BHARATHIDASAN UNIVERSITY **TIRUCHIRAPPALLI - 620 024.**

B.Sc. MATHEMATICS

CHOICE BASED CREDIT SYSTEM –

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2022-2023 onwards)

Sem.	Part	Course	Title	Ins. Hrs	Credi	Exam Hours	Marks Int.	Marks Ext.	Total
I	I	Language Course – I (LC) Tamil $ / Other Languages + #		6	3	3	25	75	100
	II	English Course - I (ELC)		6	3	3	25	75	100
	III	Core Course – I (CC)	Differential Calculus and Trigonometry	5	5	3	25	75	100
		Core Course – II (CC)	Integral Calculus and Fourier Series	5	4	3	25	75	100
		First Allied Course – I (AC)	Computer Science / Physics / Financial Accounting	4	4	3	25	75	100
		First Allied Practical (AP)	Physics / Computer Science	2	-	-	-	-	-
		First Allied Course – II (AC)	Financial Accounting						
	IV	Value Education		2	2	3	25	75	100
	TOTAL			**30**	**21**	**-**	**-**	**-**	**600**
II	I	Language Course - II (LC) Tamil $ / Other Languages + #		6	3	3	25	75	100
	II	English Course - II (ELC)		4	3	3	25	75	100
	III	Core Course – III (CC)	Differential Equations	5	5	3	25	75	100
		Core Course – IV (CC)	Analytical Geometry 3D	5	4	3	25	75	100
		First Allied Practical (AP)	Computer Science / Physics	2	2	3	40	60	100
		First Allied Course – II (AC)	Financial Accounting			3	25	75	
		First Allied Course – II (AC)	Computer Science / Physics	4	4	3	25	75	100
		First Allied Course – III (AC)	Financial Accounting						
		Add on Course – I ##	Professional English- I	*6	4	3	25	75	100
	IV	Environmental Studies		2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NMS) @@	Language Proficiency for Employability - Effective English	2	2	3	25	75	100
		TOTAL		**30**	**29**	**-**	**-**	**-**	**900**

III	III	Language Course – III (LC) Tamil $ / Other Languages + #		6	3	3	25	75	100
		English Course – III (ELC)		6	3	3	25	75	100
		Core Course – V (CC)	Classical Algebra and Theory of Numbers	5	5	3	25	75	100
		Core Course – VI (CC)	Sequence and Series	5	4	3	25	75	100
		Second Allied Course – I (AC)	Chemistry / Mathematical Statistics / Management Accounting	4	4	3	25	75	100
		Second Allied Practical (AP)	Chemistry / Mathematical Statistics	2	-	-	-	-	-
		Second Allied Course – II (AC)	Management Accounting						
		Add on Course – II ##	Professional English - II	6*	4	3	25	75	100
	IV	Non-Major Elective I @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either a) Basic Tamil if Tamil language was not studied in school level **or** b) Special Tamil if Tamil language was studied upto 10^{th} & 12^{th} std.	Quantitative Aptitude I	2	2	3	25	75	100
		TOTAL		**30**	**25**	**-**	**-**	**-**	**700**
IV	I	Language Course –IV (LC) Tamil $ / Other Languages + #		6	3	3	25	75	100
	II	English Course – IV (ELC)		6	3	3	25	75	100
	III	Core Course - VII (CC)	Vector Calculus and Laplace Transforms	5	5	3	25	75	100
		Core Course – VIII (CC)	Abstract Algebra	5	4	3	25	75	100
		Second Allied Practical (AP)	Chemistry / Mathematical Statistics	2	2	3	40	60	100
		Second Allied Course – II (AC)	Management Accounting			3	25	75	
		Second Allied Course – II (AC)	Chemistry / Mathematical Statistics	4	4	3	25	75	100
		Second Allied Course – III (AC)	Management Accounting	4	4	3	25	75	100
	IV	Non-Major Elective II @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either Basic Tamil if Tamil language was not studied in school level **or** Special Tamil if Tamil language was studied upto 10^{th} & 12^{th} std.	Quantitative Aptitude II	2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NMS) @@	Digital Skills for Employability	-	2	3	25	75	100
		TOTAL		**30**	**25**	**-**	**-**	**-**	**800**

V	III	Core Course -IX (CC)	Numerical Methods and MATLAB	5	5	3	25	75	100
		Core Course – X (CC)	Real Analysis	5	5	3	25	75	100
		Core Course – XI (CC)	Statics	5	5	3	25	75	100
		Core Practical – I (CP)	MATLAB Programming Lab	5	4	3	40	60	100
		Major Based Elective – I (Any one from Group - A)		5	4	3	25	75	100
	IV	Skill Based Elective I	Introduction to Latex	3	2	3	25	75	100
		Soft Skills Development		2	2	3	25	75	100
		TOTAL		**30**	**27**	**-**	**-**	**-**	**700**
VI	III	Core Course - XII (CC)	Linear Algebra	5	5	3	25	75	100
		Core Course - XIII (CC)	Complex Analysis	5	5	3	25	75	100
		Core Course - XIV (CC)	Dynamics	5	4	3	25	75	100
		Major Based Elective II (Any one from Group - B)		5	4	3	25	75	100
		Major Based Elective III (Any one from Group - C)		5	3	-	25	75	100
	IV	Skill Based Elective – II		3	2	3	25	75	100
	V	Gender Studies		2	1	3	25	75	100
		Extension Activities **		-	1	-	-	-	-
	VI	Naan Mudhalvan Scheme (NMS) @@		-	2	3	25	75	100
		TOTAL		**30**	**27**	**-**	**-**	**-**	**800**
		GRAND TOTAL		**180**	**154**	**-**	**-**	**-**	**4500**

LIST OF ALLIED COURSES:

First Allied Course (Any one)

1. Computer Science
2. Physics
3. Financial Accounting

Second Allied Course (Any one)

1. Chemistry
2. Mathematical Statistics
3. Management Accounting

LIST OF MAJOR BASED ELECTIVE COURSES:

Group A (Any one)

1. Operations Research
2. Stochastic Processes

Group B (Any one)

1. Graph Theory
2. Introduction to Python Programming

Group C (Any one)

1. Astronomy
2. Number Theory

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Types of the Course	No. of Courses	No. of Credits	Marks
1.	I	Language Courses	4	12	400
2.	II	English Courses	4	12	400
3.	III	Core Courses	14	70	1400
4.		Core Practical	1	4	100
5.		Allied Courses I & II	4	16	400
6.		Allied Practical	2	4	200
7.		Major Based Elective Courses	3	6	300
8.		Add –on Course (Professional English I & II)	2	8	200
9.	IV	Non Major Elective Courses	2	4	200
10.		Skill Based Elective Courses	2	4	200
11.		Soft Skill Development	1	2	100
12.		Value Education	1	2	100
13.		Environmental Studies	1	2	100
14.	V	Gender Studies	1	1	100
15.		Extension Activities	1	1	0
16.	VI	Naan Mudhalvan Scheme	3	6	300
	Total		**46**	**154**	**4500**

PROGRAMME LEARNING OBJECTIVES:

- To have a comprehension of the instruments required to have the option to quantitatively examine and comprehend the common and social world,
- To be able to take care of issues, think scientifically, and reason quantitatively.
- To be able to get to and convey Mathematical data.
- To take an interest effectively in Mathematics related occasions in particular Conferences/Seminars/Workshops and Quiz programs.

PROGRAMME OUTCOMES:

Area information: Demonstrate information on essential ideas, standards and uses of the particular science discipline.

Logical and Technical Skills: Ability to deal with/utilize suitable apparatuses/strategies/gear with a comprehension of the standard working methods, wellbeing perspectives/impediments.

Basic reasoning and Problem settling: Identify and basically break down appropriate issues in the important order utilizing proper instruments and strategies just as ways to deal with coming to feasible end results/arrangements.

Individual and collaboration: Exhibit the possibility to successfully achieve assignments freely and as a part or pioneer in various groups, and in multidisciplinary settings.

Powerful Communication: Communicate successfully in spoken and composed structure just as through electronic media with mainstream researchers just as with society on the loose.

Society: Analyse the effect of logical and innovative advances on nature and society and the requirement for reasonable improvement.

Morals: Commitment to proficient morals and duties.

Deep-rooted learning: Ability to participate in long-lasting learning with regard to the fast advancements in the control.

PROGRAMME SPECIFIC OUTCOMES:

- Explicate the concepts of pure and applied Mathematics by demonstrating the knowledge and understanding of the mathematical principles in multidisciplinary environments.
- Demonstrate a computational ability in solving a wide array of mathematical problems.
- Utilize mathematical skills of the logical and scientific approach.
- Appreciate the beauty of Mathematics with the attainment of proficiency in problem solving, computational skills, critical thinking, technical and quantitative reasoning.

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First Year	CORE COURSE I DIFFERENTIAL CALCULUS AND TRIGONOMETRY	Semester I
Code:	(Theory)	Credit: 5

COURSE OBJECTIVES:

- To inculcate what a derivative is in terms of the idea of a tangent line to the graph of a function, how a derivative can be used to describe the rate of change of one quantity with respect to another, and how to relate the geometric ideas to the analytic ideas.
- To understand intuitive explanation of the process of taking a limit, to compute basic limits of functions and understand the importance of limits to the process of differentiation and be able to compute the derivative of a simple function.
- To know continuity as related to functions and able to relate an intuitive notion of continuity to the mathematical definition of continuity, to compare and contrast the ideas of continuity and differentiability.
- To recognize and use the vocabulary of angles (including standard position, initial and terminal sides, quadrantal angles, acute, right, and obtuse angles)
- To know the usage of right triangles to evaluate the six trigonometric functions
- To compute the six trigonometric functions of any angle and use the unit circle to define the six trigonometric functions for all real numbers.

UNIT – I:

Functions and Limits: Constants and variables – Functions – Classification of functions - Limits.

UNIT – II:

Methods of Successive Differentiation – Leibnitz's Theorem and its applications- Increasing & Decreasing functions –Maxima and Minima of functions of two variables.

UNIT – III:

Curvature – Radius of curvature in Cartesian and Polar Coordinates – Centre of curvature– Radius of curvature – Evolutes& Involutes

UNIT – IV:

Expansions of $\sin(nx)$, $\cos(nx)$, $\tan(nx)$– Expansions of $\sin^n x$, $\cos^n x$ –Expansions of sin(x), cos(x), tan(x) in powers of x.

UNIT – V:

Hyperbolic functions – Relation between hyperbolic & Circular functions- Inverse hyperbolic functions.

UNIT – VI CURRENT CONTOUR (For Continuous Internal Assessment Only):

The Double angle formulas and The Half-angles identities.

REFERENCES:

1. S. Narayanan and T.K. Manicavachagam Pillai, **Calculus Volume I**, S. Viswanathan (Printers & Publishers) Pvt. Limited , Chennai -2011.
2. S. Arumugam & others, **Trigonometry and Fourier series**, New Gamma Publications -1999

   UNIT – I : Chapter I Sections 1 to 10 of [1]
   UNIT – II : Chapter III Sections 1.1 to 2.2, Chapter IV Section 2.1, 2.2 & Chapter V 1.1 to 1.4 of [1]
   UNIT – III : Chapter X Sections 2.1 to 2.6 of [1]
   UNIT – IV : Chapter 1 Section 1.2 to 1.4 of [2]
   UNIT – V : Chapter 2 Section 2.1 & 2.2 of [2]
3. S. Arumugam and Isaac, Calculus, Volume1, New Gamma Publishing House, 1991.
4. S. Narayanan, T.K. Manichavasagam Pillai, Trigonometry, S. Viswanathan Pvt. Limited, and Vijay Nicole Imprints Pvt. Ltd, 2004.

COURSE OUTCOME:

After completing this course, the students will be able to;

- Explain the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point.
- Compare and contrast the ideas of continuity and differentiability.
- Find maxima, minima, critical points and inflection points of functions and to determine the concavity of curves.
- Convert angles from degrees to radians and vice versa.
- Compute the length of a circular arc given the radius and the interior angle.
- Understand the definitions of the inverse trigonometric functions, compute the domain and range of the hyperbolic and inverse trigonometric functions and to find exact values of composite functions with inverse trigonometric functions.

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First Year **CORE COURSE II** **Semester I**

INTEGRAL CALCULUS AND FOURIER SERIES

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To get exposed to the concepts of reduction formulae and Fourier series.
- To apply double and triple integral to find the area and volume.
- To understand the concepts of Beta and Gamma functions and their applications.

UNIT – I:

Definite integrals - Integration by parts and reduction formulae.

UNIT – II:

Geometric Application of Integration-Area under plane curves: Cartesian co-ordinates -Area of a closed curve - Examples - Areas in polar co-ordinates.

UNIT – III:

Double integrals – changing the order of Integration – Triple Integrals.

UNIT – IV:

Beta and Gamma functions and the relation between them –Integration using Beta and Gamma functions.

UNIT – V:

Fourier series- definition - Fourier Series expansion of periodic functions with Period 2π – Use of odd & even functions in Fourier Series. Half-range Fourier Series – Development in Cosine series – Development in Sine series.

UNIT – VI CURRENT CONTOUR (For Continuous Internal Assessment Only):

Chemical, Physical and Biomedical Applications of Fourier series.

REFERENCES:

1. S. Narayanan and T.K. Manicavachagam Pillai, Calculus Volume II, S. Viswanathan (Printers & Publishers) Pvt. Limited, Chennai -2011.
2. S. Narayanan, T.K. Manicavachagam Pillai, Calculus, Vol. III, S. Viswanathan Pvt. Limited, and Vijay Nicole Imprints Pvt. Ltd, 2004.

UNIT – I : Chapter 1 section 11, 12 & 13 of [1]
UNIT – II : Chapter 2 section 1.1, 1.2, 1.3 & 1.4 of [1]
UNIT – III : Chapter 5 section 2.1, 2.2 & 4 of [1]
UNIT – IV : Chapter 7 section 2.1 to 2.5 of [1]
UNIT – V - Chapter 6 Section 1, 2, 3, 4, 5.1, 5.2 of [2]

REFERENCES:

1. Shanti Narayan, Differential & Integral Calculus.
2. Dr. S. Arumugam and Prof. A. ThangapandiIssac, Fourier series, New Gamma Publishing house.

COURSE OUTCOMES:

After completing this course, the students will be able to:

- Derive reduction formula and thereby evaluate some standard integrals.
- Explain the properties of Beta and Gamma functions and apply it to compute the integral.
- Identify odd and even functions and determine Fourier series expansion of these given functions.
- Apply change of variable method to evaluate double integral.
- Utilize double and triple integral to compute area and volume of a solid.

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First Year **CORE COURSE III** **Semester II**

DIFFERENTIAL EQUATIONS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know the order and degree of the ODE's.
- To study DEs and PDEs of first and second order.
- To identify some specific methods and solve them.
- To make difference between ODE and PDE.
- To know some standard methods.

UNIT – I:

Equations of the first order and first degree – Variable separable – Homogeneous, Non-homogeneous, Linear equations – Bernoulli's equation – Exact differential equations: Sufficient condition for exact differential equations – Practical rules for solving exact differential equations.

UNIT – II:

First order, higher degree differential equations– Equations solvable for dy/dx, solvable for y, solvable for x, Clairaut's form – Homogeneous equations in x and y– simple problems.

UNIT – III:

Particular integrals of second order differential equations with constant coefficients - Linear equations with variable coefficients – Method of Variation of Parameters (Omit third & higher order equations)..

UNIT – IV:

Formation of Partial Differential Equation – General, Particular & Complete integrals – Solution of PDE of the standard forms - Lagrange's method - Charpit's method and few standard forms.

UNIT – V:

PDE of second order homogeneous equation with Constant coefficients – Particular integrals of the forms e^{ax+by}, Sin(ax+by), Cos(ax+by), $x^r y^s$ and $e^{ax+by}.f(x,y)$.

UNIT – VI CURRENT CONTOUR (For Continuous Internal Assessment Only):

Moving Boundary Value Problems

REFERENCES:

1. T.K. Manicavachagam Pillay & S. Narayanan, Differential Equations, S. Viswanathan Publishers Pvt. Ltd., 1996.
2. Arumugam & Isaac, Differential Equations, New Gamma Publishing House, Palayamkottai, 2003.

   UNIT – I : Chapter II – Sections 1,2,3,4,5,6 of [1]
   UNIT – II : Chapter IV – Sections 1,2 & 3 of [1]
   UNIT – III : Chapter V – Sections 1,2,3,4 & 5, Chapter VIII – Section 4 of [1]
   UNIT – IV : Chapter XII – Sections 1 – 6 of [1]
   UNIT – V : Chapter V of [2]
3. M.D. Raisinghania , Ordinary and Partial Differential Equations, S. Chand & Co.
4. M.K. Venkatraman, Engineering Mathematics, S.V. Publications, 1985 Revised Edition.

COURSE OUTCOMES:

After completing this course, the students will be able to:

- Solve first-order ordinary differential equations.
- Solve higher order differential equations.
- Solve the Higher order differential equations using methods of variation of parameter.
- Solve partial differential equations using Lagrange's Method.

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First Year **CORE COURSE IV** **Semester II**

ANALYTICAL GEOMETRY 3D

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To study three dimensional Cartesian Co-ordinates system.
- To enable the students to develop their skill in three dimensions

UNIT – I:

Symmetrical form of equation of a straight line – Equation of a straight line passing through two given points – Condition for a line to be parallel to a plane – Angle between a plane and a line – Condition for two straight lines to be coplanar – Shortest Distance between two given lines.

UNIT – II:

Sphere – Equation of a sphere when the centre and radius are given – Plane section of a sphere – Equation of a circle – Intersection of two spheres – The equation of a tangent plane to a sphere.

UNIT – III:

Equation of a surface – Cone – Right Circular cone – Intersection of a straight line and quadric cone – Tangent plane and normal.

UNIT – IV:

Condition for a plane to touch a quadric cone - angle between lines in which a plane cuts a cone – Condition that a cone has three mutually perpendicular generators.

UNIT – V:

Central quadrics – intersection of a line and a quadric – tangents and tangent planes – condition for a plane to touch a conicoid.

UNIT – VI CURRENT CONTOUR (For Continuous Internal Assessment Only):

An Introduction to Geo Gebra software.

REFERENCES:

1. T Manickavasagam Pillay, T.K. and Natarajan. T, A Text of Analytical Geometry – Part II – Three dimensions, S. Viswanathan (Printers & Publishers) Pvt. Ltd. 2005,

   UNIT – I : Chapter III – Sections 1 to 8
   UNIT – II : Chapter IV – Sections 1 to 8
   UNIT – III : Chapter V – Sections 1 to 4

UNIT – IV : Chapter V – Sections 5 to 7
UNIT – V : Chapter V – Sections 9 to 12

2. Shanthi Narayanan and Mittal P.K, Analytical Solid Geometry, 16th Edition S. Chand & Co., New Delhi.

COURSE OUTCOMES:

After completing this course, the students will be able to:

- Gain knowledge about the regular geometrical figures and their properties.
- Analyze condition of tangency and find the tangent plane to the sphere.
- Examine the condition for the general equation of the cone.
- Understand the concept of quadric cone and its properties.
- Acquire the basic knowledge of tangents and conicoid.

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Second Year **CORE COURSE V** **Semester III**

CLASSICAL ALGEBRA AND THEORY OF NUMBERS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To lay a good foundation for the study of Theory of Equations.
- To train the students in operative algebra.

UNIT – I:

Relation between roots & coefficients of Polynomial Equations – Symmetric functions – Sum of the r^{th} Powers of the Roots

UNIT – II:

Newton's theorem on the sum of the power of the roots-Transformations of Equations – Diminishing, Increasing & Multiplying the roots by a constant - Reciprocal equations - To increase or decrease the roots of an equation by a given quantity.

UNIT – III:

Form of the quotient and remainder – Removal of terms – To form an equation whose roots are of any power – Transformation in general – Descarte's rule of sign.

UNIT – IV:

Inequalities – elementary principles – Geometric & Arithmetic means – Weirstrass inequalities – Cauchy inequality – Applications to Maxima & Minima.

UNIT – V:

Theory of Numbers – Prime & Composite numbers – divisors of a given number N – Euler's Function $\phi(N)$ and its value – The highest Power of a prime P contained in N! – Congruences – Fermat's, Wilson's & Lagrange's Theorems.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Linear Diophantine equation

REFERENCES:

1. T.K. Manickavasagam Pillai & others, Algebra Volume I, S.V. Publications – 1985 Revised Edition.
2. T.K. Manickavasagam Pillai & others, Algebra Volume II, S.V. Publications – 1985 Revised Edition.
   UNIT – I : Chapter 6 Section 11 to 13 of (1)
   UNIT – II : Chapter 6 Section 14 to 17 of (1)
   UNIT – III : Chapter 6 Section 18- 21 & 24 of (1)
   UNIT – IV : Chapter 4 of (2)
   UNIT – V : Chapter 5 of (2)
3. H.S. Hall and S.R. Knight, Higher Algebra, Prentice Hall of India, New Delhi.

COURSE OUTCOMES: After completing this course, the students will be able to

- Know the foundation of Theory of Equations.
- Applying the skills to solve problems in operative algebra.

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Second Year **CORE COURSE VI** **Semester III**

SEQUENCES AND SERIES

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- Learn to work with infinite sequences and series.
- Learn to work with infinite bounded sequences.
- Learn to work with an infinite monotonic sequences.
- Learn to work with an infinite convergent or divergent sequences.
- Find the sequences of partial sums of an infinite series.
- Determine if a geometric series is convergent or divergent.
- Find the sum of a convergent geometric series.

UNIT – I:

Sequences – Bounded Sequences – Monotonic Sequences – Convergent Sequences – Divergent Sequences – Oscillating sequences

UNIT – II:

Algebra of Limits – Behavior of Monotonic functions

UNIT – III:

Some theorems on limits – subsequences – limit points – Cauchy sequences.

UNIT – IV:

Series – infinite series – Cauchy's general principal of convergence – Comparison – test theorem and test of convergence using comparison test (comparison test statement only, no proof).

UNIT – V:

Test of convergence using dAlembert's ratio test – Cauchy's root test – Alternating Series – Absolute Convergence (Statement only for all tests).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction Power series.

REFERENCES:

1. Dr. S. Arumugam & Mr. A. Thangapandi Isaac Sequences and Series – New Gamma Publishing House, 2002 Edition.
   UNIT – I : Chapter 3 Sections 3.0 – 3.5 Page No : 39-55
   UNIT – II : Chapter 3 Sections 3.6, 3.7 Page No:56 – 82
   UNIT – III: Chapter 3 Sections 3.8-3.11, Page No:82-102
   UNIT – IV: Chapter 4 Sections (4.1 & 4.2) Page No : 112-128.

UNIT – V : Relevant part of Chapter 4 and Chapter 5: Sec. 5.1 & 5.2 Page No: 157-167.

2. Algebra – Prof. S. Surya Narayan Iyer
3. Algebra – Prof. M.I. Francis Raj

Course Outcomes: After completing this course, the students will be able to

- Determine if an infinite sequence is bounded.
- Determine if an infinite sequence is monotonic.
- Determine if an infinite sequence is convergent or divergent.
- Find the sequence of partial sums of an infinite series.
- Determine if a geometric series is convergent or divergent.
- Find the sum of a convergent geometric series.
- Determine if an infinite series is convergent or divergent by selecting the appropriate test.
- Determine if an infinite series converges absolutely or conditionally.

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Second Year **NON MAJOR ELECTIVE I** **Semester III**

QUANTITATIVE APTITUDE I

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To lean the problems solving techniques for aptitude problems
- To enable to students prepare themselves for various competitive examinations

UNIT – I:

Numbers – HCF – LCM – Problems on numbers

UNIT – II:

Decimal Fractions and Simplification

UNIT – III:

Surds and Indices – Percentage – Profit and Loss

UNIT – IV:

Ratio and Proportion – Partnership – Allegation or Mixture

UNIT – V:

Average – Problems on Age

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Theory of sets and puzzles

REFERENCES:

1. Scope and treatment as in "Quantitative Aptitude" by R.S. Aggarwal, S. Chand & Company Ltd., Ram Nagar, New Delhi (2007)
   UNIT – I : (Chapters 1, 2 & 7)
   UNIT – II : (Chapter 3 & 4)
   UNIT – III : (Chapters 9, 10 & 11)
   UNIT – IV : (Chapters 12, 13 & 20)
   UNIT – V : (Chapters 6 & 8)

COURSE OUTCOMES:

- Remembering the numbers.
- Define surds and indices. Recalling the various areas that is problems on ages, percentage, profit and loss and ratio and proportion.
- Solve the problems on ratio and proportion, partnership and average.

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Second Year **CORE COURSE VII** **Semester IV**

VECTOR CALCULUS AND LAPLACE TRANSFORMS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- Understand the fundamental concepts of vector differentiation.
- Compute line, Surface & volume integral by using Green's, Stokes & Gauss Divergence theorem.
- Apply Laplace Transform to solve differential equations

UNIT – I:

Vector differentiation –velocity & acceleration-Vector & scalar fields –Gradient of a vector- Directional derivative – divergence & curl of a vector solinoidal & irrotational vectors – Laplacian double operator –simple problems.

UNIT – II:

Vector integration –Tangential line integral –Conservative force field –scalar potential-Work done by a force - Normal surface integral- Volume integral – simple problems.

UNIT – III:

Gauss Divergence Theorem – Stoke's Theorem- Green's Theorem – Simple problems and Verification of the theorems for simple problems.

UNIT –IV:

Laplace Transforms – Standard formulae – Laplace transform of Periodic functions – Some general theorems & simple applications.

UNIT – V:

Inverse Laplace Transforms – Use of Laplace Transforms in solving ODE with constant coefficients.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Z Transforms

REFERENCES:

1. M.L. Khanna, Vector Calculus, Jai Prakash Nath and Co., 8th Edition, 1986.
2. S. Narayanan, T.K. Manicavachagam Pillai, Calculus, Vol. III, S. Viswanathan Pvt. Limited, and Vijay Nicole Imprints Pvt. Ltd, 2004.
   UNIT – I : Chapter 1 Section 1 & Chapter 2 Sections 2.3 to 2.6 , 3 , 4 , 5 , 7 of [1]
   UNIT – II : Chapter 3 Sections 1 , 2 , 4 of [1]

UNIT – III : Chapter 3 Sections 5 & 6 of [2]
UNIT – IV : Chapter 5 Section 1,2,3,4,5 of [2]
UNIT – V : Chapter 5 Section 6,7,8 of [2]

3. P. Duraipandiyan and Lakshmi Duraipandian, Vector Analysis, Emarald Publishers (1986).
4. Dr. S. Arumugam and Prof. A. Thangapandi Issac, Fourier series, New Gamma Publishing House (Nov 12).

COURSE OUTCOMES: After completing this course, the students will be able to

- Learn the basic knowledge of vector differentiation and vector integration
- Solve vector differentiation and integration problems.
- Introduce the basic concepts of Laplace Transforms.
- Solve a differential equation by using Laplace Transforms

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Second Year **CORE COURSE VIII** **Semester IV**

ABSTRACT ALGEBRA

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To introduce the basic concepts of modern algebra.
- To introduce the concepts of group theory and rings.

UNIT – I:

Groups: Definition and Examples – Elementary Properties of a Group – Equivalent Definitions of a Group.-Permutation Groups.

UNIT – II:

Subgroups – Cyclic Groups – Order of an Element – Cosets and Lagrange's Theorem.

UNIT – III:

Normal Subgroups and Quotient Groups - Isomorphism –Homomorphism.

UNIT – IV:

Rings: Definitions and Examples - Elementary properties of rings –Isomorphism - Types of rings.-Characteristic of a ring – subrings – Ideals - Quotient rings.

UNIT – V:

Maximal and Prime Ideals - Homomorphism of rings – Field of quotient of an integral domain – unique factorization domain – Euclidean domain.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Polynomial rings

REFERENCES:

1. S Arumugam and A. Thangapandi Isaac, Modern Algebra, SciTech Publications, Chennai, 2003.
   UNIT – I : Chapter 3 Sections 3.1-3.4
   UNIT – II : Chapter 3 Sections 3.5-3.8
   UNIT – III : Chapter 3 Sections 3.9-3.11
   UNIT – IV : Chapter 4 Sections 4.1-4.8
   UNIT – V : Chapter 4 Sections 4.9- 4.11, 4.13-14
2. N. Herstein, Topics in Algebra, John Wiley & Sons, Student 2nd edition, 1975.
3. Vijay, K. Khanna and S.K. Bhambri, A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd.

COURSE OUTCOMES: After completing this course, the students will be able to

- Demonstrate the abstract structures of algebra
- Prove standard theorems of groups and rings
- Check irreducibility of polynomial and verify whether a function is an isomorphism or not
- Determine cosets, automorphism, kernel, maximal and prime ideals
- Develop examples of groups and rings with specific criterions.
- Students will be able to determine whether a given group is abelian by checking the properties.
- Prove that a given subset of a group is a subgroup by applying the properties.
- Describe all elements in a cyclic subgroup by using generators.

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Second Year **NON MAJOR ELECTIVE II** **Semester IV**

QUANTITATIVE APTITUDE II

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn the problems solving techniques for aptitude problems
- To enable to students prepare themselves for various competitive examinations

UNIT – I:

Chain Rule – Time and Work – Pipes and Cisterns

UNIT – II:

Time and Distance –Problems on Trains – Boats and Streams

UNIT – III:

Simple Interest – Compound Interest - Stocks and Shares.

UNIT – IV:

Clocks – Area – Volume and Surface Area.

UNIT – V:

Permutations and Combinations

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Mathematical riddles

REFERENCES:

1. Scope and treatment as in "Quantitative Aptitude" by R.S. Aggarwal, S. Chand & Company Ltd., Ram Nagar, New Delhi - 2015
   UNIT – I : Chapters 14, 15 & 16
   UNIT – II : Chapters 21, 22 & 29
   UNIT – III : Chapters 17, 18 & 19
   UNIT – IV : Chapters 24, 25 & 28
   UNIT – V : Chapters 30 & 31

COURSE OUTCOMES: After completing this course, the students will be able to

- Solve the problems on time and distance, work and wages, pipes and cisterns.
- Recalling simple interest, compound interest and logarithm.
- Improve the problem solving skill on areas, volumes and data interpretation

*****

Third Year **CORE COURSE IX** **Semester V**

NUMERICAL METHODS AND MATLAB

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To introduce the exciting world of programming to the students through MATLAB.
- To introduce the techniques of Numerical methods.
- To solve numerical problems using MATLAB programming

UNIT – I:

MATLAB Environment: Getting Started – Solving Problems in MATLAB – Saving your works – Predefined MATLAB Functions – Using Predefined Functions – Manipulating Matrices – Computational Limitations-Special Values and Functions.

UNIT – II:

Plotting: Introduction to Two Dimensional Plotting – Three Dimensional Plotting – Editing Plots from the Menu Bar – Creating Plots from the Workshop Window. Programming in MATLAB: Introduction – Problems with Two Variables – Input/Functions – Statement level Control Structures.

UNIT – III:

Numerical Techniques: Introduction – Curve Fitting: Linear and Polynomial Regression – Using the Interactive Fitting Tools – Numerical Integration – Numerical Differentiation.

UNIT – IV:

Curve Fitting – Fitting Linear and parabolic curves by the method of least squares principles Solving algebraic and transcendental equations-Bisection method, false position method and Newton Raphson method – Solving simultaneous algebraic equations – Guass-seidal method – Guass elimination method.

UNIT – V:

Interpolation – Newton's forward and backward difference formulae – Lagrange's interpolation formula – Numerical integrations using Trapezoidal and Simpson's one – third rules – solution of ODE's – Euler method and Runge-Kutta fourth order method.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Error analysis of Numerical Methods

REFERENCES:

1. Delores M. Etter, David C. Kuncicky, Holly Moore. Introduction to MATLAB, Published by Dorling Kindersley (India) Pvt. Ltd., licenses of Pearson Education in South Asia.
2. M.K. Venkatraman, Numerical methods in Science and Engineering, National Publisher Company, Fifth Edition, 2001 (For Units IV and V).
   UNIT – I : Chapter 2&3 of [1]
   UNIT – II : Chapter 4&5 of [1]
   UNIT – III : Chapter 8 of [1]
   UNIT – IV : Chapter 1, Sections 1.7-1.8, Chapter 3, Sections 2, 4 and 5, Chapter 4, Sections 2, 6 of [2]
   UNIT – V : Chapter 6, Sections 3 & 4, Chapter 8 Section 4, Chapter 9 Sections 8 & 10, Chapter 11 Sections 10 & 16 of [2].
3. Yashavant. P. Kanetkar, Let us 'C', BPB Publications, 2002.
4. Rajaraman, Computer oriented numerical methods, Prentice-Hall of India, 1971.

COURSE OUTCOMES: After completing this course, the students will be able to

- Understanding the exciting world of programming through MATLAB.
- Know the techniques of Numerical Methods.
- Apply the MATLAB programming to solve numerical problems.

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Third Year	**CORE COURSE X REAL ANALYSIS**	**Semester V**
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

- To understand the axioms of the real numbers, supremum, infimum, upper limits.
- To know open and closed sets in $\mathbb{R}$, continuity and differentiability of functions, L'Hôpital's Rule, Taylor's and the Mean Value Theorems and metric spaces.
- To develop in a rigorous and self-contained manner the elements of real variable functions.
- To enable students to learn functions of bounded variation, grasp basic concepts about the connectedness, compact metric spaces.

UNIT – I:

Introduction – Sets and functions – Countable and Uncountable sets – Inequalities of Holder and Minkowski – Metric spaces – Definition and Examples – Bounded sets in a metric space – Open Ball in a Metric space – Open sets.

UNIT – II:

Subspace – Interior of a set – Closed sets – Closure – Limit point – Dense sets – Completeness – Baire's Category theorem.

UNIT – III:

Continuity – Homeomorphism – Uniform Continuity.

UNIT – IV:

Connectedness – Definition and examples – Connected subsets of R – Connectedness & Continuity.

UNIT – V:

Compact Metric spaces – Compact subsets of R – Equivalent Characterization for Compactness – Compactness and Continuity.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Introduction to Basic topology

REFERENCES:

1. Dr. S. Arumugam & Mr. A. Thangapandi Issac, Modern Analysis, New Gamma Publishing House, Palayamkottai, Fourth reprint 2021.
   UNIT – I : Chapter 1 Sections 1.1 to 1.4, Chapter 2 Sections 2.1 to 2.5
   UNIT – II : Chapter 2 Sections 2.6 to 2.11 & Chapter 3

UNIT – III : Chapter 4 Sections 4.1 to 4.4
UNIT – IV : Chapter 5
UNIT – V : Chapter 6

2. Ajit Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

COURSE OUTCOMES: After completing this course, the students will be able to

- Explain the concepts such as real valued functions, continuity, connectedness, compactness, etc.
- Prove standard theorems in real analysis
- Distinguish between upper bound and lower bound; continuity and uniform continuity of a function; limit point and interior point; and bounded and totally bounded.
- Characterize structures of connected sets, nowhere dense sets, continuity of a function, compact sets and category of sets.
- Generate sets and functions of required nature.

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Third Year	**CORE COURSE XI STATICS**	**Semester V**
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

- To provide the basic knowledge of equilibrium of a particle.
- To develop a working knowledge to handle practical problems.

UNIT – I:

Introduction – Forces acting at a point: Triangle of forces – Resolving of a force – Condition of equilibrium.

UNIT – II:

Parallel forces and Moments: Resultant of parallel forces – Theorems on Moments – Moment about an axis – couples.

UNIT – III:

Equilibrium of three forces acting on a rigid body: Conditions of equilibrium – Trigonometrical theorems and problems - Coplanar forces: Reduction of Coplanar forces – Equation of Line of action of the resultant **–** Conditions of equilibrium.

UNIT – IV:

Friction: Introduction – Laws of Friction – Definitions – Equilibrium of a particle on a rough inclined plane.

UNIT – V:

Equilibrium of strings: Equation of the Common Catenary -Parabolic Catenary.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Introduction to Virtual work

REFERENCES:

1. M.K. Venkataraman, Statics, Agasthiyar Publications, 17th edition, 2014.
   UNIT – I : Chapter1, Chapter2.
   UNIT – II : Chapter 3, Chapter 4.
   UNIT – III : Chapter 5 (Section 1-6), Chapter 6 (Section 1-12).
   UNIT – IV : Chapter 7 (Section 1-13) Pages: 206 – 238.
   UNIT – V : Chapter 9 (Section 1- 8)
2. A.V. Dharmapadham, Statics, S. Viswanathan Publishers Pvt.Ltd, 2006.
3. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, Mechanics S. Chand& Company PVT, LTD, 2014.
4. S.L. Lony, Elements of Statics and Dynamics, Part-I, A.I.T.B.S. Publishers, 2007.

COURSE OUTCOMES: After completing this course, the students will be able to

- The course deals the study of internal and external forces in a structure.
- Provide the basic knowledge of Equilibrium of a particle.
- Develop a working knowledge to handle practical problems.

*****

Third Year	**CORE PRACTICAL I**	**Semester V**
	MATLAB PROGRAMMING LAB	
Code:	**(Practical)**	**Credit: 4**

COURSE OBJECTIVES:

- To solve numerical problems using MATLAB programming.

LIST OF PRACTICALS

1. Linear Interpolation
2. Linear Regression
3. Curve Fitting
4. Trapezoidal rule of Integration
5. Simpson's 1/3 rule of Integration
6. Newton – Raphson method of solving equations
7. Gauss Elimination method of solving simultaneous equations
8. Gauss – Seidal method of solving simultaneous equations
9. R-K fourth order method of solving differential equations
10. Lagrange's method of interpolation

COURSE OUTCOMES: After completing this course, the students will be able to

- Experience the programming skills through numerical methods.
- Know basic commands in MATLAB programming.
- Solve numerical problems using MATLAB programming.

*****

Third Year **MAJOR BASED ELECTIVE I** **Semester V**

1. OPERATIONS RESEARCH

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
- This module aims to introduce students to use quantitative methods and techniques for effective decision–making; model formulation and applications that are used in solving business decision problems.
- To know Linear Programming (LP) and allocation of resources, LP definition, Linearity requirement
- To know and solve Maximization and Minimization problems.
- To know Graphical LP Minimization solution, Introduction, Simplex method definition, formulating the Simplex model.
- To learn Linear Programming – Simplex Method for Maximizing.

UNIT – I:

Linear programming problem - Mathematical formulation – Illustrations on Mathematical formulation on Linear Programming Problems – Graphical solution method - some exceptional cases - Canonical and standard forms of Linear Programming Problem - Simplex method.

UNIT – II:

Use of Artificial Variables (Big M method - Two phase method) – Duality in Linear Programming - General primal-dual pair - Formulating a Dual problem - Primal-dual pair in matrix form -Dual simplex method.

UNIT – III:

Transportation problem - LP formulation of the TP - Solution of a TP - Finding an initial basic feasible solution (NWCM - LCM -VAM) – Degeneracy in TP - Transportation Algorithm (MODI Method) - Assignment problem - Solution methods of assignment problem – special cases in assignment problem.

UNIT – IV:

Queuing theory - Queuing system - Classification of Queuing models - Poisson Queuing systems Model I $(M/M/1)(\infty/FIFO)$ only - Games and Strategies – Two person zero sum - Some basic terms - the maximin-minimax principle -Games without saddle points-Mixed strategies - graphic solution $2 \times n$ and $m \times 2$ games.

UNIT – V:

PERT and CPM – Basic components – logical sequencing - Rules of network construction- Critical path analysis - Probability considerations in PERT.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Applications of OR in Financial Management, Budgeting and Investments

REFERENCES:

1. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, 13th edition, Sultan Chand and Sons, 2007.
   UNIT – I: Chapter 2 Sections 2.1 to 2.4, Chapter 3 Sections 3.1 to 3.5, Chapter 4 Sections 4.1 , 4.3
   UNIT – II: Chapter 4 Section 4.4, Chapter 5 Sections 5.1 to 5.4, 5.9
   UNIT – III: Chapter 10 Sections 10.1, 10.2, 10.8, 10.9, 10.12 & 10.13, Chapter 11 Sections 11.1 to 11.4
   UNIT – IV: Chapter 21 Sections 21.1, 21.2, 21.7 to 21.9, Chapter 17 Sec 17.1 to 17.6
   UNIT – V: Chapter 25 Sections 25.1 to 25.4, 25.6, 25.7
2. Sundaresan. V, Ganapathy Subramanian. K.S. and Ganesan. K, Resource Management Techniques, A.R. Publications, 2002.
3. Taha H.A., Operations Research: An introduction, 7th edition, Pearson Prentice Hall, 2002.

COURSE OUTCOMES: After completing this course, the students will be able to

- Demonstrate the basic concepts of LPP, game theory, queuing models and networks
- Make use of different methods to get optimality in LPP, TP, AP and games
- Check the existence of alternate / infeasible / unbounded solutions
- Evaluate the solution of primal using duality, optimal solution by characteristics of queuing system
- Convert possible real life problems into OR model.

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Third Year **MAJOR BASED ELECTIVE I** **Semester V**

2. STOCHASTIC PROCESSES

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To know probability and distribution function
- To understand the concept of Stochastic Processes
- To identify Markov chains, Poisson Process and birth and death Process
- To know the concept of queuing theory with some examples

UNIT – I:

Generating function - Laplace transforms – Laplace transforms of a probability distribution function - Difference equations – Differential difference equations – Matrix analysis.

UNIT – II:

Stochastic Process - Notion – Specification – Stationary Process - Markov Chains – Definition and examples – Higher transition probabilities.

UNIT – III:

Classification of states and chains – Determination of higher transition probabilities – Stability of Markov system – Limiting behaviour.

UNIT – IV:

Poisson Process and related distributions – Generalization of Poisson Process – Birth and death process.

UNIT – V:

Stochastic Process in queuing and reliability – queuing systems – M/M/1 models – Birth and death process in queuing theory – Multi channel models – Bulk Queues.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Branching Processes

REFERENCES:

1. J. Medhi, Stochastic Processes, Chapters 1,2,3 (Omitting 3.6,3.7,3.8), Chapter 4 (Omitting 4.5 and 4.6) and Chapter 10 (Omitting 10.6,10.7).
   UNIT – I : Chapter 1 – Sec 1.1, 1.2, 1.3, Appendix A 1, 2, 3, 4.
   UNIT – II: Chapter 2 – Sec 2.1, 2.2, 2.3 & Chapter 3 – Sec 3.1, 3.2.
   UNIT – III: Chapter 3 – Sec 3.4, 3.5, 3.6.
   UNIT – IV: Chapter 4 – Sec 4.1, 4.2, 4.3, 4.4
   UNIT – V: Chapter 10 – Sec 10.1, 10.2, 10.3, 10.4, 10.5

2. First Course in Stochastic Processes by Samuel Karlin.
3. Stochastic Processes by Srinivasan and Metha (TATA McGraw Hill).
4. Elements of Applied Stochastic Processes by V. Narayan.

COURSE OUTCOMES: After completing this course, the students will be able to

- State the defining properties of various stochastic process models.
- Identify appropriate stochastic process model(s) for a given research or applied problem.
- Provide logical and coherent proofs of important theoretic results.
- Apply the theory to model real phenomena and answer some questions in applied sciences.

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Third Year **SKILL BASED ELECTIVE I** **Semester V**

INTRODUCTION TO LATEX

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To make the students learn the art of typing mathematics text on their own.
- To inculcate professional training required to become a scholar in mathematics.

UNIT – I:

Basic Structure of Latex 2e - Input file structure - Layout -Editors - Forward Search - Inverse Search - Compiling - Conversion to various formats.

UNIT – II:

Typesetting simple documents - sectioning - Titles- page layout - listing –enumerating - quote - letter formats.

UNIT – III:

Using package amsmath typing equations labeling and referring.

UNIT – IV:

Figure inclusion - Table inclusion.

UNIT – V:

Bibliography - Index typing - Beamer presentation Styles.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Type a mathematical article using various journal style files

REFERENCES:

1. Leslie Lamport. LATEX: A Document Preparation System, Addison-Wesley, Reading, Massachusetts, second edition, 1994.
2. Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl., The (Not So) Short Introduction to LATEX2e, Samurai Media Limited (or available online at http://mirrors.ctan.org/info/lshort/english/lshort.pdf)
3. LATEX Tutorials - A Primer, Indian TeX Users Group, available online at https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
4. H. J. Greenberg. A Simplified introduction to LATEX, available online at https://www.ctan.org/tex-archive/info/simplified-

latex/
5. Using Kile - KDE Documentation, https://docs.kde.org/trunk4/en/extragear_office/kile/quick-using.html
6. Amsmath and geometry package available in Ctan.org.

COURSE OUTCOMES: At the end of the course, students will be able to

1. Type their own mathematical article/notes/book/journal paper/project work.
2. Meticulously prepare their own mathematical notes.
3. Understand basic structure of Latex 2e and conversions of them to various formats.
4. Typeset and compile documents with titles, sectioning and enumeration etc.
5. Use various style files and in particular amsmath, amsfonts, amsthm.
6. Understand how to align math equations, matrices etc.
7. Include the figures in various formats into their latex document and compile it successfully.
8. Utilize bibtex feature of including bibliographies and indexes.

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Third Year	**CORE COURSE XII LINEAR ALGEBRA**	**Semester VI**
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

To inculcate vector space, linear independence, linear transformations, matrix operations, determinants, Eigen values and Eigen vectors, and applications.

UNIT – I:

Vector spaces: Vector spaces – Definition and examples – Subspaces-linear transformation – Span of a set.

UNIT – II:

Basis and Dimension: Linear Independence – Basis and Dimension –Rank and Nullity.

UNIT – III:

Matrix and Inner product space: Matrix of a linear transformation -Inner product space – Definition and examples – Orthogonality– Gram Schmidt orthogonalisation process – Orthogonal Complement.

UNIT – IV:

Theory of Matrices: Algebra of Matrices - Types of Matrices – The Inverse of a Matrix –Elementary Transformations – Rank of a matrix.

UNIT – V:

Characteristic equation: Characteristic equation and Cayley -Hamilton theorem – Eigen values and Eigen vectors.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

The algebra of polynomials

REFERENCES:

1. Arumugam S and Thangapandi Isaac A, Modern Algebra, SciTech Publications (India) Ltd., Chennai, Edition 2012.
   UNIT – I : Chapter 5, Sec 5.1 to 5.4
   UNIT – II : Chapter 5, Sec 5.5 to 5.7
   UNIT – III : Chapter 5,Sec 5.8, Chapter 6, Sec 6.1 to 6.3
   UNIT – IV : Chapter 7 Sec 7.1 to 7.5
   UNIT – V : Chapter 7, Sec 7.7, 7.8
2. I.N. Herstein, Topics in Algebra, Second Edition, John Wiley & Sons(Asia), 1975

COURSE OUTCOMES: After completing this course, the students will be able to

- Define basic concepts of vector spaces, linear transformations, inner product spaces.
- Prove standard theorems in Linear Algebra
- Distinguish linear independence and dependence; singular and nonsingular linear transformations; quadratic and diagonal forms.
- Determine basis and dimension of vector space, orthogonal basis, eigen values, eigen vector and posets.
- Construct orthonormal basis from a given basis; to reduce a quadratic form to diagonal form.

*****

Third Year	CORE COURSE XIII COMPLEX ANALYSIS	Semester VI
Code:	(Theory)	Credit: 5

COURSE OBJECTIVES:

- To introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions.
- Understand the concepts of complex integration and series expansions such as Cauchy's integral formula and its derivative, Taylor's series, Laurent's series and singularities.
- To acquire the knowledge and develop manipulation skills in the use of Rouche's theorem.
- Understand and learn to use Argument Principle and the principal of Analytic Continuation and the concerned results.

UNIT – I:

Functions of a Complex variable –Limits-Theorems on Limits –Continuous functions – Differentiability – Cauchy-Riemann equations – Analytic functions – Harmonic functions.

UNIT – II:

Elementary transformations - Bilinear transformations – Cross ratio – fixed points of Bilinear Transformation – Some special bilinear transformations.

UNIT – III:

Complex integration - definite integral – Cauchy's Theorem –Cauchy's integral formula –Higher derivatives.

UNIT – IV:

Series expansions – Taylor's series – Laurant's Series – Zeroes of an analytic functions – Singularities.

UNIT – V:

Residues – Cauchy's Residue Theorem –Evaluation of definite integrals.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Harmonic Functions

REFERENCES:

1. S. Arumugam, A. Thangapandi Isaac, & A. Somasundaram, Complex Analysis, New Scitech Publications (India) Pvt. Ltd, 2002.

UNIT – I : Chapter 2 section 2.1 to 2.8
UNIT – II : Chapter 3 Sections 3.1 to 3.5
UNIT – III : Chapter 6 sections 6.1 to 6.4
UNIT –IV : Chapter 7 Sections 7.1 to 7.4
UNIT – V : Chapter 8 Sections 8.1 to 8.3

2. J.N. Sharma, Functions of a Complex variable, Krishna Prakasan Media(P) Ltd, 13th Edition, 1996-97.
3. T.K. Manickavachaagam Pillai, Complex Analysis, S. Viswanathan Publishers Pvt. Ltd, 1994.

COURSE OUTCOMES: After completing this course, the students will be able to

- Becoming familiar with the concepts Complex numbers and their properties and operations with Complex number.
- Finding domain and range of complex functions and sketching their graphs.
- Evaluating limits and checking the continuity of complex function.
- Checking differentiability and Analyticity of functions.
- Evaluate Complex integrals and applying Cauchy integral.

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Third Year	CORE COURSE XIV DYNAMICS	Semester VI
Code:	(Theory)	Credit: 4

COURSE OBJECTIVES:

- Understand the fundamental concepts of velocity and acceleration.
- Understand the work done in stretching an elastic string Simple Harmonic motion.
- Study the motion of projectiles, impact of sphere and central orbits.

UNIT – I:

Introduction-Kinematics: Velocity-Relative Velocity-Angular Velocity-Acceleration-Relative Acceleration-Motion in a straight line under uniform acceleration.

UNIT – II:

Projectile: Projectile-Path of a projectile-Characteristics-Horizontal projection-Projectile up/down in an inclined plane.

UNIT – III:

Collision of Elastic Bodies: Introduction-Definitions-Fundamental Laws of impact-Impact of a smooth sphere on a fixed smooth plane-Direct impact of two smooth spheres-Oblique impact of two smooth spheres-Dissipation of energy due to impact-Compression and Restitution-Impact of a particle on a rough plane.

UNIT – IV:

Simple Harmonic Motion: Introduction-S.H.M. in straight line-Compositions of simple harmonic motions of the same period.

UNIT – V:

Motion Under The action Of Central Forces: Velocity and acceleration in polar coordinates-Equiangular spiral-Differential Equation of central orbits-Pedal Equation of the central orbit-Two-fold problems in central orbits.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Impulsive forces

REFERENCES:

1. Dr. M.K. Venkataraman, Dynamics, Agasthiyar Publications, Thirteenth Edition, July 2009.
   UNIT – I : Chapter 2, Chapter 3, Section 3.1-3.22
   UNIT – II : Chapter 6, Sections 6.1-6.16
   UNIT – III : Chapter 8, Sections 8.1-8.11
   UNIT – IV : Chapter 10, Sections 10.1-10.13
   UNIT – V : Chapter 11, Sections 11.1-11.11
2. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, Mechanics S. Chand & Company Pvt. Ltd., 2014.
3. A.V. Dharmapadham, Dynamics, S. Viswanathan Publishers Pvt. Ltd. 2006.

COURSE OUTCOMES: After completing this course, the students will be able to

- Acquire knowledge about the basic concepts of kinematics.
- Analyze the motion of Projectiles and their results.
- Critique the concepts of Central Orbits, differential equation of a central orbit.

Third Year	**MAJOR BASED ELECTIVE II**	**Semester VI**
	1. GRAPH THEORY	
Code:	**(Theory)**	**Credit: 4**

COURSE OBJECTIVES:

- To introduce the notion of graph theory and its applications.
- To introduce some of the most important notions of Graph Theory and develop their skills and solving basic exercises.

UNIT – I:

Introduction - The Konigsberg Bridge Problem - Graphs and subgraphs: Definition and Examples - Degrees - Subgraphs - Isomorphism – independent sets and coverings.

UNIT – II:

Matrices - Operations on Graphs - Walks, Trails and Paths –Connectedness and Components - Eulerian Graphs.

UNIT – III:

Hamiltonian Graphs (Omit Chavatal Theorem) - Characterization of Trees - Centre of a Tree.

UNIT – IV:

Planarity: Introduction - Definition and Properties - Characterization of Planar Graphs.

UNIT – V:

Directed Graphs: Introduction - Definitions and Basic Properties – Some Applications: Connector Problem - Kruskal's algorithm - Shortest PathProblem – Dijkstra's algorithm.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Independent Sets and Matchings

REFERENCES:

1. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, SciTech Publications (India) Pvt. Ltd., Chennai, 2006.
   UNIT – I : Chapter-1 Sec 1.0, 1.1 and Chapter -2 Sec 2.0, 2.1, 2.2, 2.3, 2.4.2.6
   UNIT – II: Chapter-2 Sec 2.8,2.9 ,Chapter-4 Sec 4.1,4.2 and Chapter-5 Sec 5.0,5.1
   UNIT – III: Chapter-5 Sec 5.2, Chapter-6 Sec 6.0,6.1,6.2.
   UNIT – IV: Chapter-8 Sec 8.0,8.1,8.2.
   UNIT – V: Chapter-10 Sec 10.0, 10.1 Chapter-11 Sec 11.0,11.1,11.2

2. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice Hall of India, 2004.
3. Gary Chartrand and Ping Zhang, Introduction to Graph Theory, Tata Mc Graw-Hill Edition, 2004.

COURSE OUTCOMES: After completing this course, the students will be able to

- To understand and apply the fundamental concepts in graph theory.
- To apply graph theory based tools in solving practical problems
- To understand the trees
- The students will be able to know the planarity.
- To explain the Kruskal's algorithm and Dijkstra's algorithm.

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Third Year **MAJOR BASED ELECTIVE II** **Semester VI**

2. INTRODUCTION TO PYTHON PROGRAMMING

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

1. To learn the basics of scientific computing through Python Programming.
2. To inculcate professional training in algorithmic approach of Problem Solving.

UNIT – I:

Review of Linux commands; File management and permissions; Using VI editor; Introducing a programming language, syntax, basic tools, simple programmes, etc.

UNIT – II:

Basic Tools; First Program file; Handling complex numbers; Functions and loops; Standard math functions; Conditionals; Python keywords and function names; Defining Names.

UNIT – III:

Lists in Python; Defining and accessing lists; Loops with lists; Range function; for loop with lists for sorting; Built-in sort functions; else class in loops; slicing lists; lists as stacks; using lists as queues; new lists from old.

UNIT – IV:

Data types; Numeric Types; Tuples; Accepting tuple inputs; sorting iterables; the lambda function; Sets; Dictionaries; Input and output; Output formatting; Format specifiers; align, sign, width, precision, type; File operations; Functions from Numpy and Scipy libraries.

UNIT – V:

Math problems for practice which includes the following: (a) Finding GCD of two or more integers; (b) Primality checking; Finding primes upto a given integer; (c) Plotting curves; (d) Area of a triangle; (e) Angle between vectors; (f) Convert a number in decimal to a given base n. (g) Transpose of a matrix; Product of two matrices; (h) Finding the mean; median; mode; standard deviation etc., of a given data;

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Inheritance and Encapsulation

REFERENCES:

1. Real Python, A Practical introduction to Python, https://static.realpython.com/python-basics-sample-chapters.pdf
2. Qingkai Kon et all, Python Programming and Numerical Methods - A Guide for Engineers and Scientists, https://pythonnumericalmethods.berkeley.edu/notebooks/Index.html

COURSE OUTCOMES: After completing this course, the students will be able to

- Comprehend Python Programming and basic commands.
- Use basic tools, functions and loops.
- Get expertise in Standard math functions.

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Third Year **MAJOR BASED ELECTIVE III** **Semester VI**

1. ASTRONOMY

Code: **(Theory)** **Credit: 3**

COURSE OBJECTIVES:

- To introduce the exciting world of astronomy to the students.
- To help the students to study spherical trigonometry in the field of astronomy.
- To understand the movements of the celestial objects.

UNIT – I:

Relevant properties of sphere and formulae in spherical trigonometry (no proof, no problems) - Celestial sphere and diurnal motion -Celestial coordinates-sidereal time.

UNIT – II:

Morning and evening stars -circumpolar stars- diagram of the celestial sphere -zones of earth -perpetual day-dip of horizon-twilight.

UNIT – III:

Refraction - laws of refraction -tangent formula-Cassini's formula - horizontal refraction-geocentric parallax -horizontal parallax.

UNIT – IV:

Kepler's laws - verification of 1st and 2nd laws in the case of earth - Anomalies -Kepler's equation - Seasons -causes -kinds of years.

UNIT – V:

Moon-sidereal and synodic months - elongation - phase of moon - eclipses-umbra and penumbra - lunar and solar eclipses - ecliptic limits - maximum and minimum number of eclipses near a node and in a year - Saros.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Introduction to Astrophysics

REFERENCES:

1. Kumaravel, S. and Susheela Kumaravel, *Astronomy*, 8th Edition, SKV Publications, 2004.
   UNIT – I : Sections 39-79
   UNIT – II : Sections 80-90,106-116
   UNIT – III : Sections 117-144
   UNIT – IV : Sections 146-162,173-178
   UNIT – V : Sections 229-241,256-275
2. G V Ramachandran, Text Book of Astronomy, Mission Press, Palayamkottai, 1965.

COURSE OUTCOMES: After completing this course, the students will be able to

- The Learner will acquire basic knowledge about morning, evening stars, circumpolar stars.
- Solve the problems with scientific reasoning and critical thinking skills.
- Calculation to prepare calendar and conservation of time.

Third Year **MAJOR BASED ELECTIVE III** **Semester VI**

2. NUMBER THEORY

Code: **(Theory)** **Credit: 3**

COURSE OBJECTIVES:

- To highlight the niceties and nuances in the world of numbers.
- To prepare the students for coding through congruences.

UNIT – I:

Euclid's Division Lemma – Divisibility – The Linear Diophantine Equation – The Fundamental Theorem of Arithmetic.

UNIT – II:

Permutations and Combinations – Fermat's Little Theorem – Wilson's Theorem – Generating Functions.

UNIT – III:

Basic Properties of Congruences Residue Systems. Linear Congruences – The Theorems of Fermat and Wilson Revisited.

UNIT – IV:

The Chinese Remainder Theorem – Polynomial Congruences – Combinational Study of F(n).

UNIT – V:

Formulae for d(n) and s(n) – Multiplicative Arithmetic Function – The Mobius Inversion Formula.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Prime number theorem and its applications.

REFERENCES:

1. Number Theory by George E. Andrews, Hindustan Publishing Corporation – 1984, Edition.
   UNIT – I : Chapter - 2 Sec. 2.1 – 2.4 pages 12-29
   UNIT – II: Chapter – 3 Sec. 3.1, 3.4 pages 30-44
   UNIT – III: Chapter – 4Sec. 4.1 – 4.2 Pages 49 – 55, Sec. 5.1- 5.2 Pages 58-65
   UNIT – IV: Chapter – 4 Sec. 5.3 – 5.4 pages 66-74, Sec. 6.1 Pages 75-81
   UNIT – V: Chapter – 5 Sec. 6.2 – 6.3 Pages 82-92
2. Basic Number Theory by S.B. Malik, Vikas Publishing House Pvt. Ltd.,
3. A First Course Theory of Numbers by K.C. Chowdhury. Asian Books Pvt. Ltd., I Edition (2004)

COURSE OUTCOMES: After completing this course, the students will be able to

- Understand the concepts of divisibility and fundamental theorem of arithmetic.
- The students will know about the Fermat's theorem and Wilson theorem.
- Understand the congruences.
- Solve using Chinese remainder theorem.
- Understand the Mobius inversion formula.

Third Year **PROJECT** **Semester-VI**

Code: **Credit: 3**

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External)

   I. Plan of the Project - 20 marks

   II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. - 45 marks

   III. Individual initiative - 15 marks

2. Viva-Voce / Internal & External - 20 marks

TOTAL **- 100 marks**

PASSING MINIMUM:

	Vivo-Voce 20 Marks	**Dissertation 80 Marks**
Project	40% out of 20 Marks (i.e. 8 Marks)	40% out of 80 marks (i.e. 32 marks)

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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Third Year **SKILL BASED ELECTIVE II** **Semester VI**

MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To gain quantitative aptitude required in the present scenario.
- To emphasize the right perceptive needed to crack such problems and understand the recurring pattern in those problems.

UNIT – I:

Problems on Numbers- Average-Problems on Ages.

UNIT – II:

Percentage-Profit & Loss-Simple Interest-Compound Interest.

UNIT – III:

Ratio & Proportion-Partnership-Calender-Clocks.

UNIT – IV:

Time and work-Pipes & Cistern.

UNIT – V:

Time & Distance-Problems on Trains-Boats and Streams.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Simple problems using sets, functions, group theory etc.

REFERENCES:

1. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Pearson Education, 3 edition, 2015.

Course Outcomes: At the end of the course, students will be able to

- Face competitive examinations with confidence.
- Solve a lot of problems on numbers and averages and problems on ages.
- Get a lot of training on percentage, profit and loss.
- Crack problems on calculating simple interest and compound Interest.
- Work on a plenty of problems on time and work.
- Get working knowledge on ratios and proportions.
- Calculate time, distance, speed given the other two and solve lot of problems.
- Acquire problem solving ideas on trains, boats and streams.

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