DEPARTMENT OF MATHEMATICS

Syllabus Distribution and Teaching Plan

EVEN SEMESTER, Session: 2022-2023

Term I: Commencement of classes to 1st internal,
Term II: 1st internal to 2nd internal.
Term III: 2nd internal to ESE preparatory break.

Semester II

Name of the Teacher	Syllabus Allotted	Teaching Plan
Dr. Bimal Krishna Das	**Course type:** Mathematics (Honours) Core Course **Paper-** C3T ***No. of Classes (Hour) per week*: 2** **Unit-III: Infinite Series:** (Marks-18) Infinite series, convergence and divergence of infinite series, Cauchy criterion, tests for convergence: comparison test, limit comparison test, ratio test, Cauchy's nth root test, integral test. Alternating series, Leibniz test. Absolute and conditional convergence.	**Term I: (08 Lectures)** **Lecture 1:** Introduction to Infinite series **Lecture 2:** Convergence and divergence of infinite series-I **Lecture 3:** Convergence and divergence of infinite series-II **Lecture 4:** Related problem solution **Lecture 5:** Cauchy criterion and its proof **Lecture 6:** Solution of problems based on Cauchy criterion **Lecture 7:** Tests for convergence: comparison test and its proof. **Lecture 8:** Related problem solution **Term II: (11 Lectures)** **Lecture 9:** Tests for convergence: limit comparison test and its proof **Lecture 10:** Related problem solution **Lecture 11:** D' Alembert Ratio test and its proof **Lecture 12:** Related problem solution **Lecture 13:** Tests for convergence: Cauchy's nth root test and its proof **Lecture 14:** Related problem solution **Lecture 15:** Tests for convergence: Integral test and its proof **Lecture 16:** Related problem solution **Lecture 17:** Alternating series and related problems **Lecture 18:** Leibniz test and its proof **Lecture 19:** Related problem solution **Term III: (05 Lectures + 02 Tutorials)** **Lecture 20:** Absolute convergence and related theorems **Lecture 21:** Solution of problems related to absolute convergence **Lecture 22:** Conditional convergence and related theorems **Lecture 23:** Solution of problems related to conditional convergence **Lecture 24:** Raabe's test (Statement without proof), Gauss test (Statement without proof), Miscellaneous problems solving techniques **Tutorial -1** **Tutorial -2**

<table>
<tr>
<td>Dr. Pradip Kumar Gain</td>
<td>Course type: Mathematics (Honours) Core Course

Paper- C3T
No of Classes (Hour) per week: 2

Unit-I: Real Analysis:
(Marks-24)
Review of algebraic and order properties of R, ε-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. Completeness property of R and its equivalent properties. The Archimedean property, density of rational (and Irrational) numbers in R, intervals. Limit points of a set, isolated points, open set, closed set, derived set, illustrations of Bolzano-Weierstrass theorem for sets, compact sets in R, Heine-Borel Theorem.</td>
<td><u>Term I</u>: (10 Lectures + 01 Tutorials)

Lecture-1: Number System, concept of natural number, well ordering principle, Integers,
Lecture-2: Rational Numbers Irrational numbers
Lecture-3: Algebraic structure and order structure of Q.
Lecture-4: Review of algebraic and order properties of . R .
Lecture-5: ε-neighborhood of a point in R. Interior point, exterior point, boundary point, open set, examples of open sets, properties of open sets.
Lecture-6: Countability, equivalent set, enumerable sets, countable sets, examples of countable sets. atmost countable sets, uncountable sets
Lecture-7: Theorems on countable sets. Problems on countable sets
Lecture-8: Q is countable set. The set $(0,1)$ is not enumerable,
Lecture-9: The Closed interval $[a,b]$ is uncountable.
Lecture-10: Uncountability of R.
Tutorial-1

<u>Term II</u>: (06 Lectures + 02 Tutorials)

Lecture-11: Intervals, bounded sets, examples
Lecture-12: Concept of Supremum and infimum, Greatest and smallest member of a set.
Lecture-13: Completeness property of R. L.u b axiom
Lecture-14: G.l.b axiom
Lecture-15: Archimedean property R
Lecture-16: Density property R
Tutorial-2
Tutorial-3
<u>Term III</u>: (06 Lectures + 02 Tutorials)

Lecture-17: Limit points, isolated points, derived sets, Closed sets, closure of a set.
Lecture-18: Theorems on closed sets,
Lecture-19:. Properties of closed sets.
Lecture-20: Bolzano-Weierstrass theorem for sets,
Lecture-21: Covering, sub covering, open covering, examples
Lecture-22: Compact sets in R, Heine-Borel Theorem.
Tutorial-4
Tutorial-5</td>
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<td></td>
<td>Course type: Mathematics (General) Core Course

Paper- DSC1B/2B/3B-T
No of Classes (Hour) per week: 2

Differential Equations:
(Marks-30)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p.</td>
<td><u>Term I</u>: (07 Lectures + 02 Tutorials)

Lecture-1: First order exact differential equations.
Lecture-2: Integrating factors, rules to find an integrating factor.
Lecture-3: Equations solvable by separation of variables.
Lecture-4: Homogeneous equations of first degree.
Lecture-5: Linear equations of first degree, Bernoulli's Equations.
Lecture-6: First order higher degree equations solvable for x and solvable for y.
Lecture-7: First order higher degree equations solvable for p.
Tutorial-1
Tutorial-2</td>
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	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. 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.	<u>**Term II**</u>: **(05 Lectures + 02 Tutorials)** **Lecture-8:** Basic theory of linear differential equations. **Lecture-9:** Wronskian, and its properties. **Lecture-10:** Solving differential equation by reducing its order. **Lecture-11:** Linear homogenous equations with constant coefficients **Lecture-12:** Same as Lecture-10. **Tutorial-3** **Tutorial-4** <u>**Term III**</u>: **(05 Lectures + 03 Tutorials)** **Lecture-13:** Linear non-homogenous equations, **Lecture-14:** The method of variation of parameters, **Lecture-15:** The Cauchy-Euler equation, **Lecture-16:** Simultaneous differential equations, **Lecture-17:** Total differential equations. **Tutorial-5** **Tutorial-6** **Tutorial-7**
Dr. Sangita Chakraborty	**Course type:** Mathematics (Honours) Core Course **Paper-** C4T ***No of Classes (Hour) per week*:** **3** **Unit-III: Differential Equations:** (Marks- 9) Equilibrium points, Interpretation of the phase plane, Power series solution of a differential equation about an ordinary point, solution about a regular singular point. **Unit-IV: Vector Calculus:** (Marks-16) Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.	<u>**Term I**</u>: **(08 Lectures + 02 Tutorials)** **Lecture 1:** Introduction to product of three vectors: Scalar Triple product and Vector Triple product, **Lecture 2:** Geometrical significance of scalar triple product, properties of Triple products. **Lecture 3:** Applications of Triple products in geometrical problems. Lecture 4: Continuation of the topic in Lecture 3. Lecture 5: Applications of Triple products in mechanics. Lecture 6: Reciprocal system of vectors. Lecture 7: Introduction to vector functions, operations with vector-valued functions. Lecture 8: Limits and continuity of vector functions. **Tutorial-1** **Tutorial-2** ***Doubt-clearing session:*** <u>**Term II**</u>: **(08 Lectures + 02 Tutorials)** **Lecture 9:** Differentiation of vector functions. **Lecture 10:** Integration of vector functions. **Lecture 11:** Problems solving for differentiation and integration of vector functions. **Lecture 12:** Introduction to Equilibrium points for system of differential equations, concepts of trajectories. **Lecture 13:** Concepts of Phase portrait and the phase plane with examples. **Lecture 14:** Types and stability classifications of equilibrium solutions. **Lecture 15:** Continuation of the topic in Lecture 14. **Lecture 16:** Behaviour of trajectory sets, **Lecture 17:** Interpretation of the phase plane. **Tutorial-3** **Tutorial-4** ***Doubt-clearing session:***

		Term III: **(09 Lectures + 03 Tutorials)** **Lecture 18:** Introduction to Power series, definitions: ordinary points, singular points. **Lecture 19:** Types of singular points in linear homogeneous differential equation. **Lecture 20:** To locate and classify the singular points in the differential equations. **Lecture 21:** Series solution of a differential equation about an ordinary point. **Lecture 22:** Continuation of the topic in Lecture 21. **Lecture 23:** Continuation of the topic in Lecture 21. **Lecture 24:** Series solution of a differential equation about a regular singular point. **Lecture 25:** Continuation of the topic in Lecture 24. **Lecture 26:** Continuation of the topic in Lecture 24. **Tutorial-5** **Tutorial-6:** **Tutorial-7:** ***Doubt-clearing session:*** ***Doubt-clearing session:***
Sankar Das	**Course type:** Mathematics (Honours) Core Course **Paper-** C4T ***No of Classes (Hour) per week*:** **2** **Unit-1: Differential Equations:**(Marks-22) Lipschitz condition and Picard's Theorem (Statement only). 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. **Unit-2: Differential Equations:** (Marks-13) 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	**Term I**: **(08 Lectures + 02 Tutorials)** **Lecture 1:** Introduction of Second order linear differential equations. **Lecture 2:** Linear differential equations of orders higher than the second. **Lecture 3:** Lipschitz condition and Picard's Theorem. **Lecture 4:** General solution of homogeneous equation of second order, principle of super position for homogeneous equation. **Lecture 5:** Wronskian: its properties and applications. **Lecture 6:** Linear operator with constant coefficients: Complementary function. **Lecture 7:** Particular Integral of a differential equation. **Lecture 8:** Short method of Particular Integral of a differential equation. **Tutorial-1** **Tutorial-2** **Term II**: **(06 Lectures + 02 Tutorials)** **Lecture 9:** Linear homogeneous and non-homogeneous equations of higher order with constant coefficients. **Lecture 10:** The Cauchy-Euler equations. **Lecture 11:** Solving a linear differential equation by the method of undetermined coefficients. **Lecture 12:** The method of variation of parameters. **Lecture 13:** Miscellaneous types of linear differential equations. **Lecture 14:** Solution of differential equations by changing dependent variable. **Tutorial-3** **Tutorial-4**

	Equations in two unknown functions.	**Term III: (05 Lectures + 03 Tutorials)** **Lecture 15:** Systems of linear differential equations, **Lecture 16:** Types of linear systems, differential operators, **Lecture 17:** An operator method for linear systems with constant coefficients. **Lecture 18:** Basic Theory of linear systems in normal form. **Lecture 19:** homogeneous linear systems with constant coefficients: Two Equations in two unknown functions. **Tutorial-5** **Tutorial-6** **Tutorial-7**
	Course type: Mathematics (General) Core Course **Paper-** DSC1B/2B/3B-T ***No of Classes (Hour) per week*: 2** **Differential Equations:** (Marks-30) 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. Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	**Term I: (07 Lectures + 03 Tutorials)** **Lecture 1:** Introduction of Partial differential equations (PDE). **Lecture 2:** Order and degree of partial differential equations. **Lecture 3:** Concept of linear and non-linear PDEs. **Lecture 4:** Concept of Quasi-linear and semi-linear PDEs. **Lecture 5:** Formation of first order PDEs by eliminating arbitrary constants. **Lecture 6:** Formation of first order PDEs by eliminating arbitrary functions. **Lecture 7:** Linear partial differential equation of first order. **Tutorial-1** **Tutorial-2** **Tutorial-3** **Term II: (05 Lectures + 03 Tutorials)** **Lecture 8:** Linear partial differential equation of second order. **Lecture 9:** Lagrange's Auxiliary Equations a linear PDE. **Lecture 10:** Lagrange's method to solve a linear PDE. **Lecture 11:** Find the integral surface of a linear PDE through a given curve. **Lecture 12:** Solving the PDE of first order by Charpit's method. **Tutorial-4** **Tutorial-5** **Tutorial-6** **Term III: (04 Lectures + 03 Tutorials)** **Lecture 13:** Some special method for solving non-linear PDEs. **Lecture 14:** Classification of second order PDEs into elliptic type. **Lecture 15:** Classification of second order PDEs into parabolic type. **Lecture 16:** Classification of second order PDEs into hyperbolic type through illustrations. **Tutorial-7** **Tutorial-8** **Tutorial-9**

Anjana Mondal	**Course type:** Mathematics (Honours) Core Course **Paper-** C3T ***No of Classes (Hour) per week*: 2** **Unit-II: Real Sequence:** (Marks-18) Sequences, bounded sequence, convergent sequence, limit of a sequence, lim inf, lim sup. 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.	**<u>Term I</u>: (07 Lectures + 02 Tutorials)** **Lecture 1:** Some preliminaries on the properties of real number system and real function **Lecture 2:** Definition of sequences, definition of real sequences, range of sequences, some examples, difference between sequences and sets **Lecture 3:** Convergent sequences, limit of a sequence, geometrical interpretation of convergent sequences, examples of convergent sequences, technique of proving convergent sequence using $\epsilon - \delta$ definition. **Lecture 4:** Divergent sequences, bounded sequences, relation between convergent and bounded sequences **Tutorial-1** **Lecture 5:** Some theorems on convergent sequences **Lecture 6:** Limit point of sequences, difference between limit and limit point of sequences **Lecture 7:** Algebraic properties of limit of sequences and applications. **Tutorial-2** **<u>Term II</u>: (06 Lectures + 02 Tutorials)** **Lecture 8:** Sandwich theorem and applications **Lecture 9:** Monotone sequences, Monotone convergence theorem **Lecture 10:** Some applications of Monotone convergence theorem **Tutorial-3** **Lecture 11:** Subsequence, divergence criteria, applications **Lecture 12:** Monotone subsequence theorem, applications **Tutorial-4** **Lecture 13:** The Bolzano Weierstrass theorem, applications. **<u>Term III</u>: (06 Lectures + 03 Tutorials)** **Lecture 14:** Limit superior and Limit inferior, applications **Tutorial-5** **Lecture 15:** Cauchy sequence and related theorems **Lecture 16:** Cauchy convergence criterion, applications **Tutorial-6** **Tutorial-7** **Lecture 17:** Revision **Lecture 18:** Revision **Lecture 19:** Revision

Kousik Bhattacharya	**Course type:** Mathematics Generic Elective **Paper- GE2T** ***No of Classes (Hour) per week*:** **2** **Unit I: Classical Algebra:** (Marks-22) Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. Theory of equations, Relation between roots and coefficients, transformation of equation, Descartes rule of signs, cubic and biquadratic equation. Inequality, The inequality involving AM≥ GM≥ HM, Cauchy-Schwartz inequality. **Unit II: Sets and Integers:** (Marks-15) 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.	**<u>Term I</u>: (06 Lectures + 02 Tutorials)** **Lecture 1:** Introduction of complex numbers, Polar representation of complex numbers, nth roots of unity **Lecture 2:** De Moivre's theorem for rational indices, Application of De Moivre's theorem **Lecture 3:** Relation between roots and coefficients, Transformation of equations **Lecture 4:** Theory and Applications of Descartes rule of signs **Lecture 5:** Solution of cubic equation **Lecture 6:** Solution of Biquadratic equation **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (08 Lectures + 02 Tutorials)** **Lecture 7:** Concept of the inequality AM≥ GM≥ HM, Statement and proof of Cauchy-Schwartz inequality **Lecture 8:** Introduction to Set and Relations, Properties of Equivalence relations **Lecture 9:** Different properties of functions **Lecture 10:** Composition of functions, Properties of Invertible functions **Lecture 11:** Application of one-to-one correspondence, Cardinality of sets **Lecture 12:** Well-ordering property of positive integers division algorithm **Lecture 13:** Divisibility and Euclidean algorithm **Lecture 14:** Congruence relation between integers **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (04 Lectures + 02 Tutorials)** **Lecture 15:** Principles of Mathematical induction **Lecture 16:** Different kinds of problems of Mathematical induction **Lecture 17:** Statement and application of Fundamental Theorem of Arithmetic **Lecture 18:** Problems related to Fundamental theorem of Arithmetic **Tutorial-5** **Tutorial-6** ***Doubt clearing session:*** ***Doubt clearing session:***

Buddhadeb Mondal	**Course type:** Mathematics Generic Elective **Paper- GE2T** ***No of Classes (Hour) per week*: 2** **Unit III: Systems of linear equations:** (Marks-09) Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of system of linear equations, linear independence. **Unit IV:** **Linear Transformation and Eigen Values:** (Marks- 14) Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n Rank of a matrix, Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix	**<u>Term I:</u> (07 Lectures + 02 Tutorials)** **Lecture 1:** Introduction to systems of linear equations **Lecture 2:** Row reduction and echelon forms, vector equations **Lecture 3:** The matrix equation Ax=b with examples **Lecture 4:** solution of system of linear equations **Lecture 5:** Applications of system of linear equations **Lecture 6:** Linear independence and dependence **Lecture 7:** Applications **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (07 Lectures + 02 Tutorials)** **Lecture 8:** Introduction to linear transformations with an example **Lecture 9:** Matrix of a linear transformation with an example **Lecture 10:** Inverse of a matrix with an example **Lecture 11:** Characterizations of invertible matrices **Lecture 12:** Subspaces of R^n **Lecture 13:** Dimension of subspaces of R^n **Lecture 14:** Examples solve **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (04 Lectures + 02 Tutorials)** **Lecture 15:** Rank of a matrix with an example **Lecture 16:** Eigen values, eigen vectors and characteristic equation of a matrix **Lecture 17:** Cayley-Hamilton theorem with an example **Lecture 18:** Finding the inverse of a matrix using Cayley-Hamilton theorem **Tutorial-5** **Tutorial-6**

Semester IV

Name of the Teacher	Syllabus Allotted	Teaching Plan
Dr. Bimal Krishna Das	**Course type:** Mathematics (Honours) Core Course **Paper-** C8T ***No of Classes (Hour) per week*:** **3** **Unit-II: Improper integrals:** (Marks- 11) Improper integrals, Convergence of Beta and Gamma functions **Unit-IV: Fourier Series:** (Marks- 07) Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition. Examples of Fourier expansions and summation results for series. **Unit-V: Power Series:** (Marks- 07) Power series, radius of convergence, Cauchy Hadamard theorem. Differentiation and integration of power series; Abel's theorem; Weierstrass approximation theorem.	**Term I: (11 Lectures + 02 Tutorials)** **Unit-II: Improper integrals** Lecture 1: Introduction to Improper integrals Lecture 2: Improper integrals on a closed and bounded interval, the integrand having infinite discontinuities Lecture 3: Different typical examples Lecture 4: Tests for convergence, positive integrand and related theorems Lecture 5: Comparison test and its proof Lecture 6: Different theorems and their proofs regarding improper integrals Lecture 7: Improper integrals on an unbounded interval Lecture 8: Beta functions and their properties Lecture 9: Gamma function and their properties Lecture 10: Solutions of related problems Lecture 11: Convergence of Beta and Gamma functions **Tutorial-1** **Tutorial-2** **Term II: (11 Lectures + 02 Tutorials)** **Unit-IV: Fourier Series** Lecture 12: Introduction to Fourier series Lecture 13: Definition of Fourier coefficients and series Lecture 14: Properties of Fourier coefficients and series Lecture 15: Related problem solution on Fourier series Lecture 16: Reimann Lebesgue lemma Lecture 17: Related problems on Reimann Lebesgue lemma Lecture 18: Bessel's inequality and related problems Lecture 19: Parseval's identity and related problems Lecture 20: Dirichlet's condition and its proof Lecture 21: Examples of Fourier expansions Lecture 22: Summation results for series **Tutorial-3** **Tutorial-4** **Term III: (11 Lectures + 02 Tutorials)** **Unit-V: Power Series** Lecture 23: Introduction of power series Lecture 24: Examples and different properties of power series Lecture 25: Radius of convergence of power series Lecture 26: Interval of convergence of power series Lecture 27: Related problems on radius of convergence of power series Lecture 28: Cauchy Hadamard theorem and its proof Lecture 29: Related problems on Cauchy Hadamard theorem Lecture 30: Differentiation of power series and related problems Lecture 31: Integration of power series and related problems Lecture 32: Abel's theorem and its application Lecture 33: Weierstrass approximation theorem and its application **Tutorial-1** **Tutorial-2**

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<td rowspan="2">Dr. Pradip Kumar Gain</td>
<td>Course type: Mathematics (Honours) Core Course

Paper- C8T
No of Classes (Hour) per week: 1

Unit-I: Riemann integration (Marks-19)

Inequalities of upper and lower sums, Darboux integration, Darboux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two definitions. Riemann integrability of monotone and continuous functions, properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorem of Integral Calculus.</td>
<td><u>Term I</u>: (05 Lectures + 01 Tutorials)

Lecture-1. Inequalities of upper and lower sums, Darboux integration, Riemann integration.
Lecture-2. Darboux theorem, Riemann conditions of integrability,
Lecture-3. Riemann sum and definition of Riemann integral through Riemann sums.
Lecture-4. Equivalence of two definitions.
Lecture-5. Problems
Tutorial-1

<u>Term II</u>: (04 Lectures + 01 Tutorials)

Lecture-6. Riemann integrability of monotone and continuous functions,
Lecture-7. Properties of the Riemann integral.
Lecture-8. Definition and integrability of piecewise continuous and monotone functions.
Lecture-9. Problems
Tutorial-2

<u>Term III</u>: (05 Lectures + 01 Tutorials)

Lecture-10. Intermediate Value theorem for Integrals, first mean value theorem.
Lecture-11. Second mean value theorem (Bonnet form)
Lecture-12. Second mean value theorem (Weierstrass form)
Lecture-13. Fundamental theorem of Integral Calculus.
Lecture-14. Some examples and problems on Riemann integration.
Tutorial-3</td>
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<td>Course type: Mathematics (Honours) Skill Enhancement Course
Paper- SEC-2T
No of Classes (Hour) per week: 1

Unit-I: Graph Theory : (Marks-09)
Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs.

Unit-II: Graph Theory : (Marks-14)
Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles, theorems Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.</td>
<td><u>Term I</u>: (05 Lectures + 01 Tutorials)

Lecture-1. Definition, examples and basic properties of graphs
Lecture-2. Simple graphs, Multi graphs, Trivial graphs, Handshaking lemma
Lecture-3. Some Important Theorems on graphs
Lecture-4. Complete graphs, bipartite graph, pseudo graphs, regular Graph, planar graphs
Lecture-5. Isomorphism of graphs. Problems
Tutorial-1
<u>Term II</u>: (04 Lectures + 01 Tutorials)
Lecture-6. Walk, Trial, Path, Circuit, cycle
Lecture-7. Eulerian trial, Eulerian circuit, Eulerian graph
Lecture-8. Some important theorems
Lecture-9. Hamiltonian cycles, theorems
Tutorial-2
<u>Term III</u>: (03 Lectures + 01 Tutorials)
Lecture-10. Representation of a graph by matrix, the adjacency matrix of a graph
Lecture-11. Incidence matrix of a graph, examples
Lecture-12. Weighted graph, Exercise
Tutorial-3</td>
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Dr. Sangita Chakraborty	**Course type:** Mathematics (Honours) Core Course **Paper-** C9T**:** ***No of Classes (Hour) per week*: 1** **Unit-III: Vector Field and Line Integration:** (Marks-16) 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. **Unit-IV: Green's, Stoke's and Divergence Theorem:** (Marks: 09) Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.	**<u>Term I</u>: (06 Lectures + 01 Tutorials)** **Lecture 1:** Introduction to three field operators: the gradient of a scalar field, the divergence and the curl of a vector field. **Lecture 2:** significance of divergence and curl of a vector field. **Lecture 3:** Formula relating the three field operators with some useful examples. **Lecture 4:** introduction to directional derivative and solving some problems. **Lecture 5:** Irrotational vector, solenoidal vector with solving some problems. **Lecture 6:** Finding the equations of the tangent plane and normal line to the surface. **Tutorial-1** ***Doubt-clearing session:*** **<u>Term II</u>: (03 Lectures + 01 Tutorials)** **Lecture 7:** Recapitulation: Vector integration. Introduction to Line integrals: definition and examples. **Lecture 8:** Applications of line integrals: mass and work. **Lecture 9:** Fundamental theorem for line integrals, conservative vector field and its relation with the irrorational vector field. Independence of path and its relation with the line integrals. **Tutorial-2** ***Doubt-clearing session:*** **<u>Term III</u>: (05 Lectures + 02 Tutorials)** **Lecture 10:** Introduction to Surface integrals and Volume integrals, its definition and examples. **Lecture 11:** Green's theorem, integrals over parametrically defined surfaces. **Lecture 12:** Stoke's theorem. **Lecture 13:** The Divergence theorem of Gauss **Lecture 14:** Verification of the above theorems. **Tutorial-3** **Tutorial-4** ***Doubt-clearing session:***
	Course type: Mathematics (Honours) Core Course **Paper-** C10T ***No of Classes (Hour) per week*: 2** **Unit-I: Ring Theory** (Marks: 16) 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-II:Ring homomorphisms** (Marks: 09) Ring homomorphisms,	**<u>Term I</u>: (07 Lectures + 02 Tutorials)** **Lecture 1:** Definition and examples of rings, properties of rings, concepts of zero ring and trivial ring. **Lecture 2:** Units in the ring of integral quaternions, divisors of zero with examples. **Lecture 3:** Definition and examples of Integral domain. **Lecture 4:** Characteristic of a ring and an integral domain, idempotent and nilpotent elements with examples. **Lecture 5:** Definition and examples of Skew field and Fields, properties of fields. **Lecture 6:** Definition and examples of subrings, necessary and sufficient conditions for a nonempty subset of a ring to be a subring. **Lecture 7:** Theorems and problems relating subrings. **Tutorial-1:** **Tutorial-2:** ***Doubt-clearing session:***

	properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.	**Term II**: **(07 Lectures + 02 Tutorials)** **Lecture 8:** Definition of Ideals of a ring, necessary and sufficient conditions to be an ideal. **Lecture 9:** Examples of ideals, problems solving on ideals, **Lecture 10:** Operations on ideals. **Lecture 11:** Theorems relating ideals. **Lecture 12:** Ideal generated by a subset of a ring. Definition and examples of principal ideal. **Lecture 13:** Definitions and examples: prime ideal in a ring. **Lecture 14:** Definitions and examples: maximal ideal in a ring. **Tutorial-3:** **Tutorial 4:** ***Doubt-clearing session:*** **Term III**: **(07 Lectures + 02 Tutorials)** **Lecture 15:** Introduction to factor rings with examples and properties, connection with prime and maximal ideals. **Lecture 16:** Introduction to Homomorphism and Isomorphism of rings, **Lecture 17:** Examples and properties of ring homomorphisms. **Lecture 18:** Field of quotients. **Lecture 19:** Isomorphism theorem I with proof. **Lecture 20:** Isomorphism theorem II with proof. **Lecture 21:** Isomorphism theorem III with proof. **Tutorial-5:** **Tutorial-6:** ***Doubt-clearing session:*** ***Doubt-clearing session:***
Sankar Das	**Course type:** Mathematics (Honours) Core Course **Paper-** C9T ***No of Classes (Hour) per week*:** **3** **Unit-I: Functions of several variables:** (Marks-21) Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, 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.	**Term I**: **(12 Lectures + 02 Tutorials)** **Lecture 1:** Introduction of functions of several variables. **Lecture 2:** Explicit and Implicit functions. **Lecture 3:** Limit point and limit of a function of two variables. **Lecture 4:** Repeated limit and Simultaneous limit of a function of two variables. **Lecture 5:** Continuity of a function of two variables. **Lecture 6:** Discontinuity of a function of two variables. **Lecture 7:** Sufficient condition for continuity of a function of two variables. **Lecture 8:** Partial differentiation of a function. **Lecture 9:** Total differentiability and differentiability. **Lecture 10:** Sufficient condition for differentiability. **Lecture 11:** Partial derivatives of higher order. **Lecture 12:** Young's theorem and Schwarz's theorem. **Tutorial-1:** **Tutorial-2:** **Term II**: **(09 Lectures + 03 Tutorials)** **Lecture 13:** Differentials of higher order. **Lecture 14:** The derivation of composite functions: Chain rule for one and two independent parameters. **Lecture 15:** Taylor's theorem for the function of two variables. **Lecture 16:** directional derivatives.

	Unit-II: Multivariable Integration: (Marks-14) 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. Change of variables in double integrals and triple integrals.	**Lecture 17:** The gradient, maximal and normal property of the gradient, tangent planes. **Lecture 18:** Stationary points, Extreme points and saddle points. **Lecture 19:** Extrema of functions of two variables, **Lecture 20:** Method of Lagrange multipliers. **Lecture 21:** Constrained optimization problems. **Tutorial-3** **Tutorial-4** **Tutorial-5** **<u>Term III</u>: (09 Lectures + 03 Tutorials)** **Lecture 22:** Introduction of Double and Triple integrations. **Lecture 23:** Double integration over rectangular region. **Lecture 24:** Double integration over non-rectangular region. **Lecture 25:** Double integrals in polar co-ordinates. **Lecture 26:** Triple integrals over a parallelepiped and solid regions. **Lecture 27:** Volume by triple integrals. **Lecture 28:** Triple integrals over a cylindrical and spherical co-ordinate. **Lecture 29:** Change of variables in double integrals. **Lecture 30:** Change of variables in triple integrals. **Tutorial-3** **Tutorial-4** **Tutorial-5**
Anjana Mondal	**Course type:** Mathematics (Honours) Core Course **Paper-** C8T **Unit-III: Sequence of functions:** (Marks-16) ***No of Classes (Hour) per week*: 3** 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.	**<u>Term I</u>: (06 Lectures + 03 Tutorials)** **Lecture 1:** Sequence of real numbers, sequence of functions, Pointwise convergence **Lecture 2:** Uniform convergence of sequence of functions **Lecture 3:** Exercises on pointwise and uniform convergences **Tutorial-1** **Lecture 4:** Cauchy's criterion for uniform convergence **Lecture 5:** Examples of uniform convergence on using Cauchy's criterion **Lecture 6:** Theorems on boundedness and continuity of the limit function of a sequence of functions **Tutorial-2** **Tutorial-3** **<u>Term II</u>: (09 Lectures + 02 Tutorials)** **Lecture 7:** Theorems on derivability of the limit of a sequence of functions **Lecture 8:** Applications of the theorems taught in Lecture 7 **Lecture 9:** Theorems on integrability of the limit function of a sequence of functions **Lecture 10:** Applications of the theorems taught in Lecture 9. **Lecture 11:** Series of functions, pointwise and uniform convergence of series of functions **Lecture 12:** Weierstrass M-Test **Tutorial-4** **Tutorial-5**

		<u>Term III</u>: (09 Lectures + 02 Tutorials) **Lecture 13:** Cauchy criterion for uniform convergence **Lecture 14:** Applications of Lecture 13 **Lecture 15:** Theorems on the continuity of the sum function of a series of functions **Lecture 16:** Theorems on the derivability of the sum function of a series of functions **Lecture 17:** Applications of the theorems taught in Lecture 16 **Tutorial-6** **Tutorial-7** **Lecture 18:** Revision **Lecture 19:** Revision **Lecture 20:** Revision **Lecture 21:** Revision
	Course type: Mathematics (General) Core Course **Paper-** DSC1D/2D/3D-T ***No of Classes (Hour) per week*:** **2** **Algebra:** 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 (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. Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.	**<u>Term I</u>: (07 Lectures + 03 Tutorials)** **Lecture 1:** Binary composition, groupoid, semigroup, monoid, quasigroup and examples **Lecture 2:** Definition and examples of groups and some theorems related to this **Tutorial-1** **Lecture 3:** Abelian, non-ableian groups, examples, theorems and applications **Lecture 4:** The group Z_n of integers under addition modulo n **Lecture 5:** The group $U(n)$ of units under multiplication modulo n **Tutorial-2** **Lecture 6:** Cyclic groups and examples **Lecture 7:** Results on cyclic groups and application **Tutorial-3** **<u>Term II</u>: (07 Lectures + 02 Tutorials)** **Lecture 8:** The general linear group $GL_n(R)$ **Lecture 9:** Groups of symmetries of an (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square **Lecture 10:** Permutation group and symmetric group S_n, Group of quaternions **Lecture 11:** Subgroups, examples **Lecture 12:** Cyclic subgroups **Lecture 13:** the concept of a subgroup generated by a subset and the commutator subgroup of group **Lecture 14:** Center of a group **Tutorial-4** **Tutorial-5** **<u>Term III</u>: (07 Lectures + 02 Tutorials)** **Lecture 15:** Cosets **Lecture 16:** Index of subgroup **Lecture 17:** Lagrange's theorem **Lecture 18:** Order of an element, order of group **Lecture 19:** Normal subgroups, their definitions, examples, characterization **Lecture 20:** Theorems on normal subgroups **Lecture 21:** Quotient groups

		Tutorial-6 **Tutorial-7**
Kousik Bhattacharya	**Course type:** Mathematics (Honours) Skill Enhancement Course **Paper-** SEC-2T ***No of Classes (Hour) per week*:** **1** **Unit-III: Graph Theory:** (Marks- 11) Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	**<u>Term I</u>: (02 Lectures + 02 Tutorials)** **Lecture 1:** Solution of Travelling salesman's problem **Lecture 2:** Shortest path problems and their solutions **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (02 Lectures + 02 Tutorials)** **Lecture 3:** Graphs with circuit and without circuit **Lecture 4:** Tree and related examples, Properties of trees **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (02 Lectures + 02 Tutorials)** **Lecture 5:** Spanning tree and their properties **Lecture 6:** Dijkstra's algorithm, Warshall algorithm **Tutorial-5** **Tutorial-6** ***Doubt clearing session:***
Buddhadeb Mondal	**Course type:** Mathematics (Honours) Core Course **Paper-** C10T ***No of Classes (Hour) per week*:** **2** **Unit-III: Vector Spaces:** (Marks-16) Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. **Unit-IV: Linear Transformations:** (Marks-19) 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.	**<u>Term I</u>: (08 Lectures + 02 Tutorials)** **Lecture 1:** Introduction to Vector spaces with an examples **Lecture 2:** Subspaces with an examples **Lecture 3:** Algebra of subspaces with an examples **Lecture 4:** Quotient spaces with examples **Lecture 5:** Linear combination of vectors with examples **Lecture 6:** linear span with examples **Lecture 7:** linear independence and dependence **Lecture 8:** Basis and dimension dimension of subspaces. **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (07 Lectures + 02 Tutorials)** **Lecture 9:** Linear transformations with an examples **Lecture 10:** Null space, range of a linear transformation **Lecture 11:** Rank and nullity of a linear transformation **Lecture 12:** Algebraic theorem over rank and nullity **Lecture 13:** Matrix representation of a linear transformation **Lecture 14:** Determine the rank of a matrix of linear transformation **Lecture 15:** Algebra of linear transformations **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (04 Lectures + 02 Tutorials)** **Lecture 16:** Introduction to Isomorphism with an examples **Lecture 17:** Isomorphism theorems **Lecture 18:** Invariability and isomorphism's **Lecture 19:** Change of coordinate matrix **Tutorial-5** **Tutorial-6**

	Course type: Mathematics (General) Core Course **Paper-** DSC1D/2D/3D-T ***No of Classes (Hour) per week*: 2** **Algebra:** Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n 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.	**<u>Term I</u>: (04 Lectures + 02 Tutorials)** **Lecture 1:** Introduction of rings with examples **Lecture 2:** Examples of commutative and non-commutative rings **Lecture 3:** Rings from number systems **Lecture 4:** Zn the ring of integers modulo n, ring of real quaternion **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (07 Lectures + 02 Tutorials)** **Lecture 5:** Rings of matrices, polynomial rings **Lecture 6:** Examples over ring of matrices and polynomial rings **Lecture 7:** Rings of continuous functions with an examples **Lecture 8:** Subrings with an examples **Lecture 9:** Algebra of subrings **Lecture 10:** Ideals with an examples **Lecture 11:** Algebraic theorem over Ideal **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (07 Lectures + 02 Tutorials)** **Lecture 12:** Integral domains with an examples **Lecture 13:** Algebra of integral domain **Lecture 14:** Fields with examples **Lecture 15:** Algebra of field **Lecture 16:** Relation between integral domain and field with examples **Lecture 17:** Examine the field test of this sets Z_p, Q, R, and C. **Lecture 18:** Field of rational functions **Tutorial-5** **Tutorial-6**

Semester VI

Name of the Teacher	Syllabus Allotted	Teaching Plan
Dr. Bimal Krishna Das	**Course type:** Mathematics (Honours) Discipline Specific Elective **Paper-** DSE4T ***No of Classes (Hour) per week*:** **3** **Unit-I: Special Functions and Laplace Transform:** (Marks- 32) Power series solution of Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.	**<u>Term I</u>: (11 Lectures + 02 Tutorials)** **Lecture 1:** Introduction to series solution **Lecture 2:** Ordinary point, Singular point, Regular singular point **Lecture 3:** Related problems of ordinary point, regular singular point **Lecture 4:** Series Solution at an ordinary point **Lecture 5:** Different kind of Problems and their solution **Lecture 6:** Series Solution near a regular singular point **Lecture 7:** Different kind of Problems and their solution **Lecture 8:** Legendre equation and its properties **Lecture 9:** Solution of Legendre equation **Lecture 10:** Bessel equation and Bessel function **Lecture 11:** Solution of Bessel equation **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (11 Lectures + 02 Tutorials)** **Lecture 12:** Introduction to Laplace transform **Lecture 13:** Laplace transform of some elementary functions **Lecture 14:** The inverse Laplace transform of some simple functions **Lecture 15:** Piecewise functions and Functions of exponential order **Lecture 16:** Sufficient conditions for the existence of Laplace transform **Lecture 17:** Properties of Laplace transform and its inverse **Lecture 18:** Laplace transform of the integrals **Lecture 19:** Convolution theorem **Lecture 20:** Related problems on convolution theorems **Lecture 21:** Proof of $\int_0^t t^{a-1}(1-t)^{b-1}dt = \frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)}, a, b > 0$ **Lecture 22:** Proof of $\int_0^t \sin u \cos(t-u)\, du = \frac{1}{2} t \sin t$, Proof of $F(p) = \frac{1}{1-e^{-pT}} \int_0^T e^{-pT} f(t)dt$, where $f(t)$ is a periodic function with period T>0. **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (11 Lectures + 02 Tutorials)** Lecture 23: Laplace transform of a function multiplied by the integral power of t Lecture 24: Laplace transform of a function divided by t Lecture 25: Laplace transform of two special functions Lecture 26: Solution of problems related to Laplace transform Lecture 27: Laplace transform of derivatives Lecture 28: Statement and proof of Initial Value Theorem and Final Value Theorem using Laplace transform Lecture 29: Solution of ordinary differential equations by Laplace transform Lecture 30: Related problems and solutions

		Lecture 31: Solution of partial differential equations by Laplace transform Lecture 32: Related problems and solutions Lecture 33: Application of Laplace transform to partial differential equations **Tutorial-5** **Tutorial-6**
Dr. Pradip Kumar Gain	**Course type:** Mathematics (Honours) Core Course **Paper-** C13T ***No of Classes (Hour) per week*: 3** **Unit-I: Metric Spaces:** (Marks-07) Metric spaces: sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem. **Unit-II: Metric Spaces:** (Marks-14) Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Connectedness: Connectedness, connected subsets of R. Compactness: Sequential compactness, Heine-Borel property, totally bounded spaces, finite intersection property, and continuous functions on compact sets. Homeomorphism. Contraction mappings. Banach fixed point theorem and its application to ordinary differential equation.	**<u>Term I</u>: (06 Lectures + 02 Tutorials)** **Lecture-1.** Metric spaces: sequences in metric spaces, Cauchy sequences. **Lecture-2.** Complete metric spaces, incomplete metric spaces, examples. **Lecture-3.** Nested sequences of sets, Cantor's intersection theorem. **Lecture-4.** Problems on metric spaces. **Lecture-5.** Sequential criterion and other characterizations of continuity. **Lecture-6.** Uniform continuity. **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (07 Lectures + 02 Tutorials)** **Lecture-7.** Connectedness, connected subsets of R. Hausdorff-Lennes condition. **Lecture-8.** Dsconnected spaces and disconnected sets. Theorems on connectedness. **Lecture-9.** Connected sets in the real line. **Lecture-10.** Compactness, Lindelöf Covering Theorem, Heine-Borel property, Heine-Borel theorem. Finite intersection property. **Lecture-11.** Continuity and compactness. **Lecture-12.** Sequentially compact spaces, Properties of sequentially compact sets. **Lecture-13.** Compactness and total boundedness. Totally bounded spaces. **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (04 Lectures + 02 Tutorials)** **Lecture-14.** Homeomorphism. Contraction mappings. **Lecture-15.** Banach fixed point theorem. **Lecture-16.** Applications of Banach fixed point theorem to ordinary differential equation. **Lecture-17.** Problems. **Tutorial-5** **Tutorial-6**
Dr. Sangita Chakraborty	**Course type:** Mathematics (Honours) Core Course **Paper-** C14T**:** **Ring Theory II:** ***No of Classes (Hour) per week*: 3** **Unit-I: Polynomial Rings** (Marks: 21)	**<u>Term I</u>: (10 Lectures + 02 Tutorials)** **Lecture 1:** Recapitulation: Rings and its properties, examples of rings. Introduction to the set of all polynomials over a ring and to show it forms a ring. **Lecture 2:** Properties of polynomial rings over commutative rings, integral domain and field. **Lecture 3:** Degrees of polynomials and its related theorems with examples, Division algorithm for polynomials with its proof.

	Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z[x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.	**Lecture 4:** Consequences of Division algorithm: Remainder theorem, Factor theorem, maximum number of zeros of polynomial depending on its degree with examples. **Lecture 5:** Factorization in Integral Domain: Definitions: Associates, irreducible elements, prime elements, multiplicative norm function, GCD, LCM. **Lecture 6:** Theorems relating prime element and irreducible element with examples. **Lecture 7:** Problems solving for finding irreducible element and prime element using multiplicative norm function. **Lecture 8:** Factorization of polynomials: Definition of irreducible and reducible polynomials with examples, Reducibility test for polynomials of degrees 2 and 3 with examples. **Lecture 9:** Methods of testing irreducibility for polynomials: Brute Force method, Roots test. **Lecture 10:** Continuation of irreducibility testing methods: Rational root test, Eisenstein criterion, Mod p irreducibility test. **Tutorial-1** **Tutorial-2** ***Doubt-clearing session :*** **<u>Term II</u>: (09 Lectures + 02 Tutorials)** **Lecture 11:** Irreducibility of p^{th} cyclotomic polynomial, Solution of some exercises on testing irreducibility for polynomials. **Lecture 12:** Theorems relating principal ideal and maximal ideal with irreducibility of polynomial **Lecture 13: A**pplication Lecture 12 on some problems. **Lecture 14:** Definition of Primitive polynomial, Gauss Lemma. **Lecture 15:** Theorem relating reducibility over $\mathbb{Q}$ implies reducibility over $\mathbb{Z}$. **Lecture 16:** Introduction to Unique Factorization Domain (UFD), criterion for D[x] to be a UFD. **Lecture 17:** Irreducible and prime elements in a UFD, problems solving to check I.D. as a UFD. **Lecture 18:** Introduction to Principal Ideal Domain (PID), behaviour of irreducible and prime elements in a PID. **Lecture 19:** Theorem to prove every PID is a UFD. **Tutorial-3** **Tutorial-4** ***Doubt-clearing session:*** **<u>Term III</u>: (08 Lectures + 02 Tutorials)** **Lecture 19:** Introduction to Euclidean Domain (E.D.) with examples. **Lecture 20:** Relation between E.D., PID and UFD with related theorems and proofs. **Lecture 21:** Euclidean algorithm **Lecture 22: A**pplication of Lecture for finding a GCD. **Lecture 23:** Solving problems on Euclidean valuation. **Lecture 24:** Solving problems on E.D. **Lecture 25:** Solving problems on PID. **Lecture 26:** Solving problems on UFD. **Tutorial-5**

		Tutorial-6 ***Doubt-clearing session:*** ***Doubt-clearing session:***
Sankar Das	**Course type:** Mathematics (Honours) Core Course **Paper-** C14T**:** **Linear Algebra II** ***No of Classes (Hour) per week*:** **3** **Unit-II: Diagonalization and Canonical Forms:** (Marks-18) 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, canonical forms. **Unit-III: Inner Product Spaces:** (Marks-21) Inner product spaces and norms, Gram-Schmidt orthogonalization 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.	**<u>Term I</u>: (09 Lectures + 03 Tutorials)** **Lecture 1:** Introduction of Euclidean space and Inner product spaces. **Lecture 2:** Norm of a vector and its related properties. **Lecture 3:** Schwarz's inequality, Triangle inequality. **Lecture 4:** Unit vector, Orthogonal and Orthonormal set of vectors. **Lecture 5:** Bessel's inequality and Parseval's theorem. **Lecture 6:** Gram-Schmidt orthogonalization process. **Lecture 7:** orthogonal complements. **Lecture 8:** Cayley-Hamilton theorem. **Lecture 9:** Dual spaces, dual basis, double dual. **Tutorial-1** **Tutorial-2** **Tutorial-3** **<u>Term II</u>: (10 Lectures + 02 Tutorials)** **Lecture 10:** Introduction of Linear mapping. **Lecture 11:** Matrix representation of a Linear mapping. **Lecture 12:** Matrix of the composite mapping and inverse mapping. **Lecture 13:** Transpose of a linear transformation and its matrix in the dual basis, annihilators. **Lecture 14:** Algebraic operations on the set of all Linear mappings. **Lecture 15:** Isomorphism between Linear mappings and matrices. **Lecture 16:** Linear operator and its adjoint. **Lecture 17:** Normal and self-adjoint operators. **Lecture 18:** Least squares approximation, minimal solutions to systems of linear equations. **Lecture 19:** Orthogonal projections and Spectral theorem. **Tutorial-4** **Tutorial-5** **<u>Term III</u>: (10 Lectures + 02 Tutorials)** **Lecture 20:** Matrix representation of a linear operator. **Lecture 21:** Orthogonal mapping of the Euclidean spaces. **Lecture 22:** Matrix of an orthogonal transformation. **Lecture 23:** Eigen spaces of a linear operator. **Lecture 24:** Diagonalization of a matrix, Orthogonal diagonalisation. **Lecture 25:** Diagonalization of linear operator. **Lecture 26:** invariant subspaces. **Lecture 27:** The minimal polynomial for a linear operator. **Lecture 28:** Introduction of Quadratic forms with its classes. **Lecture 29:** Reduction to canonical forms. **Tutorial-6** **Tutorial-7**

Anjana Mondal	**Course type:** Mathematics (Honours) Core Course **Paper-** C13T**:** **Complex Analysis:** ***No of Classes (Hour) per week*:** **3** **Unit-III: Complex Analysis** (Marks-11) 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 IV: Complex Analysis** (Marks-14) Analytic functions, examples of analytic functions, exponential function, logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula. **Unit V: Complex Analysis** (Marks-07) Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. **Unit VI: Complex Analysis** (Marks-07) Laurent series and its examples, absolute and uniform convergence of power series.	**<u>Term I</u>: (08 Lectures + 02 Tutorials)** **Lecture 1:** Some preliminaries on complex numbers, properties, regions in the complex plane **Lecture 2:** Complex function, Graphing complex functions, limit of complex functions, examples, theorems, exercises **Lecture 3:** Limits of complex functions involving the point at infinity, theorems, examples, exercises **Lecture 4:** Continuity of complex functions, theorems, examples and exercises **Tutorial-1** **Lecture 5:** Derivatives, differentiation formulas **Lecture 6:** Cauchy-Riemann equations in Cartesian coordinate system**,** applications **Lecture 7:** Cauchy-Riemann equations in polar coordinate system, applications **Lecture 8:** Sufficient conditions of differentiability **Tutorial-2** **<u>Term II</u>: (07 Lectures + 04 Tutorials)** **Lecture 9:** Analytic functions, examples **Lecture 10:** Some results on analytic functions **Tutorial-3** **Lecture 11:** Exponential function, their properties and derivatives of the functions **Lecture 12:** logarithmic function, trigonometric function, properties and derivatives of the functions **Tutorial-4** **Lecture 13:** The definite integrals of complex valued functions **Lecture 14:** Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. **Tutorial-5** **Tutorial-6** **<u>Term III</u>: (10 Lectures + 03 Tutorials)** **Lecture 15:** Cauchy- Goursat theorem and applications **Lecture 16:** Cauchy integral formula and applications **Tutorial-7** **Lecture 17:** Liouville's theorem and applications, the fundamental theorem of algebra. **Lecture 18:** Convergence of complex sequences and series **Lecture 19:** Taylor series and its examples **Lecture 20:** Tutorial **Lecture 21:** Laurent series and its examples **Tutorial-8** **Lecture 22:** absolute and uniform convergence of power series. **Tutorial-9** **Lecture 23:** Revision **Lecture 24:** Revision

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<td>Course type: Mathematics (Honours)
Discipline Specific Elective

Paper- DSE3T
Number Theory:
No of Classes (Hour) per week: 1

Unit I: Diophantine Equation and Conguences:
(Marks- 21)
Linear diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues. Chinese remainder theorem, Fermat’s little theorem, Wilson’s theorem.</td>
<td><u>Term I</u>: (04 Lectures + 01 Tutorials)

Lecture 1: Linear diophantine equation and examples
Lecture 2: prime counting function
Lecture 3: statement of prime number theorem and applications
Lecture 4: Goldbach conjecture
Tutorial-1

<u>Term II</u>: (04 Lectures + 01 Tutorials)

Lecture 5: linear congruences and related theorems, examples
Lecture 6: complete set of residues
Lecture 7: Chinese remainder theorem
Lecture 8: Applications of Chinese remainder theorem
Tutorial-2

<u>Term II</u>: (03 Lectures + 01 Tutorials)

Lecture 9: Fermat’s little theorem
Lecture 10: Fermat’s little theorem and applications
Lecture 11: Wilson’s theorem
Tutorial-3</td>
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<td>Kousik Bhattacharya</td>
<td>Course type: Mathematics (Honours)
Discipline Specific Elective

Paper- DSE4T
Mathematical Modelling:
No of Classes (Hour) per week: 2

Unit-II: Monte Carlo simulation modelling:
(Marks- 28)
Monte Carlo simulation modelling: 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 modelling. Linear programming model: geometric solution algebraic solution, simplex method, sensitivity analysis.</td>
<td><u>Term I</u>: (06 Lectures + 02 Tutorials)

Lecture 1: Introduction to simulation and its applications
Lecture 2: Procedure for modelling
Lecture 3: simulating deterministic behaviour: area under a curve
Lecture 4: Related algorithms and problems
Lecture 5: simulating deterministic behaviour: volume under a surface
Lecture 6: Related algorithms and problems
Tutorial-1
Tutorial-2

<u>Term II</u>: (08 Lectures + 02 Tutorials)

Lecture 7: Introduction to random numbers and pseudo random numbers
Lecture 8: Generating random numbers: middle square method and related problems
Lecture 9: Generating random numbers: linear congruence method and related problems
Lecture 10: Introduction to queuing models
Lecture 11: Queuing models: Harbor system, Morning rush hour
Lecture 12: Overview of optimization modelling
Lecture 13: Different kinds of optimization methods (Geometric programming, Stochastic programming)
Lecture 14: Different kinds of optimization methods (Dynamic programming, Goal programming, Integer programming problem)
Tutorial-3
Tutorial-4</td>
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<u>Term III</u>: (05 Lectures + 02 Tutorials)

Lecture 15: Linear programming model and its application, Advantages and disadvantages of LPP
Lecture 16: Procedure for solving LPP, Geometric solution of LPP, Algebraic solution of LPP
Lecture 17: Procedure of simplex method
Lecture 18: Problem solution using simplex method
Lecture 19: sensitivity analysis of Linear programming problem
Tutorial-5
Tutorial-6
Doubt clearing session:
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Course type: Mathematics (General)
Discipline Specific Elective

Paper- DSE-1B/2B/3B-T:
No of Classes (Hour) per week: 2

Linear Programming:
Linear Programming: Definition and formation Problems, Graphical Approach for solving some Linear Programming problems. Convex Sets, Supporting and Separating Hyperplanes.
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<u>Term I</u>: (06 Lectures + 02 Tutorials)

Lecture 1: Introduction to Linear Programming
Lecture 2: Definition and notations of Linear Programming
Lecture 3: Formulation of LPP
Lecture 4: Different problem formulation of LPP
Lecture 5: Discussion about different kind of solution procedure of LPP
Lecture 6: Solution algorithm
Tutorial-1
Tutorial-2

<u>Term II</u>: (08 Lectures + 02 Tutorials)

Lecture 7: Graphical Method of solving LPP
Lecture 8: Problem Solution by graphical method
Lecture 9: Algebraic method of solving LPP
Lecture 10: Problem solution by algebraic method
Lecture 11: Application of LPP in real world problem
Lecture 12: Introduction to Convex sets
Lecture 13: Different examples of convex sets with diagram
Lecture 14: Theorems related to convex sets
Tutorial-3
Tutorial-4

<u>Term III</u>: (04 Lectures + 02 Tutorials)

Lecture 15: Concept of Hyperplanes
Lecture 16: Different examples of Hyperplanes
Lecture 17: Theorems related to Hyperplanes
Lecture 18: Theorems related to supporting Hyperplanes, separating Hyperplanes
Tutorial-5
Tutorial-6
Doubt clearing session:
Doubt clearing session:
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Buddhadeb Mondal	**Course type:** Mathematics (Honours) Discipline Specific Elective **Paper-** DSE3T **Number Theory:** ***No of Classes (Hour) per week*: 2** **Unit-II: Number Theoretic Function**: (Marks- 20) Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. **Unit-III: Quadratic Reciprocity :** (Marks- 19) Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, Quadratic reciprocity, quadratic congruence with composite modulo, Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem	**<u>Term I</u>: (07 Lectures + 02 Tutorials)** **Lecture 1:** Introduction of number theoretic functions with examples **Lecture 2:** Sum and number of divisors **Lecture 3:** Totally multiplicative functions **Lecture 4:** Definition and properties of the Dirichlet product **Lecture 5:** The Mobius Inversion formula, the greatest integer function **Lecture 6:** Algebra of μ-function and greatest integer function **Lecture 7:** Euler's phi-function **Tutorial-1** **Tutorial-2** **<u>Term II</u>: (06 Lectures + 02 Tutorials)** **Lecture 8:** Euler's theorem, reduced set of residues **Lecture 9:** Some properties of Euler's phi-function **Lecture 10:** Order of an integer modulo n, primitive roots for primes **Lecture 11:** Examples over primitive roots and indices **Lecture 12:** Composite numbers having primitive roots, Euler's criterion **Lecture 13:** The Legendre symbol and its properties **Tutorial-3** **Tutorial-4** **<u>Term III</u>: (05 Lectures + 02 Tutorials)** **Lecture 14:** Quadratic reciprocity with examples **Lecture 15:** Quadratic congruence with composite modulo **Lecture 16:** Public key encryption, RSA encryption and decryption **Lecture 17:** Solution of the equation $x^2 + y^2 = z^2$ **Lecture 18:** Fermat's Last theorem **Tutorial-5** **Tutorial-6**
	Course type: Mathematics (General) Discipline Specific Elective **Paper-** DSE-1B/2B/3B-T: ***No of Classes (Hour) per week*: 2** **Linear Programming**: Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, Introduction to artificial variables, two-phase method, Big-M method and their comparison. Duality, formulation of the dual problem, primal- dual	**<u>Term I</u>: (05 Lectures + 03 Tutorials)** **Lecture 1:** Introduction of simplex method **Lecture 2:** Optimality and unboundedness **Lecture 3:** The simplex algorithm **Lecture 4:** Simplex method in tableau format **Lecture 5:** Nature of solution of a L.P.P from simplex method **Tutorial-1** **Tutorial-2** **Tutorial-3** **<u>Term II</u>: (05 Lectures + 02 Tutorials)** **Lecture 6:** Introduction of artificial variables **Lecture 7:** Two-phase method **Lecture 8:** Big-M method **Lecture 9:** Algebra of two-phase method and Big-M method

	relationships, economic interpretation of the dual.	**Lecture 10:** Their comparison **Tutorial-4** **Tutorial-5** **<u>Term III</u>: (07 Lectures + 02 Tutorials)** **Lecture 11:** Introduction of Duality **Lecture 12:** Formulation of the dual problem **Lecture 13:** Primal- dual relationships **Lecture 14:** Solution of primal using dual problem **Lecture 15:** Solution of dual using primal problem **Lecture 16:** Economic interpretation of the dual **Lecture 17:** Applications **Tutorial-6** **Tutorial-7**