DEPARTMENT OF MATHEMATICS
CITY COLLEGE
LESSON PLAN FOR THE UNDERGRADUATE & POSTGRADUATE COURSE

ACADEMIC YEAR 2021-2022

DR. RITA CHANDA

SL. NO.	SEMESTER	CLASS	NAME OF TEACHER	TOPICS TO BE COVERED	NO. OF LECTURES	EXAMINATION
1	Odd Semester - 1,3,5 - July-December,2021	B.Sc. Hons Sem 1 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course-1: Calculus, Geometry & Vector Analysis <u>Unit 1: Calculus</u> • Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications, curvature, concavity and points of inflection, en velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Reduction formulae, derivations and illustrations of reduction formulae. Parametric equations, parametriz ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution.	25	Online Univ exam of UG Sem 1,3 & 5,2021

2	Odd Semester - 1,3,5 - July-December,2022	B.Sc. Gen. Sem 1 (CBCS Syllabus 2018)	DR. RITA CHANDA	GE1: <u>Unit-2 : Differential Calculus-I</u> • Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included). • Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity. • Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de creasing functions. Relation between continuity and derivability. Differential - application in finding approximation. • Successive derivative - Leibnitz's theorem and its application. • Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables. • Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).	20	

3	Odd Semester - 1,3,5 - July-December,2022	B.Sc. Hons Sem 3 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course-5: Theory of Real Functions <u>Unit 1 : Limit & Continuity of Functions</u> • Limits of functions (− δ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important limits. • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point. • Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main tenance of same sign. Continuous function on [a, b] is bounded and attains its bounds. Intermediate value theorem. • Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous. • Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval I will be uniformly continuous on I. A sufficient condition under which a continuous function on an unbounded open interval I will be uniformly continuous on I(statement only). Lipschitz condition and uniform continuity.	35+25	

				Unit 2: Differentiability of Functions • Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule. • Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of functions. Application of Taylor's theorem to inequalities. • Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems		
4	Odd Semester - 1,3,5 - July-December,2022	B.Sc. Gen. Sem 3 (CBCS Syllabus 2018)	DR. RITA CHANDA	GE3: Unit 1 : Integral Calculus • Evaluation of definite integrals. • Integration as the limit of a sum (with equally spaced as well as unequal intervals). • Reduction formulae and associated problems (m and n are non-negative integers). • Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. • Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.	10	

5	Odd Semester - 1,3,5 - July-December,2021	B.Sc. Hons Sem 5 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course 12: Group Theory II & Linear Algebra II <u>Unit 2: Linear Algebra</u> • Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties. • Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature. • Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).	35	
6	Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 2 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course 3: Real Analysis <u>Unit-1</u> • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R. • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R r Q are dense in R.	25+25	Online Univ exam of UG Sem 2,4 2022

				Unit-2 • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver gent sequence. Uniqueness of limit. Algebra of limits. • Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Mono tone sequences and their convergence. Sandwich rule. Nested interval theorem. Cauchy's first and second limit theorems. • Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence. A bounded sequence {xn} is convergent if and only if lim sup xn = lim inf xn. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence.		

7	Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 4 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course 8: Riemann Integration & Series of Functions <u>Unit-1 : Riemann integration</u> • Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum U(P, f) and lower Darboux sum L(P, f) and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Properties of Riemann integrable functions arising from the above results. • Function defined by definite integral and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus. <u>Unit-2 : Improper integral</u> • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product. • Convergence and working knowledge of Beta and Gamma function and their interrelation	30+25	

8	Even Semester - 2,4,6- January-June, 2022	B.Sc. Gen. Sem 4 (CBCS Syllabus 2018)	DR. RITA CHANDA	Unit-1 : Algebra-II • Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2×2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. • Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite number of vectors, Sub- space, Concepts of generators and basis of a finite dimensional vector space. Problems on formation of basis of a vector space (No proof required). • Real Quadratic Form involving not more than three variables (problems only). • Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem	10	
9	Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 6 (CBCS Syllabus 2018)	DR. RITA CHANDA	Core Course 13: Metric Space & Complex Analysis Unit-2 : Complex analysis • Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. • Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func tions. M¨obius transformation. • Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series. • Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.	35	

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ACADEMIC YEAR 2021-22

TEACHER: MASIUR RAHAMAN SARDAR

Academic Month	Class	Name of teacher	Topics to be covered	No. of lectures	Examination
July, 2021	(1)B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	Unit-3: Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's n-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence	6	
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		(1) Unit-2(Multivariate Calculus-II):Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem. (2) SEC B (Scientific computing with SageMath): Use of inbuilt functions that deal with matrices, determinant, inverse of a given real square matrix (if it exists), solving a system of linear equations, finding roots of a given polynomial, solving differential equations.	4+4	Internal Assessment and Tutorial Examination for Semester - II/IV/VI (Hons./Gen.) from 13.07.2021 to 28.07.2021 (Online mode)
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		(1) CC-14 Practical(Solution of ordinary differential equations): Runge Kutta method (order 4), The method of successive approximations (Picard) (2) DSE-B2(Point Set Topology): The concept of compactness in metric space, sequentially compactness of a metric space X and the Bolzano-Weiertrass property of X are equivalent	4+6	
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		DSE-B (Advanced Calculus): Expansions of elementary functions such as $e^x, sinx, log(1+x), (1+x)^n$, Simple problems	4	
August, 2021	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	Classes suspended for University examination	nil	
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		Classes suspended for University examination	nil	University examination for Semester - II/IV/VI (Hons./Gen.) from 29.07.2021 to 21.08.2021 (Online mode)
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		Classes suspended for University examination	nil	

	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		Classes suspended for University examination	nil	
September, 2021	(1) B.Sc. Hons, Sem: 3 (CBCS syllabus 2018)	Masiur Rahaman Sardar	(1) CC-7 (Unit-2 : Multivariate Calculus-I): Concept of neighbourhood of a point in $\mathbb{R}^n$ $(n > 1)$, interior point, limit point, open set and closed set in $\mathbb{R}^n$ $(n > 1)$, Functions from $\mathbb{R}^n$ $(n > 1)$ to $\mathbb{R}^m$ $(m \geq 1)$, limit and continuity of functions of two or more variables, Partial derivatives (2) SEC-A (C Programming Language): An overview of theoretical computers, history of computers, overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language and importance of C programming, Constants, Variables and Data type of C-Program : Character set, Constants and variables data types, expression, assignment statements, declaration, Operation and Expressions: Arithmetic operators, relational operators, logical operators	12+8	
	(2) B.Sc. Hons, Sem: 5 (CBCS syllabus 2018)		CC-11 (Probability and Statistics) Unit 1: Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probability space, Finite sample spaces, Conditional probability, Bayes theorem, independence, Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distributions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions: uniform, normal, exponential	24	
	(3) B.Sc. General, Sem: 5 (CBCS syllabus 2018)		DSE-A (Graph Theory): Definition, examples and basic properties of graphs, pseudographs, complete graphs, bipartite graphs, isomorphism of graphs	8	
October, 2021	(1) B.Sc. Hons, Sem: 1 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-1 (Calculus, Geometry and Vector Analysis) Unit-3 (Vector Analysis): Triple product, vector equations	4	
	(2) B.Sc. Hons, Sem: 3 (CBCS syllabus 2018)		(1) CC-7 (Unit-2 : Multivariate Calculus-I): total derivative and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters (2) SEC-A (C Programming Language): Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement,	4+4	
	(3) B.Sc. Hons, Sem: 5 (CBCS syllabus 2018)		CC-11 (Probability and Statistics) Unit 2: Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution	10	
	(4) B.Sc. General, Sem: 5 (CBCS syllabus 2018)		DSE-A (Graph Theory): Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem	6	

	(5) B.Com. General, Sem: 1 (CBCS syllabus 2018)		GE 1.1 Chg (Microeconomics I and Statistics (50+50)): Fundamentals: Definition of Statistics, Scope and limitation of Statistics, Attribute and variable, Primary and secondary data, Method of data collection, Tabulation of data, Graphs and charts, Frequency distribution, Diagrammatic presentation of frequency distribution	4	
November, 2021	(1) B.Sc. Hons, Sem: 1 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-1 (Calculus, Geometry and Vector Analysis) Unit-3 (Vector Analysis): applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions	12	
	(2) B.Sc. Hons, Sem: 3 (CBCS syllabus 2018)		(1) CC-7 (Unit-2 : Multivariate Calculus-I): directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes. Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems. (2) SEC-A (C Programming Language): Control Statements: While statement, do-while statement, for statement. Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.	12+8	
	(3) B.Sc. Hons, Sem: 5 (CBCS syllabus 2018)		CC-11 (Probability and Statistics) Unit 3: Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance	16	
	(4) B.Sc. General, Sem: 5 (CBCS syllabus 2018)		DSE-A (Graph Theory): shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm	8	
	(5) B.Com. General, Sem: 1 (CBCS syllabus 2018)		GE 1.1 Chg (Microeconomics I and Statistics (50+50)): Measures of Central Tendency:Meaning of central tendency, Common measures – mean (A.M., G.M., H.M.) median and mode, Partition values- quartiles, deciles and percentiles, Applications of different measures	4	
December, 2021	(1) B.Sc. Hons, Sem: 1 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-1 (Calculus, Geometry and Vector Analysis) Unit-3 (Vector Analysis): differentiation and integration of vector functions of one variable and related problems	9	
	(2) B.Sc. Hons, Sem: 3 (CBCS syllabus 2018)		SEC-A (C Programming Language): User-defined Functions : Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function, Introduction to Library functions: stdio.h, math.h, string.h stdlib.h, time.h etc, Some hands on examples are included.	18	
	(3) B.Sc. Hons, Sem: 5 (CBCS syllabus 2018)		CC-11 (Probability and Statistics) Unit 5: Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, onesided and twosided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values	15	
	(4) B.Sc. General, Sem: 5 (CBCS syllabus 2018)		DSE-A (Graph Theory): Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs	8	
	(5) B.Com. General, Sem: 1 (CBCS syllabus 2018)		GE 1.1 Chg (Microeconomics I and Statistics (50+50)): Measures of Dispersion:Meaning of dispersion,Common measure– range, quartile deviation, mean deviation and standard deviation; Relative measures of dispersion,Combined standard deviation,Applications of different measures	4	

January, 2022	(1) B.Sc. Hons, Sem: 1 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-2 (Algebra) Unit-3: Rank of a matrix, inverse of a matrix, characterizations of invertible matrices, 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	8	
	(2) B.Sc. Hons, Sem: 3 (CBCS syllabus 2018)		Classes suspended for Internal Assessment, Tutorial Examination and University Examination	nil	Internal Assessment and Tutorial Examination for Semester - III/V (Hons./Gen.) from 05.01.2022 to 10.01.2022 (Online mode)
	(3) B.Sc. Hons, Sem: 5 (CBCS syllabus 2018)		Classes suspended for Internal Assessment, Tutorial Examination and University Examination	nil	University Examination for Semester - III/V (Hons./Gen.) from 15.01.2022 to 01.02.2022 (Online mode)
	(4) B.Sc. General, Sem: 5 (CBCS syllabus 2018)		Classes suspended for Internal Assessment, Tutorial Examination and University Examination	nil	
	(5) B.Com. General, Sem: 1 (CBCS syllabus 2018)		GE 1.1 Chg (Microeconomics I and Statistics (50+50)): Moments, Skewness and Kurtosis: Different types of moments and their relationships, Meaning of skewness and kurtosis, Different measures of skewness, Measure of kurtosis, Applications of different measures	4	
February, 2022	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-3(Unit-2): Real sequence, Bounded sequence, Convergence and non-convergence and Examples, Boundedness of convergent sequence, Uniqueness of limit, Algebra of limits	2	
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		SEC-B(Scientific computing with SageMath): Introduction to SageMath, Installation Procedure, Use of SageMath as a Calculator, Numerical and symbolic computations using mathematical functions such as square root, trigonometric functions, logarithms, exponentiations etc.	5	
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		(1) CC-14 Practical: Calculate the sum $\frac{1}{1}+\frac{1}{2}+\frac{1}{3}+\cdots+\frac{1}{n}$, Enter 100 integers into an array and sort them in an ascending order (2) DSE-B2(Point Set Topology): Topological spaces, basis and subbasis for a topology, neighbourhoods of a point, interior points, limit points, derived set, boundary of a set, closed sets, closure and interior of a set, dense subsets, subspace topology	2+6	
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		DSE-B (Advanced Calculus): Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series, Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions and Simple applications	4	

March, 2022	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-3(Unit-2): Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequences, Cauchy's first and second limit theorems	4	Class Test on Sequence of real numbers
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		(1) CC-9 (Unit-2: Multivariate Calculus-II): Definition of vector field, divergence and curl, Line integrals, applications of line integrals: mass and work (2) SEC-B(Scientific computing with SageMath): Graphical representations of few functions through plotting in a given interval, like plotting of polynomial functions, trigonometric functions, Plots of functions with asymptotes, superimposing multiple graphs in one plot like plotting a curve along with a tangent on that curve (if it exists), polar plotting of curves, SageMath commands for differentiation, higher order derivatives, plotting $f(x)$ and $\frac{d}{dx}f(x)$ together, integrals, definite integrals etc.	10+8	
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		(1) CC-14 Practical(Solution of transcendental and algebraic equations by): Bisection method, Newton Raphson method (Simple root, multiple roots, complex roots), Secant method, Regula Falsi method (2) DSE-B2(Point Set Topology): First countability, T_1 and T_2 separation axioms of topological spaces, convergence and cluster point of a sequence in topological spaces and some related concepts on first countable as well as on T_2 spaces. Heine's continuity criterion	10+12	
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		DSE-B (Advanced Calculus): Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions	8	
April, 2022	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-3(Unit-2): Subsequence, Subsequential limits, lim sup as the L.U.B, and lim inf as the G.L.B of a set containing all the subsequential limits, Alternative definition of limsup and liminf of a sequence using inequality, Equivalence between these definitions, A bounded sequence is convergent if and only if lim sup = lim inf, Every sequence has a monotone subsequence	5	
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		(1) CC-9 (Unit-2: Multivariate Calculus-II): Fundamental theorem for line integrals, conservative vector fields, independence of path, Green's theorem, surface integrals, integrals over parametrically defined surfaces, Stoke's theorem, The Divergence theorem. (2) SEC-B(Scientific computing with SageMath): Introduction to Programming in SageMath, relational and logical operators, conditional statements, loops and nested loops, without using inbuilt functions write programs for average of integers, mean, median, mode, factorial, checking primes, checking next primes, finding all primes in an interval, finding gcd, lcm, finding convergence of a given sequence	10+8	Mid-term test on Scientific computing with SageMath
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		(1) CC-14 Practical(Numerical Integration): Trapezoidal Rule, Simpson's one third rule, Weddle's Rule, Gauss Quadrature (2) DSE-B2(Point Set Topology): Connected spaces, connected sets in $\mathbb{R}$, components, Compact spaces, compactness and T_2, compact sets in $\mathbb{R}$, Heine-Borel Theorem for $\mathbb{R}^n$, real valued continuous function on connected and compact spaces	10+14	Mid-term test on Point Set Topology
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		DSE-B (Advanced Calculus): Power Series, Determination of Radius of convergence of Power Series, Statement of properties of continuity of sum function power series, Term by term integration and Term by term differentiation of Power Series, Statements of Abel's Theorems on Power Series	8	

May, 2022	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	CC-3(Unit-2): Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence and related problems	3	Mid-term Test on Sequence of real numbers
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		SEC-B(Scientific computing with SageMath): Use of in-built functions that deal with matrices, determinants, inverse of a given real square matrix (if it exists), solving a system of linear equations, finding roots of a given polynomial, solving differential equations.	6	
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		(1) CC-14 Practical(Solution of ordinary differential equations): Runge Kutta method (order 4), The method of successive approximations (Picard) (2)DSE-B2(Point Set Topology): The concept of compactness in metric space, sequentially compactness of a metric space X and the BolzanoWeiertrass property of X are equivalent	6+8	
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		DSE-B (Advanced Calculus): Convergence of Power Series, Expansions of elementary functions such as $e^x, sinx, log(1+x), (1+x)^n$, Simple problems	6	
June, 2022	(1) B.Sc. Hons, Sem: 2 (CBCS syllabus 2018)	Masiur Rahaman Sardar	Class suspended due to Summer Recces	nil	
	(2) B.Sc. Hons, Sem: 4 (CBCS syllabus 2018)		Class suspended due to Summer Recces	nil	Internal Examination (MTMA, SEC-B, Scientific computing with SageMath) on 23.06.2022
	(3) B.Sc. Hons, Sem: 6 (CBCS syllabus 2018)		Class suspended due to Summer Recces	nil	(1) Internal Examination (MTMA, DSE-B2, Point Set Topology) on 17.06.2022 (2) Tutorial Examination (MTMA, DSE-B2, Point Set Topology) on 25.06.2022
	(4) B.Sc. General, Sem: 6 (CBCS syllabus 2018)		Classes suspended due to Summer Recces	nil	(1) Internal Examination (MTMG, DSE-B, Advanced Calculus) on 16.06.2022 (2) Tutorial Examination (MTMA, DSE-B, Advanced Calculus) on 24.06.2022

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LESSON PLAN FOR THE UNDERGRADUATE COURSE

ACADEMIC YEAR 2021-2022

Teacher : Syamsundar Dhara

Semester	CLASS	NAME OF TEACHER	TOPICS TO BE COVERED	NO. OF LECTURES	EXAMINATION
Odd Semester - 1,3,5 - July-December,2021	B.Sc. Hons Sem 1 (CBCS Syllabus 2018)	Syamsundar Dhara	**Core Course-2: Algebra** Unit-1 : Algebra • Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable. • Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method). • Inequality : The inequality involving AM ≥ GM ≥ HM, Cauchy-Schwartz inequality. • Linear difference equations with constant coefficients (up to 2nd order).	30	Online Univ exam of UG Sem 1,3 & 5,2021
Odd Semester - 1,3,5 - July-December,2022	B.Sc. Gen. Sem 1 (CBCS Syllabus 2018)	Syamsundar Dhara	**GE-1:** Unit-4 : Coordinate Geometry • Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants. • General equation of second degree in x and y : Reduction to canonical forms. Classification of conic. • Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by ax2 + 2hxy +by2 = 0. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. • Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola. • Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal. • Sphere and its tangent plane. Right circular cone.	20	

Odd Semester - 1,3,5 - July-December,2022	B.Sc. Hons Sem 3 (CBCS Syllabus 2018)	Syamsundar Dhara	**Core Course-7: Ordinary Differential Equation & Multivariate Calculus-I** Unit-1 : Ordinary differential equation • First order differential equations : Exact differential equations and integrating factors, special integrating factors and transformations, linear equations and Bernoulli equations, the existence and uniqueness theorem of Picard (Statement only). • Linear equations and equations reducible to linear form. First order higher degree equations solvable for x, y and p. Clairaut's equations and singular solution. • Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions. • Linear differential equations of second order, Wronskian : its properties and applications, Euler equation, method of undetermined coefficients, method of variation of parameters. • System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients. • Planar linear autonomous systems : Equilibrium (critical) points, Interpretation of the phase plane and phase portraits. • Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order).	40	
Odd Semester - 1,3,5 - July-December,2022	B.Sc. Gen. Sem 3 (CBCS Syllabus 2018)	Syamsundar Dhara	GE3: Unit-2 : Numerical Methods • Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percentage. • Operators - Δ, ∇ and E (Definitions and some relations among them). • Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of Newton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally- spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments. • Numerical Integration : Trapezoidal and Simpson's 1/3-rd formula (statement only). Problems on Numerical Integration. • Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems.	25	
Odd Semester - 1,3,5 - July-December,2021	B.Sc. Hons Sem 5 (CBCS Syllabus 2018)	Syamsundar Dhara	**DSE-A(1): Advanced Algebra** Unit-1: Group Theory • Group actions, stabilizers, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem. • 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 $n \geq 5$, non-simplicity tests. Unit-2: Ring Theory • Principal ideal domain, principal ideal ring, prime element, irreducible element, greatest common divisor (gcd), least common multiple (lcm), expression of gcd, examples of a ring R and a pair of elements $a, b \in R$ such that gcd(a, b) does not exist, Euclidean domain, relation between Euclidean domain and principal ideal domain. • Polynomial rings, division algorithm and consequences, factorization domain, unique factorization domain, irreducible and prime elements in a unique factorization domain, relation between principal ideal domain, unique factorization domain, factorization domain and integral domain, Eisenstein criterion and unique factorization in Z[x]. • Ring embedding and quotient field, regular rings and their examples, properties of regular ring, ideals in regular rings.	25+50	

Odd Semester - 1,3,5 - July-December,2021	B.Sc. Gen Sem 5 (CBCS Syllabus 2018)	Syamsundar Dhara	**DSE-B(1): Advanced Calculus** •Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary exponential, logarithm, trigonometric functions Simple problems. • Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. • Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.	60	
Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 2 (CBCS Syllabus 2018)	Syamsundar Dhara	**Core Course -4: Group Theory-I** Unit-2 • 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, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem.	25	Online Univ exam of UG Sem 2,4 2022
Even Semester - 2,4,6- January-June, 2022	B.Sc. Gen Sem-2 (CBCS Syllabus 2018)	Syamsundar Dhara	Unit-1 : Differential Calculus-II • Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence. Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application. • Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.Alembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. • Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like exponential, logarithm, trigonometric functions with restrictions wherever necessary. • Indeterminate Forms : L'Hospital's Rule : Statement and Problems only. • Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems. • Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only	15	

Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 4 (CBCS Syllabus 2018)	Syamsundar Dhara	**Core Course-9: Partial differential equation & Multivariate Calculus-II** Unit-1 : Partial differential equation • Partial differential equations of the first order, Lagrange's solution, non linear first order partial differential equations, Charpit's general method of solution, some special types of equations which can be solved easily by methods other than the general method. • Derivation of heat equation, wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order linear equations to canonical forms. • The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of finite and infinite string. Initial boundary value problems. Semi-infinite string with a fixed end, semi-infinite string with a free end. Equations with non-homogeneous boundary conditions. Non-homogeneous wave equation. Method of separation of variables, solving the vibrating string problem. Solving the heat conduction problem. **Core Course-10: Mechanics** Unit-2 • Virtual work : Workless constraints - examples, virtual displacements and virtual work. The principle of virtual work, Deductions of the necessary and sufficient conditions of equilibrium of an arbitrary force system in plane and space, acting on a rigid body. • Stability of equilibrium : Conservative force field, energy test of stability, condition of stability of a perfectly rough heavy body lying on a fixed body. Rocking stones.	40+10	
Even Semester - 2,4,6- January-June, 2022	B.Sc. Gen. Sem 4 (CBCS Syllabus 2018)	Syamsundar Dhara	GE-4: Unit-2 : Computer Science & Programming • Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. • Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a dataASCII, etc. • Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc. • Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.	25	

Even Semester - 2,4,6- January-June, 2022	B.Sc. Hons Sem 6 (CBCS Syllabus 2018)	Syamsundar Dhara	**DSE-A(2): Fluid Statics & Elementary Fluid Dynamics** Unit-1 • Introduction and Fundamental Concepts: Definition of Fluid, Distinction Between Solid and Fluid, Concept of Continuum, Fluid Properties : Density, Specific Weight, Specific Volume, Specific Gravity. Stress field [(Normal stress: σn = limδAn→0(δFn/δAn) and Shear stress: τn = limδAn→0(δFt/δAn)], Viscosity, Vapor pressure,. Newtonian fluid, Non-Newtonian Fluids. Ideal Fluid, Compressibility, Distinction between an Incompressible and a Compressible Flow, Surface Tension of Liquids. Forces on Fluid Elements: Definition of Fluid Elements, Body Force, Surface Force, Normal Stress in a Stationary Fluid, Pascal's Law of Hydrostatics, Fundamental Equation of Fluid Statics: ∇~ p = ρF~ , Fundamental Fluid Static Equations in Scalar Form: ∂p ∂z = ρg, Constant Density Solution. Unit-2 • Hydrostatics Hydrostatic Thrusts on Submerged Plane Surface: Centre of pressure, determination of coordinates of centre of pressure. Hydrostatic Thrusts on Submerged Curved Surfaces. Buoyancy: Center of the buoyancy. Archimedes principle. Stability of Unconstrained Submerged Bodies in Fluid: Stable Equilibrium, Unstable Equilibrium, Neutral Equilibrium. Stability of Floating Bodies in Fluid: Metacentre, Metacentric height. • Gas Pressure of gases, The Atmosphere, Relation between pressure, density and temperature, Pressure in an isothermal atmosphere, Atmosphere in convective equilibrium. Unit-3 • Kinematics of Fluid: Scalar and Vector Fields, flow field, Description of Fluid Motion: Lagrangian Method, Eulerian Method, Relation between Eulerian and Lagrangian Method, Variation of Flow Parameters in Time and Space: Steady and Unsteady Flow, Uniform and Non-uniform Flows. Material Derivative and Acceleration: temporal derivative, convective derivative Unit-4 • Conservation Equations: Control Mass System, Control Volume System, Isolated System. Conservation of Mass - The Continuity Equation: Differential Form and Vector Form, Integral form. Conservation of Momentum: Momentum Theorem, Reynolds Transport Theorem. Conservation of energy	20+25+15+15	

CITY COLLEGE
DEPARTMENT OF MATHEMATICS
LESSON PLAN FOR THE UNDERGRADUATE COURSE
ACADEMIC YEAR 2021-22

TEACHER: ***NIHAR SARKAR***

Academic Quarter	***Class***	***Name of Teacher***	***Topics to be covered***	***No. of lectures***	***Examination***
July, 2021 – September,2021	B.Sc. Hons, Sem-1 (CBCS Syllabus-2018)	NIHAR SARKAR	**Core Course-1:** **Unit-2 : Geometry** • Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics. • Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.	15	
	B.Sc. Hons, Sem-3 (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-6** **Unit-2 : Linear algebra** • Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of Rn, dimension of subspaces of Rn. Geometric significance of subspace.	20	
	B.Sc. Hons, Sem-5, (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-11** **Unit-4** • Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics. • Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distributions, Chi-square, t and F-distributions, sampling distribution of X, $s2$, p, n s $(X - \mu)$ • Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and variance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness,	15	

			consistency, sufficiency, Minimum-Variance Unbiased Estimator (MVUE). • Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.		
			Core Course-12 **Unit-1 : Group theory** • Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.	15	
	B.Sc. General, Sem-1, (CBCS syllabus 2018)	NIHAR SARKAR	**GE1** **Unit-1 : Algebra-I** Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^z ($a \neq 0$). Inverse circular and Hyperbolic functions. • Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications. • Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no real root or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric functions of roots, transformations of equations. Cardan's method of solution of a cubic equation. • Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistency and solution of a system of linear equations with not more than 3 variables by matrix method.	10	
	B.Sc. General, Sem-3, (CBCS syllabus	NIHAR SARKAR	**GE3** **Unit-3 : Linear Programming** • Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus	10	

	2018)		variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S. • The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions.		
October, 2021 – December,2021	B.Sc. Hons, Sem-1 (CBCS Syllabus-2018)	NIHAR SARKAR	**Core Course-1:** **Unit-2 : Geometry** • Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines. • Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.	15	Internal Assessment and Tutorial Examination for Semester 1,3 &5 (Online Mode) (Hons./Gen.) and Online Univ exam of UG Sem 1,3 & 5,2021.
	B.Sc. Hons, Sem-3 (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-6** **Unit-2 : Linear algebra** • Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamiltontheorem and its use in findingthe inverse of a matrix,	20	
	B.Sc. Hons, Sem-5, (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-12** **Unit-1 : Group theory** • External direct product and its properties, the group of units modulo *n* as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for	20	

			finite abelian group, Fundamental theorem of finite abelian groups.		
	B.Sc. General, Sem-1, (CBCS syllabus 2018)	NIHAR SARKAR	**GE1** **Unit-3 : Differential Equation-I** • Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE. • First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions. • Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations. • Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.	10	
	B.Sc. General, Sem-3, (CBCS syllabus 2018)	NIHAR SARKAR	**GE3** **Unit-3 : Linear Programming** • Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.	15	
January, 2022 -March, 2022	B.Sc. Hons, Sem-2 (CBCS Syllabus-2018)	NIHAR SARKAR	**Core Course-4** **Unit-2** • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group,	15	

	B.Sc. Hons, Sem-4 (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-9** **Unit-2 : Multivariate Calculus-II** • Multiple integral: Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Iterated or repeated integral, change of order of integration. Triple integral. Cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals. Transformation of double and triple integrals (problems only). Determination of volume and surface area by multiple integrals (problems only). Differentiation under the integral sign, Leibniz's rule (problems only).	15	
			Core Course- 10 **Unit-3** • **Kinematics of a particle :** velocity, acceleration, angular velocity, linear and angular momentum. Relative velocity and acceleration. Expressions for velocity and acceleration in case of rectilinear motion and planar motion - in Cartesian and polar co-ordinates, tangential and normal components. Uniform circular motion. • **Newton laws of motion and law of gravitation :** Space, time, mass, force, inertial reference frame, principle of equivalence and g. Vector equation of motion. Work, power, kinetic energy, conservative forces - potential energy. Existence of potential energy function. Energy conservation in a conservative field. Stable equilibrium and small oscillations: Approximate equation of motion for small oscillation. Impulsive forces**.**	20	
	B.Sc. Hons, Sem-6, (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-14** **Unit-4** • Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified	20	

			Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method. Numerical solution of system of nonlinear equations - Newton's method. **Unit-5** • System of linear algebraic equations : Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies. • Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LU decomposition method (Crout's LU decomposition method). • Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts). • The algebraic eigen value problem : Power method.		
			Discipline Specific Elective-A(2) **Unit-2** • **Hydrostatics** Hydrostatic Thrusts on Submerged Plane Surface: Centre of pressure, determination of coordinates of centre of pressure. Hydrostatic Thrusts on Submerged Curved Surfaces. Buoyancy: Center of the buoyancy. Archimedes principle. Stability of Unconstrained Submerged Bodies in Fluid: Stable Equilibrium, Unstable Equilibrium, Neutral Equilibrium. Stability of Floating Bodies in Fluid: Metacentre, Metacentric height.	10	
			Core Course-14 Practical 4. Solution of system of linear equations i) LU decomposition method ii) Gaussian elimination method iii) Gauss-Jacobi method iv) Gauss-Seidel method 5. Interpolation i) Lagrange Interpolation ii) Newton's forward, backward and divided difference interpolations	10	
	B.Sc. General, Sem-2, (CBCS syllabus 2018)	NIHAR SARKAR	**GE2** **Unit-3 : Vector Algebra** • Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equation	15	

			of plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment). **Unit-4 : Discrete Mathematics** • Integers: Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbitrary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers ˆa" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation ˆa" when such an equation has solution, some applications.		
April, 2022 – June,2022	B.Sc. Hons, Sem-2 (CBCS Syllabus-2018)	NIHAR SARKAR	**Core Course-4** **Unit-2** • Properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem.	10	Internal Assessment and Tutorial Examination for Semester 2, 4 & 6 (Online Mode) (Hons./Gen.) and Online Univ exam of UG Sem 2,4 & 6,2022.
	B.Sc. Hons, Sem-4 (CBCS syllabus 2018)	NIHAR SARKAR	**Core Course-9** **Unit-2 : Multivariate Calculus-II** • Definition of vector field, divergence and curl. Line integrals, applications of line integrals : mass and work. Fundamental theorem for line integrals, conservative vector fields, independence of path. • Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.	20	
			Core Course- 10 **Unit-5** • **Many particles system** **The linear momentum principle :** Linear momentum, linear momentum principle,	10	

			motion of the centre of mass, conservation of linear momentum. • **The angular momentum principle :** Moment of a force about a point, about an axis. Angular momentum about a point, about an axis. Angular momentum principle about centre of mass. Conservation of angular momentum (about a point and an axis). Impulsive forces. • **The energy principle :** Configurations and degrees of freedom of a multi-particle system, energy principle, energy conservation. Rocket motion in free space and under gravity, collision of elastic bodies. The two-body problem.		
	B.Sc. Hons, Sem-6 (CBCS syllabus 2018)		**Core Course-14** **Unit-6** [5 classes] • Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.	5	
			Discipline Specific Elective-A(2) **Unit-2 (5)** • **Gas** Pressure of gases, The Atmosphere, Relation between pressure, density and temperature, Pressure in an isothermal atmosphere, Atmosphere in convective equilibrium.	5	
			Core Course-14 Practical 6. Numerical Integration i) Trapezoidal Rule ii) Simpson's one third rule iii) Weddle's Rule iv) Gauss Quadrature 7. Method of finding Eigenvalue by Power method (up to 4 × 4) 8. Fitting a Polynomial Function (up to third degree) 9. Solution of ordinary differential equations i) Euler method ii) Modified Euler method iii) Runge Kutta method (order 4) iv) The method of successive approximations (Picard)	15	
	B.Sc. General, Sem-2, (CBCS	NIHAR SARKAR	**GE2** **Unit-4 : Discrete Mathematics** • Congruences : Congruence relation on integers, Basic properties of this relation.	20	

	syllabus 2018)		Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence ˆa" to show it is an equivalence relation, to prove the following : $a \_ b$ (mod m) implies (I) $(a + c) \_ (b + c)$ (mod m) (Ii) $ac \_ bc$ (mod m) (Iii) $an \_ bn$ (mod m), for any polynomial $f(x)$ with integral coefficients $f(a) \_ f(b)$ (mod m) etc. Linear Congruence, to show how to solve these congruences, Chinese remainder theorem ˆa" Statement and proof and some applications. System of linear congruences, when solution exists ˆa" some applications. • Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides $(b - 1)$ then $n = (akak{-}1a1b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers ˆa" International standard book number, universal product code etc. Theorem regarding error detecting capability. • Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement, proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.		

Rita Chandra.

12.07.2021