গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

ACADEMIC CALENDAR

DEPARTMENT OF MATHEMATICS

JULY 2021 - JUNE 2022

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./B. SC.

Session: Odd semester 2021 (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: **Calculus**	Unit-1	16	20 Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type sinx, e, cosx, (ax +b), n sinx, (ax+b), 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.	4
C2: **Algebra**	Unit-2	25	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.	5
GE-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: **Group Theory I**	Unit-1	16	Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.	4
	Unit-2	12	Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	3
	Unit-3	15	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.	5
	Unit-4	15	External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.	5
	Unit-5	11	Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.	4

GE-3: **Real Analysis**	Unit-1	23	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
	Unit-2	14	Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).	6
C12(C5.2): **Group Theory II**	Unit-1	30	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.	5
	Unit-2	20	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.	5

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./ BSc.
Session: Even semester 2022 (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	Allotted Unit	No. of Class Required	Details of the topics to be taught	No. of Tutorials
C4: **Differential Equations**	Unit-1	10	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.	5
	Unit-3	20	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.	5
GE-2: **Differential Equation**	Unit-1	10	First order exact differential equations. Integrating factors, rules to find an integrating factor.	5
	Unit-3	15	Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.	5
C8: **Numerical Methods**	Unit-1	4	Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.	1
	Unit-2	8	Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.	2
	Unit-3	7	System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.	3
	Unit-4	8	Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.	2
	Unit-5	13	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.	2
	Unit-6	9	Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.	1
	Practical	16	(i) Calculate the sum $1/1 + 1/2 + 1/3 + 1/4 +$	4

			----------+ 1/N.	
			(ii) To find the absolute value of an integer.	
			(iii) Enter 100 integers into an array and sort them in an ascending order.	
			(iv) Bisection Method.	
			(v) Newton Raphson Method.	
GE-4: **Algebra**	Unit-1	**25**	Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers 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 GLn(n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.	**5**

C13(C6.1): **Metric Spaces & Complex Analysis**	Unit-3	**16**	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.	**2**
	Unit-4	**10**	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.	**2**
	Unit-5	**7**	Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.	**3**
	Unit-6	**8**	Laurent series and its examples, absolute and uniform convergence of power series.	

Sheekan

Head
Deptt. of Mathematics
Gargaon College

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./B. SC.
Session: Odd semester 2021 (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: **Calculus**	Unit-2	8	Reduction Formulae of the types $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int (\log x)^n dx$ and $\int \sin^n x \cos^n x\, dx$ and their derivations. Rectification, volume and surface area of revolution of a curve.	4
GE-1: **Differential Calculus**	Unit-2	10	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
C5: **Theory of Real Function**	Unit-1	25	Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits 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.	5
	Unit-2	24	Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.	6
	Unit-3	26	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 n and Maclaurin's series expansions of	4

			exponential and trigonometric functions, ln(1 + x), 1/ax+b and (1 +x)	
GE-3: **Real Analysis**	Unit-3	**15**	Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.	**5**
	Unit-4	**14**	Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.	**6**

DSE 1: **Analytical Geometry**	**Unit-1**	**35**	Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.	**10**
	Unit-2	**32**	Spheres, Cylindrical surfaces Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	**13**

Shekar
Head
Deptt. of Mathematics
Gargaon College

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./ BSc.

Session: Even semester 2022 (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	Allotted Unit	No. of Class Required	Details of the topics to be taught	No. of Tutorials
C3: **Real Analysis**	Unit-2	**25**	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.	**10**
C4: **Differential Equation**	Unit-2	**8**	Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.	**2**
GE-2: **Differential Equation**	Unit-4	**16**	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.	**4**

C10: **Ring Theory and Linear Algebra I**	Unit-1	**14**	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.	**6**
	Unit-2	**16**	Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.	**4**
GE-4: **Algebra**	Unit-3	**25**	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 of rational functions.	**5**
DSE3 **Discrete Mathematics**	**Unit-1**	**25**	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.	**5**
	Unit-2	**22**	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 switching circuits.	**8**
	Unit-3	**23**	Definitions, examples and basic properties of graph, pseudographs, complete 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	**7**

GARGAON COLLEGE
TEACHING PLAN
Course: B.A./ BSc.
Session: Even semester 2021 (January-June)

Subject: MATHEMATICS

Name of the Teacher: Ms. Sujata Goala

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

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

Paper Code/Title	Allotted Unit/ Topic	No. of Class Required	Detail of the topics to be taught	No. of tutorials
C3: **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 uncountability 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
C9: **Riemann Integration and Series of Functions**	Unit-4	21	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.	4
	Unit-5	17	Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.	3
C10: **Ring Theory and Linear Algebra I**	Unit-3	16	Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.	4
	Unit-4	25	Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism	5

			theorems, invertibility and isomorphisms, change of coordinate matrix.	
C12(C5.2): **Group Theory II**	Unit-3	25	Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, *p*-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for n ≥ 5, non-simplicity tests.	5
DSE 2 (DSE2.1): **Mathematical Modeling**	Unit-1	25	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.	5
	Unit-2	25	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	5
	Practical	24	(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 Frobenius 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. Rushhour). (vii) Programming of the Simplex method for 2/3variables.	5

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Name of the Teacher: Ms. Sujata Goala
Methods to be applied: Lecture, activity method, interaction, and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Books, Journals, Laptop, Projector

Paper Code/Title	Allotted Unit/ Topic	No. of Class Required	Detail of the topics to be taught	No. of tutorials
C3: **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 uncountability 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: **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
GE2: **Differential Equation**	Unit-5	12	Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	3
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**	Practical	26	(i) Calculate the sum $1/1 + 1/2 + 1/3 + 1/4 + \text{----------}+ 1/N$. (ii) To find the absolute value of an integer. (iii) Enter 100 integers into an array and sort them in an ascending order. (iv) Bisection Method. (v) Newton Raphson Method.	4
C9(C4.2): **Riemann Integration and Series of Functions**	Unit-4	22	Pointwise and uniform convergence of a 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.	3
C13(C6.1): **Metric Spaces and Complex Analysis**	Unit-2	12	Continuous mappings, sequential criteria, and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, compactness Banach Fixed point Theorem. Connectedness, connected subsets of R.	3
C14(C6.2): **Ring Theory and Linear Algebra II**	Unit-2	25	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.	5

	Unit-3	25	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.	5
DSE 4.1: Mathematical Methods	Unit-2	16	**Laplace Transform**: Definition of Laplace transform, Existence theorem for Laplace transform. Linearity property of Laplace transform, Laplace transform of some elementary functions. (algebraic functions, trigonometric functions, exponential functions, hyperbolic functions). First Shifting theorem, Second shifting theorem, Change of scale property, Laplace transform of derivatives, Laplace transform of Integrals.	4
	Unit-3	8	**Inverse Laplace Transform**: Definition of Inverse Laplace Transform, Linearity property, first and second shifting theorems, change of scale, Convolution theorem.	2
	Unit-5	12	**Applications of Fourier and Laplace transform**: Solution of Boundary value problems and initial value problems in 1-D and 2-D cases. Solution of Laplace and Poisson equations in 2-D cases**.**	3

Sheekon

Head
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