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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY: Arpita Paul

PAPER: Linear Programming (DSE-B1)

LECTURES ALLOTED: 45

ALLOTED SYLLABUS:

Unit-1 [15 classes]

• Definition of Linear Programming Problem (L.P.P.). Formation of L.P.P. from daily life involving inequations.
Graphical solution of L.P.P. Basic solutions and Basic Feasible Solution (B.F.S) with reference to L.P.P. Matrix formulation of L.P.P. Degenerate and Non-degenerate B.F.S.
• Hyperplane, Convex set, Cone, extreme points, convex hull and convex polyhedron. Supporting and Separating hyperplane. The collection of a feasible solutions of an L.P.P. constitutes a convex set. The extreme points of the convex set of feasible solutions correspond to its B.F.S. and conversely. The objective function has its optimal value at an extreme point of the convex polyhedron generated by the set of feasible solutions (the convex polyhedron may also be unbounded). In the absence of degeneracy, if the L.P.P. admits of an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to a B.F.S.

Unit-2 [20 classes]

• Slack and surplus variables. Standard form of L.P.P. theory of simplex method. Feasibility and optimality conditions.
• The algorithm. Two phase method. Degeneracy in L.P.P. and its resolution.

Unit-3 [10 classes]

• Duality theory: The dual of dual is the primal. Relation between the objective values of dual and the primal problems. Relation between their optimal values. Complementary slackness, Duality and simplex method and their applications.

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TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-5	Definition of Linear Programming Problem (L.P.P.). Formation of L.P.P. from daily life involving inequations.
6-10	Graphical solution of L.P.P. Basic solutions and Basic Feasible Solution (B.F.S) with reference to L.P.P. Matrix formulation of L.P.P. Degenerate and Non-degenerate B.F.S.
11-15	Hyperplane, Convex set, Cone, extreme points, convex hull and convex polyhedron.
16-20	Supporting and Separating hyperplane. The collection of a feasible solutions of an L.P.P. constitutes a convex set.
26-30	The extreme points of the convex set of feasible solutions correspond to its B.F.S. and conversely. The objective function has its optimal value at an extreme point of the convex polyhedron generated by the set of feasible solutions (the convex polyhedron may also be unbounded).
31-35	In the absence of degeneracy, if the L.P.P. admits of an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to a B.F.S.
36-40	Slack and surplus variables. Standard form of L.P.P. theory of simplex method. Feasibility and optimality conditions.
41-45	Duality theory: The dual of dual is the primal. Relation between the objective values of dual and the primal problems.
46-50	Relation between their optimal values. Complementary slackness, Duality and simplex method and their applications.
51-60	Revisions

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY: Ashim Sarkar

PAPER: Group Theory (CC-12)

LECTURES ALLOTED: 35

ALLOTED SYLLABUS:

Unit-1 : Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.
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 finite abelian group, Fundamental theorem of finite abelian groups.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-4	Automorphism, inner automorphism
5-8	automorphism groups, automorphism groups of finite and infinite cyclic groups
9-12	applications of factor groups to automorphism groups.
13-16	External direct product and its properties, the group of units modulo *n* as an external direct product,
17-20	internal direct product, converse of Lagrange's theorem for finite abelian group.
21-24	internal direct product, converse of Lagrange's theorem for finite abelian group(contd.)
25-28	Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.
29-32	Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups(contd.)
33-35	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-III

NAME OF FACULTY: Ashim Sarkar

PAPER: Linear Algebra (CC-6)

LECTURES ALLOTED: 40

ALLOTED SYLLABUS:

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 R_n, dimension of subspaces of R_n. Geometric significance of subspace. 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-Hamilton theorem and its use in finding the inverse of a matrix.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-4	Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span.
5-8	linear independence, basis and dimension, dimension of subspaces.
9-12	Subspaces of R_n, dimension of subspaces of R_n. Geometric significance of subspace.
13-16	Linear transformations, null space, range, rank and nullity of a linear transformation
17-20	matrix representation of a linear transformation
21-24	matrix representation of a linear transformation (contd.)
25-28	change of coordinate matrix. Algebra of linear transformations
29-32	. Isomorphisms. Isomorphism theorems. invertibility and isomorphisms.

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33-36	Eigen values, eigen vectors and characteristic equation of a matrix.
37-40	Cayley-Hamilton theorem and its use in finding the inverse of a matrix,

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-I

NAME OF FACULTY: Ashim Sarkar

PAPER: Modern Algebra (CC-2)

LECTURES ALLOTED: 30

ALLOTED SYLLABUS:

Unit-2

Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation.

Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$.

Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, divisibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-3	Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span.
5-8	linear independence, basis and dimension, dimension of subspaces.
9-12	Subspaces of R_n, dimension of subspaces of R_n. Geometric significance of subspace.
13-15	Linear transformations, null space, range, rank and nullity of a linear transformation
16-18	matrix representation of a linear transformation
19-21	change of coordinate matrix. Algebra of linear transformations
22-24	Isomorphisms. Isomorphism theorems. invertibility and isomorphisms.
25-27	. Eigen values, eigen vectors and characteristic equation of a matrix.
28-30	Cayley-Hamilton theorem and its use in finding the inverse of a matrix

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-III

NAME OF FACULTY: Kallol Mazumdar

PAPER: Theory of Real Functions (CC-5)

LECTURES ALLOTED: 40

ALLOTED SYLLABUS:

Unit-1 Limit and Continuity of Functions [40 classes]

• Limits of functions (ε-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 like $\frac{\sin(x)}{x}, \frac{\log(1+x)}{x}, \frac{a^x-1}{x}\ (a>0)\ as\ x \to 0$

• 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. Familiarity with the figures of some well-known functions:
$y = x^a \left(2,3,\frac{1}{2},-1\right), |x|, \sin x, \cos x, \tan x, \log(x), e^x$. 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 maintenance 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.

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TOPIC/SUBTOPIC:

LEC. NO.	PROPOSED TOPIC(S) TO BE TAUGHT
1-4	Limits of functions (ε-δ approach), sequential criterion for limits. Problems.
5-8	Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Problems.
9-12	Infinite limits and limits at infinity. Important limits like $\frac{\sin(x)}{x}, \frac{\log(1+x)}{x}, \frac{a^x-1}{x}$ $(a>0)$ as $x \to 0$ .Define Continuity at a point. Problems.
13-16	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. Problems.
17-20	Familiarity with the figures of some well-known functions : $y = x^a \left(2,3,\frac{1}{2},-1\right), \lvert x\rvert, \sin x, \cos x, \tan x, \log(x), e^x$. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Problems.
21-24	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 maintenance of same sign.
25-28	Continuous function on [*a, b*] is bounded and attains its bounds. Intermediate value theorem. Discontinuity of functions, type of discontinuity. Problems.
29-32	Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have at most countably many points of discontinuity. Problems.
33-36	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. Problems.
37-40	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. Problems.

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY: Prabir Rudra

PAPER: Probability & Statistics (CC-11)

LECTURES ALLOTED: 100

ALLOTED SYLLABUS:

Unit-1 [25 classes]

• Random experiment, _-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.

Unit-2 [25 classes]

• 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.

Unit-3 [10 classes]

• 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.

Unit-4 [20 classes]

• 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 various statistic like mean, variance, etc.

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• Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and variance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency, Minimum-Variance Unbiased Estimator (MVUE).
• Method of Maximum likelihood: likelihood function, ML estimators for discrete and continuous models.

Unit-5 [20 classes]

• Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one-sided and two-sided 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.
• Simple hypothesis versus simple alternative: Neyman-Pearson lemma (Statement only).
• Bivariate frequency Distribution: Bivariate data, Scatter diagram, Correlation, Linear Regression, principle of least squares and fitting of polynomials and exponential curves.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-2	Probability-Introduction, Conceptualization
3-10	Probability-Random expt., Sample space, axioms, Conditional probability, Bayes' Theorem, Independence of events, Problems
11-18	Compound or joint experiment, One dimensional Probability distribution-random variable, discrete and continuous distributions, mass and density functions, Binomial, Poisson, Uniform, Normal distributions, Problems
19-26	Problems on One dimensional Probability distribution contd., Probability distribution of more than one dimensions, marginal & conditional distribution, transformation of continuous random variable in two dimensions, Problems
27-34	Problems on probability distribution of more than one dimensions contd., Mathematical expectations of a continuous function of single random variable, Mean, Variance, standard deviation, moments, skewness & kurtosis of a distribution, Problems
35-42	Moment generating function, characteristic function, Median, quartiles, mode, Problems, Two dimensional expectations, moments, covariance, correlation coefficient, joint characteristic function, conditional expectations, Problems

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43-50	Problems on two dimensional expectations contd., Linear regression of two variables, Regression curves, bivariate normal distribution, Problems
51-58	Markov and Tchebychev's inequality, Convergence in probability, Weak and strong law of large numbers, central limit theorem, Problems, Statistics-introduction and conceptualization
59-66	Sampling & sampling distribution, population, samples, random samples, distribution of samples, SRSWR, SRSWOR, Sample characteristics, Problems
67-74	Problems contd., sampling distribution, sample moments, sample variance, sampling from normal distributions, chi-square, t and F distributions, Problems, Estimation of parameters, Point and interval estimation, Problems
75-82	Confidence intervals, mean squared error, good, unbiased and consistent estimators, MVUE, problems, method of maximum likelihood
83-90	Statistical hypothesis, simple, composite, null, alternative hypotheses, critical region, test statistic, type I and type II error, level of significance, power function of a test, p-value, Neyman-Pearson lemma, problems
91-98	Bivariate frequency distribution, scatter diagram, correlation, linear regression, principle of least squares, curve fitting (polynomial and exponential curves), Problems
99-106	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-I

NAME OF FACULTY: Prabir Rudra

PAPER: Geometry, Vector Analysis (CC-1), Linear Algebra (CC-2)

LECTURES ALLOTED: 45+20+20=85

ALLOTED SYLLABUS:

CC-1

Unit-2 : Geometry [45 classes]

• 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.
• 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.

Unit-3 : Vector Analysis [20 classes]

• Triple product, vector equations, 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, differentiation and integration of vector functions of one variable.

CC-2

Unit-3: Linear Algebra [20 classes]

• 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.

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TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-7	CC1 (Unit-2, Geometry): 2D geometry-Introduction, Translation and Rotation of axes, Problems, General equation of second degree, Problems
8-14	Classification of conics using discriminant, tangent and normals, Problems
15-21	Polar equations of conics, Problems, 3D geometry: Introduction, Plane, Problems
22-28	Plane contd., Problems
29-35	Straight lines in 3D, Problems
36-42	Straight lines in 3D contd., Problems, Spheres, Problems.
43-49	Cylindrical surfaces, Conicoids, Problems.
50-56	CC-2 (Unit-3, Linear Algebra): Rank of a matrix, inverse of a matrix, characterization of invertible matrices, Problems
57-63	System of linear equations, row reduction and echelon forms, vector equations, Problems
64-70	Problems contd., matrix equation AX=B, solution sets of linear systems, Applications, Problems
71-77	CC-1 (Unit-3, Vector Analysis): Triple product, vector equations, applications to geometry and mechanics, Problems
78-84	Problems contd., operations with vector valued functions, limits and continuity of vector functions
85-91	Problems on limits and continuity, differentiation and integration of vector functions of one variable, Problems.
92-98	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-I

NAME OF FACULTY : Sukanta Bhunia

PAPER :Unit-1 -CC 1(Calculus)

LECTURES ALLOTED: 28

ALLOTED SYLLABUS:

- Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, 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.(18 Classes)

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin mx\,dx$, $\int \sin^n x \cos^m x\,dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. (8 Classes)

Revision(2 Classes)

TOPIC/SUBTOPIC:		
LEC.NO.	**DATE**	**TOPIC(S) TAUGHT**
1-2	1st (19.09.2022-24.09.2022)	Hyperbolic Function and Higher Order Derivatives.
3-4	2nd (26.09.2022-01.10.2022)	Leibnitz Rule and Application.
Puja Vacation		
5-6	3rd (31.10.2022-05.11.2022)	Curvature
7-8	4th (07.11.2022-12.11.2022)	Concavity and points of inflection
9-10	5th (14.11.2022-19.11.2022)	Envelopes

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11-12	6th (21.11.2022-26.11.2022)	Rectilinear Asymptotes
13-14	7th (28.11.2022-3.12.2022)	Curve tracing in Cartesian and Tracing in Polar Co-Ordinates
15-16	8th (05.12.2022-10.12.2022)	L'Hospital's Rule
17-18	9th (12.12.2022-17.12.2022)	Applications in Business , Economics and Life Sciences
19-20	10th (19.12.2022-24.12.2022)	Reduction Formula
21-22	11th (26.12.2022-31.12.2022)	Arc length of a Curve,
23-24	12th (02.01.2023-07.01.2023)	Area .
24-26	13th (09.01.2023-14.01.2023)	Volume of Surface of Revolution
27-28	14th (16.01.2023-21.01.2023)	**REVISION**

DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-III

NAME OF FACULTY : Sukanta Bhunia

PAPER :O.D.E (CC-7)

LECTURES ALLOTED: 50

ALLOTED SYLLABUS:

O.D.E (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).(14 Classes)
- Linear equations and equations reducible to linear form. First order higher degree equations solvable for (4 Classese)
  x, y and p. Clairaut's equations and singular solution.(4 Classes)

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- Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: TwoEquations in two unknown functions.(4 Classes)
- Linear differential equations of second order, Wronskian : its properties and applications, Euler equation, method of undetermined coefficients, method of variation of parameters.(8 Classes)
- System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients.(4 Classes)
- Planar linear autonomous systems : Equilibrium (critical) points, Interpretation of the phase plane and phase portraits. (4 Classes)
- Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order). (4 Classes)

Revision (4 Classes)

TOPIC/SUBTOPIC:		
LEC.NO.	**DATE**	**TOPIC(S)TAUGHT)**
1-2	1st (17.08.2022-20.08.2022)	Differential Equation : Preliminary Notion
3-6	2nd (22.08.2022-27.08.2022)	Formulation O.D.E/Types of the O.D.E/Application
7-10	3rd (29.08.2022-03.09.2022)	Equation of First Order and First Degree Exact / Separation of Variables /Homogeneous
11-14	4th (05.09.2022-10.09.2022)	Linear Equation .Rules for Determining I.F
15-18	5th (12.09.2022-17.09.2022)	Linear Equation and equation Reducible to Linear form
19-22	6th (19.09.2022-24.09.2022)	Singular Solution and Application
23-26	7th (26.09.2022-30.09.2022)	Basic Theory of Linear Systems in Normal From

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Puja Vacation		
27-30	8th (31.10.2022-05.11.2022)	Linear D.E of second order Wronskian Euler Equation .Method of Undetermined Co-efficients.
31-34	9th (07.11.2022-12.11.2022)	Method of Variation Parameter System of Linear D.E.
35-38	10th (14.11.2022-19.11.2022)	Types of Linear System and Application
39-42	11th (21.11.2022-26.11.2022)	Planar Linear Autonomous System,
43-46	12th (28.11.2022-03.12.2022)	Power Series Solutions.
47-50	13th (05.12.2022-10.12.2022)	**REVISION**

DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-I

NAME OF FACULTY : Sukanta Bhunia

PAPER :Unit-1 -CC2 (Algebra)

LECTURES ALLOTED: 52

ALLOTED SYLLABUS:

- 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. (16 Classes)
- 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 (solutionby Ferrari's method).(16 Classes)
- Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality. (8 Classes)

Linear difference equations with constant coefficients (up to 2nd order). (8 Classes)

Revision: (4 Classes)

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TOPIC/SUBTOPIC		
LEC.NO.	**DATE**	**TOPIC(S)TAUGHT**
1-4	1st (19.09.2022-24.09.2022)	Complex Number -Introduction And nth roots of unity
5-8	2nd (26.09.2022-01.10.2022)	De-Moivre's Theorem and Application ,Exponential
Puja Vacation		
9-12	3rd (31.10.2022-05.11.2022)	Logarithmic Function,Trigonometric and Hyperbolic Function
13-16	4th (07.11.2022-12.11.2022)	Application
17-20	5th (14.11.2022-19.11.2022)	Polynomial and Descartes Rule
21-24	6th (21.11.2022-26.11.2022)	Sturm's Theorem
25-28	7th (28.11.2022-3.12.2022)	Relation between root's and Co-efficients
29-32	8th (05.12.2022-10.12.2022)	Solve :Cubic Equation and Biquadratic Equation
33-36	9th (12.12.2022-17.12.2022)	Inequality :Introduction (AM,GM and HM)
37-40	10th (19.12.2022-24.12.2022)	Cauchy -Schwartz Iquality
41-44	11th (26.12.2022-31.12.2022)	Linear Difference: Introduction (Homogeneous & Non Homogeneous)
45-48	12th (02.01.2023-07.01.2023)	Application
49-52	13th (09.01.2023-14.01.2023)	REVISION

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-III

NAME OF FACULTY : **SIRSENDU KARMAKAR**

PAPER : **Core Course-6**

LECTURES ALLOTED: **35**

ALLOTED SYLLABUS:

Unit-1 : Ring theory [35 classes]

• Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third isomorphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-7	Definition and examples of rings, properties of rings, subrings
8-15	Necessary and sufficient condition for a nonempty subset of a ring to be a subring , integral domains and fields
16-23	Subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring, operations on ideals
24-31	Ideal, ideal generated by a subset of a ring, factor rings
32-35	Prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms, First isomorphism theorem, second isomorphism theorem, third isomorphism theorem.
35-42	Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring

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42-49	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY : **SIRSENDU KARMAKAR**

PAPER : **Discipline Specific Elective- DSE-A (1)**

LECTURES ALLOTED: 50

ALLOTED SYLLABUS:

Unit-2: Ring Theory [50 classes]

• 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.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-7	Principal ideal domain, principal ideal ring, prime element, irreducible element, greatest common divisor(gcd), least common multiple (lcm)
8-15	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
16-23	Euclidean domain, relation between Euclidean domain and principal ideal domain.
24-31	Polynomial rings, division algorithm and consequences, factorization domain, unique factorization domain
32-39	Irreducible and prime elements in a unique factorization domain, relation between principal ideal domain,

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	unique factorization domain, factorization domain and integral domain, Eisenstein criterion and unique factorization in Z[*x*].
40-47	Ring embedding and quotient field, regular rings and their examples, properties of regular ring, ideals in regular rings.
48-55	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-III

NAME OF FACULTY : **SIRSENDU KARMAKAR**

PAPER : **Core Course-7**

LECTURES ALLOTED: **35**

ALLOTED SYLLABUS:

Unit-2 : Multivariate Calculus-I [35 classes]

- Concept of neighbourhood of a point in R^n (n $>$ 1), interior point, limit point, open set and closed set in R^n (n $>$ 1).
- Functions from $\mathrm{R}^n(n > 1)$ to $\mathrm{R}^m(m \geq 1)$, limit and continuity of functions of two or more variables. Partial derivatives, total derivative 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.

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-7	Concept of neighbourhood of a point in R^n (n $>$ 1), interior point, limit point, open set and closed set in R^n (n $>$ 1).
8-15	Functions from $\mathrm{R}^n(n > 1)$ to $\mathrm{R}^m(m \geq 1)$
16-23	Limit and continuity of functions of two or more variables. Partial derivatives
24-31	Total derivative and differentiability, sufficient condition for differentiability, Chain rule for one and two independent parameters, directional derivatives
32-35	The gradient, maximal and normal property of the gradient, tangent planes.
35-42	Extrema of functions of two variables, method of Lagrange multipliers

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42-49	Constrained optimization problems
49-46	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY: Sukanya Banerjee

PAPER: Linear Programming & Game Theory DSE-B(1), Unit-4.

LECTURES ALLOTED: 30 classes

ALLOTED SYLLABUS:

Unit-4 [30 classes]

• Transportation and Assignment problems. Mathematical justification for optimality criterion. Hungarian method. Traveling Salesman problem.

• Concept of game problem. Rectangular games. Pure strategy and Mixed strategy. Saddle point and its existence. Optimal strategy and value of the game. Necessary and sufficient condition for a given strategy to be optimal in a game. Concept of Dominance. Fundamental Theorem of rectangular games. Algebraic method. Graphical method and Dominance method of solving Rectangular games. Inter-relation between **theory of games and L.P.P.**

TOPIC/SUBTOPIC:	
LEC. NO.	**PROPOSED TOPIC(S) TO BE TAUGHT**
1-2	Concept of game problem. Rectangular games. Pure strategy and Mixed strategy. Saddle point and its existence. Optimal strategy and value of the game.
3-5	Graphical method of solving Rectangular games
6-8	Algebraic method. of solving (2x2) games
9	Necessary and sufficient condition for a given strategy to be optimal in a game. Concept of Dominance.
10-13	Fundamental Theorem of rectangular games. Dominance method of solving Rectangular games.
14-15	Inter-relation between theory of games and L.P.P. Solving game problem using LPP.
16-18	Algebraic method for solution of general games.
19-20	Revision of Game Theory.
21-23	Introduction to assignment problem, Mathematical formulation of assignment problem.

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24-26	Optimality criteria. Hungarian assignment method. Special cases. Sums practice.
27-29	Introduction and Mathematical formulation of transportation problem.
30-32	Existence of feasible solution. Solution of transportation problem by North-West corner method and matrix minima method.
33-35	Solution of transportation problem by VAM, testing for optimality. Special Cases. Sum Practice.
36-38	Degeneracy in transportation problem. Special Cases. Sum Practice.
39-40	Revision of Transportation and Assignment problem.

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TEACHING PLAN FOR SEMESTER-V

NAME OF FACULTY: Subhasis Nalui

PAPER: CC-12 (Linear Algebra -ll)

LECTURES ALLOTED: 40

ALLOTED SYLLABUS:

Unit-2[40 classes]

• Inner product spaces and norms, Gram-Schmidt orthogonormalisation 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, annhilators. Eigenspaces of linear operator, diagonalizability, invariant subspaces and Cayley -Hamilton theorem, the minimal polynomial for a linear operator, canonical forms(Jordan & rational).

• Lec NO.	PROPOSED TOPIC(S) TO BE TAUGHT
1-3	Inner product spaces- introduction, motivation.
4-6	Norms, Gram-Schmidt orthogonormalisation process, problems.
7-9	Orthonal complements, Bessel's inequality, theorems and problems.
10-12	Dual spaces and dual basis- introduction and motivation.
13-15	Transpose of a linear transformation and its matrix in the dual basis, Annhilators, problems.
16-21	Eigen space of a matrix and linear operator, problems. Diagonalizability.

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22-27	Invariant subspaces and Cayley -Hamilton theorem, the minimal polynomial for a linear operator, problems.
28-33	Canonical forms(Jordan and rational) and problems. Bilinear and quadratic forms- introduction and motivation.
34-37	Second derivative test, Hessian matrix, Sylvester's law of inertia, index, signature, problems.
38-40	Revision

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DEPARTMENT OF MATHEMATICS

TEACHING PLAN FOR SEMESTER-I

NAME OF FACULTY: Subhasis Nalui

PAPER: Group Theory (DSE- A(1))

LECTURES ALLOTED: 25

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ALLOTED SYLLABUS:

Unit-1: Group Theory [25 classes]

• Group actions, stabilizers, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, index theorem.
• Group acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-group, Sylow' s theorems and consequences, Cauchy theorem, simplicity's of An, non simplicity test.

LEC. NO.	PROPOSED TOPIC(S) TO BE TAUGHT
1-3	Group action – introduction and motivation.
4-6	Stabilizers and permutation representation associated with a group action.
7-9	Application of group action : Generalized Cayley theorem, index theorem and problems
13-16	Conjugacy in Sn, p- group, cauchy theorems, problems.
17-19	Sylow's theorems and problems.
20-22	Simplicity of An, non simplicity test, problems
23-25	Revision

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