Department of Mathematics
Oriental College (Autonomous), Takyel, Imphal

TEACHING PLAN FOR THE ACADEMIC YEAR 2020 – 2021 (ODD SEM)

B.A. / B.Sc. Mathematics (Honours)

Program Outcomes (POs)

PO No.	After completion of the B.A. /B.Sc. Mathematics (Honours) 3 Year UG Programme under the Choice Based Credits System (CBCS), the graduates will be able to understand
PO - 1	Numerical, analytical and logical skills.
PO - 1	Better problem solving skills.
PO - 1	Real world applications.
PO - 1	Understand the world better.
PO - 1	Understand hypothesis, theories and proofs.

SEMESTER I

CORE COURSE (HC) – I
Name of the Course: Algebra – I & Complex Trigonometry
Paper Code: MAT – HC – 1016

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory- 05, Tutorial-01	90	**100**

Course Objectives: The course is designed

1. to improve students' abstract and logical thinking capabilities applying mathematical ability to handle proofs, to give the applications of the

concept of binary operations and groups, basic properties of groups and subgroups, to explore different types of subgroups, cyclic groups, permutation groups, symmetric groups.

2. to give relation between roots and coefficients.
3. to give knowledge of complex functions in complex variable.

Course Learning Outcomes(CO)	On successful completion of this Course, the student should be able
CO – 1	to prove some group theoretic statements including groups, cyclic groups, permutation Groups, normal subgroups.
CO – 2	to Prove Lagrange's theorem, Fermat's & Wilson's theorem.
CO - 3	to find solutions of cubic equations by Cardan's method & biquadratic equations by Ferrari's method.
CO - 4	to understand De Moivre's theorem, Gregory's theorem & Hyperbolic functions of complex functions.

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
I	**Inequalities**					
	1.	Geometric mean and Arithmetic mean.	**1**	To understand the definition, theorems of G.M. & A. M., including Weighted means.	White Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Geometric mean and Arithmetic mean (Continued).	**1**	To solve questions on G.M. & A.M., relations between them.		
	3.	Cauchy – Schwarz inequalities.	**2**	To identify some famous inequalities, & solving	White Board/ Lecture	Unit Test/ Class Test/

				related problems of Cauchy Schwarz inequalities.	with discussion/ PPT.	Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	4.	Holder's and Minkowski's inequalities.	**2**	Deduction of Cauchy Schwarz inequalities from Holder's inequalities, methods other than the given inequalities.	White Board/ Lecture with discussion/ PPT.	
	Theory of equations					
	1.	Polynomial, Descartes rule of signs, Fundamental theorem of Algebra.	**2**	To recall the fundamentals of algebraic equations, matrices and rules of derivative, integration .	White Board/ Lecture with discussion/ PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Relation between roots and Coefficient, Symmetric functions of roots.	**2**	To understand nature of roots , Symmetric functions of roots.		
	3.	Relation between roots and Coefficient, Symmetric functions of roots (Continued).	**1**	To identify additional relations between the roots.		
	4.	Transformation of equations.	**3**	Practice the formation of equations whose roots are related to the roots of another equation in		Unit Test/ Class Test/ Assignment/

				some way		Q & A Session/ Group Discussion/ Seminar/ Quiz.
	5.	Solution of cubic equations by Cardan's method.	**2**	To solve cubic equations by Cardan's method	White Board/ Lecture with discussion/ PPT.	
	6.	Biquadratic equations by Ferrari's method and Euler's method.	**2**	To solve the biquadratic equations by Ferrari's method and Euler's method.		
II	**Matrices**					
	1.	Some types of Matrices, Elementary operations on matrices.	**1**	To understand the basic concepts in matrices.	White Board/ Lecture with discussion/ PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Inverse of a matrix.	**1**	Practice for finding inverse of a given matrix.		
	3.	Linear independence of row and column matrices.	**2**	To test the linear independence of given vectors.		
	4.	Row rank, Column rank and rank of a matrix, Equivalence of column and row ranks.	**2**	Practice for finding Row rank, Column rank and rank of a matrix, Equivalence of column and row ranks.		
	5.	Eigen values, eigenvectors and the characteristic equation of a matrix.	**2**	To evaluate Eigen values, eigenvectors and the characteristic equation of a matrix.		

	6.	Cayley Hamilton theorem and its use in finding inverse of a matrix.	**2**	To understand Cayley Hamilton theorem & to solve problems based on it.	White Board/ Lecture with discussion/ PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
III	**Abstract Algebra**					
	1.	Mappings	**1**	To learn different types of mappings.		
	2.	Equivalence relations and partitions, equivalence classes.	**2**	To understand equivalence relations and partitions, equivalence classes and solved problems based on them.	White Board/ Lecture with discussion/ PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	3.	Congruence modulo n Group and its elementary properties.	**2**	To learn congruence modulo n Group and its elementary properties.		
	4.	Examples of Abelian and Non- Abelian groups.	**1**	To evaluate problems based on Abelian and non- Abelian groups.		
	5.	Subgroups, Condition for being a subgroup.	**1**	To identify subgroups, to study conditions for being a subgroup.		

	6.	Integral powers of an element, Order of a group and order of an element of a group.	**3**	To understand Integral powers of an element, Order of a group and order of an element of a group with certain theorems on the order of an element of a group.	White Board/ Lecture with discussion/ PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	7.	Cyclic groups and generators, Alternating groups.	**2**	To understand basic concepts in Cyclic groups and generators, Alternating groups with certain theorems on cyclic groups.		
	8.	Definition and properties of normal sub-group.	**1**	To understand basic concepts in normal sub-group with evaluation of different characterization.		Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	9.	Permutation group, product of two permutations ,Even and odd permutation.	**2**	To understand different types of permutations and theorems, solve problems based on	White Board/ Lecture with discussion/	

				permutations .	PPT.	
	10.	Symmetric groups $S_1, S_2, S_3, \ldots, S_n$ is abelian for n ≤ 2 and non – abelian for n ═3.	**2**	To evaluate Symmetric groups $S_1, S_2, S_3, \ldots, S_n$ is abelian for n ≤ 2 and non – abelian for n ═3.		Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	11.	Lagrange's theorem, Fermat's theorem and Wilson's theorem.	**3**	To understand Lagrange's theorem, Fermat's theorem and Wilson's theorem,and to solve problems based on them with deductions.	White Board/ Lecture with discussion/ PPT.	
	Complex Trigonometry					
	1.	De Moivre's theorem and its applications.	**2**	To understand De Moivre's theorem & important deductions from the theorem.	White Board/ Lecture with discussion/ PPT.	
	2.	Expansion of trigonometric functions.	**3**	To expand sin nθ, cos nθ, tan nθ, sin α, cos α, tan α.		
	3.	Exponential values for circular functions, complex argument .	**3**	To learn Euler's exponential values and their properties.		
	4.	Gregory's series	**1**	To evaluate θ in powers of		

IV				tan θ	White Board/ Lecture with discussion/ PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	5.	Gregory's series(continued).	**1**	Evaluation of the value of π using Gregory's series.		
	6.	Hyperbolic functions	**2**	To understand Hyperbolic functions, Expansions and formulae.		
	7.	Summation of series including C+iS method.	**2**	To understand method of difference, to evaluate sum of sines/cosines of n angles in A.P. and deduction of certain results, to apply C+iS method for finding the sum of given finite, infinite trigonometric series.		
	8.	Infinite product	**1**	Resolution of sin , cos θ, into factors to evaluate the sums of the various powers of the reciprocals of natural numbers.		
N.B: The contact hours for tutorial classes will be 15 hrs.						

Reference Books:

1. Das and Mukherjee - *Higher Trigonometry,* U.N. Dhur & Sons Pvt. Ltd., Kolkata.
2. Chandrika Prasad - *Algebra and Theory of Equations*, Pothisala Pvt.
3. I.N. Herstein - *Topics in Algebra,* John Wiley & Sons, New Delhi.
4. J.G, Chakravorty & P.R. Ghosh : *Advance Higher Algebra,* U.N. Dhur & Sons Pvt. Ltd., Kolkata.
5. Joseph A. Gallan: *Contemporary Abstract Algebra,* Narosa.

Course Teachers:

1. Dr. L. Ibeni Devi (UNIT – IV)
2. Kh. Bikramjit Singh (UNIT – III)
3. L. Ragini Devi (UNIT – II)
4. Dr. Kh. Bulbul Singh (UNIT – I)

HOD

DR. L. Ibeni Devi

,

CORE COURSE (HC) – II
Name of the Course: Calculus
Paper Code: MAT – HC – 1026

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory-05, Tutorial-01	90	**100**

Course Objectives: To focus on general concepts of

1. Limit continuity and differentiability.
2. successive and partial differentiations and their physical interpretation
3. Introduce the idea of double integrals and its applications.

Course Learning Outcomes(CO)	On successful completion of this Course, the student should be able to
CO – 1	express the physical problems containing more variables
CO – 2	find volume and surface areas of solid of revolution and ready to solve problems arise in mathematical physics.

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
I	**Differentiation:**				White Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	1.	Limit and Continuity (using $\varepsilon - \delta$ definition) of the functions	**2**	The students will have a thorough understanding of the limit and continuity of different functions		
	2.	Successive differentiation	**1**	To understand the method of finding successive differentiation		
	3.	Leibniz's theorem and its application	**1**	To understand Leibniz's theorem, to solve problems based on it		
	4.	Rolle's Theorem, Lagrange's and Cauchy's Mean Value theorems	**2**	To understand Rolle's Theorem, Lagrange's and Cauchy's Mean Value theorems and to solve problems based on them		
	5.	Taylor's and Maclarin's theorem with Lagrange's and Cauchy's	**3**	To understand Taylor's and Maclarin's theorem with		

		form of remainders.		Lagrange's and Cauchy's form of remainders		
	6.	Indeterminate forms	**1**	To learn Indeterminate forms		
	7.	L-Hospital's rule	**1**	To learn L-Hospital's rule		
	8.	Expansion of standard functions: e^x , sin x, cos x, log (1+x), $(1+x)^m$, $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$.	**4**	To learn Expansion of standard functions		
II	Partial Differentiation:					
	1.	Limit and Continuity for functions of two and three variables	**2**	To evaluate Limit and Continuity for functions of two and three variables	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Partial differentiation, successive partial differentiations	**2**	Practice to solve Partial differentiation, successive partial differentiations of different functions		
	3.	Euler's theorem on Homogenous functions of two and three variables	**4**	To understand and solve Euler's theorem on Homogenous functions of two and		

				three variables		
	4.	Maxima and Minima of functions of two variables.	**2**	To solve problems based on Maxima and Minima of functions of two variables		
	5.	Curvature, radius of curvature for the Cartesian, Parametric, implicit and polar equations	**5**	To understand the definition of center, radius of curvature of the curve and practice problems		
	6.	Asymptotes	**2**	To understand the method of finding asymptotes		
	7	Length of tangent and normal, sub tangent and sub normal	**3**	To understand the definitions Length of tangent and normal, sub tangent and sub normal		
III	**Integration**					Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	1.	Integration as the limit of a sum	**2**	To understand the method of integration as the limit of sum		
	2.	Fundamental theorem of integral calculus	**2**	To understand Fundamental Theorem and to practice various related	White	

				problems	Board/ Lecture with illustrations /Discussion /PPT	
	3.	Reduction formulae for indefinite and definite integrals	**3**	To understand reduction formulae and practice solving indefinite and definite integrals		
	4.	Definition of improper integral	**1**	To acquire the knowledge about improper integral		
	5.	Beta and Gamma functions	**4**	To learn Beta, Gamma functions and its basic properties and other properties with related problems		
	6.	Quadrature and Rectification	**4**	To practice various problems based on Quadrature and Rectification		
IV	**Double Integrals**					
	1.	Working knowledge of double integrals	**2**	Review of basic working properties of double integrals	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Jacobian	**2**	To understand the Jacobian method for transformation		
	3.	change of variable in	**3**	The students will exposed to the best		

		double integrals		method		
	4.	Application of double integral	**4**	The students will exposed to different applications of double integrals		
	5.	Volume and surface areas of solid of revolution	**5**	To study volume and surface areas of solid of revolution of some standard conic sections in different co-ordinate systems		

N.B: The contact hours for tutorial classes will be 15 hrs.

RECOMMEMDED BOOKS

1. Das and Mukherjee - *Differential Calculus*, U.N. Dhur & Sons, Kolkata.

2. Das and Mukherjee - *Integral Calculus*, U.N. Dhur & Sons Pvt. Ltd., Kolkata.

REFFERENCES

1. Maity and Bagchi - *Integral Calculus*, *An introduction to Analysis,* New CentralBook Agency, Calcutta.
2. T.M. Apostol - *Calculus, Vulume I and II,* Willey Eastern Ltd., New Delhi.
3. Shanti Narayan - *Integral Calculus*, S. Chand & Co.Pvt. Ltd., New Delhi.
4. Gorakh Prasad - *Integral Calculus,* Pothisala Pvt.Ltd., Allahabad.
5. Gorakh Prasad - *Differential Calculus,* Pothisala Pvt.Ltd. Allahabad.
6. Erwin Kreyszig - *Advanced Engineering Mathematics,* John Wiley & Sons
7. N.Piskunov - *Differential and Integral Calculus,* Peace Publishers, Moscow.
8. Murray R. Spiegel - *Theory and Problems of Advanced Calculus* Schaum's Outline Series, Schaum Publishing Co., New York.
9. Maity and Gosh - *Integral Calculus,* New Central Book Agency, Kolkata.

Course Teachers: **HOD**

1. Dr. L. Ibeni Devi (UNIT – IV) DR. L. Ibeni Devi
2. L. Ragini Devi (UNIT – II)
3. Dr. Kh. Bulbul Singh (UNIT – I & III)

,

Generic Elective Course (GE – I)
Name of the Course: Group Theory, Matrices & Trigonometry
Paper Code: MAT – HG – 1016

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory-05, Tutorial-01	90	**100**

Course Objectives: The course gives

1. The definitions of the basic concepts of abstract algebra, analysis of the concept of permutation groups, definition of Isomorphism of groups, properties of ring.
2. It will help to find solutions of linear equations.
3. It gives knowledge of complex functions in complex variables.

Course Learning Outcomes(CO)	The student should be able to
CO – 1	apply Lagrange's theorem, Fermat's & Wilson's theorem to some exercise
CO – 2	explore the groups of permutations and the alternating groups
CO - 3	prove Cayley's theorem & its generalization

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
	Group Theory					
				To		

I	**1.**	Groupoid, Monoid, Semi group, Abelian group and their elementary properties;	**5**	understand definitions and elementary properties of Groupoid, Monoid, Semi group, Abelian group	. White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	permutation group	**3**	To study definition and theorems on permutation and calculation by taking physical examples		
	3.	Even and Odd permutation	**3**	To understand Even and Odd permutation by study examples		
	4.	Alternating group	**3**	To understand alternating group and solve problems based on it		
	5.	Subgroup, conditions for being a subgroup (finite cases)	**3**	To understand Subgroup, conditions for being a subgroup (finite cases		
	6.	Examples of Abelian and Nonabelian groups.	**3**	To practice various problems related to abelian and nonabelian		

				groups		
II	**Group Theory (Continued)**					
	1.	Lgrange's theorem, Fernat's and Wilson's theorem.	**3**	To understand Lgrange's theorem, Fernat's and Wilson's theorem, to solve problems based on these theorems	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Theorem: If H and K are subgroups, then HK is a subgroup if HK = KH.	**3**	To study theorems and problems on sub group		
	3.	Union and Intersection of subgroups	**2**	To practice problems on union and intersection of sub groups		
	4.	Order of finite group, index of a group.	**2**	Finding order and index of group		
	5.	Cyclic group and its examples	**2**	To understand cyclic group by solving examples		
	6.	Isomorphism of groups	**2**	To study the conditions of isomorphism of groups		
	7.	Elementary properties of a ring.	**1**	To understand a ring with properties		

	8.	sub rings, Integral of domains	**2**	To identify sub rings		
	9.	Division ring	**3**	To understand Division ring (Definition and examples		
III	**Matrix:**					
	1.	Definition, Operations on Matrices, Matrix Algebra	**2**	To study basic concepts in Matrices	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Types of Matrices	**2**	To identify different types of Matrices by taking examples		
	3.	Transpose	**1**	To practice formation of Transpose of a given Matrix		
	4.	Adjoint and Inverse of a matrix	**2**	To find adjoint and inverse of different Matrices		
	5.	Rank of a matrix	**3**	Determination of rank by reducing it to triangular matrix, different approaches for introduction of notion of rank		
	6.	Solutions of System of linear equations	**2**	To calculate different systems of linear equations		

IV	**Trigonometry:**					
	1.	De Moivre's theorem for a rational index	**1**	To understand De Moivre's theorem with some deductions	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Expansion of sin x, cos x, in power of x	**2**	To practice deductions and expansion of circular functions in terms of x		
	3.	exponential values for circular functions	**1**	To practice various problems related to exponential values for circular functions		
	4.	Complex argument	**1**	To study definition and examples		
	5.	Gregory's series	**1**	To understand Gregory's series and evaluation of different Gregory's series		
	6.	Hyperbolic functions	**2**	To acquire the knowledge of hyperbolic function, and solve problems based on hyperbolic functions		

	7.	summation of series including C + iS method.	**2**	To know C+iS method and to apply C+iS method to find sum of different trigonometric series		

N.B: The contact hours for tutorial classes will be 15 hrs.

RECOMENDED BOOKS

1. Das and Mukherjee – Higher Trigonometry, U.N. Dhur & Sons Pvt. Ltd, Cal.-73.
2. Chandrika Prasad – Algebra and Theory of Equations, Pothisala Pvt.Ltd, 2Lajpat Road.
3. Surjeet Singh and Quazi Zameerudin – Modern Algebra, V. Kas

Course Teachers:

1. Dr. L. Ibeni Devi (UNIT – IV)
2. Kh.Bikramjit Singh (UNIT – I and II)
3. L. Ragini Devi (UNIT – III)

HOD

Dr. L. Ibeni Devi

SEMESTER III

HONOURS CORE COURSE (HC)
Name of the Course: Mechanics I (Dynamics and Statics)
Paper Code: MAT – HC – 3016

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory- 05, Tutorial-01	90	**100**

Course Objectives:
This course aims to provide knowledge how a physical system might develop or alter over time and study the causes of those changes.

Course Learning Outcomes(CO)	On successful completion of this Course, the student should be able
CO – 1	to analyse the problems involving tension in a string
CO – 2	to illustrate laws of motion, kinematics of motion and their interrelationship
CO - 3	to explain the concepts of motion of particles

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
	Dynamics					
	1.	Components of velocities and accelerations	**2**	To study components of velocities and accelerations of moving particles along OX and OY (analytical		

				treatment)		
	2.	Radial and Transverse Velocities	**1**	To define Radial and Transverse Velocities		
I	**3.**	Radial and Transverse Accelerations	**2**	To define Radial and Transverse Accelerations under different conditions	White Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	4.	Tangential and normal velocities and accelerations	**2**	To discuss Tangential and normal velocities and accelerations Under different conditions		
	5.	Simple Harmonic motions	**1**	To understand formal definition of S.H.M. through analytical treatment		
	6.	Simple Harmonic motions(continued)	**2**	To discuss S.H.M. in case of Simple Pendulum,		
	7.	Simple Harmonic motions(continued)	**1**	To discuss oscillation in case of elastic string or spiral spring		
	Dynamics of a particle:					
	1.	Motion on	**3**	To study	White	

I (continued)		smooth and rough plane curves		motion on smooth and rough plane curves under gravity by taking related examples	Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Motion in resisting medium including projectile	**3**	To study motion in resisting medium including projectile, related examples		
	3.	Motion of varying mass	**4**	To study motion of varying mass under different conditions		
	4.	Central orbit	**2**	To identify central orbit and solved problems based on it		
	5.	Kepler's Law	**3**	Statement and explanation of Kepler's Law, related examples		
	6.	Acceleration in different Coordinates system	**5**	To study acceleration in different Coordinates system		
II	**Statics**					
	1.	Resultant of two parallel forces	**2**	Practice for finding resultant of two parallel forces from related problems		

	2.	Unlike parallel forces	**2**	Practice for solving Unlike parallel forces	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	3.	Moment of a force	**2**	Basic concepts for moment of a force with examples		
	4.	Couples, moment of couple	**2**	To identify couples of moment and practice various examples		
	5.	Theorem on moment of forces	**2**	To practice various theorems on moment of forces		
	6.	Resultant of a couple and a force	**2**	Finding resultant of a couple and a force with examples		
	7.	Equilibrium of three coplanar forces	**2**	To discuss the conditions of equilibrium of three coplanar forces		
	8.	Any system of coplanar forces	**2**	To practice various examples of any system of coplanar forces		
	9.	Centenary: Freely suspended thin, perfectly flexible string lines	**2**	Centenary: Freely suspended thin, perfectly flexible string lines		
	10.	Geometrical	**2**	To		

		properties of common Catenary		understand different geometrical properties of common Catenary		
	11.	Tension of the Catenary	**2**	To identify and study of Tension of the Catenary		
	12.	Parameter of a Catenary for a uniform string	**2**	Finding the parameter of a Catenary for a uniform string		
	13.	Forces in 3-dimension , Conditions of equilibrium	**2**	To study basic concepts of Forces in 3-dimension , Conditions of equilibrium		
	14.	Point sot's central axis	**1**	To understand basic concepts of Point sot's central axis		
	15.	Null points, lines and planes Stable, Unstable and Neutral equilibrium	**3**	To identify and practice related topics on Null points, lines and planes Stable, Unstable and Neutral equilibrium		

N.B: The contact hours for tutorial classes will be 15 hrs.

RECOMMENDED BOOKS

1. **S.L. LONEY:** An elementary treatise on dynamics of particle and of rigid bodies. Cambridge University press 1956, reprinted by S. Chand & Company (P) Ltd. 1988.
2. **DAS & MUKHERJEE**: Dynamics published by S. Chand & company (P) Ltd, 2010 ISBN-81-85624-96-8.
3. **DAS & MUKHERJEE:** Statics published by S. Chand & company (P) Ltd. 2010, ISBN-81-85624-18-6.
4. **S.L. LONEY:** An Elementary treatise on Statics published by A.I.T.B.S., New Delhi, 2004 ISBN-81-7473-123-7.
5. **A.S. RAMSEY**: Statics, CBS Publishers and Distribution, Shahdara, New Delhi-110032, India.

Course Teachers:

1. Dr. L. Ibeni Devi (UNIT – I)
2. Kh. Bikramjit Singh (UNIT – II)

HOD

DR. L. Ibeni Devi

HONOURS CORE COURSE (HC)
Name of the Course: Real Analysis - I
Paper Code: MAT – HC – 3026

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory- 05, Tutorial-01	90	**100**

Course Objectives: The course will develop a deep and rigorous understanding of real line R and of defining terms to prove results about convergence and divergence of sequences and series of real numbers**.**

Course Learning Outcomes(CO)	On successful completion of this Course, the student should be able
CO – 1	Will understand many properties of the real line
CO – 2	to recognize bounded convergent, divergent, Cauchy and monotonic sequences

CO - 3	to apply the ratio, root, alternating series and limit comparison test for convergence and absolute convergence of an infinite series of real numbers

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
I	**Fundamental Properties of Real Numbers and Elements of Point Set Topology**					
	1.	Interval and its different kinds, Bounded and unbounded sets, Supremum and infimum	**3**	To study definitions and concepts with related topics on interval and its different kinds, Bounded and unbounded sets, Supremum and infimum	White Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Field axioms, Order axioms, Order completeness in R	**3**	To understand Field axioms, Order axioms, Order completeness in R		
	3.	Archimedean property	**2**	Proving some results on Archimedean property		
	4.	Neighbourhood of a point, Interior points, Open sets and related properties/theorems	**3**	To learn with related illustrations /theorems on neighbourhood of a point, Interior points, Open		

				sets and related properties		
	5.	Limits points and derived set	**2**	To identify Limits points and derived sets and practice problem based on them		
	6.	Bolzano-Weierstrass Theorem	**2**	To understand Bolzano-Weierstrass Theorem and solve problems based on it		
	7.	Adherent point and Closure of a set, Closed sets	**3**	To study related properties and theorems on Adherent point and Closure of a set, Closed sets		
	8.	Concept of compactness; Heine-Borel theorem	**2**	To learn basic concepts of compactness and study of Hein-Borel theorem and its applications		
II	**Sequence of Real Numbers**					
	1.	Concept of sequence, Bounds of sequence, Limit points of a sequence	**3**	To understand basic concepts and related topics on Concept of sequence, Bounds of	White Board/ Lecture with illustrations /Discussion /PPT	

				sequence, Limit points of a sequence		Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Bolzano Weierstrass theorem for sequence	**3**	To learn Bolzano Weierstrass theorem for sequence and solve problems on it		
	3.	Limit inferior and superior	**2**	To learn Limit inferior and superior with illustrations		
	4.	Convergent and their properties, divergent and oscillate sequences	**3**	To study properties of convergent sequence as well as divergent sequences, to identify oscillate sequences		
	5.	Cauchy sequences, Cauchy's general principle of convergence	**3**	To understand Properties and theorems on Cauchy sequences with Cauchy's general principle of convergence		
	6.	Algebra of sequences, monotonic sequence and their properties	**3**	To understand and study the algebra of sequences, monotonic sequence and their properties		

	7.	Subsequences, Nested interval theorem.	**3**	To solve problems related on subsequences, Nested interval theorem		
III	**Infinite Series:**					
	1.	Series of real numbers	**1**	Introduction to basic concepts on series of real numbers	White Board/ Lecture with illustrations /Discussion	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	2.	Sequence of partial sums	**1**	Introduction on sequence of partial sums with problems		
	3.	Convergence of infinite series, Necessary condition for the convergence of an infinite series	**2**	To understand basic concepts and necessary conditions on convergence of an infinite series, to solve related problems		
	4.	Cauchy's general principle for convergence	**1**	To identify Cauchy's general principle for convergence		
	5.	Geometric series	**1**	To evaluate geometric series		
	6.	useful theorems on series of positive terms	**2**	To evaluate some useful theorems on series of positive terms		
	7.	Comparison test of convergence	**2**	To practice Comparison test of convergence		

	8.	convergence and divergence of p-series	**2**	To evaluate convergence and divergence of p-series	/PPT	
	9.	Cauchy's root test, D'Alembert's ratio test, Raabe's test	**3**	To practice Cauchy's root test, D'Alembert's ratio test, Raabe's test		
	10.	Logarithmic test, D'Morgan & Bertrand test	**2**	To practice Logarithmic test, D'Morgan & Bertrand test		
	11.	Leibnitz's test for alternating series	**2**	To practice Leibnitz's test for alternating series		
	12.	Conditional and Absolute convergence	**2**	To understand and evaluation on conditional and absolute convergence		
IV	**Limits and Continuity:**					
	1.	Limit and Continuity (using $\varepsilon - \delta$ definition) of a function	**2**	To evaluate limit and continuity of functions using $\varepsilon - \delta$ definition	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group
	2.	Algebra of limits and continuous functions	**1**	To understand basic concepts of Algebra of limits and continuous functions		
	3.	Sequential criterion for	**2**	To evaluate problems		

		limits and continuity		related to Sequential criterion for limits and continuity		Discussion/ Seminar/ Quiz.
	4.	Types of discontinuities	**1**	To identify types of discontinuity by taking examples		
	5.	Properties of continous functions on a closed interval	**3**	To study Properties of continuous functions on a closed interval and practice related problems		
	6.	Uniform continuity	**1**	Defining Uniform continuity by illustrations		

N.B: The contact hours for tutorial classes will be 15 hrs.

RECOMMENDED BOOKS

1. **S.C. Malik and Savita Arora** - Mathematical Analysis, New Age International (P) Limited; Publishers, New Delhi.

2. **K.C. Maity & R.K. Ghosh** - An Introduction to Analysis, Differential Calculus Part I & II, Integral Calculus, Books and Allied (P) Ltd., Kolkata 700009.

3. **Shanti Narayan and P.K. Mittal** - A Course of Mathematical Analysis, S. Chand & Company Ltd. Ram Nagar, New Delhi - 110055.

Course Teacher:
Dr. Kh. Bulbul Singh

HOD
Dr. L.Ibeni Devi

HONOURS CORE COURSE (HC)
Name of the Course: Laplace Transform & Vector Analysis
Paper Code: MAT – HC – 3036

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory- 05, Tutorial-01	90	**100**

Course Objectives: This course aims to introduce students to the following concepts and cognitive skills. In this course the students

1. Understand Laplace Transformation, their properties and applications
2. Understand the concepts of Differential and Integration of vectors.

Course Learning Outcomes(CO)	After studying this course the students will be able to
CO – 1	1. State and prove Heaviside's shifting theorem
CO – 2	2. Apply Laplace Transformation in solving PDE
CO - 3	3. Solve the related problems of Gauss's, Green's and Stoke's theorems

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	**Section**	**Topics of Discussion**	**Lecture hours**	**Learning outcomes**	**Pedagogy**	**Assessment /evaluation**
	Laplace Transformation :					
	1.	Laplace Transform	**2**	Acquire basic Concept & definition of Laplace Transform with examples		

I	**2.**	Kernel of the Integral transformation	**2**	To identify Kernel of the Integral transformation , solve related problems	White Board/ Lecture with illustrations /Discussion /PPT.	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz.
	3.	Existence of Laplace Transformation	**3**	To study Existence of Laplace Transformation, solve related problems		
	4.	Transformation of some elementary functions	**5**	To understand the Transformation of some elementary functions such as f (t) = e^{-at}, Cos at, Sin at, Cosh at, Sinh at, t^n etc.		
II	**Laplace Transformation(continued):**					
	1.	Properties of Laplace Transformation	**1**	To study properties of Laplace Transformation by taking related examples	White Board/ Lecture with illustrations /Discussion /PPT.	Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	First Translation / Shifting Theorem.	**2**	Discussion of problems and applications of First Translation / Shifting Theorem		
	3.	Second Translation /Heaviside's shifting Theorem	**2**	Second Translation /Heaviside's shifting Theorem		

III	**Laplace Transformation(continued):**					
	1.	Differentiation property	**5**	To study and solve the change of scale property with examples	White Board/ Lecture with illustrations /Discussion /PPT.	Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Laplace Transformation of Derivatives of order n	**5**	Practice to solve Laplace Transformation of Derivatives of order n with problems		
IV	**Laplace Transformation(continued):**					
	1.	Inverse Laplace transformations	**1**	Learn basic concepts of Inverse Laplace transformations, related problems	White Board/ Lecture with illustrations /Discussion /PPT.	Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Theorems on multiplication by s and 1/s.	**2**	To learn Theorems on multiplication by s and 1/s by taking related examples		
	3.	First and Second Shifting properties	**2**	To study First and Second Shifting properties by taking related topics		
	4.	Convolution Theorem	**3**	Statement of Convolution Theorem with examples		
	5.	Properties of Convolution	**2**	To study by taking examples the Properties of		

				Convolution		
	6.	Application of Laplace Transformation in solving PDE	**5**	To learn and apply the technique of Laplace Transformation in solving PDE		
V	**Vector Analysis:**					
	1.	Scalar and vector product of three and four vectors	**4**	Evaluation techniques for Scalar and vector product of three and four vectors with related examples	White Board/ Lecture with illustrations /Discussion /PPT.	Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	Reciprocal vectors	**1**	Concept and identification of Reciprocal vectors		
	3.	Differentiation of vectors	**3**	Familiar with differentiability of vector functions and related topics		
	4.	Gradient, Divergence and Curl of a vector	**3**	Concepts of Gradient, Divergence and Curl of a vector with examples		
	5.	Ordinary integrals	**2**	Definition and examples		
	6.	Line, Surface and Volume integrals	**4**	To learn evaluation techniques and use of Line, Surface and Volume integrals		
	7.	Theorems of Gauss, Green, Stokes	**5**	To understand Gauss, Green and Stock's		

				theorems with examples and their applications		

N.B: The contact hours for tutorial classes will be 15 hrs.

RECOMMENDED BOOKS

1. **B. Das**-Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.
2. **M.R. Spiegel-**Vector analysis and an introduction to tensor analysis-Schaum series.
3. Vector Analysis by Maity & Ghosh.
4. **Spiegel**: *Laplace Transform,* Schuam Outlines Series.

Course Teachers:

1. Kh. Bikramjit Singh (Unit – V)
2. L. Ragini Devi (Unit – I,II,III,IV)

HOD

Dr. L. Ibeni Devi

Generic Elective Course (GE – 3)
Name of the Course: Ordinary Differential Equations, Partial Differential Equations & Vectors
Paper Code: MAT – HG – 3016

No of hours per week	Credits	Total No. of hours	Marks
6	**6** Theory-05, Tutorial-01	90	**100**

Course Objectives: The course aims to provide knowledge about existing world of Differential equations, Mathematical Modelling and their applications.

Course Learning Outcomes(CO)	**The student should be able to** solve different mathematical problems with variation of parameters.

Total contact hours: 90 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
	Ordinary differential equations:					
I	**1.**	Exact equations	**2**	To study Definition , necessary and sufficient Condition of exactness of a 1^{st} order and 1^{st} degree ODE with examples	. White Board/ Lecture with illustrations /Discussion /PPT White	

	2.	Exact equations (continued)	**2**	Rules of finding integrating factors, by taking different examples for each rule	Board/ Lecture with illustrations /Discussion /PPT	
	3.	Exact equations (continued	**3**	Finding solution of linear and Bernoulli's equation with related problems		Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	4.	Exact equations (continued	**3**	To practice various reducible equations to linear and Bernoulli's equation		
	5.	Equations of first order and higher degree	**5**	To solve equations of nonlinear first order, higher degree, solvable for p, solvable for y, solvable for x		
	6.	Clairaut's equation	**5**	To study general and singular solution of Clairaut's equation with geometric meaning, related problems		

	7.	Clairaut's equation(continued)	**2**	To identify equations reducible to Clairaut's form		
II	**Partial Differential Equations**:					
	1.	Partial Differential Equations	**3**	To understand basic concepts and definition with related problems	White Board/ Lecture with illustrations /Discussion /PPT	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2.	First order equations	**4**	To acquire the knowledge of classification, construction with geometrical interpretation, illustrations by examples		
	3.	Quasi Linear equations	**4**	To find the method of characteristic for obtaining general solution of Quasi Linear equations		
	4.	Canonical forms of First –b order Linear Equations	**3**	To identify the Canonical forms of First –b order Linear Equations		
	5.	Method of Separation of Variables for solving first	**6**	To study techniques of solution with proper		

		order partial differential equations.		examples		
III	**Vector**					
	1.	Scalar and vector product of three and four vectors	**4**	Evaluation techniques for Scalar and vector product of three and four vectors with related examples		
	2.	Reciprocal vectors	**1**	Concept and identification of Reciprocal vectors		
	3.	Differentiation of vectors	**3**	Familiar with differentiability of vector functions and related topics		
	4.	Gradient, Divergence and Curl of a vector	**3**	Concepts of Gradient, Divergence and Curl of a vector with examples		
	5.	Ordinary integrals	**2**	Definition and examples		
	6.	Line, Surface and Volume integrals	**4**	To learn evaluation techniques and use of Line, Surface and Volume integrals		
	7.	Theorems of Gauss, Green, Stokes	**5**	To understand Gauss, Green and Stock's theorems with examples		

				and their applications		
N.B: The contact hours for tutorial classes will be 15 hrs.						

Course Teachers:

3. Kh. Bikramjit Singh (Unit – III)
4. L. Ragini Devi (Unit – I,II)

HOD
Dr. L. Ibeni Devi

SKILL ENHANCEMENT COURSE (SEC – I)
Name of the Course: Computer Science & Programming I (in C)
Paper Code: MAT – SE – 3024

No of hours per week	Credits	Total No. of hours	Marks
6	**4** Theory- 02, Practical-02	60	**100**

Course Objectives: The objective of the course is to generate qualified manpower in the area of Information Technology which will enable such person to work at any offices or for future entrepreneur in the field of IT.

Course Learning Outcomes(CO)	On successful completion of this Course, the student should be able
CO – 1	to find importance of software for lab Experimentation, in research by simulation work,
CO – 2	To develop basic mathematical problems in any software

Total contact hours: 60 (Including lectures, assignments, projects , group discussions, seminars, tests, quiz, Practicals for computer programmes)

Unit	Section	Topics of Discussion	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
I	**Computer**					
	1.	Basics of computer	**1**	To acquire knowledge of Historical evolution with computer generations	White Board/ Lecture with illustrations /Demonstration/Discussion /PPT/ Practical	Unit Test/ Class Test/ Assignment/ Q & A Session/ Group Discussion/ Seminar/ Quiz
	2	A standard model of Computer	**1**			
	3.	Functional description	**1**			
	4.	Types of computer	**1**			
	5.	Operating system	**1**			
	6.	Hardware and software	**1**			
II	**Positional number systems**					
	1.	Integers and real numbers, effect of finite representations				
	2.	Underflow and overflow conditions				
	3.	Associativity and normalisation				
	4.	Number systems				
	5.	Conversion of a number from one system to another				

	6.	Binary arithmetic				
	7.	Storing of data in a computer		BIT, BYTE, NIBBLE, WORD, coding of data- ASCII, EBCDIC, etc.		
III	**Algorithm and flow charts:**					
	1.	Algorithm				
	2.	Complexities of algorithm				
	3.	Flow-charts				
	Programming Languages:					
	1.	Machine language, Assembly language, High level language				
	2.	Compiler and Interpreter				
	3.	Object and source program				
	ANSIC					
	1.	DaTa type				
	2.	Expressions				
	3.	Statement**s**				
	4.	Standard input/output				
	5.	Use of loop				
	6.	Array				
	7.	User defined functions				