গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

NAAC accredited with 'B' Grade

TEACHING PLAN
DEPARTMENT OF MATHEMATICS
JULY 2022 - JUNE 2023

গড়গাঁও মহাবিদ্যালয়
GARGAON COLLEGE
NAAC accredited with 'B' Grade

NAME OF THE TEACHER: DR. KABITA PHUKON
DESIGNATION: ASSISTANT PROFESSOR
SESSION: JULY - DEC 2022

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./B. SC.
Session: Odd semester 2022 (July-December)

Subject: MATHEMATICS
Name of the Teacher: Dr. Kabita Phukon
Methods to be applied: Lecture, analytical and activity method, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector

Paper Code/ Title	Allotted Unit	No. of Classes Required	Details of the topics to be taught	No. of Tutorials
C1(C1.1) Calculus	Unit-1	15	Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type e^{ax+b} sinx, e^{ax+b} cosx, $(ax+b)^n$ sinx, $(ax+b)^n$ cosx , concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospitals rule, applications of maxima and minima.	5
C2(C1.2) Algebra	Unit-1 & 3	25	**Unit-1:** Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. **Unit-3**:Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.	5
GE 1.1 Differential Calculus	Unit-1	25	Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.	5
C6(C3.2) Group Theory-I	Unit-1,2,3,4 & 5	65	**Unit-1**: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. **Unit-2**: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. **Unit-3**: Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem. **Unit-4:** External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. **Unit-5**: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.	15
C12(C5.2) Group Theory-II	Unit-1 & 2	50	**Unit-1** Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties. **Unit-2** Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.	10

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NAME OF THE TEACHER: DR. KABITA PHUKON
DESIGNATION: ASSISTANT PROFESSOR
SESSION: JAN- JUNE 2023

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./ BSc.
Session: Even semester 2023(January-June)

Subject: MATHEMATICS

Name of the Teacher: Dr. Kabita Phukon

Methods to be applied: Lecture, activity method, interaction, and discussion.

Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector

Paper Code/ Title	Alloteed Unit	No. of Class Required	Details of the topics to be taught	No. of Tutorials
C 2.2 Differential Equation	Unit-1 & 3	30	**Unit-1:** Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations. **Unit-3:** General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.	10
GE2.1 Differential Equations	Unit 1 & 2	30	**Unit-1**: First order exact differential equations. Integrating factors, rules to find an integrating factor. **Unit-2** : First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.	5
C 4.1 Numerical Methods	Unit 1,2,3,4,5, 6	45	**Unit-1**: Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. **Unit-2**: Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods. **Unit-3**: System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. **Unit-4**: Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation. **Unit-5**: Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule. **Unit-6**: Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.	15
GE 4.1 Algbra	Unit 1	22	Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn ofintegers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GL.n(n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral	8

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			triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.	
C13 (C6.1): Metric Spaces & Complex Analysis	**Unit 3,4,5,6**	**45**	**Unit-3**: Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. **Unit-4**:Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula. **Unit-5**: Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. **Unit-6**: Laurent series and its examples, absolute and uniform convergence of power series.	**10**

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NAME OF THE TEACHER: MR. HAREKRISHNA MILI
DESIGNATION: ASSISTANT PROFESSOR
SESSION: JULY - DECEMBER 2022

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./B. SC.
Session: Odd semester 2022 (July-December)

Subject: MATHEMATICS
Name of the Teacher: Mr. Harekrishna Mili
Methods to be applied: Lecture, analytical and activity method, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector, Smart Tv

Paper Code/ Title	Allotted Unit	No. of Classes Required	Details of the topics to be taught	No. of Tutorials
C1.1 Calculus	Unit-3& Practicals	40	**Unit-3:** Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx\,dx$, $\int \cos nx\,dx$, $\int \tan nx\,dx$, $\int \sec nx\,dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin^m x\,dx$, volume by slicing, disks and washer methods, volumes by cylindrical shells **Practicals:** Plotting of graphs of function e^{ax+b}, log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax + b| and to illustrate the effect of a and b on the graph. Plotting the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph andcomparing them. Sketching parametric curves (E.g., Trochoid, cycloid, epicycloids, hypocycloid). Obtaining surface of revolution of curves. Tracing of conics in Cartesian coordinates/ polar coordinates. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic,paraboloid, hyperbolic paraboloid using cartesian coordinates. Matrix operations (addition, multiplication, inverse, transpose).	5
GE 1.1 Differential Calculus	Unit-2	30	Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.	6
C3.1 Theory of Real Functions	Unit-1,3	60	Unit-1:Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits	5

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			at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem. Unit-3: Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series	
C6(C3.2) Group Theory-I	**Unit-1,2,3,4 & 5**	**80**	**Unit-1**: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. **Unit-2**: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. **Unit-3**: Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem. **Unit-4:** External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. **Unit-5**: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.	**10**
GE-3.1 Real Analysis	**Unit-1 & 2**	**50**	**Unit-1** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. **Unit-2** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.	**7**

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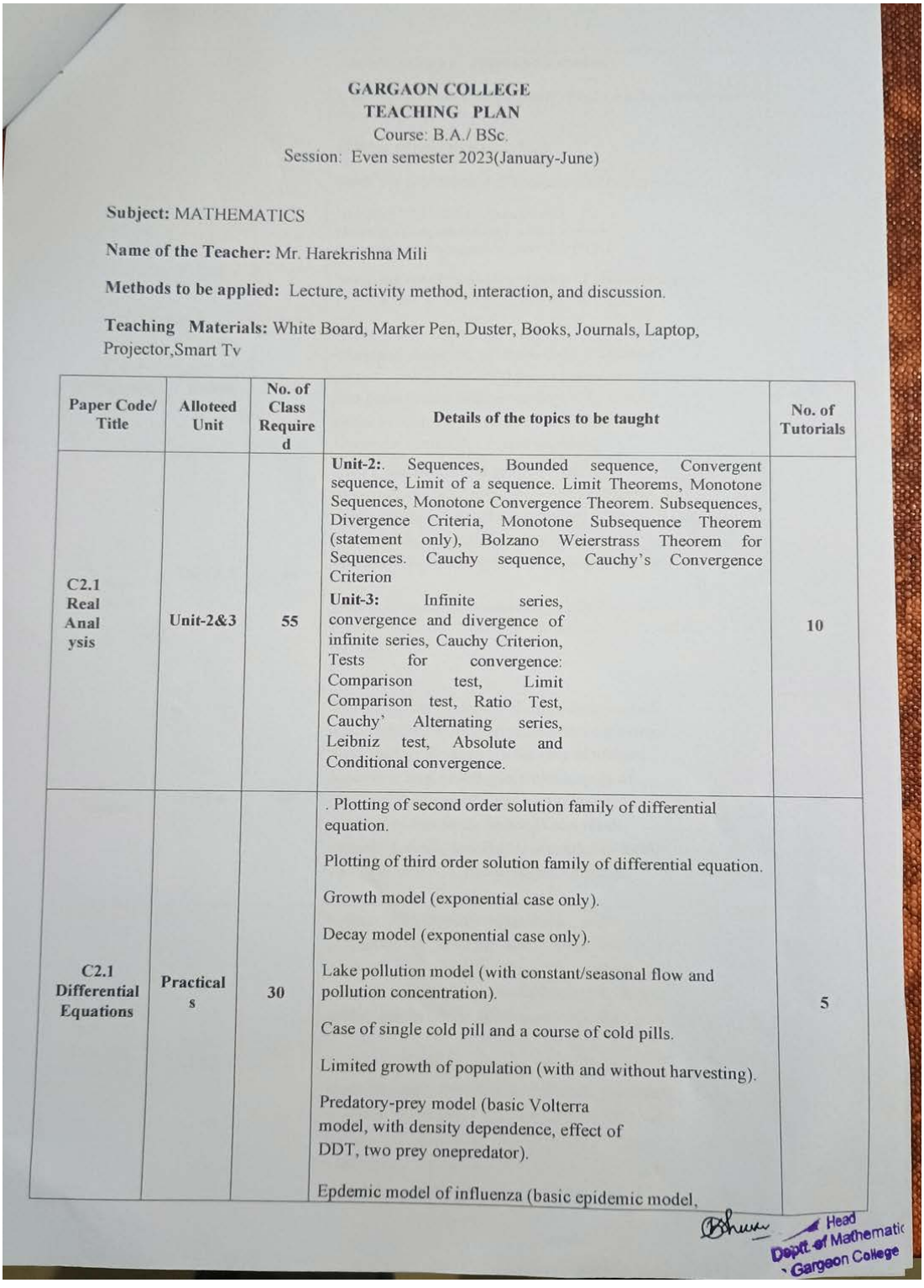
NAME OF THE TEACHER: MR. HAREKRISHNA MILI
DESIGNATION: ASSISTANT PROFESSOR
SESSION: JAN - JUNE 2023



GARGAON COLLEGE
TEACHING PLAN
Course: B.A./ BSc.
Session: Even semester 2023(January-June)

Subject: MATHEMATICS

Name of the Teacher: Mr. Harekrishna Mili

Methods to be applied: Lecture, activity method, interaction, and discussion.

Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector,Smart Tv

Paper Code/ Title	Alloteed Unit	No. of Class Required	Details of the topics to be taught	No. of Tutorials
C2.1 Real Analysis	Unit-2&3	55	**Unit-2:** Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion **Unit-3:** Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy' Alternating series, Leibniz test, Absolute and Conditional convergence.	10
C2.1 Differential Equations	Practicals	30	. Plotting of second order solution family of differential equation. Plotting of third order solution family of differential equation. Growth model (exponential case only). Decay model (exponential case only). Lake pollution model (with constant/seasonal flow and pollution concentration). Case of single cold pill and a course of cold pills. Limited growth of population (with and without harvesting). Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey onepredator). Epdemic model of influenza (basic epidemic model,	5

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			contagious for life, disease with carriers). Battle model (basic battle model, jungle warfare, long range weapons). Plotting of recursive sequences. Study the convergence of sequences through plotting. Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergentsubsequences from the plot. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.	
GE-2.1 Differential Equation	**Unit-4**	**20**	Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.	5
C4.3 Ring Theory and Linear Algebra I	**Unit 1,2**	**40**	**Unit-1**: Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. **Unit-2**: Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.	15
GE 4.1 Algbra	**Unit 4**	**30**	Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field ofrationalfunctions.	5
DSE 3.3 Discrete Mathematics	**Unit 1,2&3**	**55**	**Unit-1**:. Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms. **Unit-2**: Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of	1

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			switching circuits. **Unit-3**: Definitions, examples and basic properties of graph, pseudographs, cpmplete graphs, bipartite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm .	

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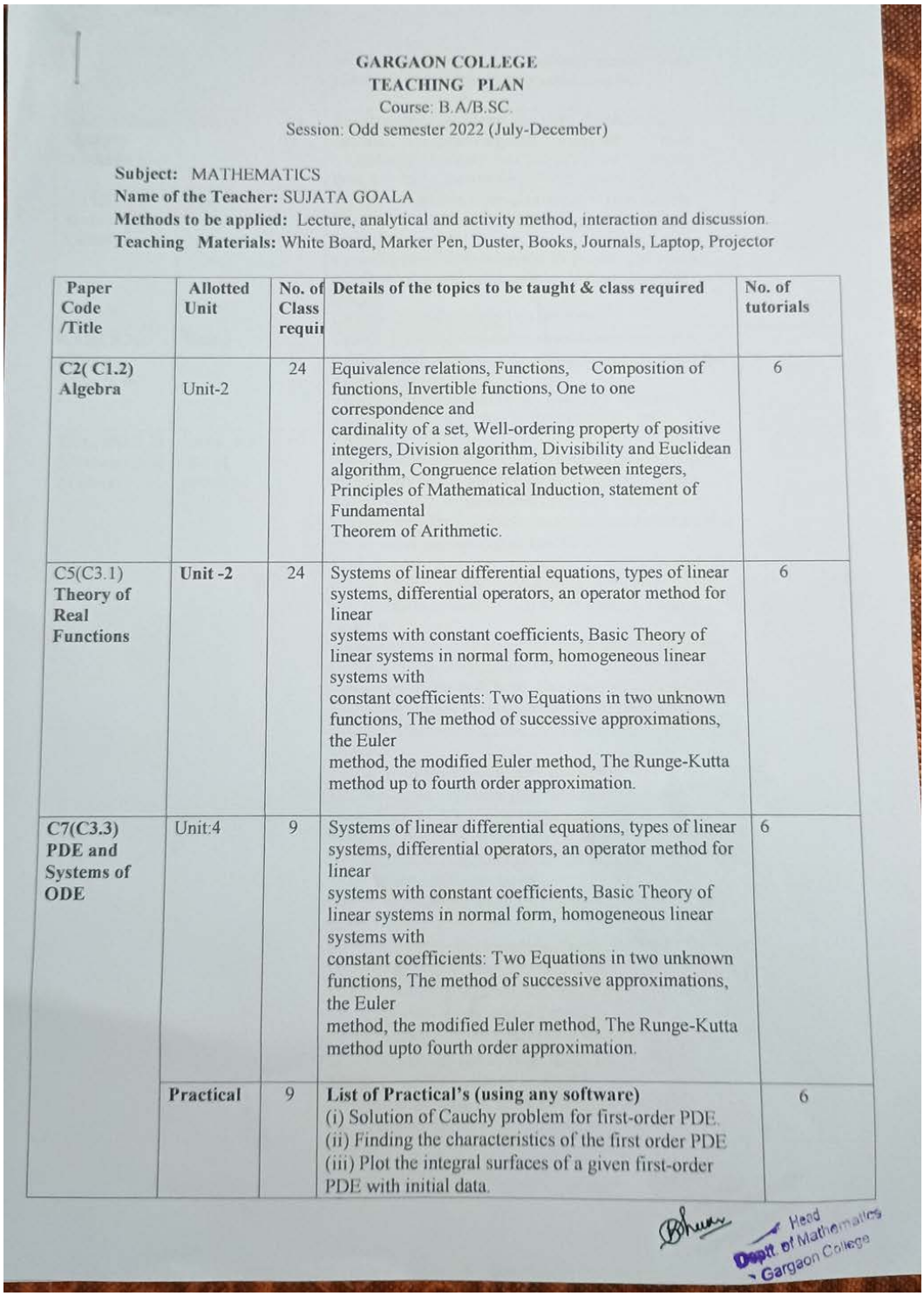
NAME OF THE TEACHER: SUJATA GOALA
DESIGNATION: ASSISTANT PROFESSOR
SESSION: JULY - DECEMBER 2022



GARGAON COLLEGE
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Course: B.A/B.SC.
Session: Odd semester 2022 (July-December)

Subject: MATHEMATICS
Name of the Teacher: SUJATA GOALA
Methods to be applied: Lecture, analytical and activity method, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector

Paper Code /Title	Allotted Unit	No. of Class requi	Details of the topics to be taught & class required	No. of tutorials
C2(C1.2) Algebra	Unit-2	24	Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	6
C5(C3.1) **Theory of Real Functions**	**Unit -2**	24	Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method up to fourth order approximation.	6
C7(C3.3) PDE and Systems of ODE	Unit:4	9	Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method upto fourth order approximation.	6
	Practical	9	**List of Practical's (using any software)** (i) Solution of Cauchy problem for first-order PDE. (ii) Finding the characteristics of the first order PDE (iii) Plot the integral surfaces of a given first-order PDE with initial data.	6

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			(iv) Plotting Heat equation and wave equation with suitable initial and boundary value condition.	
GE-1.3 Finite Element Methods	**Unit- 4**	9	Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, Serendipity elements and isoperimetric elements and their assembly, discretization with curved boundaries.	6
C11(C5.1) Multivariate Calculus	**Unit -2**	15	Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar Co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, Cylindrical and spherical co-ordinates.	5
C12(C5.2) Group Theory II	**Unit-3**	25	Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, *p*-groups, Solow's Theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq 5$, non-simplicity tests.	5
DSE(DSE2.1) Mathematical Modeling	**Units -1,2 list of practical**	60	**Unit-1** Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to Initial value problem up to second order. **Unit-2** Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis **List of Practical (using any software)** (i) Plotting of Legendre polynomial for n = 1 to 5 in the interval [0, 1]. Verifying graphically that all the Roots of Pn (x) lie in the interval [0, 1]. (ii) Automatic computation of coefficients in the series solution near ordinary points. (iii) Plotting of the Bessel's function of first kind of order 0 to3. (iv) Automating the Fresenius Series Method. (v) Random number generation and then use it for one of the following (a) Simulate area under a curve (b) Simulate volume under a surface. (vi) Programming of either one of the queuing model (a) Single server queue (e.g. Harbor system) (b) Multiple server queue (e.g. Rush hour). (vii) Programming of the Simplex method for 2/3variables.	20

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DESIGNATION: ASSISTANT PROFESSOR
SESSION: JAN - JUNE 2023

GARGAON COLLEGE
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Methods to be applied: Lecture, activity method, interaction, and discussion.

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Paper Code /Title	Allotted Unit	No. of Class requ	Detail of the topics to be taught &and class required	No. of tutorials
C3(C2.1) Real Analysis	Unit -1	30	Review of Algebraic and Order Properties of *R*, -neighborhood of a point in *R*, Idea of countable sets, uncountable sets and unaccountability of *R*. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of *R*, The Archimedean Property, Density of Rational (and Irrational) numbers in *R*, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.	5
C4(C2.2) Differential Equations	Unit- 4	8	Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	2
C8(C4.1) Numerical Methods	List of Practical's	24	**Marks: 20** Contact hrs. 30 (i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/N. (ii) To find the absolute value of aninteger. (iii) Enter 100 integers into an array and sort them in an ascendingorder. (iv) Bisection Method. (v) Newton Raphson Method.	6
C9(C4.2) Riemann Integration and Series of Functions	Unit-4	20	Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.	5
C10(C4.3)Ring Theory and Linear Algebra I	UNIT-3,4	35	Unit-3 Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of	10

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			subspaces. Unit-4 Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.	
C13(C6.1) Metric Spaces and Complex Analysis	**Unit-2**	10	Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, compactness Banach Fixed point Theorem. Connectedness, connected subsets of R.	5
C14(C6.2) Ring Theory and Linear Algebra II	**Units-2 & 3**	50	**Unit-2** Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator. **Unit-3** Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.	10
DSE4(DSE4.1) Mathematical Methods	Unit -1	16	Fourier Series : Fourier Series, Dirichlet conditions, Fourier series for even and odd functions Half range Fourier series.	4
	Unit- 4	16	Fourier Transform, and Inverse Fourier transform: Dirichlet conditions, Definition of Fourier transform, Inverse theorem for Fourier transform, Fourier Sine and Fourier cosine transforms and their inversion formula, Linearity property, change of scale property , shifting property, modulation theorem, convolution theorem.	4

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