.</td></tr>
</table>

Name of the Course Teacher
Dr. A. Nagarajan
Assistant Professor
Department of Computer Applications

Elective Course			
Course Code: 511513	**Skills in Latex**	**Credits: 5**	**Hours: 6**

Objectives	➢ To learn the basic functions of Latex and to explore some of the more advanced features available. ➢ To develop their skills in order to more fully utilize its functions in particular using Bibtex to help manage their references in relation to the Latex document.
Unit – I	**Text, Symbols and Commands:** Command names and arguments – Environments- Declarations – Lengths – Special characters – Fine-tuning text – Word division.
Unit - II	**Document Layout and Organization:** Document class – Page style – Parts of the document – Table of contents.
Unit - III	**Displayed Text:** Changing font – Centering and indenting – Lists – Generalized lists – Theorem like declarations – Tabulator stops.
Unit - IV	**Displayed Text:** Boxes – Tables – Printing literal text – Footnotes and marginal notes – Comments within text.
Unit - V	**Mathematical Formulas:** Mathematical environments - Main elements of Math mode - Mathematical symbols – Additional elements – Fine tuning Mathematics– Beyond standard latex.

Reference &Textbooks:

Kopka, H., Daly, P.W.(2003).*A Guide to LATEX*, Fourth Edition, London: Addision Wesley.

Kottwitz, S.(2011).*Latex Beginners Guide*. Packt publishing.

Lamport, L.(1994).*Latex: A document preparation system.* Addison Wesley Professional.

Mittelbach, F.(2007).*The Latex Graphics Companion* (2nd ed.). Addison-Wesley Professional.

Mittelbach, F., Goossens, M., Braams, J., Carlisle, D., Rowley, C.(2004).*The Latex Companion*. Addison-Wesley Professional.

Outcomes	Upon completion of the course, students will be able to ➢ Typeset mathematical formulae using LaTeX. ➢ Use the preamble of LaTeX file to define document class and layout options. ➢ Use nested list and enumerate environments within a document. ➢ Use tabular and array environments within LaTeX document. ➢ Use various methods to either create or import graphics into a LaTeX document.

Name of the Course Teacher
Dr. R. Jeyabalan
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511514	**Measure And Integration**	**Credits: 5**	**Hours: 6**

Objectives	➢ Understand the abstract measure theory, definition and main properties of the integral. ➢ Construct Lebesgue's measure on the real line and in *n*-dimensional Euclidean space. ➢ Explain the basic advanced directions of the theory.
Unit – I	**Measure on the Real line** – Lebesgue's Outer measure – Measurable sets – Regularity – Abstract Measure Spaces – Measures and Outer Measures - Extension of a Measure.
Unit - II	**Measure on the Real Line** – Measurable functions – Borel and Lebesgue's Measurability.
Unit - III	**Integration of Functions of a Real Variab**le – Integration of Non–negative Functions – The General Integral – Integration of series -Riemann and Lebesgue integrals.
Unit - IV	**Signed Measures and their Derivatives** – Signed Measures and the Hahn Decomposition – The Jordan Decomposition – the Radon – Nikodym Theorem.
Unit - V	**Measure and Integration in a Product Space** – Measurability in a Product Space – The Product Measure and Fubini's Theorem.

Reference &Textbooks:

De Barra, G. (2011). *Measure theory and Integration.* Wiley Eastern, New Delhi.

Gerald Folland, B. (2012). *Real Analysis, Modern Techniques and their Applications*. Secod Edition, Wiley InderScience Series of Texts.

Jain, P.K. and Gupta, V.P. (2000). *Lebesgue Measure and Integration.* New Age Int. (P) Ltd., New Delhi.

Royden, H.L. (1993). *Real Analysis*. Mc Millian Publ. Co, New York.

Rudin, W. (1966). *Real and Complex Analysis*. Tata McGraw Hill Publ. Co. Ltd., New Delhi.

Serge Lang. (1993). *Real and Functional Analysis*. Springer.

Outcomes	After the successful completion of this course, students will be able to ➢ Demonstrate understanding of the basic concepts underlying the definition of the general Lebesgue's integral. ➢ Prove basic results of measure theory and integration theory. ➢ Demonstrate understanding of the statement and proof of the fundamental integral convergence theorems, and their applications.

Name of the Course Teacher
Dr. B. Sundaravadivoo
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511515	**Calculus of Variations & Integral Equations**	**Credits: 5**	**Hours: 6**
Objectives	➢ Deals with the definition of the Maxima and Minima and application of the problem. ➢ Discuss problem of constraints and Lagrange'smultipliers, Variation and its properties.		
Unit - I	**Calculus of variations** – Maxima and Minima – The simplest case – Natural boundary and transition conditions – Variational notation – More general case – Constraints and Lagrange'smultipliers–Variableendpoints–Sturm-Liouvilleproblems.		
Unit - II	**Introduction** - Problem of brachistochrone - Problem of geodesics - Isoperimetric problem - Variation and its properties - Functions and functional - Comparison between the notion of extrema of a function and a functional.		
Unit - III	**Hankel Transform :** Definition – Inverse formula – Some important results for Bessel function – Linearity property – Hankel Transform of the derivatives of the function – HankelTransformofdifferentialoperators–Parsaval'sTheorem.		
Unit - IV	**Linear Integral Equations** - Definition, Regularity conditions – Special kind of kernels – Eigen values and eigen functions – Convolution Integral – the inner and scalar product of two functions – Notation – Reduction to a system of Algebraic equations – Examples – Fredholmalternative-Examples–Anapproximatemethod.		
Unit - V	**Method of successive approximations:** Iterative scheme – Examples – Volterra Integral equation – Examples – Some results about the resolvent kernel.Classical Fredholm Theory: the method of solution of Fredholm – Fredholm's first theorem – Second theorem – Thirdtheorem.		
Reference &Textbooks: Hildebrand, F.B. (1972).*MethodsofAppliedMathematics* (2^{nd} ed.).PHI,ND. Ram Kanwal, P. (1971). *Linear Integral Equations Theory and Practice*. Academic Press. Vasishtha, A.R. and Gupta, R.K. (2002). *Integral Transforms*. Krishna Prakashan Media Pvt Ltd, India.			
Outcomes	After the successful completion of this course, the student will be able to ➢ Define and recognize Maxima and minima problem and Calculus of variation and its application. ➢ Define and recognize Decomposition, direct computation, Successive approximation, Successive substitution methods for Fredholm Integral Equations Ability to apply in a correct mathematical way.		

Name of the Course Teacher
Dr. R. Jeyabalan
Assistant Professor
Department of Mathematics

Elective Course			
Course Code: 511516	**MATLAB**	**Credits: 5**	**Hours: 6**

Objectives	➢ Working with the MATLAB user interface. ➢ Entering commands and creating variables. ➢ Analyzing vectors and matrices. ➢ Visualizing vector and matrix data. ➢ Working with data files, data types and .writing programs with branching, loops and functions. ➢ Automating commands with scripts.
Unit - I	**Introduction** – Basics of MATLAB, Input-Output, File types – Platform dependence – General commands
Unit - II	**Interactive computation:** Matrices and vectors – Matrix and array operations – Creating and using Inline functions – Using Built in functions and Online help – Saving and loading data – Plotting simple graphs.
Unit - III	**Programming in MATLAB:** Scripts and functions – Script files – Function files – Language specific features – Advanced data objects.
Unit - IV	**Applications** – Linear Algebra – Curve fitting and interpolation – Data analysis and statistics – Numerical integration – Ordinary differential equations – Nonlinear algebraic equations.
Unit - V	**Graphics:** Basics 2D plots – Using subplot to layout multiple graphs – 3D plots – Handle graphics – Saving and printing graphics – Errors.

Reference &Textbooks:

Dolores Etter, M., David C. Kuncicky, (2004). *Introduction to Matlab 7.* Prentice Hall.

Edward Magrab, B. Balakumar, B. Duncan, J. Walsh, G. Azarm, S., Keith E. Herold, (2000). *An Engineers Guide to Matlab*. (3rd ed.). Pearson.

Rudra Pratap. (2010). Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers. Oxford University Press.

Stephen J. Chapman, (1999). Matlab Programming for Engineers. (4th ed.). Cl Engineering.

William John. P. (2005). *Introduction to Matlab 7 for Engineers*. Mc Graw-Hill Professional.

Outcomes	After the successful completion of this course, students will be able to ➢ Build programs to solve Engineering problems. ➢ Apply MATLAB conventions and good programming practices. ➢ Manipulate and control hardware in team based design projects. ➢ Analyze the program for correctness and determine/estimate/predict the output and verify it under simulation environment using MATLAB tools.

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Elective Course			
Course Code: 511517	**Financial Mathematics**	**Credits: 5**	**Hours: 6**

Objectives	➢ Study the active and practical use of mathematics, which includes probability theory, linear algebra, calculus, partial differential equations, and stochastic calculus, and numerical mathematics. ➢ Know the price popular types of financial derivatives such as Put and Call options and create financial strategies which use these derivatives to reduce risk. ➢ Develop mathematically model phenomena using stochastic processes and geometric Brownian motion. ➢ Approximate discrete stochastic processes by continuous stochastic processes and vice versa. ➢ Apply the "efficient market hypothesis" and the Arbitrage Theorem and their implications in various financial modeling situations. ➢ Solve the Black-Scholes equation with the appropriate boundary and final/initial conditions to model the value of a financial derivative or combination of derivatives.
Unit - I	**Basic Financial Calculations:** Introduction: financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.
Unit - II	**Annuities and Equation of Value:** Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.
Unit - III	**Capital Budgeting Techniques and Compound Interest Problems:** Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.
Unit - IV	**Arbitrage, Forward Contracts, and Term Structure of Interest:** Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk.
Unit - V	**Stochastic Interest Models and Investments:** Simple stochastic interest rate models, fixed and varying interest model, log normal distribution; fixed interest government borrowings, government bonds, tax, security, marketability and return; government bills: corporate debt, debentures, unsecured loan stocks, eurobonds, certificates of deposit, convertibles, property, derivatives, future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures.

Reference &Textbooks:

Baxter, M., Rennie, A. L. (1996). *Financial Calculus*. Cambridge University Press.

Karatzas, L., Shreve, S.E. (1998). *Methods of Mathematical Finance*. Springer.

Martin, P.G., Michael, B. (1991). *Applied Financial Mathematics*. Prentice Hall.

Ross, S.M. (1999). *An Introduction to Mathematical Finance*. Cambridge University Press, Norton, London.

Watsham, T.J., Perramore, K. (1997). *Quantitative Methods in Finance*. International Thomson Business Press.

Outcomes	After the successful completion of this course, students will be able to: ➢ Determine and select the most appropriate standard mathematical, statistical and computational methods for specifying mathematical problems in banks and other financial institutions through a critical understanding of the relative advantages of these methods, and to develop extensions to these methods appropriate for the solution of non-standard problems. ➢ Know the main features of models commonly applied in financial firms, be able to express these mathematically and be able to appraise their utility and effectiveness. ➢ Explain and critically appraise the rationale for the selection of mathematical tools used in the analysis of common financial problems. ➢ Demonstrate the appropriateness of modeling or numerical solutions in analyzing common problems in banks and other financial institutions. ➢ Select and apply numerical solutions in appropriate areas of finance. ➢ Undertake a piece of directed research in mathematical finance.

Name of the Course Teacher
Dr. N. Anbazhagan
Professor& Head
Department of Mathematics

Elective Course			
Course Code: 511518	**Data Analytics**	**Credits: 5**	**Hours: 6**

Objectives	➢ Optimize business decisions and create competitive advantage with Big Data analytics ➢ Explore the fundamental concepts of big data analytics. ➢ Learn to analyze the big data using intelligent techniques. ➢ Understand the various search methods and visualization techniques. ➢ Learn to use various techniques for mining data stream. ➢ Understand the applications using Map Reduce Concepts. ➢ Introduce programming tools PIG & HIVE in Hadoop echo system.
Unit - I	**Introduction to big data :** Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.
Unit - II	**Mining data streams :** Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.
Unit - III	**Hadoop:** History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce FeaturesHadoop environment.
Unit - IV	**Frameworks:** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams.
Unit - V	**Predictive Analytics**- Simple linear regression- Multiple linear regression- Interpretation 5 of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

Reference &Textbooks:

Berthold, M., David J. Hand. (2007). *Intelligent Data Analysis*. Springer.

Eaton, C. DeRoos, D. Deutsch, T. Lapis,G. Zikopoulos, P. (2012). *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*. McGrawHill Publishing.

Han,J., Kamber,M. (2008). *Data Mining Concepts and Techniques*. Second Edition, Elsevier.

Franks,B. (2012). Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics. John Wiley& sons.

Glenn J. Myatt, (2007). *Making Sense of Data*. John Wiley & Sons.

Outcomes	After the successful completion of this course, students will be able to: ➢ Gather sufficient relevant data, conduct data analytics using scientific methods, and make appropriate and powerful connections between quantitative analysis and real-world problems. ➢ Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using data analytics skills to provide constructive guidance in decision making. ➢ Use advanced techniques to conduct thorough and insightful analysis, and

	interpret the results correctly with detailed and useful information. ➢ Show substantial understanding of the real problems; conduct deep data analytics using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration. ➢ Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details. ➢ Make better business decisions by using advanced techniques in data analytics.

Name of the Course Teacher
Dr. N. Anbazhagan
Professor & Head
Department of Mathematics

Elective Course			
Course Code: 511704	**Effective Communication And Soft Skills**	**Credits: 5**	**Hours: 6**

Objectives	➢ Expose the students to the channels and levels of communication. ➢ Acquaint them with the strategies. in planning, preparing and presenting a speech.
Unit – I	**(Importance and significance of communication)** Principles of effective communication, The flow of communication, The levels of communication, Types of communication-Verbal & Non-verbal, Barriers to effective communication – How to get rid of them.
Unit – II	**(Conversation skills & Basic etiquettes)** Modes of greeting, Requesting, Thanking, Writing, Introducing, Congratulating, Giving opinion and Granting permission, Expression of agreement, Disagreement, Giving orders, Advice, Suggestion, Apology, Warning and gratitude etc. Telephone conversation- Dos and Don'ts (Specific dialogues to be given to enable the students understand and use the expressions in conversations).
Unit – III	**(Presentation Skills)** Preparing, Planning and presenting a talk. Preparing for the introduction, Body and conclusion of presentation structure, Language and delivery of the presentation how to Make an Impressive Presentation? Analyzing Audience and Locale The Use of Audio-Visual Aids.
Unit – IV	**(Group Communication)** Behavior Pattern –peer Group – Cooperation – Analysis is of the Given Topic- Arguments and Force of Expressions - Avoiding interference and Rudeness Language-Guiding the Group Members at points of dullness - Leadership Qualities – Summing Up.
Unit – V	**(Writing Skills)** Writing Letters, The Essentials of Letters, Writing Job Applications, Preparing a Resume and Resume Types, Advantage and Disadvantage of E-mail, Advantage and Disadvantage of Advertisements.

Reference &Textbooks:

Bill R. Swetmon, (2006). *Communication Skills for the 21't Century*. Chennai: Eswari Press, First South Asian Edition.

Dutt, Kiranmai and Geetha Rajeevan, (2006). *Basic Communication Skills*. New Delhi: Rev. Ed. Foundation books Pvt. Ltd, Cambridge House.

Outcomes	After the successful completion of this course, students will be able to ➢ Demonstrate an understanding of interpersonal skills as part of effective communication processes. ➢ Identify the significance of attitudes, values and perceptions in interpersonal communication.

Name of the Course Teacher
Dr. M. Kanimozhi
Assistant Professor
Department of English

Non- Major Elective Course			
Course Code: 541104	**Image Processing And Pattern Recognition**	**Credits: 2**	**Hours: 3**

Objectives	➢ Assess and understand the challenges behind the design of machine vision systems. ➢ Understand the general processes of image acquisition, storage, enhancement, segmentation, representation, and description. ➢ Implement filtering and enhancement algorithms for monochrome as well as color images. ➢ Appreciate the challenges and understand the principles and applications of visual pattern recognition.
Unit – I	**Image model:** Sampling- Image shape-Human vision system-Image Acquisition-Real time capture- Video camera- Scanners satellite imagery- Ranging devices- Calibration- Image Presentation: Raster screen printers – Three dimensional imaging- Image processors- Gray level transformation – Histogram equalization- Multi image operation – Spatially dependent transformation – Templates and convolution – Two dimensional geometric – transformation.
Unit – II	**Object Region operation:** Basic edge detection – Second order edge detection – Pyramid edge Detection – Crack edge detection – Edge following – Basic morphological operation – Opening and closing operations.
Unit – III	**Image compression:** Statistical – Spatial compression – Contour coding – Quantizing compression – Fractal compression – Real time image transmission – Quadrees – Image standards – some application sketches.
Unit – IV	**Introduction:** Basic concept of pattern recognition – System design – Design concepts and methodologies – Examples of automatic pattern recognition systems – Decision functions: Introduction – Linear decision functions – Generalized decision functions – Implementation of decision functions.
Unit – V	**Pattern Classification:** Pattern classification by distance functions – Minimum distance pattern classification – Single prototypes- Multi prototypes – A design example – Cluster seeking – Measures of similarity clustering criteria- cluster seeking algorithm- Maximum distance algorithm- K-means algorithm- Isodata, algorithm- Evaluation of clustering results- Graph theoretic approach- Unsupervised pattern recognitions- Introduction to pattern classification by likelihood functions- Syntactic pattern recognition: Concepts of formal languages theory – formulation of syntactic pattern recognition problem- syntactic pattern description- Recognition grammar – statistical considerations- Learning and grammatic interference.

Reference &Textbooks:

Adrian Low, (1991). Computer Vision and Image Processing. McGraw Hill.

TOU, J.T, R.C. Gonzalez, (1974). *Pattern Recognition principles*. Addision – Wesley publishing Company.

Cuevas, E., Zaldivar, D., Perez-cisneros, M. (2016). *Applications of Evolutionary Computation in Image Processing and Pattern Recognition*. Switzerland: Springer International Publishing.

Leondes, C.T., (1998). *Image Processing and Pattern Recognition*. (1st ed.). USA: Academic Press.

Shih, F.Y., (2010). Image Processing and Pattern Recognition: Fundamentals and Techniques, New Jersey: John Wiley & Sons, Inc., Hoboke.

Outcomes	After the successful completion of this course, students will be able to ➢ Know the foundational techniques of image processing and analysis such as filtering, segmentation and local features. ➢ Build a statistical classifier and know how to use other classifiers.

	➢ Use image processing and pattern recognition techniques to detect objects and activities in images and video. ➢ Collaborate with team members to design a solution. ➢ Use Matlab to develop scripts in these areas.

Name of the Course Teacher
Dr. K. Shankar
Department of Computer Applications

Non-Major Elective Course			
Course Code: 541104	**Discrete Mathematics**	**Credits: 2**	**Hours: 3**

Objectives	➢ To introduce a number of Mathematical Foundation to be serving as tools even today in the development of theoretical computer science. ➢ To gain some confidence on how to deal with problems.
Unit – I	**Mathematical Logic:** Statements and notation – Connectives - Normal forms – The theory of inference for the statement calculus – The predicate calculus – Inference theory and predicate calculus.
Unit – II	**Set theory :** Sets – Basic concepts – Notation – Inclusion and equality of sets – The power set – Relations and ordering – Properties – relation matrix and graph of a relation – Partition – Equivalence and compatibility relations – Composition – Partial ordering – Partially ordered set - Functions – Definition – Composition – Inverse – Binary and n-ary operations – Characteristic function – Hashing function.
Unit – III	**Algebraic structures** - Algebraic systems: Examples and general properties – semigroups and monoids: Definitions and examples – Homomorphism of semigroups and monoids – Subsemigroups and submonoids – Groups: Definitions and examples – Cosets and Lagrange's theorem – Normal subgroups – Algebraic systems with two binary operations.
Unit – IV	**Graph theory:** Basic concepts – Definitions – Paths – Reachability and connectedness – Matrix representation of graphs – Trees.
Unit – V	**Finite probability** – Probability distributions – Conditional probability – independence – Bayes' theorem – Mathematical expectation.

Reference &Textbooks:

Judith Gersting, L. (2003). *Mathematical Structures for Computer Science*. (5th ed.). W.H.Freeman and Company. (Unit V)

Kolman, B., Roberty Busby, C., Sharn Cutter Ross, (2013). *Discrete Mathematical Structures*. (6th ed.). Pearson Education.

Ramasamy, V., (2006). Discrete Mathematical Structures with application to Combinatorics. Universities Press.

Tremblay, J.P., Manohar, R. (2017). *Discrete Mathematical Structures with Applications to Computer Science*. New York: Mc-Graw Hill Book Company. (Unit I to IV).

Outcomes	After the successful completion of this course, students will be able to ➢ Develop Problem-solving skills. ➢ Enhance Analytical skills. ➢ Learn Collaborative skills.

Name of the Course Teacher
Dr. B. Yasodara
Department of Mathematics

Non-Major Elective Course			
Course Code: 541106	**Methods of Mathematical Physics**	**Credits: 2**	**Hours: 3**
Objectives	➢ Introduce the mathematical methods to solve physics problems. ➢ Provide basic skills necessary for the application of mathematical methods in physics.		
Unit – I	**Boundary value problems and series solution** – Examples of boundary value problems – Eigen values, eigen functions and the Sturm-Liouville problem – Hermitian operators, their eigen values and eigen functions.		
Unit – II	**Bessel functions** – Bessel functions of the second kind - Hankel functions – Spherical Bessel functions – Legendre polynomials – Associated Legendre polynomials and spherical harmonics.		
Unit – III	**Hermite polynomials** – Laguerre polynomials – The Gamma function – The Dirac Delta function.		
Unit – IV	**Non homogeneous boundary value problems and Green's function** – Green's function for one dimensional problems – eigen function expansion of Green's function – Fourier transform method of construction of Green's function.		
Unit – V	**Green's function in higher dimensions** – Green's function for Poisson's equation and a formal solution of electrostatic boundary value problems – Wave equation with source – quantum mechanical scattering problem.		
Reference &Textbooks: Chattopadhyay, P.K. (1990). *Mathematical Physics*. New Age International (P) Ltd. Publishers. George Arfken, B. Hans Weber, J., Frank Harris, E. (2013). Mathematical Methods For Physicists, Oxford, Uk: Academic Press, Elsevier. Riley, K.F. Hobson, M.P., Bence, S.J. (2006). *Mathematical Methods For Physics And Engineering*. Uk: Cambridge University Press. Svozil, K. (2019). Mathematical Methods Of Theoretical Physics. (6^{th} Ed.). Funzl.			
Outcomes	After the successful completion of this course, students will be able to ➢ Identify various types of matrices and explain how one type of matrix differs from another explain the differences between matrices and determinants. ➢ Identify different special mathematical functions. ➢ Explain linear dependence and linear combination of vectors as quantities in physics differentiate between Fourier transform and Laplace transform.		

Name of the Course Teacher
Dr. R. Raja
Assistant Professor
Ramanujan Centre for Higher Mathematics

Non-Major Elective Course			
Course Code: 541107	**Classical Mechanics**	**Credits: 2**	**Hours: 3**

Objectives	➢ Develop the fundamental concepts in mechanics more rigorously as needed for further study in physics, engineering and technology. ➢ Apply advanced mathematical and computational techniques to complex problems. ➢ Contribute to the development of the student's thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems.
Unit – I	**Constraints:** Classification of constraints - Principal of virtual work. D'Alembert's principle and Lagrange's equations-Velocity dependent potentials and the dissipation function - Simple application problems (D'Alembert's, Lagrangian and Hamilton's).
Unit – II	**Variational principles and Lagrange's equations:** Hamilton's principle -Derivation of Lagrange's equations from Hamilton's principle - Extension of Hamilton's principle to Non-holonomic systems-Variational principle formulation - Conservation theorems and symmetry properties - Energy function and conservation of energy.
Unit – III	**The Hamilton equations of motion:** Legendre transformation and the Hamilton's equations of motion-Cyclic coordinates and conservation theorems-Routh's procedure - Derivation of Hamilton's equations from a variational principle-The principle of least action.
Unit – IV	**Canonical transformations:** The equations and examples of canonical transformations - The harmonic oscillator problem - Poisson brackets and other canonical invariants - Liouville's theorem.
Unit – V	**Hamilton-Jacobi theory:** The Hamilton-Jacobi equation for Hamilton's principal function - The Harmonic oscillator problem - separation of variables in the Hamilton-Jacobi equation - Ignorable coordinates and the Kepler problem.

Reference &Textbooks:

Chandra, S. (2009). *Classical Mechanics: A Textbook*. UK: Alpha Science International.

Goldstein, H. (2018). *Classical Mechanics*. (2nd ed.). New Delhi: Narosa Publishing Home.

John Taylor, R. (2005). *Classical Mechanics*. (2nd ed.). Sausalito, California: University Science Books.

Panat, P.V. (2013). *Classical Mechanics*. New Delhi: Narosa Publishing Home.

Rana, N.C. and Joag, P.S. (2015). *Classical Mechanics*. New Delhi: Tata Mc-Graw Hill Publishing Company Limited.

Synge J.L. and Griffth, B.A. (1970). *Principles of Mechanics*. New York: McGraw Hill Book Co.

Outcomes	After the successful completion of this course, students will be able to ➢ Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics. ➢ Apply their mathematics skills to intermediate classical mechanics problems. ➢ Exhibit an ability to use Newton's Laws of Motion and conservation laws in the solution of physical problems.

Name of the Course Teacher
Dr. R. Raja, Assistant Professor
Ramanujan Centre for Higher Mathematics

Non-Major Elective Course			
Course Code: 541560	**Resource Management Techniques**	**Credits: 2**	**Hours: 3**

Objectives	➢ Emphasize the application of Operations Research for solving business problems. ➢ Know and understand the common and important business problems. ➢ Develop the problem modeling and solving skills and learn how to make intelligent business decisions from the point of view of optimization.
Unit - I	**Linear programming:** Formulations and graphical solutions to linear programming problems – Simplex method – Degeneracy – Unbounded – Infeasible solution – Method of penalty – Two phase method.
Unit - II	**Duality** – Primal and dual computations – Dual simplex method – Transportation problem – Assignment problem.
Unit - III	**Integer programming:** Pure and mixed integer programming problems – Gomary cutting – Plane method – Fractional and mixed Algorithms – Branch and bound techniques.
Unit - IV	**Project scheduling** - PERT-CPM: Phase of project scheduling – Arrow diagram – CPM – Probability and cost considerations in project scheduling – Crashing of networks.
Unit - V	**Queuing Theory:** Queuing system – Characteristics of queuing system – Classification of queues – M/M/1 and M/M/C queuing models. Inventory management: Inventory control – ABC analysis – Economic lot size problems – EOQ with uniform demand and shortages – Limitations of inventories – Buffer stock – Determination of buffer stocks.

Reference &Textbooks:

Fredericks Hillier, S. Gerold Lieberman, J. Bodhibrata Nag, Preetam Basu. (2013). *Introduction to Operation Research*. McGraw Hill Education Pvt Ltd.

Hamdy Taha, A. (1992). *Operations Research: An Introduction.* (5th ed.). Macmillan.

Pradeep Prabhakaran Pai. (2012). *Operation Research, Principle and Practice*. Oxford University Press.

Swarup, K. Gupta, P.K. Man Mohan. (2016). *Operations Research.* (18th ed.). Sultan Chand.

Outcomes	After the successful completion of this course, students will be able to: ➢ Understand how to know the model operations in management system ➢ and management accounting problems using quantitative OR techniques. ➢ Be familiar with various operations in management and management accounting problems encountered in today's business world from an analytical perspective. ➢ Develop analytical and computer modeling skills necessary to implement and analyze these problems.

Name of the Course Teacher
Dr. B. Yasodhara
Department of Mathematics

Non-Major Elective Course			
Course Code: 541109	**Descriptive Statistics**	**Credits: 2**	**Hours: 3**

Objectives	➢ To acquaint students with some basic concepts in Statistics. ➢ Introduce the concept of statistics to some elementary statistical methods of analysis of data will be introduced.
Unit - I	**Origin** - Scope – Functions, limitations, uses and misuses of statistics – Classification and tabulation of data - Diagrammatic and graphical representation of data.
Unit - II	**Measure of central tendency** - Measures of dispersion - Relative measures of dispersion - skewness and kurtosis - Lorenz curve.
Unit - III	**Elementary probability space** - Sample space - discrete probability, independent events - Mathematical and statistical probability -Axiomatic approach to probability - Addition and multiplication theorems - conditional probability – Bayes' theorem - Simple problems.
Unit - IV	**Random variables** - Discrete and continuous random variables - Distribution function – probability mass function and probability density function of a random variable – Expectation of a random variable - evaluation of standard measures of location, dispersion, skewness and kurtosis.
Unit - V	**Simple linear correlation and regression** - Scatter diagram - Karl Pearson's correlation co-efficient and its properties - Spearman's correlation co-efficient. Regression equations– fitting of regression equations - regression coefficients and its properties.

Reference &Textbooks:

Goon, A.M. Gupta, M.K. and Dasgupta, B. (2008). *Fundamentals of Statistics, Volume-I*. Calcutta: World Press Ltd.

Gupta, S.C. and Kapoor, V.K. (2000). *Fundamentals of Mathematical Statistics*. (10^{th} ed.).New Delhi: Sultan Chand and Sons.

Hogg, R.V. McKean, J.W. and Craig, A.T. (2013). *Introduction to Mathematical Statistics*. (7^{th} ed.). Pearson Education Ltd.

Spiegel, M.R. Schiller, J. and Srinivasan, R.A. (2012). *Probability and Statistics, Schaum's Outline Series*. (4^{th} ed.).New Delhi: McGraw- Hill Publishing Company.

Outcomes	After the successful completion of this course, students will be able to ➢ Know the three measures of central tendency: mean, mode, and median. ➢ Know when it is appropriate to use each measure of central tendency. ➢ Know how relationships among measures of central tendency inform you about the shape of a distribution.

Name of the Course Teacher
Dr. N. Anbazhagan
Professor & Head
Department of Mathematics

Non-Major Elective Course			
Course Code: 541502	**Biostatistics**	**Credits:2**	**Hours: 3**

Objectives	Provide an introduction to the basic concepts of statistical ideas and methods that aims to equip students to carry out common statistical procedures and to follow statistical reasoning in their fields of study.
Unit - I	**Introduction to biostatistics:** Numerical summary measures-measures of Central tendency- Mean, Median, Mode. Measures of Dispersion: Range, Inter-Quartile Range, Standard Deviation and Coefficient of Variation. Grouped data-Grouped mean, grouped variance, Chebyshev's Inequality.
Unit - II	**Data presentation** – Types of numerical data – Frequency distributions, relative frequency. Graphs- Bar Charts, Histograms, Frequency polygons, One –way scatter Plots, Box plots, Two-way scatter plots, Line graphs.
Unit - III	**Confidence interval**-Standard deviation, Gaussian distribution, confidence interval of a mean, Survival Curves. Comparing groups with confidence intervals-Confidence interval of a difference between means, Confidence interval for the difference or ratio of two proportions.
Unit - IV	**Introduction to P values**-what is a P value? Statistical significance and hypothesis testing, multiple comparisons. Probability, Bayesian logic-Bayes theorem in genetics. Population genetics, gene pool, allele frequency, genotype frequencies, Hardy-Weinberg equation, implications of Hardy-Weinberg equation. Diagnostic tests-sensitivity and specificity, ROC curves, calculations of prevalence.
Unit - V	**Simple correlation**-correlation coefficient. Regression-simple linear regression. Base idea of significance test-hypothesis testing, level of significance.

Reference & Textbooks:

Campbell, R.C. (1989). *Statistics for Biologists*. (3rd ed.). Cambridge University Press, London.

Daniel, W.W. (2008). Bio-Statistics: A Foundation for Analysis in the Health Science. John Wiley & Sons, Inc.

Glantz, S.A. (2012). *Primer of Bio-Statistics*. (7th ed.). McGraw-Hill Professional Publishing, USA.

Sokal, R.R. and Rohlf, F.J. (1995). *Biometry: The Principles and Practice of Statistics in Biological Research* (3rd ed.). San Francisco, California: Freeman and Company.

Outcomes	After the successful completion of this course, students will be able to ➢ Know the critical consumers of the public health and medical literature by understanding the basic principles and methods of epidemiology, including disease (outcome) measures, measures of association, study design options, bias, confounding, and effect modification.

Name of the Course Teacher
Dr. M.S. Anitha
Department of Mathematics

CURRICULUM VITAE

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Educational Qualification

Ph. D. (Mathematics) – Madurai Kamaraj University, Madurai, India. (2002).
M. Phil (Mathematics) - Madurai Kamaraj University, Madurai, India(1996).
M.Sc. (Mathematics) - Cardamom Planters Association College, Bodinayakanur.(1995).
B. Sc (Mathematics) - Cardamom Planters Association College, Bodinayakanur.(1993).
P.G.D.C.A – ICC & CE of Madurai Kamaraj University, Madurai, India. (1996).

Administrative Posts held during the Service:

Chairperson, School of Mathematics, Alagappa University, Karaikudi.(22.06.2015 to till date).
Head, Department of Mathematics, Alagappa University, Karaikudi.(05.06.2015 to till date).

Professional Experience

Professor of Mathematics, Alagappa University, Karaikudi.(09.03.2013 to till date).
Associate Professor of Mathematics, Alagappa University, Karaikudi. (09.03.2010 to 08.03.2013).
Reader in Mathematics, Alagappa University, Karaikudi. (09.03.2007 to 08.03.2010)
Lecturer in Mathematics, Thiagarajar College of Engineering, Madurai.(26.09.2001 to 08.03.2007)
Teaching Experience: 17years
Research Experience: 17 Years

Area of Research

Stochastic, Modelling, Datamining.

Honours and awards

Excellence Award (2018) from Association of Inventory Academicians and Practitioners, New Delhi.(23.12.2018).
Tamilnadu Scientist Award (TANSA 2017) from Tamilnadu State Council for Science and Technology, Chennai, INDIA.(27.12.2019).
Outstanding Researcher Award (2017) from International Institute of Organized Research (I2OR), Chandigarh, India.
Research Award (2014-16) from University Grants Commission (UGC), New Delhi, India
Shri P. K. Das Memorial Best Faculty Award (2013) from Nehru Group of Institutions, Coimbatore, INDIA.
Career Award for Young Teachers (2005) from All India Council for Technical Education (AICTE), New Delhi, INDIA.
Young Scientist Fellowship (2005) from Tamilnadu State Council for Science and Technology, Chennai, India.
Young Scientist Award (2004) from Department of Science and Technology (DST), New Delhi, INDIA.

Recent Publications

J. Kathiresan, K. Jeganathan and N.Anbazhagan, A retrial queueing-inventory system with service option on arrival and Multiple vacations. Afrika Statistika, 14(1), 1917-1936, 2019.
M. Ravi and N. Anbazhagan, An E_cient Framework to Improve QoS of CSP using Enhanced Minimal Resource Optimization based Scheduling Algorithm. Indonesian J. of Electrical Engineering and Computer Science, 12(3), 1179-1186, December 2018.

D. Ramalingam, S. Arun and N. Anbazhagan, Novel Approach for Optimizing Governance, Risk management and Compliance for Enterprise Information security using DEMATEL and FoM. Procedia Computer Science, 134, 365-370, 2018.

V. S. S. Yadavalli, J. Kathiresan and N. Anbazhagan, A Continuous Review Inventory System with Retrial Customers and Two-Stage Service. Applied Mathematics & Information Sciences, 12(2), 441-449, March 2018.

Total Publications: 72,Total Citation: 528,h- index: 12,i10- index: 11.

CURRICULUM VITAE

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Educational Qualification

PhD (Mathematics) – Alagappa University, Karaikudi, India. (Part-time)(1995)
M.Phil (Mathematics) – Anna University, Chennai, India. (Part-time)(1985)
M.Sc (Mathematics) – V.H.N.S.N College, (Madurai Kamaraj University), India.(1983)
B.Sc (Mathematics) – V.H.N.S.N College, (Madurai Kamaraj University), India.(1981)
P.G.D.C.A (Computer Applications) - Alagappa University, Karaikudi, India. (Part-time)(1993)

Professional Experience

Teaching Assistant, Department of Mathematics, Anna University.(1983 to 1986)
Lecturer, Department of Mathematics , Alagappa University.(1988 to 1996)
Senior Lecturer, Department of Mathematics , Alagappa University.(1996 to 2000)
Reader, Department of Mathematics , Alagappa University. (2000 to 2008)
Professor, Department of Mathematics , Alagappa University. (2008 to 2013)
Professor and Head, Department of Mathematics , Alagappa University.(2013 to 2015)
Professor, Department of Mathematics, Alagappa University.(2015 – till date)
Teaching Experience: 34 years
Research Experience: 29 Years

Area of Research

Graph Theory
Topology
Functional Analysis

Achievements

Solved **50 year <u>old problem</u>** for Ph.D thesis and published in Cambridge University Press Journal
Thesis Title: MEASURE THEORY AND HAUSDORFF DIMENSION OF CANTOR POINT SETS OF CONTINUED FRACTIONS.

Recent Book Publications

Planets and Electromagnetic Waves, First Edition, Idea Publishing, *2018*. (ISBN: 9789386518835, 938651883X).
Mathematics in Material Science, First Edition, Lambert Academic Publishing (Germany), *2019*. (ISBN: 9786200084248, 6200084246).
Total Article Publications: 67

CURRICULUM VITAE

Name : **Dr. J.Vimala**
Designation : Assistant Professor
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Alagappa University,Karaikudi
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E. Mail :vimaljey@alagappauniversity.ac.in

Educational Qualification

Ph. D (Mathematics) - Alagappa University, Karaikudi, India. (2007)
M.Sc. (Mathematics) -Alagappa University, Karaikudi, India. (2002)
B. Sc (Mathematics) -Sri Meenakshi College for Women, Madurai, India. (2000)
B. Ed - Annamalai University, Chithambaram, India.
PGDCA - Alagappa University, Karaikudi, India. (2004)

Professional Experience

Assistant Professor,Department of Mathematics , Alagappa University, Grade -2. (May 2016 to till date)
Assistant Professor, Department of Mathematics , Alagappa University, Grade -1. (May 2012 - 2016)
Teaching Experience: 15years
Research Experience: 12 Years

Area of Research

Algebra –Lattice Theory
Fuzzy Algebra
Decision Theory
Soft computing

Honours & Award

Women Researcher Award-IOSRD 2018 , International Research Awards in Engineering Science & Technology, Chennai.
Distinguished Woman in Science (Mathematics) VIWA 2017, Venus International Foundation, Chennai.
Best Researcher Award (Mathematics) IMRF 2016, International Multidisciplinary Research Foundation, Goa.

Recent Publications

Multiset Filters Of Residuated Lattices And Its Application In Medical Diagnosis - *Journal of Intelligent and Fuzzy Systems*. vol. 36, no. 3, pp. 2297-2305, 2019, **DOI:** 10.3233/JIFS-169940, ISSN 1064-1246 (P)
Implementation of anti-lattice ordered fuzzy soft groups and its matrix operations in deciding process"- Journal of Intelligent and Fuzzy Systems. vol. 35, no. 4, pp. 4857-4864, 2018 doi: 10.3233/JIFS-18914 ISSN 1875-8967 (E), ISSN 1064-1246 (P)
Morphisms on Lattice Ordered Interval-Valued Hesitant Fuzzy Soft Sets - Journal of Intelligent and Fuzzy Systems. vol. 36, no. 3, pp. 2307-2310, 2019, **DOI:** 10.3233/JIFS-169941, ISSN 1064-1246 (P)
4. Application of lattice ordered multi-fuzzy soft set in forecasting process - *Journal of Intelligent and Fuzzy Systems.* vol. 36, no. 3, pp. 2323-2331, 2019, **DOI:** 10.3233/JIFS-169943, ISSN 1064-1246 (P)

Total Publications: 32, Cumulative Impact factor: 10, Total citation: 68 , h-index: 5.

CURRICULUM VITAE

Name : **Dr. R. RAJA**
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Educational Qualification

PhD (Mathematics) - Periyar University, Salem, India. (2011)
M. Phil (Mathematics) - Periyar University, Salem, India. (2006)
M .Sc (Mathematics) - Periyar University, Salem, India. (2005)
B. Sc (Mathematics) - Govt. Arts College Salem, Tamilnadu, India. (2003)

Professional Experience

Assistant Professor, RCHM, Alagappa University, Grade -2. (May 2016 to till date)
Assistant Professor, RCHM , Alagappa University, Grade -1. (May 2012 -2016)
Teaching Experience: 8 years
Research Experience: 7 Years

Area of Research

Abstract & Fractional Differential Equations
Stability Analysis of Dynamical Systems
Neural Networks
Synchronization Theory
Mathematical Modeling and Population Systems
Genetic Regulatory Networks, Complex Dynamical Networks, Multi-Agent Systems

Honours& Awards

2018, Outstanding Reviewer Award for the year 2018in Mathematics and Computers in Simulation (Elsevier).
2017, Outstanding Reviewer Award for the year 2017 in Journal of the Franklin Institute (Elsevier).
2015, Awarded travel grant from NBHM for attending ICIAM in Beijing, China.
2014, Awarded travel grant from NBHM for attending ICM in Seoul, South Korea.
2010, Received Sir. C.V. Raman Budding Innovator Award from Periyar University, Salem.
2008, Awarded Senior Research Fellow under Rajiv Gandhi National Fellowship, New Delhi.
2005, Awarded Junior Research Fellow under Rajiv Gandhi National Fellowship, New Delhi.

Recent Publications

A.Pratap, R.Raja, J.Cao, G.Rajchakit, Stability and synchronization criteria for fractional order Competitive neural networks with time delays: An asymptotic expansion of Mittag Leffler function, Journal of the Franklin Institute 356 (2019) 2212-2239. [SCIE, Elsevier Publication, IF: 3.576].

C.Sowmiya, R.Raja, R.P.Agarwal, G.Rajchakit, Passivity analysis for Uncertain discrete time BAM Neural Networks with leakage and mixed delay using novel summation inequality, International Journal of Control, Automation and Systems, 17 (8) 2019 2114-2124. [SCIE, Springer Publication, IF: 2.173].

C.Sowmiya, R.Raja, J.Cao, G.Rajchakit, A delay-dependent asymptotic stability criteria for uncertain discrete-time BAM neural networks with leakage and time varying delays: A novel summation inequality, Asian Journal of Control, 2018 (Accepted). [SCI, Wiley Balackwell Publication, IF: 1.528].

A.Pratap, R.Raja, J.Cao, G.Rajchakit, Fuad E.Alsaadi, Further synchronization in finite time analysis for time-varying delay fractional order memristive competitive neural networks with leakage delay, Neurocomputing 317 (2018) 110-126. [SCI, Elsevier Publication, IF: 3.241].
C.Sowmiya, R.Raja, J.Cao, Xiaodi Li, Discrete-time stochastic impulsive BAM neural network with multiple and leakage in the delay term: An exponential stability problem, Journal of The Franklin Institute 355(10) (2018) 4404-4435. [SCIE, Elsevier Publication, IF: 3.576].

Total Publications: 63, Cumulative Impact Factor: 172, Total Citations: 648,
h-index: 15, i-10 index: 23.

CURRICULUM VITAE

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Designation : Assistant Professor
Address : Department of Mathematics,
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Educational Qualification

Ph. D (Mathematics), Alagappa University, Karaikudi, India (2018)
M. Phil (Mathematics) , Madurai Kamaraj University, Madurai, India. (2009)
M.Sc. (Mathematics), CPA College, Madurai Kamaraj University, Madurai, India (1998)
B. Sc (Mathematics), CPA College, Madurai Kamaraj University, Madurai, India (1996)
CSIR-NET (Mathematics), (2010)
PGDOR (Operations Research), Pondicherry University, Puducherry, India (2004)

Professional Experience

Assistant Professor, Department of Mathematics , Alagappa University, Grade -1. (May 2012 - 2016)
Assistant Professor, Department of Mathematics , Alagappa University,Grade -2. (May 2016 to till date)
Teaching Experience: 16 years
Research Experience: 1 Year

Area of Research

Differential Equations
Fractional Differential equations
Control Theory
Mathematical Modelling
Perturbation Theory

Honours and awards

University IV th Rank Holder in M.Sc Mathematics, Madurai Kamaraj University, Madurai, India.

Recent Publications

Controllability criteria of fractional differential dynamical systems withnon-instantaneous impulses,10.1093/imamci/dnz025, (Impact Factor 1.00).

Total Publications: 7, Cumulative Impact factor: 5,Total citations:11,
H-index: 2, i-10 index: 1.

CURRICULUM VITAE

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Educational Qualification

Ph. D (Mathematics) – Alagappa University, Karaikudi, India.(2011)
M. Phil (Mathematics) - Manonmaniam Sundaranar University, Tirunelveli, India.(2001)
M.Sc. (Mathematics) - Manonmaniam Sundaranar University, Tirunelveli, India. (1999)
B. Sc (Mathematics) - Sri Sarada College for Women, Tirunelveli, India, (1997).
Post Graduate Diploma in Computer Applications(P.G.D.C.A) - Manonmaniam Sundaranar University, Tirunelveli, India.(2000)

Professional Experience

Assistant Professor, RCHM, Grade – 2. (May 2016 to till date).
Assistant Professor, RCHM, Grade – 1. (May 2012 – 2016).
Teaching Experience: 10years
Research Experience: 8 Years

Area of Research

Graph Theory,
Domination Theory,
Algorithmic Graph theory,
Discrete Mathematics,
Cryptography.

Honors and awards

Bright Educator Award from International Institute of Organized Research for the year **2017**.
Eminent MathematicianAward from The International Multidisciplinary Research Foundation for the year **2019.**

Recent Publications

Sankara Gomathi. S, Amutha. S, Jayaprakasan. "Personify Educational Assistance Application for Special Children Using Deep Learning", International Journal of Innovative Technology and Exploring Engineering, Volume 8, Issue 10, August 2019, pp.1609-1614, ISSN 2278-3075.

Sankara Gomathi. S , Amutha. S, Latha . A, Jayaprakasan. "Design of Power Optimization of Reversible Carry Select Adder using MPFA"", International Journal of Emerging Technology & Advanced Engineering Volume 8, Issue 10, October, 2018, pp.58-63, ISSN 2250-2459.

K.Suriya Prabha and S.Amutha, "Split Domination number of a Congruent Dominating Graphs", International Journal of Pure and Applied Mathematics. Vol.119, No.12 , 2018, pp.14633-14642, ISSN: 1314-3395.

S.Amutha "Vertex odd and even mean labeling of a Regular graph", Journal of Advanced Research in Applied Sciences. Vol.5(3), pp.378-394, March 2018, DOI:16.10089.JARAS.2018.V513.453459-2464.

K.Suriya Prabha and S.Amutha, "Edge Mean Labeling of a Regular Graphs", International Journal of Mathematics Trends and Technology. Vol. 53, Number 4, ISSN No. 2231-5373 (2018) 24-33, [Seventh Sense Research Group].

N.Sridharan, S.Amutha and A.Ramesh Babu, " Bounds for Lamda Domination Number Gamma Lamda of G of a Graph", Journal of Computational Mathematica. Vol.1(2), pp.78-90, November 2017.

Total Publications: 6, h-index: 3, i10 – index:1

CURRICULUM VITAE

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Educational Qualification

Ph. D. (Mathematics) – Bharathidasan University, Trichy, India. (2015)
M. Phil. (Mathematics) – Alagappa University, Karaikudi, India. (2010)
M. Sc. (Mathematics) –Dr. Zakir Hussain College, (Alagappa University), India.(2007)
B. Sc**.** (Mathematics) – Dr. Zakir Hussain College, (Madurai Kamaraj University), India. (2005)

Professional Experience

Assistant Professor, Department of Mathematics, Alagappa University.(2016 to Till date)
Teaching Experience: 4 years
Research Experience: 4 Years

Area of Research

Magic labeling Graph Theory
Fuzzy Topology
Fuzzy Magic labeling Graph Theory

Recent Publications

Jeyabalan.R. IVF- almost generalized semi-precontinuous mappings, International Journal of Applied Mathematical Sciences ISSN 0973-0176 Volume 9, Number 1 (2016), pp. 99-111.
G. Kumar and R. Jeyabalan, Completely generalized semi-precontinuous mapping in IVF- topological space, International Journal of Mathematics and Its Applications, Volume 6, Issue 2, 2018.
G. Kumar and R. Jeyabalan, IVF-almost generalized semi-preclosed mappings, International Journal of Mathematics Trends and Technology, Volume 55, Number 2, March 2018.
G. Kumar and R. Jeyabalan, Strongly Edge Multiplicative Graphs, (Accepted).
G. Kumar and R. Jeyabalan, On Vertex N-magic total labelling of graphs (Review)
R. Jeyabalan and G. Kumar, Strongly Vertex Multiplicative Graphs(Review)

Total Article Publications:10 h-index: 2, Total citations:5

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Educational Qualification

Ph.D (Mathematics) – Alagappa University, Karaikudi, India. (2012)
M.Phil (Mathematics) – Alagappa University, Karaikudi, India.(2002)
M.Sc (Mathematics) – Alagappa University, Karaikudi, India.(2001).
B.Sc (Mathematics) – Alagappa Govt. Arts College, Karaikudi, (Madurai Kamaraj University), India. (1999).
P.G.D.C.A (Computer Applications) - Alagappa University, Karaikudi, India. (2001)

Professional Experience

Assistant Professor in Mathematics, Directorate of Distance Education, Alagappa University.(2013 – till date)
Associate Professor and Head, Department of Science and Humanities, Sri Raaja Raajan College of Engineering and Technology, Amaravathipudur. (2011 to 2013).
Assistant Professor, Department of Mathematics, St. Michael College of Engineering and Technology, Kalaiyarkoil. (2010 to 2011)
Lecturer, Department of Mathematics, Veltech, Avadi,Chennai. (2005 to 2006).
Guest Lecturer, Department of Mathematics, Alagappa Govt. Arts College, Karaikudi (2004 to 2005 and from 2006 to 2010).
Teaching Experience: 15 years
Research Experience: 12 Years

Area of Research

Algebra & Fuzzy Algebra
Operations Research
Mathematical Modelling
Neutrosophic sets (Neutrosophic Inventory, Neutrosophic Graph theory, Neutrosophic Optimization, Neutrosophic Adhoc networks).

Honours and Awards

Best Article Award 2018 for the paper entitled Neutrosophic EOQ Model with price break by Neutrosophic Science International Association(NSIA), University of New Mexico, Maths and Science Department, 705, Gurley Ave, Gallup NM 87301, USA, 7 February 2019.

Recent Publications

M. Mullai & R. Surya., Neutrosophic EOQ Model with Price Break, Neutrosophic Sets and Systems, Vol. 19: 24-28(2018).
M.Mullai & K.Shanmuga Priya.,Direct product of SP-Algebra, Journal of Global Research in Mathematical Archives, Vol.5(5), 90-94(2018).
M.Mullai & K.Shanmuga Priya., Polynomials on SP-Ring, International Journal of Computer Science, Volume 6, Issue 1, No 04, 2018, pp. 2293-2300.
M.Mullai., S.Broumi., et.al., A Neutrosophic Technique Based E_cient Routing Protocol For MANET Based On Its Energy And Distance, Vol. 24, 2019, pp. 61-69.DOI:10.5281/zenodo.2593923.
M.Mullai & R.Surya., Neutrosophic Project Evaluation and Review Techniques, Neutrosophic Sets and Systems, Vol. 24, 2019, pp. 1-9. DOI: 10.5281/zenodo.2593903.

M. Mullai., S. Broumi., et.al., Single valued (2N+1) sided polygonal neutrosophic numbers and single valued (2N) sided polygonal neutrosophic numbers, Neutrosophic Sets and Systems, vol.25, 2019, pp. 54-65. DOI: 10.5281/zenodo.2631502.

Total Article Publications: 32, Total Citations: 14, h-index:01