सत्यमेव जयते
Government of Maharashtra
ISMAIL YUSUF COLLEGE OF ARTS, SCIENCE & COMMERCE
Jogeshwari (East), Mumbai – 400060

Teaching Plan for Academic Year 2023 – 24 (First Half)

Subject: Mathematics Class : SYBSc and TYBSc Sem: III and V

Faculty Name: **Sh. Thakare Rajesh B.**

Month	Topics to be covered	Assigned Lecture	Lectures Undertaken
June – 23 S. Y. B. Sc. P- III	The general n−th order linear differential equations, Linear independence, An existence and uniqueness theorem, the Wronskian, Classification: homogeneous and non-homogeneous, General solution of homogeneous and non-homogeneous LDE, The Differential operator and its properties.	20	20
June – 23 T. Y. B. Sc. P – II	Definition and elementary properties of a group. Order of a group. Subgroups. Criterion for a subset to be a subgroup.	24	24
June – 23 T. Y. B. Sc. P – IV	Review of Divisibility, Primes and The fundamental theorem of Arithmetic. Congruences : Definition and elementary properties,	24	24
July – 23 S. Y. B. Sc. P- III	Higher order homogeneous linear differential equations with constant coefficients, the auxiliary equations, Roots of the auxiliary equations: real and distinct, real and repeated, complex and complex repeated. Higher order homogeneous linear differential equations with constant coefficients, the method of undermined coefficients, method of variation of parameters. The inverse diff-erential operator and particular integral, Evaluation of 1/ f(D) for the functions like e^{ax}, sin ax, cos ax, x^m, x^m sin ax, x^m cos ax, $e^{ax}V$ and xV where V is any function of x,	20	20

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July – 23 T. Y. B. Sc. P – II	Abelian groups. Center of a group. Homomorphisms and isomorphisms. Examples of groups including Z, Q, R, C, Klein 4-group, symmetric and alternating groups, S 1 (= the unit circle in C), GLn(R), SLn(R), the group of n × n nonsingular upper triangular matrices, the group of n × n nonsingular upper triangular matrices, and groups of symmetries of plane figures.	24	24
July – 23 T. Y. B. Sc. P – IV	Complete residue system modulo m, Reduced residue system modulo m , Euler's function and its properties, Fermat's little Theorem. Wilson's theorem, Linear congruence, The Chinese remainder Theorem, Congruences of Higher degree	24	24
August – 23 S. Y. B. Sc. P- III	Higher order linear differential equations with variable coefficients: The Cauchy's equation: $x^3\, d^3y/dx3 + x^2\, d^2y/dx^2 + x\, dy/dx + y = f(x)$ and The Legendre's equation: $(ax + b)3\, d^3y/dx^3 + (ax + b)^2\, d^2y/dx^2 + (ax + b)\, dy/dx + y = f(x)$. Existence and uniqueness theorem for the solutions of initial value problems for a system of two first order linear differential equations in two unknown functions x, y of a single independent variable t, of the form $\begin{cases} \frac{dx}{dt} = F(t,x,y) \\ \frac{dy}{dt} = G(t,x,y) \end{cases}$ (Statement only). Homogeneous linear system of two first order differential equations in two unknown functions of a single independent variable t, of the form $\begin{cases} \frac{dx}{dt} = a_1(t)x + b_1(t)y \\ \frac{dy}{dt} = a_2(t)x + b_2(t)y \end{cases}$	20	20
August – 23 T. Y. B. Sc. P- II	Order of an element. Subgroup generated by a subset of the group. Cosets of a subgroup in a group. Lagrange's Theorem. Normal subgroups. Alternating group A_n. Listing normal subgroups of A_4, S_3. Quotient (or Factor) groups. Fundamental Theorem of homomorphisms of groups.	24	24
August – 23 T. Y. B. Sc. P- IV	The linear equations $ax + by = c$. The equations $x^2 + y^2 = p$, where p is a prime. The equation $x^2 + y^2 = z^2$, Pythagorean triples, primitive solutions, The equations $x^4 + y^4 = z^2$ and $x^4 + y^4 = z^4$ have no solutions (x; y; z) with xyz 6= 0. Every positive integer n can be expressed as sum of squares of four integers, Universal quadratic forms $x^2 + y^2 + z^2 + t^2$. Assorted examples	24	24

September – 2023 S. Y. B. Sc. P - III	Numerical Solution of initial value problem of first order ordinary differential equation using: (i) Taylors series method, (ii) Picard's method for successive approximation and its convergence, (iii) Euler's method and error estimates for Euler s method, (iv) Modified Euler's Method, (v) Runge-Kutta method of second order and its error estimates, (vi) Runge-Kutta fourth order method	16	16
September – 2023 T. Y. B. Sc. P - II	External direct products of groups. Examples. Relation with internal products such as HK of subgroups H, K of a group. Cayley's Theorem for finite groups	18	18
September – 2023 T. Y. B. Sc. P - IV	Order of an integer and Primitive Roots. Basic notions such as encryption (enciphering) and decryption (deciphering), Cryptosystems, symmetric key cryptography,	18	18
October – 2023 S. Y. B. Sc. P - III	Numerical solution of simultaneous and higher order ordinary differential equation using: (i) Runge-Kutta fourth order method for solving simultaneous ordinary differential equation, (ii) Finite difference method for the solution of two point linear boundary value problem.	10	10
October – 2023 T. Y. B. Sc. P - II	Examples of cyclic groups such as Z and the group μ_n of the n–th roots of unity. Properties of cyclic groups and cyclic subgroups. Finite cyclic groups, infinite cyclic groups and their generators. Properties of generators. The group Z/nZ of residue classes (mod n). Characterization of cyclic groups (as being isomorphic to Z or Z/nZ for some $n \in N$).	18	18
October – 2023 T. Y. B. Sc. P - IV	Simple examples such as shift cipher, Affine cipher, Hill cipher, Vigenere cipher. Concept of Public Key Cryptosystem; RSA Algorithm. An application of Primitive Roots to Cryptography.	18	18

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ISMAIL YUSUF COLLEGE OF ARTS, SCIENCE & COMMERCE

Jogeshwari (East), Mumbai – 400060

Teaching Plan for Academic Year 2023 – 24 (Second Half)

Subject: Mathematics Class : SYBSc and TYBSc Sem: IV and VI

Faculty Name: Sh. Thakare Rajesh B.

Month	Topics to be covered	Assigned Lecture	Lectures Undertaken
December – 23 S. Y. B. Sc. P- III	Unit I. Solution of Algebraic and Transcendental Equations 1. Measures of Errors: Relative, absolute and percentage errors, Accuracy and precision: Ac curacy to n decimal places, accuracy to n significant digits or significant figures, Rounding and Chopping of a number, Types of Errors: Inherent error, Round-o error and Truncation error. 2. Iteration methods based on first degree equation: Newton - Raphson method. Secant method. Regula - Falsi method. Derivations and geometrical interpretation and rate of convergence of all above methods to be covered. 3. General Iteration method: Fixed point iteration method	16	16
December – 23 T. Y. B. Sc. P – II	Unit I. Rings (1) Definition and elementary properties of rings (where the definition should include the existence of unity), commutative rings, integral domains and fields. Examples, including Z,Q,R,Z/nZ, C,Mn(R),Z[i],Z[√2],Z[√−5],Z[X],R[X],C[X],(Z/nZ)[X]. (2) Units in a ring. The multiplicative group of units in a ring R [and, in particular, the multiplicative group F∗ of nonzero elements of a field F]. Description of the units in Z/nZ. Results such as: A finite integral domain is a field. Z/pZ, where p is a prime, as an example of a finite field. (3) Characteristic of a ring. Examples. Elementary facts such as: the characteristic of an integral domain is either 0 or a prime number.	24	24

December – 23 T. Y. B. Sc. P – IV	Unit I: Quadratic Reciprocity: Quadratic residues and Legendre Symbol, Gauss's Lemma, Theorem on Legendre Symbol (2/ p) , the result: If p is an odd prime and a is an odd integer with (a, p) = 1 then (a/ p) = $(-1)^t$ where $t = \sum_{k=1}^{\frac{p-1}{2}} \left[\frac{ka}{p}\right]$, Quadratic Reciprocity law. Theorem on Legendre Symbol p. The Jacobi Symbol and law of reciprocity for Jacobi Symbol. Quadratic Congruences with Composite moduli.	24	24
January – 24 S. Y. B. Sc. P- III	Unit II. Interpolation, Curve fitting, Numerical Integration. 1. Interpolation: Lagrange's Interpolation. Finite difference operators: Forward Difference operator, Backward Difference operator. Shift operator. Newton's forward difference interpolation formula. Newton's backward difference interpolation formula. Derivations of all above methods to be covered. 2. Curve fitting: linear curve fitting. Quadratic curve fitting. 3. Numerical Integration: Trapezoidal Rule. Simpsons 1/3 rd Rule. Simpsons 3/8th Rule. Derivations all the above three rules to be covered	20	20
January – 24 T. Y. B. Sc. P- II	Unit II. Ideals and special rings (1) Ideals in a ring. Sums and products of ideals. Quotient rings. Examples. Prime ideals and maximal ideals. Characterization of prime ideals and maximal ideals in a commutative ring in terms of their quotient rings. Description of the ideals and the prime ideals in Z,R[X] and C[X]. (2) Homomorphisms and isomorphism of rings. Kernel and the image of a homomorphism. Fundamental Theorem of homomorphism of a ring. (3) Construction of the quotient field of an integral domain (Emphasis on Z,Q). A field contains a subfield isomorphic to Z/pZ or Q. (4) Notions of euclidean domain (ED), principal ideal domain (PID). Examples such as Z, Z[i], and polynomial rings. Relation between these two notions (ED ⟹ PID).	24	24
January – 24 T. Y. B. Sc. P- IV	Unit II: Continued Fractions: Finite continued fractions. Infinite continued fractions and representation of an irrational number by an infinite simple continued fraction, Rational approximations to irrational numbers and order of convergence, Best possible approximations. Periodic continued fractions	24	24

February – 24 S. Y. B. Sc. P- III	Unit III. Solution Linear Systems of Equations, Eigen value problems Linear Systems of Equations: LU Decomposition Method (Dolittle's Method and Crout's Method). Gauss-Seidel Iterative method.	20	20
February – 24 T. Y. B. Sc. P- II	Unit III. Factorization (15L) (1) Divisibility in a ring. Irreducible and prime elements. Examples. (2) Division algorithm in F[X] (where F is a field). Monic polynomials, greatest common divisor of $f(x),g(x) \in F[X]$ (not both 0). Theorem: Given $f(x)$ and $g(x)= 0$, in F[X] then their greatest common divisor $d(x) \in F[X]$ exists; moreover, $d(x) = a(x)f(x) + b(x)g(x)$ for some $a(x),b(x) \in F[X]$. Relatively prime polynomials in F[X], irreducible polynomial in F[X]. Examples of irreducible polynomials in (Z/pZ)[X] (p prime), Eisenstein Criterion (without proof).	24	24
February – 24 T. Y. B. Sc. P- IV	Unit III: Pell's equation, Arithmetic function and Special numbers (15 L) Pell's equation $x2 - dy2 = n$, where d is not a square of an integer. Solutions of Pell's equation (The proofs of convergence theorems to be omitted). Arithmetic functions of number theory: $d(n)$ (or $\tau(n)$,) $\sigma(n),\sigma_k(n),\omega(n)$ and their properties, $\mu(n)$ and the M¨obius inversion formula.	24	24
March – 24 S. Y. B. Sc. P- III	Eigen value problems: Jacobi's method for symmetric matrices. Rutishauser method for arbitrary matrices	8	8
March – 24 T. Y. B. Sc. P- II	Notion of unique factorization domain (UFD). Elementary properties. Example of a non UFD is $Z[\sqrt{-5}]$ (without proof). Theorem (without proof). Relation between the three notions (ED $\Rightarrow$ PID $\Rightarrow$ UFD). Examples such as Z[X] of UFD that are not PID. Theorem (without proof): If R is a UFD, then R[X] is a UFD.	12	12
March – 24 T. Y. B. Sc. P- IV	Special numbers: Fermat numbers, Mersenne numbers, Perfect numbers, Amicable numbers, Pseudo primes, Carmichael numbers	12	12

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Head of the Department

Class : F.Y.B.Sc. Semester I		
Course Code: USMT101		
Course Title : Calculus-I		
Name of the Teacher: Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Introduction to the course
2		Introduction to real numbers
3		Algebraic and order properties of real numbers
4	Week 2	Geometric Mean- Arithmetic Mean inequality, Bernoulli's inequality
5		Absolute Value of real numbers, Triangle inequality and its applications
6		Bounded set, Supremum and Infimum of a set
7	Week 3	Completeness property of real numbers
8		Archimedean property of R
9		Density of rational numbers in R
10	Week 4	Intervals of real line, nested interval property
11		Introduction to sequence of real numbers
12		Definition of sequence of real numbers and examples
13	Week 5	Limit of sequence, and Uniqueness of limit
14		Bounded sequence and examples
15		Algebra of limits of sequences
16	Week 6	Squeeze theorem for sequences
17		Ratio test for sequences
18		Monotone sequence, Monotone convergence theorem
19	Week 7	Subsequences, Divergence Criteria
20		Monotone subsequence theorem
21		Bolzano-Weierstrass theorem
22	Week 8	Bolzano-Weierstrass theorem and Cauchy sequence
23		Introduction to series of real numbers
24		Sequence of partial sums
25	Week 9	Convergent series
26		Divergent series
27		Some tests for convergence of series
28	Week 10	Some tests for convergence of series
29		Introduction to limit of function
30		Limit of functions definition and examples
31	Week 11	Limits of some standard functions
32		Sequential criteria for limits
33		Examples and problem solving
34	Week 12	Uniqueness of limit
35		Divergence criteria, and Algebra of limits
36		Squeeze theorem for limit.

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Class : F.Y.B.Sc. Semester I		
Course Code:USMT102		
Course Title : Algebra		
Name of the Teacher: Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Sets
2		Properties of sets
3		Properties of sets
4	Week 2	Natural Numbers
5		Set of Integers
6		Well ordering principle for N
7	Week 3	Principle of Mathematical induction
8		First Principal Of Insuction
9		Second Principal Of Insuction
10	Week 4	Sets, Relation and Functions
11		Power set, Operation on sets
12		Cartesian product of sets
13	Week 5	Definition of relation
14		Equivalence relation
15		Equivalence classes
16	Week 6	Definition of partition
17		Every partition gives an equivalence relation and vice-versa.
18		Definition of function
19	Week 7	Domain, co-domain and the range of function,
20		Injective, surjective and bijective functions
21		Composite function
22	Week 8	Criteria for injective function
23		Criteria for surjective function
24		Cantor's Theorem
25	Week 9	Schroder-Bernstein Theorem
26		Division algorithm
27		Euclidean algorithm
28	Week 10	Properties of G.C.D and L.C.M
29		Primes, Euclid's lemma
30		Unique Factorization Theorem
31	Week 11	Congruences: Definition and elementary properties
32		Addition and multiplication modulo n
33		Fermat's Little theorem, Euler's phi-function.
34	Week 12	Complex Numbers: Addition and multiplication of complex numbers.
35		Geometric representation of sum, differences.
36		De-Moivre's Theorem, roots of unity, Euler's Formula

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(Subject Teacher)

Class : S.Y.B.Sc. Semester IV		
Course Code: USMT401		
Course Title : Linear Algebra-II		
Name of the Teacher: : Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Introduction to the course
2		Definition of points in n-space and its rules
3		Examples and problem solving
4		located vectors, equivalent vectors, parallel vectors
5	Week 2	scalar or dot product and its properties
6		perpendicular or orthogonal vectors
7		Examples and problem solving
8		norm of a vector, Pythagoras theorem
9	Week 3	projection, angle between vectors
10		Schwarz inequality, triangle inequality
11		Examples and problem solving
12		Lines planes and their parametric equations
13	Week 4	homogeneous linear equations
14		row operations
15		Examples and problem solving
16		Gauss elimination, echelon form
17	Week 5	Limit of sequence
18		Uniqueness of limit
19		Examples and problem solving
20		Definition of field and examples
21	Week 6	definition of vector space over a field and examples
22		vector subspace and examples
23		Examples and problem solving
24		Necessary and sufficient condition for subspace
25	Week 7	sum and direct sum of subspaces
26		linear combination
27		Examples and problem solving
28		linear span/ generator
29	Week 8	convex sets
30		linear dependence
31		Examples and problem solving
32		linear independence
33	Week 9	basis of vector space
34		dimension of a vector space
35		Examples and problem solving
36		coordinates of a vector

37	Week 10	basis as a maximal linearly independent set
38		Examples and problem solving
39		isomorphism, similar matrices
40		finite dimensional vector spaces
41	Week 11	infinite dimensional vector spaces
42		the rank of a matrix
43		Matrix associated with linear map
44		row rank and column rank.
45	Week 12	Linear Transformations
46		Definition of linear transformation
47		linear map associated with matrix.
48		properties of linear transformations

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Class : S.Y.B.Sc. Semester III		
Course Code: USMT 303		
Course Title : Ordinary Differential Equations		
Name of the Teacher: : Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Introduction to differential equations
2		First order Ordinary differential Equations
		Examples and problem solving
3		Definition, solution
4	Week 2	Formation of differential equation
5		Order, degree of differential equation
		Examples and problem solving
6		Picard's Theorem for existence and uniqueness of solution
7	Week 3	Methods of solution: Variable Separable
8		Homogeneous equation
		Examples and problem solving
9		Exact differential equation
10	Week 4	Necessary and sufficient condition for exactness
11		Integration factor
		Examples and problem solving
12		Linear differential equation
13	Week 5	Bernoulli's differential equation
14		Orthogonal trajectories
		Examples and problem solving
15		Brachistochrone problem
16	Week 6	Hanging Chain Problem
17		Applications
		Examples and problem solving
18		Differentials Equations of degree greater than one
19	Week 7	Solvable for p
20		Solvable for x
		Examples and problem solving
21		Solvable for y
22	Week 8	Second order Linear Equations
23		Existence and uniqueness
		Examples and problem solving
24		General solution, Particular solution
25	Week 9	General Solution of homogeneous equation
26		Linear dependence-independence
		Examples and problem solving
27		The Wronskian
28		Use of known solution to find another
29		Solution of Homogeneous Equation with constant Coefficients

	Week 10	Examples and problem solving
30		Method of Undetermined coefficients
31	Week 11	Method of Variation of Parameter
32		Method of reduction of order
		Examples and problem solving
33		Applications od second order ODE
34	Week 12	Newtons Laws
35		Simple Harmonic Motion: Damped, Undamped
		Examples and problem solving
36		Variations in mechanical and electrical systems

(Subject Teacher)

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Class : T.Y.B.Sc. Semester V		
Course Code: USMT5B4		
Course Title : Number Theory and it's Applications I		
Name of the Teacher: : Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Divisibility in intgers
2		Problems on above
3		The Division algorithms
4		Problems on division algorithms
5	Week 2	Theorem on G.C.D.
6		Euclid's lemma
7		The Euclidean algorithm
8		Problems on Euclidean algorithm
9	Week 3	The least common multiple
10		Problems on least common multiple
11		The Diophantine equations
12		The Diophantine equations
13	Week 4	Problems on Diophantine equations
14		The fundamental theorem of a Arithmetic
15		The number $\sqrt{2}$ is irrational
16		Problems on distribution of primer
17	Week 5	The sieve of Eratosthenes
18		There is an infinite number of primer
19		Basic properties of Congruences
20		Properties of Congruences
21	Week 6	Problems on Congruences
22		Problems on Congruences
23		Linear Congruences
24		Chinese Remainder Theorem
25	Week 7	Fermat's Little Theorem
26		Problems on Fermat's Little Theorem
27		Problems on Fermat's Little Theorem
28		Wilson's Theorem and examples
29		Problems on Wilson's Theorem
30		The Sum and Number of Divisors

31	Week 8	The multiplicative functions
32		Problems on multiplicative functions
33		Mobius inversion formula
34	Week 9	Problems on Mobius inversion formula
35		The greatest integer function
36		Problems on greatest integer function
37	Week 10	Problems on greatest integer function
38		Euler's phi-function
39		Problems on Euler's phi-function
40		Euler's theorem
41	Week 11	Problems on Euler's theorem
42		Properties of Euler's phi-function
43		Quadratic Reciprocity Law
44		Problems on Quadratic Reciprocity Law
45	Week 12	Legendre symbol and properties
46		Quadratic Reciprocity Law
47		Quadratic Congruences with Composite Moduli
48		Public Key Cryptography

(Subject Teacher)

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Class : T.Y.B.Sc. Semester V		
Course Code: USMT503		
Course Title : Topology of Metric Spaces		
Name of the Teacher: : Mr.Manojkumar.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Introduction to the course
2		Definition and examples of metric spaces
3		open spheres and closed spheres
4		Examples and problem solving
5	Week 2	Examples and problem solving
6		neighborhoods
7		open sets
8		equivalent Metrics
9	Week 3	interior points
10		closed sets
11		limit points and isolated points
12		closure of a set
13	Week 4	boundary points
14		distance between sets and diameter of a set
15		subspace of a metric space
16		product metric spaces.
17	Week 5	Examples and problem solving
18		Completeness
19		Convergent sequences
20		Examples and problem solving
21	Week 6	Examples and problem solving
22		Cauchy sequences
23		complete spaces
24		Examples and problem solving
25	Week 7	dense sets and nowhere dense sets
26		. Continuous Functions
27		Examples and problem solving
28		Examples and problem solving
29	Week 8	Definition and characterizations
30		extension theorem
31		uniform continuity
32		homeomorphism
33	Week 9	Examples and problem solving
34		Compactness
35		Examples and problem solving
36		Compact spaces
37		Examples and problem solving
38		sequential compactness

39	Week 10	equivalence of compactness
40		Examples and problem solving
41	Week 11	sequential compactness
42		compactness and finite intersection property
43		continuous functions and compact spaces.
44		Connectedness
45	Week 12	Examples and problem solving
46		Separated sets
47		disconnected and connected sets
48		Examples and problem solving

(Subject Teacher)

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Class : S.Y.B.Sc. Semester III		
Course Code: USMT301		
Course Title : Calculus III		
Name of the Teacher: Mr. Manojkumar S Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Algebraic and Order properties of Real numbers
2		Consequences of algebraic properties
3		Absolute Value of real numbers, Triangle inequality and its applications
4		Some inequalities
5	Week 2	Bounded set, Supremum (l.u.b.), Infimum (g.l.b.)
6		Archimedean property of R, Density of rational numbers in R
7		Countable sets
8		Countability of Z, NxN, Q, R, RxR
9	Week 3	Cardinalities of closed and open intervals are same
10		Cantors Theorem,Schroder-Berstein Theorem
11		Sequences and Series: Sequence: Definition of sequence
12		Convergence and algebra of limits
13	Week 4	Uniqueness of limit, Bounded sequence, Tail of a sequence
14		Algebra of limits of sequences
15		Limit Superior, limit inferior and limit of sequence
16		Limit Superios and limit
17	Week 5	Properties of Limit Superior and limit inferior
18		Monotone sequence, Monotone convergence theorem
19		Subsequences, Divergence Criteria
20		Bolzano-Weierstrass theorem
21	Week 6	Monotone subsequence theorem,
22		Bolzano-Weierstrass theorem
23		Cauchy sequence, Cauchy criteria for convergence
24		Contracting and Cauchy sequence
25	Week 7	Infinite Series, Convergence criteria
26		Cauchy Convergence criteria
27		Absolute and conditional convergence
28		Series of positive terms and series of negative terms
29	Week 8	Rearrangement of series
30		Tests for Convergence: Harmonic serise
31		Sequence of Bounded Variation, Abel's Test
32		Ratio test, n th root test, Dirichlet's test
33	Week 9	Concept of limit, Continuous functions, Algebra of Continuous functions
34		Types of discontinuity
35		Continuous function on closed and bounded interval
36		Uniform continuity
37		Riemann integration: Set of measure zero
38		Subdivision, Upper sum, lower sum

39	Week 10	Upper Integral, Lower integral, Riemann integration
40		Criteria for integrability
41	Week 11	Existence of Riemann integral
42		Examples of integrable function
43		Sum, difference, multiple of integrable functions
44		Riean summation formula
45	Week 12	First Fundamental Theorem of Calculus
46		Second Fundamental Theorem of Calculus
47		Mean value theorems for integral
48		Applications of mean value theorem

(Subject Teacher)

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Class : T.Y.B.Sc. Semester V		
Course Code: USMT502		
Course Title : Group Theory		
Name of the Teacher:Mr.Manojkumar S Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Group: definition
2		Group: examples
3		Abelian groups
4		finite groups
5	Week 2	infinite groups
6		Properties of groups
7		Order of an element - definition, examples, properties
8		groups including Z, Q, R, C, Klein 4-group
9	Week 3	Group of quaternions, integers modulo n
10		S1 , GLn(R); SLn(Fp), SLn(R), On
11		Bn (= the group of n x n non-singular upper triangular matrices)
12		the group of one-one and onto functions from a set S to itself
13	Week 4	groups of symmetries of plane figures such as D4 and S3
14		GLn(Fp) the integers modulo under addition and multiplication
15		Uniqueness of identity, inverse, etc
16		Subgroups: definition, necessary and sufficient conditions
17	Week 5	examples on finding subgroups of finite groups
18		Cosets: definition and properties
19		Lagrange's theorem and corollaries
20		HK is a subgroup of G if and only if HK = KH
21	Week 6	Order of HK
22		Subgroup generated by an element of the group
23		Cyclic groups: Definition
24		Examples of cyclic groups such as Z
25	Week 7	Every cyclic group is abelian
26		If G = (a), then G = (a-1)
27		Every subgroup of a cyclic group is cyclic
28		Let G be a cyclic group of order n.
29	Week 8	Let G = (a) and o(G) = n, Then (am) = G if and only if (m, n) = 1
30		An element m in Z* n is a generator of Z* n if and only if (m, n) = 1
31		If G is an abelian group
32		N is a normal subgroup of G if and only if gNg -1 = N for every g ϵ G
33	Week 9	The subgroup N of G is a normal subgroup of G if and
34		only if every left coset of N in G is a right coset of N in G
35		A subgroup N of G is a normal subgroup of G if and
36		only if the product of two right cosets of N in G
37		If H is a subgroup of index 2 in G then H is a normal subgroup of G
38		If H is the only subgroup of G of a fixed finite order

39	Week 10	Homomorphism and Isomorphism: definition, examples
40		Fundamental Theorem of homomorphisms of groups
41	Week 11	The group Z/nZ of residue classes (mod n)
42		Cauchy's theorem and Sylow's theorem for Finite Abelian Groups
43		inverse image under a homomorphism of a subgroup
44		Characterization of cyclic groups
45	Week 12	Automorphims
46		Cayley's Theorem for finite groups
47		Classification of groups of order less equal 8
48		Properties: (i) o(Sn) = n! (ii) An is a subgroup of Sn,

(Subject Teacher)

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DEPARTMENT OF MATHEMATICS
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Class : S.Y.B.Sc. Semester V		
Course Code: USMT302		
Course Title : Ordinary Differential Equations		
Name of the Teacher: M.S.Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Introduction to differential equations
2		First order Ordinary differential Equations
		Examples and problem solving
3		Definition, solution
4	Week 2	Formation of differential equation
5		Order, degree of differential equation
		Examples and problem solving
6		Picard's Theorem for existence and uniqueness of solution
7	Week 3	Methods of solution: Variable Separable
8		Homogeneous equation
		Examples and problem solving
9		Exact differential equation
10	Week 4	Necessary and sufficient condition for exactness
11		Integration factor
		Examples and problem solving
12		Linear differential equation
13	Week 5	Bernoulli's differential equation
14		Orthogonal trajectories
		Examples and problem solving
15		Brachistochrone problem
16	Week 6	Hanging Chain Problem
17		Applications
		Examples and problem solving
18		Differentials Equations of degree greater than one
19	Week 7	Solvable for p
20		Solvable for x
		Examples and problem solving
21		Solvable for y
22	Week 8	Second order Linear Equations
23		Existence and uniqueness
		Examples and problem solving
24		General solution, Particular solution
25	Week 9	General Solution of homogeneous equation
26		Linear dependence-independence
		Examples and problem solving
27		The Wronskian
28		Use of known solution to find another
29		Solution of Homogeneous Equation with constant Coefficients

	Week 10	Examples and problem solving
30		Method of Undetermined coefficients
31	Week 11	Method of Variation of Parameter
32		Method of reduction of order
		Examples and problem solving
33		Applications od second order ODE
34	Week 12	Newtons Laws
35		Simple Harmonic Motion: Damped, Undamped
		Examples and problem solving
36		Variations in mechanical and electrical systems

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Class : T.Y.B.Sc. Semester V		
Course Code: MT337F		
Course Title : Number Theory		
Name of the Teacher: Mr. Manojkumar S Kaurav.		
Lecture No.	Week	Topic
1	Week 1	Divisibility in intgers
2		Problems on above
3		The Division algorithms
4		Problems on division algorithms
5	Week 2	Theorem on G.C.D.
6		Euclid's lemma
7		The Euclidean algorithm
8		Problems on Euclidean algorithm
9	Week 3	The least common multiple
10		Problems on least common multiple
11		The Diophantine equations
12		The Diophantine equations
13	Week 4	Problems on Diophantine equations
14		The fundamental theorem of a Arithmetic
15		The number $\sqrt{2}$ is irrational
16		Problems on distribution of primer
17	Week 5	The sieve of Eratosthenes
18		There is an infinite number of primer
19		Basic properties of Congruences
20		Properties of Congruences
21	Week 6	Problems on Congruences
22		Problems on Congruences
23		Linear Congruences
24		Chinese Remainder Theorem
25	Week 7	Fermat's Little Theorem
26		Problems on Fermat's Little Theorem
27		Problems on Fermat's Little Theorem
28		Wilson's Theorem and examples
29		Problems on Wilson's Theorem
30		The Sum and Number of Divisors

31	Week 8	The multiplicative functions
32		Problems on multiplicative functions
33	Week 9	Mobius inversion formula
34		Problems on Mobius inversion formula
35		The greatest integer function
36		Problems on greatest integer function
37	Week 10	Problems on greatest integer function
38		Euler's phi-function
39		Problems on Euler's phi-function
40		Euler's theorem
41	Week 11	Problems on Euler's theorem
42		Properties of Euler's phi-function
43		Quadratic Reciprocity Law
44		Problems on Quadratic Reciprocity Law
45	Week 12	Legendre symbol and properties
46		Quadratic Reciprocity Law
47		Quadratic Congruences with Composite Moduli
48		Public Key Cryptography

(Subject Teacher)

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ISMAIL YUSUF COLLEGE OF ARTS, SCIENCE & COMMERCE

Jogeshwari (East), Mumbai – 400060

Teaching Plan

Subject: Mathematics Class :SYBSc. Sem: III & IV Paper- III

Faculty Name: Sh. Obaidullah S. Shaikh

Month	Topics to be covered	Assigned Lecture	Lectures Undertaken
June – 22	• The general n−th order linear differential equations, Linear independence, An existence and uniqueness theorem, the Wronskian. • Classification: homogeneous and non-homogeneous, General solution of homogeneous and non-homogeneous LDE, The Differential operator and its properties.	20	20
July – 22	• Higher order homogeneous linear differential equations with constant coefficients, the auxiliary equations, Roots of the auxiliary equations: real and distinct, real and repeated, complex and complex repeated. Higher order homogeneous linear differential equations with constant coefficients, the method of undermined coefficients, method of variation of parameters. • The inverse differential operator and particular integral, Evaluation of 1/ f(D) for the functions like e^{ax}, sin ax, cos ax, x^m, x^m sin ax, x^m cos ax, $e^{ax}V$ and xV where V is any function of x.	20	20
Aug – 22	• Higher order linear differential equations with variable coefficients: • The Cauchy's equation: $x^3 d^3 y/ dx3 + x^2 d^2y /dx^2 + x dy/dx + y = f(x)$ and The Legendre's equation: $(ax + b)3 d^3y/dx^3 + (ax + b)^2 d^2y /dx^2 + (ax + b) dy/ dx + y = f(x)$. • Existence and uniqueness theorem for the solutions of initial value problems for a system of two first order linear differential equations in two unknown functions x, y of a single	20	20

	independent variable t, of the form $\begin{cases} \frac{dx}{dt} = F(t,x,y) \\ \frac{dy}{dt} = G(t,x,y) \end{cases}$ (Statement only). • Homogeneous linear system of two first order differential equations in two unknown functions of a single independent variable t, of the form $\begin{cases} \frac{dx}{dt} = a_1(t)x + b_1(t)y \\ \frac{dy}{dt} = a_2(t)x + b_2(t)y \end{cases}$		
Sep – 22	• Numerical Solution of initial value problem of first order ordinary differential equation using: • Taylors series method. • Picard's method for successive approximation and its convergence. • Euler's method and error estimates for Euler s method. • Modified Euler's Method, • Runge-Kutta method of second order and its error estimates. • Runge-Kutta fourth order method	16	16
Oct – 22	• Numerical solution of simultaneous and higher order ordinary differential equation using: • Runge-Kutta fourth order method for solving simultaneous ordinary differential equation. • Finite difference method for the solution of two point linear boundary value problem.	10	10
Dec – 22	• Solution of Algebraic and Transcendental Equations. • Measures of Errors: Relative, absolute and percentage errors, Accuracy and precision: • Accuracy to n decimal places, accuracy to n significant digits or significant figures. • Rounding and Chopping of a number. • Types of Errors: Inherent error, Round-off error and Truncation error.	16	16

	• Iteration methods based on first degree equation: • Newton - Raphson method. • Secant method and Regula - Falsi method. • Derivations and geometrical interpretation and rate of convergence of all above methods to be covered. • General Iteration method: Fixed point iteration method.		
Jan-23	• Interpolation, Curve fitting, Numerical Integration. • Interpolation: Lagrange's Interpolation. • Finite difference operators: Forward Difference operator, Backward Difference operator. Shift operator. • Newton's forward difference interpolation formula. Newton's backward difference interpolation formula. • Derivations of all above methods to be covered. • Curve fitting: linear curve fitting. Quadratic curve fitting. • Numerical Integration: Trapezoidal Rule. Simpsons 1/3 rd Rule. Simpsons 3/8th Rule. • Derivations all the above three rules to be covered.	20	20
Feb – 23	• Solution Linear Systems of Equations. • Eigen value problems. • Linear Systems of Equations: LU Decomposition Method (Dolittle's Method and Crout's Method). • Gauss-Seidel Iterative method.	20	20
Mar–23	• Eigen value problems: Jacobi's method for symmetric matrices. Rutishauser method for arbitrary matrices	8	8

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Faculty member

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Teaching Plan

Subject: Mathematics and Statistics- I & II Class :FYBCOM Sem: I & II

Faculty Name: **Sh. Obaidullah S. Shaikh**

Month	Topics to be covered	Assigned Lecture	Lectures Undertaken
July – 20 FYBCOM SEM-I	• **Shares:** Concept of share, face value, market value, dividend, equity shares, preferential shares, bonus shares. Simple examples • **Mutual Funds**: Simple problems on calculation of Net income after considering entry load, dividend, change in Net Asset Value (N.A.V.) and exit load. Averaging of price under the Systematic Investment Plan (S.I.P.)	32	32
Aug – 20 FYBCOM SEM-I	• **Permutation and Combination**: Factorial Notation, Fundamental principle of counting, Permutation as arrangement, Simple examples, combination as selection, Simple examples, Relation between r n C and r n P Examples on commercial application of permutation and combination. • **Random Variable:** Probability distribution of a discrete random variable; Expectation and Variance of random variable, simple examples on probability distributions.	40	40
Sep – 20 FYBCOM SEM-I	• **Probability Theory:** Concept of random experiment/trial and possible outcomes; Sample Space and Discrete Sample Space; Events their types, Algebra of Events, Mutually Exclusive and Exhaustive Events, Complimentary events. Classical definition of Probability, Addition theorem (without proof), conditional probability.	40	40

Oct – 20 FYBCOM SEM-I	• **Linear Programming Problem:** Sketching of graphs of (i) linear equation Ax + By + C = 0 (ii) linear inequalities. Mathematical Formulation of Linear Programming Problems upto 3 variables. Solution of Linear Programming Problems using graphical method up to two variables.	32	32
Dec-20 FYBCOM SEM-II	**Functions, Derivatives and Their Applications:** • Concept of real functions: constant function, linear function, x^n , e^x , a^x , $log\ x$. • Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break-even point **Derivative of functions:** • Derivative as rate measure, Derivative of x^n , e^x , a^x , $log\ x$. • **Rules of derivatives:** Scalar multiplication, sum, difference, product, quotient (Statements only), Simple problems. Second order derivatives. • **Applications:** Marginal Cost, Marginal Revenue, Elasticity of Demand. Maxima and Minima for functions in Economics and Commerce.	32	32
JAN-21 FYBCOM SEM-II	• **Interest:** Simple Interest, Compound Interest (Nominal & Effective Rate of Interest),. Calculations involving up to 4 time periods. • **Annuity:** Annuity Immediate and its Present value, Future value. Equated Monthly Installments (EMI) using reducing balance method & amortization of loans. Stated Annual Rate & Affective Annual Rate Perpetuity and its present value. Simple problems involving up to 4 time periods	40	40

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FEB-21 FYBCOM SEM-II	• **Index Numbers:** Concept and usage of Index numbers, Types of Index numbers, Aggregate and Relative Index Numbers, Lasperye's, Paasche's, Dorbisch-Bowley's, Marshall-Edgeworth and Fisher's ideal index numbers. • **Test of Consistency:** Time Reversal Test and Factor Reversal Test. Chain Base Index Nos. Shifting of Base year. Cost of Living Index Numbers, Concept of Real Income, Concept of Wholesale Price Index Number. (Examples on missing values should not be taken).	38	38
MAR-21 FYBCOM SEM-II	**Probability Distributions:** • **Discrete Probability Distribution:** Binomial, Poisson (Properties and applications only, no derivations are expected). • **Continuous Probability distribution:** Normal Distribution. (Properties and applications only, no derivations are expected)	32	32

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