SYLLABUS AND PROGRAMMME / COURSE OUTCOMES

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programme : B. Sc. **Course: Mathematics**

Program Code: **Course Code:**

(As per the Credit Based Semester and Grading System with effect from the academic year 2020-21)

Year : 2020-21 **Semester : I & II**

Programme Outcomes :

(1) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling, solving and interpreting.

(2) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

(3) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.

(4) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences

Course Outcomes:

1. Calculus (Sem I & II): This course gives introduction to basic concepts of Analysis with rigor and prepares students to study further courses in Analysis. Formal proofs are given lot of emphasis in this course which also enhances understanding of the subject of Mathematics as a whole. The portion on first order, first degree differentials prepares learner to get solutions of so many kinds of problems in all subjects of Science and also prepares learner for further studies of differential equations and related fields.

2. Algebra I (Sem I) & Discrete Mathematics (Sem II): This course gives expositions to number systems (Natural Numbers & Integers), like divisibility and prime numbers and 4 their properties. These topics later find use in advanced subjects like cryptography and its uses in cyber security and such related fields.

SEM-I

USMT 101 - CALCULUS I

UNIT I - Real Number System (15 Lectures)

(1) Real number system R and order properties of R, absolute value | | and its properties.

(2) AM-GM inequality, Cauchy-Schwarz inequality, Intervals and neighbourhoods, interior points, limit point, Hausdorff property.

(3) Bounded sets, statements of I.u.b. axiom and its consequences, supremum and infimum, maximum and minimum, Archimedean property and its applications, density of rationals.

UNIT II - Sequences in R (15 Lectures)

(1) Definition of a sequence and examples, Convergence of sequences, every convergent sequences is bounded. Limit of a convergent sequence and uniqueness of limit, Divergent sequences.

(2) Convergence of standard sequences

$\left(\frac{1}{1+na}\right), \forall a > 0, (b^n) \forall b > 0, 0 < b < 1, \left(c^{\frac{1}{n}}\right) c > 0, \left(n^{\frac{1}{n}}\right)$

(3) Algebra of convergent sequences, sandwich theorem, monotone sequences, monotone convergence theorem and consequences as convergence of $\left(\left(1+\frac{1}{n}\right)^n\right)$.

(4) Definition of subsequence, subsequence of a convergent sequence is convergent and converges to the same limit, definition of a Cauchy sequences, every convergent sequences s a Cauchy sequence and converse.

Unit III: First order First degree Differential equations (15 Lectures)

Review of Definition of a differential equation, order, degree, ordinary differential equation and partial differential equation, linear and non- linear ODE. Solution of homogeneous and nonhomogeneous differential equations of first order and first degree. Notion of partial derivatives.

(1) Exact Equations: General solution of Exact equations of first order and first degree. Necessary and sufficient condition for $Mdx + Ndy = 0$ to be exact. Non-exact equations: Rules for finding integrating factors (without proof) for non -exact equations, such as :

i) $\frac{1}{Mx+Ny}$ y is an I.F. if $Mx + Ny \neq 0$ and $Mdx + Ndy = 0$ is homogeneous.

ii) $\frac{1}{Mx-Ny}$ is an I.F. if $Mx - Ny \neq 0$and $Mdx + Ndy = 0$ is of the form $f_1(x,y)y\,dx + f_2(x,y)x\,dy = 0$.

iii) $e^{\int f(x)dx}$ (resp $e^{\int g(y)dy}$) is an I.F. if $N \neq 0$ (resp $(M \neq 0)$) $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$resp $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$ is a function of x (resp y) alone, say f(x) (resp g(y)).

iv) Linear and reducible linear equations of first order, finding solutions of first order differential equations of the type for applications to orthogonal trajectories, population growth, and finding the current at a given time.

(2) Reduction of order :

(i) If the differential equation does not contain only the original function y, that is equations of type$F(x, y', y'') = 0$.

(ii) If the differential equation does not contain the independent variable x that is, equations of $F(y, y', y'') = 0$

Reference Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.

USMT 102 – ALGEBRA I

Unit I : Integers & Divisibility (15 Lectures)

(1) Statements of well-ordering property of non-negative integers, Principle of finite induction (first and second) as a consequence of Well-Ordering Principle.

(2) Divisibility in integers, division algorithm, greatest common divisor (g.c.d.) and least common multiple (l.c.m.) of two non zero integers, basic properties of g.c.d. such as existence and uniqueness of g.c.d. of two non zero integers a & b and that the g.c.d. can be expressed as ma + nb for some m, n $\in \mathbb{Z}$, Euclidean algorithm.

(3) Primes, Euclid's lemma, Fundamental Theorem of arithmetic, The set of primes is infinite, there are arbitrarily large gaps between primes, there exists infinitely many primes of the form 4n − 1 or of the form 6n − 1.

(4) Congruence, definition and elementary properties, Results about linear congruence equations. Examples.

Unit II : Functions, Relations and Binary Operations (15 Lectures)

(1) Definition of relation and function, domain, co-domain and range of a function, composite functions, examples, Direct image f(A) and inverse image $f^{-1}(B)$ for a function f, injective, surjective, bijective functions, Composite of injective, surjective, bijective functions when

defined, invertible functions, bijective functions are invertible and conversely, examples of functions including constant, identity, projection, inclusion, Binary operation as a function, properties, examples.

(2) Equivalence relation, Equivalence classes, properties such as two equivalences classes are either identical or disjoint, Definition of partition, every partition gives an equivalence relation and vice versa. (3) Congruence is an equivalence relation on ℤ, Residue classes and partition of ℤ, Addition modulon, Multiplication modulo n, examples.

Unit III: Polynomials (15 Lectures)

(1) Definition of a polynomial, polynomials over F where F = Q, R or C, Algebra of polynomials, degree of polynomial, basic properties.

(2) Division algorithm in F[X] (without proof), and g.c.d of two polynomials and its basic properties, Euclidean algorithm (proof of the above results may be given only in the case of Q[X] with a remark that the results as well as the proofs remain valid in the case of R[X] or C[X]). 8

(3) Roots of a polynomial, relation between roots and coefficients, multiplicity of a root. Elementary consequences such as the following.

(i) Remainder theorem, Factor theorem.

(ii) A polynomial of degree n has at most n roots.

(iii) Complex and non-real roots of a polynomials in R[X] occur in conjugate pairs. (Emphasis on examples and problems in polynomials with real coefficients).

(4) Necessary condition for a rational number p q to be a root of a polynomial with integer coefficients (viz. p divides the constant coefficient and q divides the leading coefficient), corollary for monic polynomials (viz. a rational root of monic polynomial with integer coefficients is necessarily an integer). Simple consequence such as the irrationality is necessarily of √p for any prime number p. Irreducible polynomials in Q[x], Unique Factorisation Theorem. Examples.

Reference Books:

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd. 2.

2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.

SEM-II

USMT 201- CALCULUS II

Unit-I: Limits and Continuity (15 Lectures)

{Brief review: Domain and range of a function, injective function, surjective function, bijective function, composite of two functions (when defined), Inverse of a bijective function. Graphs of some standard functions such as |x|, e^x, log x, $ax^2 + bx + c$, $\frac{1}{x}$, x^n n ≥ 3), sin x, cos x, tan x, $sin\frac{1}{x}$, $x^2 sin\frac{1}{x}$ over suitable intervals of R

1) (1) ε − δ definition of Limit of a function, uniqueness of limit if it exists, algebra of limits, limits of composite function, sandwich theorem, left-hand-limit $\lim_{x\to a^-} f(x)$right-hand limit $\lim_{x\to a^+} f(x)$ non-existence of limits $\lim_{x\to -\infty} f(x)$ $\lim_{x\to \infty} f(x)$ and $\lim_{x\to a} f(x) = \pm\infty$

2) Continuous functions: Continuity of a real valued function at a point and on a set using ε − δ definition, examples, Continuity of a real valued function at end points of domain using ε −δ definition, f is continuous at a if and only if $\lim_{x\to a} f(x)$exists and equals to f(a), Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity

3)) Intermediate Value theorem and its applications, Bolzano-Weierstrass theorem (statement only): A continuous function on a closed and bounded interval is bounded and attains its bound

Unit-II: Differentiability of functions (15 Lectures)

1) Differentiation of real valued function of one variable: Definition of differentiability of a function at a point of an open interval, examples of differentiable and non- differentiable functions, differentiable functions are continuous but not conversely, algebra of differentiable function

2)Chain rule, Higher order derivatives, Leibniz rule, Derivative of inverse functions, Implicit differentiation (only example)

Unit-III: Applications of differentiability (15 Lecture)

1) Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, applications and examples, Monotone increasing and decreasing functions, examples
2) L-Hospital rule (without proof), examples of indeterminate forms, Taylor's theorem with Lagrange's form of remainder with proof, Taylor polynomial and applications
3) Definition of critical point, local maximum/minimum, necessary condition, stationary points, second derivative test, examples, concave/convex functions, point of inflection
4) Sketching of graphs of functions using properties

Reference books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. James Stewart, Calculus, Third Edition, Brooks/ Cole Publishing company, 1994.
3. T. M. Apostol, Calculus, Vol I, Wiley And Sons (Asia) Pte. Lt
4. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, Springer International Ltd, 2000.

USMT 202- DISCRETE MATHEMATICS

Unit I: Preliminary Counting (15 Lectures)

1)Finite and infinite sets, countable and uncountable sets examples such as N, Z, N × N, Q (0, 1),R

2) Addition and multiplication Principle, counting sets of pairs, two ways counting.

3) Stirling numbers of second kind. Simple recursion formulae satisfied by S(n, k) for k = 1, 2, · ·, n − 1, n

4) Pigeonhole principle simple and strong form and examples, its applications to geometry.

Unit II: Advanced Counting (15 Lectures)

1) Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.
2) Binomial and Multinomial Theorem, Pascal identity, examples of standard identities such as the following with emphasis on combinatorial proofs.

$$\sum_{k=0}^{n}\binom{m}{k}\binom{n}{r-k}=\binom{m+n}{r} \quad \sum_{i=0}^{k}\binom{k}{i}^2=\binom{2k}{k}$$

$$\sum_{i=r}^{n}\binom{i}{r}=\binom{n+1}{r+1} \quad \sum_{i=0}^{n}\binom{n}{i}=2^n$$

3) Non-negative integer solutions of equation $x_1 + x_2 + \cdots + x_n = n$
4) Principal of inclusion and exclusion, its applications, derangements, explicit formula for d_n, deriving formula for Euler's function φ(n).

Unit III: Permutations and Recurrence relation (15 lectures)

1) Permutation of objects, Sn, composition of permutations, results such as every permutation is a product of disjoint cycles, every cycle is a product of transpositions, signature of a permutation, even and odd permutations, cardinality of Sn, An
2) Recurrence Relations, definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation, obtaining recurrence relations of Tower of Hanoi, Fibonacci sequence, etc. in counting problems, solving homogeneous as well as non-homogeneous recurrence relations by using iterative methods, solving a homogeneous

recurrence relation of second degree using algebraic method proving the necessary result.

Recommended Books:

1) Norman Biggs, Discrete Mathematics, Oxford University Press
2) Richard Brualdi, Introductory Combinatorics, John Wiley and sons.
3) V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
4) Discrete Mathematics and its Applications, Tata McGraw Hills
5) Schaum's outline series, Discrete mathematics,
6) Allen Tucker, Applied Combinatorics, John Wiley and Sons.
7) Sharad Sane, Combinatorial Techniques, Springer.

Scheme of Examination (75:25)

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25 percent marks in the first part and by conducting the Semester End Examinations with 75 percent marks in the second part. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

I. Internal Evaluation of 25 Marks:

(i) One class Test of 20 marks to be conducted during Practical session.

Paper pattern of the Test:

Q1: Defnitions/ Fill in the blanks/ True or False with Justi_cation (04 Marks).
Q2: Multiple choice 5 questions. (10 Marks: 5 _ 2)
Q3: Attempt any 2 from 3 descriptive questions. (06 marks: 2 _ 3)
(ii) Active participation in routine class: 05 Marks.

II. Semester End Theory Examinations: There will be a Semester-end external Theory examination of 75 marks for each of the courses USMT101/UAMT101, USMT102 of Semester I and USMT201/UAMT201, USMT202 of semester II to be conducted by the college.

1. Duration: The examinations shall be of 2 and 1/2 hours duration.

2. Theory Question Paper Pattern:

a) There shall be FOUR questions. The _rst three questions Q1, Q2, Q3 shall be of 20 marks, each based on the units I, II, III respectively. The question Q4 shall be of 15 marks based on the entire syllabus.
b) All the questions shall be compulsory. The questions Q1, Q2, Q3, Q4 shall have internal choices within the questions. Including the choices, the marks for each question shall be 25-27.
c) The questions Q1, Q2, Q3, Q4 may be subdivided into sub-questions as a, b, c,d & e, etc and the allocation of marks depends on the weightage of the topic.

3. Semester End Examinations Practicals : At the end of the Semesters I & II Practical examinations of three hours duration and 100 marks shall be conducted for the courses USMTP01, USMTP02. In semester I, the Practical examinations for USMT101 and USMT102 are held together by the college. In Semester II, the Practical examinations for USMT201 and USMT202 are held together by the college.

Paper pattern : The question paper shall have two parts A and B. Each part shall have two Sections. Section I Objective in nature: Attempt any Eight out of Twelve multiple choice questions (04 objective questions from each unit) ($8 \times 3 = 24$ Marks). Section II Problems: Attempt any Two out of Three (01 descriptive question from each unit) ($8 \times 2 = 16$ Marks).

Practcal Course	**Part A**	**Part B**	**Marks out of**	**duration**
USMTP01	Questions from USMT101	Questions from USMT101	80	3 hrs
USMTP02	Questions from USMT201	Questions from USMT202	80	3 hrs

Marks for Journals and Viva:

For each course USMT301/UAMT301, USMT302/UAMT302, USMT303, USMT401/UAMT401, USMT402/UAMT402 and USMT403:

1. Journals: 5 marks.
2. Viva: 5 marks.

Each Practical of every course of Semester III and IV shall contain 10 (ten) problems out of which minimum 05 (five) have to be written in the journal. A student must have a certified journal before appearing for the practical examination.

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S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programme : B. Sc. **Course: Mathematics**
Program Code: **Course Code:**

(As per the Credit Based Semester and Grading System with effect from the academic year 2021-22)

Year : 2021-22 **Semester : III& IV**

Programme Outcomes :

(1) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling, solving and interpreting.

(2) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

(3) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.

(4) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences

Course Outcomes:

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2. Algebra I (Sem I & II): This course gives expositions to number systems (Natural Numbers & Integers), like divisibility and prime numbers and 4 their properties. These topics later find use in advanced subjects like cryptography and its uses in cyber security and such related fields.

3. Ordinary Differential Equations (Sem III) and Numerical Methods (Sem IV) prepares learner to get solutions of so many kinds of problems in all subjects of Science and also prepares learner for further studies of differential equations and related fields.

SEM-III

USMT 301 CALCULUS III

Unit I. Infinite Series (15 Lectures)

1. Infinite series in R. Definition of convergence and divergence. Basic examples including geometric series. Elementary results such as if is convergent, then $a_n \longrightarrow 0$ but converse not true. Cauchy Criterion. Algebra of convergent series.

2. Tests for convergence: Comparison Test, Limit Comparison Test, Ratio Test(without proof), Root Test (without proof), Abel Test (without proof) and Dirichlet Test (without proof). Examples. The decimal expansion of real numbers.

3. Alternating series. Leibnitz's Test. Examples. Absolute convergence, absolute convergence implies convergence but not conversely. Conditional Convergence.

Unit II. Riemann Integration (15 Lectures)
1. Idea of approximating the area under a curve by inscribed and circumscribed rectangles. Partitions of an interval. Refinement of a partition. Upper and Lower sums for a boundedreal valued function on a closed and bounded interval. Riemann integrability and theRiemann integral.
2. Criterion for Riemann integrability. Characterization of the Riemann integral as the limitf a sum. Examples.
3. Algebra of Riemann integrable function
4. Riemann integrability of a continuous function, and more generally of a bounded function whose set of discontinuities has only finitely many points. Riemann integrability of mono-tone functions.

Unit III. Applications of Integrations and Improper Integrals (15 lectures)
1. Area between the two curves. Lengths of plane curves. Surface area of surfaces of revolu-tion.
2. Continuity of the function is Riemann integrable. First and second Fundamental Theorems of Calculus.
3. Mean value theorem. Integration by parts formula. Leibnitz's Rule.
4. Definition of two types of improper integrals. Necessary and sufficient conditions forconvergence.
5. Absolute convergence. Comparison and limit comparison tests for convergence.
6. Gamma and Beta functions and their properties. Relationship between them (without proof).

Reference Books:
1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (secondedition); Springer.
2. R.R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970.
3. Calculus and Analytic Geometry (Ninth Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998.
4. T. Apostol; Calculus Vol. 2; John Wiley.

USMT 302: ALGEBRA III

Unit I. System of Equations, Matrices (15 Lectures)
1. Systems of homogeneous and non-homogeneous linear equations, Simple examples of finding solutions of such systems. Geometric and algebraic understanding of the solutions.Matrices (with real entries), Matrix representation of system of homogeneous and non-homogeneous linear equations. Algebra of solutions of systems of homogeneous linearequations. A system of homogeneous linear equations with number of unknowns morethan the number of equations has infinitely many solutions.
2. Elementary row and column operations. Row equivalent matrices. Row reduction (of a matrix to its row echelon form). Gaussian elimination. Applications to solving systems oflinear equations. Examples.
3. Elementary matrices. Relation of elementary row operations with elementary matrices. Invertibility of elementary matrices. Consequences such as (i) a square matrix is invertible if and only if its row echelon form is invertible. (ii) invertible matrices are products of elementary matrices. Examples of the computation of the inverse of a matrix using Gauss elimination method.

Unit II. Vector space over R (15 Lectures)

1. Definition of a vector space over R. Subspaces; criterion for a nonempty subset to be a subspace of a vector space. Examples of vector spaces, including the Euclidean space R^n, lines, planes and hyperplanes in R^n passing through the origin, space of systems of homogeneous linear equations, space of polynomials, space of various types of matrices, space of real valued functions on a set.
2. Intersections and sums of subspaces. Direct sums of vector spaces. Quotient space of a vector space by its subspace.
3. Linear combination of vectors. Linear span of a subset of a vector space. Definition of a finitely generated vector space. Linear dependence and independence of subsets of a vector space.
4. Basis of a vector space. Basic results that any two bases of a finitely generated vector space have the same number of elements. Dimension of a vector space. Examples. Bases of a vector space as a maximal linearly independent sets and as minimal generating sets.

Unit III. Determinants, Linear Equations (Revisited) (15 Lectures)

1. Inductive definition of the determinant of a $n \times n$ matrix (e. g. in terms of expansion along the first row). Example of a lower triangular matrix. Laplace expansions along an arbitrary row or column. Determinant expansions using permutations
2. Basic properties of determinants (Statements only);
3. Row space and the column space of a matrix as examples of vector space. Notion of row rank and the column rank. Equivalence of the row rank and the column rank. Invariance of rank upon elementary row or column operations. Examples of computing the rank using row reduction.
4. Relation between the solutions of a system of non-homogeneous linear equations and the associated system of homogeneous linear equations. Necessary and sufficient condition for a system of non-homogeneous linear equations to have a solution [viz., the rank of the coefficient matrix equals the rank of the augmented matrix $[A|B]$].
5. Cramers Rule. LU Decomposition. If a square matrix A is a matrix that can be reduced to row echelon form U by Gauss elimination without row interchanges, then A can be factored as $A = LU$ where L is a lower triangular matrix.

Reference books:

1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition).
2. Serge Lang, Introduction to Linear Algebra, Springer.
3. S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning.
4. Sheldon Axler, Linear Algebra done right, Springer.
5. David W. Lewis, Matrix theory
6. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers.

USMT 303 – Ordinary Differential Equations

Unit I. Higher order Linear Differential equations (15 Lectures)

1. 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.
2. Higher order homogeneous linear differential equations with constant coefficients, the aux-iliary equations, Roots of the auxiliary equations: real and distinct, real and repeated, complex and complex repeated.

3. Higher order homogeneous linear differential equations with constant coefficients, the method of undermined coefficients, method of variation of parameters.
4. The inverse differential operator and particular integral
5. Higher order linear differential equations with variable coefficients:

Reference Books:

1. Units 5, 6, 7 and 8 of E.D. Rainville and P.E. Bedient; Elementary Differential Equations;Macmillan.
2. Units 5, 6 and 7 of M.D. Raisinghania; Ordinary and Partial Differential Equations; S.Chand.

Unit II. Systems of First Order Linear Differential Equations (15 Lectures)

1. 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
2. Wronskian for a homogeneous linear system of first order linear differential equations in two functions x, y of a single independent variable t. Vanishing properties of the Wronskian.Relation with linear independence of solutions.
3. Homogeneous linear systems with constant coefficients in two unknown functions x, y of a single independent variable t. Auxiliary equation associated to a homogenous system of equations with constant coefficients. Description fo the general solution depending on the roots and their multiplicities of the auxiliary equation, proof of independence of the solutions. Real form of solutions in case the auxiliary equation has complex roots.
4. Non-homogeneous linear system of linear system of two first order differential equations in two unknown functions of a single independent variable t

Reference Books:

1.G.F. Simmons; Differential Equations with Applications and Historical Notes; Taylor'sand Francis

Unit III. Numerical Solution of Ordinary Differential Equations (15 lectures)

1. Numerical Solution of initial value problem of first order ordinary differential equationusing:
Taylor's 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.
2. 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.

Reference Books:

1.Units 8 of S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.

SEM-IV

USMT 401: Multivariable Calculus I

UNIT I. Functions of Several Variables (15Lectures)

1. Review of vectors in R^n [with emphasis on R^2 and R^3] and basic notions such as addition and scalar multiplication, inner product, length (norm), and distance between two points.
2. Real-valued functions of several variables (Scalar fields). Graph of a function. Level sets (level curves, level surfaces, etc). Examples. Vector valued functions of several variables(Vector fields). Component functions. Examples.
3. Sequences, Limits and Continuity: Sequence in R^n [with emphasis on R^2 and R^3] and their limits. Neighbourhoods in R^n. Limits and continuity of scalar fields. Compositionof continuous functions. Sequential characterizations. Algebra of limits and continuity (Results with proofs). Iterated limits.
4. Limits and continuity of vector fields. Algebra of limits and continuity vector fields. (without proofs).
5. Partial and Directional Derivatives of scalar fields: Definitions of partial derivative and directional derivative of scalar fields (with emphasis on R^2 and R^3). Mean Value Theorem of scalar fields.

UNIT II. Differentiation of Scalar Fields (15 Lectures)

1. Differentiability of scalar fields (in terms of linear transformation). The concept of (total) derivative. Uniqueness of total derivative of a differentiable function at a point. Examplesof functions of two or three variables. Increment Theorem. Basic properties including continuity at a point of differentiability, (ii)existence of partial derivatives at a pointof differentiability, and (iii) differentiability when the partial derivatives exist and are continuous.
2. Gradient. Relation between total derivative and gradient of a function. Chain rule. Geometric properties of gradient. Tangent planes.
3. Euler's Theorem.
4. Higher order partial derivatives. Mixed Partial Theorem (n=2).

UNIT III. Applications of Differentiation of Scalar Fields and Differentiation ofVector Fields (15 lectures)

1. Applications of Differentiation of Scalar Fields: The maximum and minimum rate of change of scalar fields. Taylor's Theorem for twice continuously differentiable functions. Notions of local maxima, local minima and saddle points. First Derivative Test. Examples. Hessian matrix. Second Derivative Test for functions of two variables. Examples. Method of Lagrange Multipliers.
2. Differentiation of Vector Fields: Differentiability and the notion of (total) derivative. Differentiability of a vector field implies continuity, Jacobian matrix. Relationship betweentotal derivative and Jacobian matrix. The chain rule for derivative of vector fields (statements only).

Reference Books:

1.T. Apostol; Calculus, Vol. 2 (Second Edition); John Wiley.
2. Sudhir Ghorpade, Balmohan Limaye; A Course in Multivariable Calculus and Analysis (Second Edition); Springer.
3. Walter Rudin; Principles of Mathematical Analysis; McGraw-Hill, Inc.

4. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus; Springer.
5.D.Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa, New Delhi, 1996.
6. K. Stewart; Calculus; Booke/Cole Publishing Co, 1994.

USMT402/UAMT402: Linear Algebra II

UNIT I. Linear Transformations

1. Definition of a linear transformation of vector spaces; elementary properties. Examples. Sums and scalar multiples of linear transformations. Composites of linear transformations. A Linear transformation of $V \longrightarrow W$, where V, W are vector spaces over R and V is a finite-dimensional vector space is completely determined by its action on an ordered basis of V.
2. Null-space (kernel) and the image (range) of a linear transformation. Nullity and rank of a linear transformation. Rank-Nullity Theorem (Fundamental Theorem of Homomor-phisms).
3. Matrix associated with linear transformation of $V \longrightarrow W$ where V and W are finite dimensional vector spaces over R.. Matrix of the composite of two linear transformations. Invertible linear transformations (isomorphisms), Linear operator, Effect of change of bases on matrices of linear operator.
4. Equivalence of the rank of a matrix and the rank of the associated linear transformation. Similar matrices.

UNIT II. Inner Products and Orthogonality

1. Inner product spaces (over R). Examples, including the Euclidean space R^n and the space of real valued continuous functions on a closed and bounded interval. Norm associated to an inner product. Cauchy-Schwarz inequality. Triangle inequality.
2. Angle between two vectors. Orthogonality of vectors. Pythagoras theorem and some geometric applications in R^2. Orthogonal sets, Orthonormal sets. Gram-Schmidt orthog-onalizaton process. Orthogonal basis and orthonormal basis for a finite-dimensional inner product space.
3. Orthogonal complement of any set of vectors in an inner product space. Orthogonal com-plement of a set is a vector subspace of the inner product space. Orthogonal decomposition of an inner product space with respect to its subspace. Orthogonal projection of a vector onto a line (one dimensional subspace). Orthogonal projection of an inner product space onto its subspace.

UNIT III. Eigenvalues, Eigenvectors and Diagonalisation

1. Eigenvalues and eigenvectors of a linear transformation of a vector space into itself and of square matrices. The eigenvectors corresponding to distinct eigenvalues of a linear trans-formation are linearly independent. Eigen spaces. Algebraic and geometric multiplicity of an eigenvalue.
2. Characteristic polynomial. Properties of characteristic polynomials (only statements). Examples. Cayley-Hamilton Theorem. Applications.
3. Invariance of the characteristic polynomial and eigenvalues of similar matrices.
4. Diagonalisable matrix. A real square matrix A is diagonalisable if and only if there is a basis of R^n consisting of eigenvectors of A. (Statement only - $A_{n\times n}$ is diagonalisable if and only if sum of algebraic multiplicities is equal to sum of geometric multiplicities of all the eigenvalues of $A = n$). Procedure for diagonalising a matrix.

5.Spectral Theorem for Real Symmetric Matrices (Statement only). Examples of orthogonal diagonalisation of real symmetric matrices. Applications to quadratic forms and classifi-cation of conic sections.

Reference Books:

1.Howard Anton, Chris Rorres; Elementary Linear Algebra; Wiley Student Edition).
2.Serge Lang; Introduction to Linear Algebra; Springer.
3.S Kumaresan; Linear Algebra - A Geometric Approach; PHI Learning.4.Sheldon Axler; Linear Algebra done right; Springer.

USMT403A: Numerical Methods (Elective A)

Unit I. Solution of Algebraic and Transcendental Equations (15L)

1. 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.
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.

Unit II. Interpolation, Curve fitting, Numerical Integration(15L)

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. Simpson's 1/3 rd Rule. Simpson's 3/8th Rule. Derivations all the above three rules to be covered.

Unit III. Solution Linear Systems of Equations, Eigenvalue problems(15L)

1. Linear Systems of Equations: LU Decomposition Method (Dolittle's Method and Crout'sMethod). Gauss-Seidel Iterative method.
2. Eigenvalue problems: Jacobi's method for symmetric matrices. Rutishauser method for arbitrary matrices.

Reference Books:

1. Kendall E. and Atkinson; An Introduction to Numerical Analysis; Wiley.
2.M. K. Jain, S. R. K. Iyengar and R. K. Jain; Numerical Methods for Scientific and Engineering Computation; New Age International Publications.
3.S. Sastry; Introductory methods of Numerical Analysis; PHI Learning.
4.An introduction to Scilab-Cse iitb.

Scheme of Examination (75:25)

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25 percent marks in the first part and by conducting the Semester End Examinations with 75 percent marks in the second part. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

I. Internal Evaluation of 25 Marks:

(i) One class Test of 20 marks to be conducted during Practical session.

Paper pattern of the Test:

Q1: De_nitions/ Fill in the blanks/ True or False with Justi_cation (04 Marks).
Q2: Multiple choice 5 questions. (10 Marks: 5 _ 2)
Q3: Attempt any 2 from 3 descriptive questions. (06 marks: 2 _ 3)
(ii) Active participation in routine class: 05 Marks.

II. Semester End Theory Examinations: There will be a Semester-end external Theory examination of 75 marks for each of the courses USMT101/UAMT101, USMT102 of Semester I and USMT201/UAMT201, USMT202 of semester II to be conducted by the college.

1. Duration: The examinations shall be of 2 and 1/2 hours duration.

2. Theory Question Paper Pattern:

a) There shall be FOUR questions. The _rst three questions Q1, Q2, Q3 shall be of 20 marks, each based on the units I, II, III respectively. The question Q4 shall be of 15 marks based on the entire syllabus.

b) All the questions shall be compulsory. The questions Q1, Q2, Q3, Q4 shall have internal choices within the questions. Including the choices, the marks for each question shall be 25-27.

c) The questions Q1, Q2, Q3, Q4 may be subdivided into sub-questions as a, b, c, d & e, etc and the allocation of marks depends on the weightage of the topic.

3. Semester End Examinations Practicals :

At the end of the Semesters III and IV, Practical examinations of three hours duration and 150 marks shall be conducted for the courses USMTP03, USMTP04.

At the end of the Semesters III and IV, Practical examinations of three hours duration and 150 marks shall be conducted for the courses UAMTP03, UAMTP04. 16

In semester III, the Practical examinations for USMT301/UAMT301 and USMT302/UAMT302 are held together by the college. The Practical examination for USMT303 is held separately by the college.

In semester IV, the Practical examinations for USMT401/UAMT401 and USMT402/UAMT402 are held together by the college. The Practical examination for USMT403 is held separately by the college.

Paper pattern: The question paper shall have three parts A, B, C. Each part shall have two Sections. Section I Objective in nature: Attempt any Eight out of Twelve multiple choice questions. (8 × 3 = 24 Marks)

Section II Problems: Attempt any Two out of Three. (8 × 2 = 16 Marks)

Practical Course	Part A	Part B	Part C	Marks out of	duration
USMTP03	Questions from USMT301	Questions from USMT302	Questions from USMT303	120	3 hours
USMTP04	Questions from USMT401	Questions from USMT402	Questions from USMT403	120	3 hours

Marks for Journals and Viva:

For each course USMT301/UAMT301, USMT302/UAMT302, USMT303, USMT401/UAMT401, USMT402/UAMT402 and USMT403:

1. Journals: 5 marks.
2. Viva: 5 marks.

Each Practical of every course of Semester III and IV shall contain 10 (ten) problems out of which minimum 05 (five) have to be written in the journal. A student must have a certified journal before appearing for the practical examination.

SYLLABUS AND PROGRAMMME / COURSE OUTCOMES

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: F. Y. B. Sc. C.S. **Course: Discrete Mathematics**
Program Code: **Course Code:** USCS105

(As per the Credit Based Semester and Grading System with effect from the academic year 2021-22)

Year : 2021-22 **Semester : I**

Programme Outcomes:
At the end of three year Bachelor of Computer Science the students will be able:

- To formulate, to model, to design solutions, procedure and to use software tools to solve real world problems.
- To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies.
- To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems.
- To apply concepts, principles, and theories relating to computer science to new situations.
- To use current techniques, skills, and tools necessary for computing practice
- To apply standard Software Engineering practices and strategies in real-time software project development
- To pursue higher studies of specialization and to take up technical employment.
- To work independently or collaboratively as an effective tame member on a substantial software project.
- To communicate and present their work effectively and coherently.
- To display ethical code of conduct in usage of Internet and Cyber systems.

To engage in independent and life-long learning in the background of rapid changing IT industry

Course Outcomes:
After successful completion of this course, learners would be able to:

- Define mathematical structures (relations, functions, graphs) and use them to model real life situations.
- Understand, construct and solve simple mathematical problems.
- Solve puzzles based on counting principles.
- Provide basic knowledge about models of automata theory and the corresponding formal languages.
- Develop an attitude to solve problems based on graphs and trees, which are widely used in software.

Unit I
Functions: Definition of function; Domain, co-domain, range of a function; Examples of standard functions such as identity and constant functions, absolute value function, logarithmic and exponential functions, flooring and ceiling functions; Injective, surjective and bijective functions; Composite and inverse functions.
Relations: Definition and examples of relation; Properties of relations, Representation of relations using diagraphs and matrices; Equivalence relation; Partial Order relation, Hasse Diagrams, maximal, minimal, greatest, least element, Lattices

Recurrence Relations: Definition and Formulation of recurrence relations; Solution of a recurrence relation; Solving recurrence relations- Back tracking method, Linear homogeneous recurrence relations with constant coefficients; Homogeneous solution of linear homogeneous recurrence relation with constant coefficients; Particular solution of non-linear homogeneous recurrence relation with constant coefficients; General solution of non- linear homogeneous recurrence relation with constant coefficients; Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.

Unit II

Counting Principles: Basic Counting Principles (Sum and Product Rule); Pigeonhole Principle (without proof) - Simple examples; Inclusion Exclusion Principle (Sieve formula) (without proof); Counting using Tree diagrams.

Permutations and Combinations: Permutation without and with repetition; Combination without and with repetition; Binomial numbers and identities: Pascal Identity, Vandermonde‟s Identity, Pascal triangle, Binomial theorem (without proof) and applications; Multionomial numbers, Multinomial theorem (without proof) and applications.

Languages, Grammars and Machines: Languages and Grammars – Introduction, Phase structure grammar, Types of grammar, derivation trees; Finite-State Machines with Output; Finite- State Machines with No Output; Regular Expression and Regular Language.

Unit III

Graphs: Graphs and Graph Models; Graph terminologies and Special types of graphs; Definition and elementary results; Representing graphs, Linked representation of a graph; Graph Isomorphism; Connectivity in graphs – path, trail, walk; Euler and Hamilton paths; Planar graphs, Graph coloring and chromatic number.

Trees: Definition, Tree terminologies and elementary results; Linked representation of binary trees; Ordered rooted tree, Binary trees, Complete and extended binary trees, Expression trees, Binary Search tree, Algorithms for searching and inserting in binary search trees, Algorithms for deleting in a binary search tree; Traversing binary trees

Text book:

1. Discrete Mathematics and Its Applications, Seventh Edition by Kenneth H. Rosen, McGraw Hill Education (India) Private Limited. (2011)
2. Discrete Mathematics: SemyourLipschutz, Marc Lipson, Schaum‟s out lines, McGraw-Hill Inc. 3rd Edition
3. Data Structures Seymour Lipschutz, Schaum‟s out lines, McGraw- Hill Inc. 2017
4. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.

Additional References:

1. Elements of Discrete Mathematics: C.L. Liu, Tata McGraw- Hill Edition.
2. Concrete Mathematics (Foundation for Computer Science): Graham, Knuth, Patashnik Second Edition, Pearson Education.
3. Discrete Mathematics: SemyourLipschutz, Marc Lipson, Schaum‟s out lines, McGraw-Hill Inc.
4. Foundations in Discrete Mathematics: K.D. Joshi, New Age Publication, New Delhi.

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: F. Y. B. Sc. C.S. **Course: Descriptive Statistics**
Program Code: **Course Code:** USCS106

(As per the Credit Based Semester and Grading System with effect from the academic year 2021-22)

Year : 2021-22 **Semester : I**

Programme Outcomes:

At the end of three year Bachelor of Computer Science the students will be able:

- To formulate, to model, to design solutions, procedure and to use software tools to solve real world problems.
- To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies.
- To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems.
- To apply concepts, principles, and theories relating to computer science to new situations.
- To use current techniques, skills, and tools necessary for computing practice
- To apply standard Software Engineering practices and strategies in real-time software project development
- To pursue higher studies of specialization and to take up technical employment.
- To work independently or collaboratively as an effective tame member on a substantial software project.
- To communicate and present their work effectively and coherently.
- To display ethical code of conduct in usage of Internet and Cyber systems.

To engage in independent and life-long learning in the background of rapid changing IT industry

Course Outcomes:

After successful completion of this course, learners would be able to

1. Organize, manage and present data.
2. Analyze Statistical data using measures of central tendency and dispersion.
3. Analyze Statistical data using basics techniques of R.
4. Study the relationship between variables using techniques of correlation and regression.

Unit I

Data Types and Data Presentation: Data types: Attribute, Variable, Discrete and Continuous variable, Univariate and Bivariate distribution. Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio.

Data presentation: Frequency distribution, Histogram, Ogive curves.

Introduction to R: Data input, Arithmetic Operators, Vector Operations, Matrix Operations, Data Frames, Built-in Functions. Frequency Distribution, Grouped Frequency Distribution, Diagrams and Graphs, Summary statistics for raw data and grouped frequency distribution.

Measures of Central tendency: Concept of average/central tendency, characteristics of good measure of central tendency. Arithmetic Mean (A.M.), Median, Mode - Definition, examples for ungrouped and grouped data, effect of shift of origin and change of scale, merits and demerits. Combined arithmetic mean. Partition Values: Quartiles, Deciles and Percentiles - examples for ungrouped and grouped data

Unit II

Measures dispersion: Concept of dispersion, Absolute and Relative measure of dispersion, characteristics of good measure of dispersion. Range, Semi-interquartile range, Quartile deviation, Standard deviation - Definition, examples for ungrouped and grouped data, effect of shift of origin and change of scale, merits and demerits. Combined standard deviation, Variance. Coefficient of range, Coefficient of quartile deviation and Coefficient of variation (C.V.)

Moments: Concept of Moments, Raw moments, Central moments, Relation between raw and central moments.

Measures of Skewness and Kurtosis: Concept of Skewness and Kurtosis, measures based on moments, quartiles.

Unit III

Correlation: Concept of correlation, Types and interpretation, Measure of Correlation: Scatter diagram and interpretation; Karl Pearson"s coefficient of correlation (r): Definition, examples for ungrouped and grouped data, effect of shift of origin and change of scale, properties; Spearman"s rank correlation coefficient: Definition, examples of with and without repetition. Concept of Multiple correlation.

Regression: Concept of dependent (response) and independent (predictor) variables, concept of regression, Types and prediction, difference between correlation and regression, Relation between correlation and regression. Linear Regression - Definition, examples using least square method and regression coefficient, coefficient of determination, properties. Concept of Multiple regression and Logistic regression.

Text book:

1. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.

2. Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi

Additional References:

1. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, NewDelhi.

2. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, NewDelhi.

3. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.

4. Schaum"s Outline Of Theory And Problems Of Beginning Statistics, Larry J. Stephens, Schaum"s Outline Series Mcgraw-Hill

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: F. Y. B. Sc. C.S. **Course: Calculus**
Program Code: **Course Code:** USCS205

(As per the Credit Based Semester and Grading System with effect from the academic year 2021-22)

Year : 2021-22 **Semester : II**

Programme Outcomes:

At the end of three year Bachelor of Computer Science the students will be able:

- To formulate, to model, to design solutions, procedure and to use software tools to solve real world problems.
- To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies.
- To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems.
- To apply concepts, principles, and theories relating to computer science to new situations.
- To use current techniques, skills, and tools necessary for computing practice
- To apply standard Software Engineering practices and strategies in real-time software project development
- To pursue higher studies of specialization and to take up technical employment.
- To work independently or collaboratively as an effective tame member on a substantial software project.
- To communicate and present their work effectively and coherently.
- To display ethical code of conduct in usage of Internet and Cyber systems.

To engage in independent and life-long learning in the background of rapid changing IT industry

Course Outcomes:

After successful completion of this course, students would be able to

- Develop mathematical skills and enhance thinking power of learners.
- Understand mathematical concepts like limit, continuity, derivative, integration of functions, partial derivatives.
- Appreciate real world applications which use the learned concepts.

Skill to formulate a problem through Mathematical modelling and simulation

Unit I

DERIVATIVES AND ITS APPLICATIONS: Review of Basic Concepts: Functions, limit of a function, continuity of a function, derivative function.

Derivative In Graphing And Applications: Increase, Decrease, Concavity, Relative Extreme; Graphing Polynomials, Rational Functions, Cusps and Vertical Tangents. Absolute Maxima and Minima, Applied Maximum and Minimum Problems, Newton"s Method.

Unit II

INTEGRATION AND ITS APPLICATIONS: Integration: An Overview of the Area Problem, Indefinite Integral, Definition of Area as a Limit; Sigma Notation, Definite Integral, Evaluating Definite Integrals by Substitution, Numerical Integration: Simpson"s Rule.

Applications of Integration: Area between two curves, Length of a plane curve.
Mathematical Modeling with Differential Equations: Modeling with Differential Equations, Separation of Variables, Slope Fields, Euler‟s Method, First-Order Differential Equations and Applications.

Unit III
PARTIAL DERIVATIVES AND ITS APPLICATIONS: Functions of Several Variables: Functions of two or more variables, Limits and Continuity of functions of two or three variables.
Partial Derivatives: Partial Derivatives, Differentiability, Differentials, and Local Linearity, Chain Rule, Implicit Differentiation, Directional Derivatives and Gradients,
Applications of Partial Derivatives: Tangent Planes and Normal Vectors, Maxima and Minima of Functions of Two Variables.

Text book:
1. Calculus: Early transcendental (10th Edition): Howard Anton, IrlBivens, Stephen Davis, John Wiley & sons, 2012.

Additional References:
1. Calculus and analytic geometry (9th edition): George B Thomas, Ross L Finney, Addison Wesley, 1995
2. Calculus: Early Transcendentals (8th Edition): James Stewart, Brooks Cole, 2015.
3. Calculus (10th Edition): Ron Larson, Bruce H. Edwards, Cengage Learning, 2013.
4. Thomas' Calculus (13th Edition): George B. Thomas, Maurice D. Weir, Joel R. Hass, Pearson, 2014.

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: F. Y. B. Sc. C.S. **Course: Statistical Methods**
Program Code: **Course Code:** USCS205

(As per the Credit Based Semester and Grading System with effect from the academic year 2021-22)

Year : 2021-22 **Semester : II**

Programme Outcomes:

At the end of three year Bachelor of Computer Science the students will be able:

- To formulate, to model, to design solutions, procedure and to use software tools to solve real world problems.
- To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies.
- To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems.
- To apply concepts, principles, and theories relating to computer science to new situations.
- To use current techniques, skills, and tools necessary for computing practice
- To apply standard Software Engineering practices and strategies in real-time software project development
- To pursue higher studies of specialization and to take up technical employment.
- To work independently or collaboratively as an effective tame member on a substantial software project.
- To communicate and present their work effectively and coherently.
- To display ethical code of conduct in usage of Internet and Cyber systems.

To engage in independent and life-long learning in the background of rapid changing IT industry

Course Outcomes:

After successful completion of this course, students would be able to

- Calculate probability, conditional probability and independence.
- Apply the given discrete and continuous distributions whenever necessary.
- Define null hypothesis, alternative hypothesis, level of significance, test statistic and p value.
- Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.

Apply non-parametric test whenever necessary. Conduct and interpret one-way and two-way ANOVA.

Unit I

Probability: Random experiment, sample space, events types and operations of events, Probability definition: classical, axiomatic, Elementary Theorems of probability (without proof). Conditional probability, „Bayes" theorem, independence, Examples on Probability.
Random Variables: Concept and definition of a discrete random variable and continuous random variable. Probability mass function, Probability density function and cumulative distribution function of discrete and continuous random variable, Properties of cumulative distribution function.

Unit II

Mathematical Expectation and Variance: Expectation of a function, Variance and S.D of a random variable, properties.

Standard Probability distributions: Introduction, properties, examples and applications of each of the following distributions: Binomial distribution, Normal distribution, Chi-square distribution, t distribution, F distribution

Unit III

Hypothesis testing: One sided, Two sided hypothesis, critical region, p- value, tests based on t, Normal and F, confidence intervals.

Analysis of Variance: One-way, two-way analysis of variance.

Non-parametric tests: Need of non-parametric tests, Sign test, Wilicoxon‟s signed rank test, run test, Kruskal-Walis tests, Chi square test.

Text book:

1. Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi
2. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.

Additional References:

1. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
2. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
3. Hogg, R.V. and Craig R.G. (1989). Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.
4. Walpole R. E., Myers R. H. and Myers S. L. (1985), Probability and Statistics for Engineers and Scientists
5. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

: Question Paper Pattern :

Evaluation Scheme

I. Internal Evaluation for Theory Courses – 25 Marks

(i) Mid-Term Class Test– 15Marks

It should be conducted using any learning management system such as Moodle (Modular object-oriented dynamic learning environment)

The test should have 15 MCQ's which should be solved in a time duration of 30 minutes.

(ii) Assignment/ Case study/ Presentations– 10 Marks

Assignment / Case Study Report / Presentation can be uploaded on any learning management system.

II. External Examination for Theory Courses – 75 Marks

Duration: 2.5 Hours

Theory question paper pattern:

	All questions are compulsory.		
Question	Based on	Options	Marks
Q.1	Unit I	*Any 4 out of 6*	20
Q.2	Unit II	*Any 4 out of 6*	20
Q.3	Unit III	*Any 4 out of 6*	20
Q.4	Unit I,II and III	*Any 5 out of 6*	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question maybe sub-divided into subquestions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subjectcarries50 Marks 40 marks + 05 marks (journal) + 05 marks (viva)
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

The final submission and evaluation of journal in electronic form using a Learning Management System / Platform can be promoted by college.

SYLLABUS AND PROGRAMMME / COURSE OUTCOMES

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: S.Y.B.Sc **Course:**Combinatorics and Graph Theory

Program Code: **Course Code:** USCS305

(As per the Credit Based Semester and Grading System with effect from the academic year 2017-18)

Year : 2021-22 **Semester : III**

Programmme Outcomes:
The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context.

Course Outcomes:
1. Appreciate beauty of combinatorics and how combinatorial problems naturally arise in many settings.
2. Understand the combinatorial features in real world situations and Computer Science applications.
3. Apply combinatorial and graph theoretical concepts to understand Computer Science concepts and apply them to solve problems

UNIT I - Introduction to Combinatorics:
Enumeration, Combinatorics and Graph Theory/ Number Theory/Geometry and Optimization, Sudoku Puzzles. Strings, Sets, and Binomial Coefficients: Strings- A First Look, Combinations, Combinatorial, The Ubiquitous Nature of Binomial Coefficients, The Binomial, Multinomial Coefficients. Induction: Introduction, The Positive Integers are Well Ordered, The Meaning of Statements, Binomial Coefficients Revisited, Solving Combinatorial Problems Recursively, Mathematical Induction, and Inductive Definitions Proofs by Induction. Strong Induction

UNIT II - Graph Theory:
Basic Notation and Terminology, Multigraphs: Loops and Multiple Edges, Eulerian and Hamiltonian Graphs, Graph Coloring, Planar Counting, Labeled Trees, A Digression into Complexity Theory. Applying Probability to Combinatorics, Small Ramsey Numbers, Estimating Ramsey Numbers, Applying Probability to Ramsey Theory, Ramsey's Theorem The Probabilistic Method

UNIT III - Network Flows:
Basic Notation and Terminology, Flows and Cuts, Augmenting Paths, The Ford-Fulkerson Labeling Algorithm,
A Concrete Example, Integer Solutions of Linear Programming Problems. Combinatorial Applications of Network Flows: Introduction, Matching in Bipartite Graphs, Chain partitioning, Pólya's Enumeration Theorem: Coloring the Vertices of a Square.

Textbook(s): 1) Applied Combinatorics, Mitchel T. Keller and William T. Trotter, 2016, http://www.rellek.net/appcomb.

Additional Reference(s):
1) Applied Combinatorics, sixth.edition, Alan Tucker, Wiley; (2016)
2) Graph Theory and Combinatorics, Ralph P. Grimaldi, Pearson Education; Fifth edition (2012)
3) Combinatorics and Graph Theory, John Harris, Jeffry L. Hirst, Springer(2010).
4) Graph Theory: Modeling, Applications and Algorithms, Agnarsson, Pearson Education India (2008).

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programmme: S.Y.B.Sc **Course:**Linear Algebra using Python

Program Code: **Course Code:** USCS405

(As per the Credit Based Semester and Grading System with effect from the academic year 2017-18)

Year : 2021-22 **Semester : IV**

Programmme Outcomes:
The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context.

Course Outcomes:
1. Appreciate the relevance of linear algebra in the field of computer science.
2. Understand the concepts through program implementation
3. Instill a computational thinking while learning linear algebra.

UNIT I -Field:
Introduction to complex numbers, numbers in Python , Abstracting over fields, Playing with GF(2), Vector Space: Vectors are functions, Vector addition, Scalar-vector multiplication, Combining vector addition and scalar multiplication, Dictionary-based representations of vectors, Dot-product, Solving a triangular system of linear equations. Linear combination, Span, The geometry of sets of vectors, Vector spaces, Linear systems, homogeneous and otherwise

UNIT II
Matrix: Matrices as vectors, Transpose, Matrix-vector and vector-matrix multiplication in terms of linear combinations, Matrix-vector multiplication in terms of dot-products, Null space, Computing sparse matrix-vector product, Linear functions, Matrix-matrix multiplication, Inner product and outer product,From function inverse to matrix inverse
Basis: Coordinate systems, Two greedy algorithms for finding a set of generators, Minimum Spanning Forest and GF(2), Linear dependence, Basis , Unique representation, Change of basis, first look, Computational problems involving finding a basis Dimension: Dimension and rank, Direct sum, Dimension and linear functions, The annihilator

UNIT-III
Gaussian elimination: Echelon form, Gaussian elimination over GF(2), Solving a matrix-vector equation using Gaussian elimination, Finding a basis for the null space, Factoring integers,
Inner Product: The inner product for vectors over the reals, Orthogonality, Orthogonalization: Projection orthogonal to multiple vectors, Projecting orthogonal to mutually orthogonal vectors, Building an orthogonal set of generators, Orthogonal complement, Eigenvector: Modeling discrete dynamic processes, Diagonalization of the Fibonacci matrix, Eigenvalues and eigenvectors, Coordinate representation in terms of eigenvectors, The Internet worm, Existence of eigenvalues, Markov chains, Modeling a web surfer: PageRank.

Textbook(s): 1) Coding the Matrix Linear Algebra through Applications to Computer Science Edition 1, PHILIP N. KLEIN, Newtonian Press (2013)
Additional References: 1) Linear Algebra and Probability for Computer Science Applications, Ernest Davis, A K Peters/CRC Press (2012). 2) Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 4th Edition (2007). 3) Linear Algebra and Its Applications, David C Lay, Pearson Education India; 3rd Edition (2002)

Question Paper Pattern:

Duration - These examinations shall be of 1 Hours duration.

Online question paper pattern:-

1. There shall be 50 questions. On **each unit** there will be one question with **1.5 Marks** each All questions shall be compulsory with internal choice within the questions.
2. **Question 1 (Unit-I),Question 2 (Unit-II) & Question 3 (Unit-III) & vice versa**
3. There shall be internal 50 marks practical of each paper

SYLLABUS AND PROGRAMMME / COURSE OUTCOMES

S.P.Mandal's
KANKAVLI COLLEGE,KANKAVLI
(Affiliated to University of Mumbai)
Syllabus

Programme : B.Com.

Course: MATHEMATICAL AND STATISTICAL TECHNIQUES - I

Program Code: **Course Code:**

(As per the Credit Based Semester and Grading System with effect from the academic year 2016-17)

Year : 2021-22 **Semester : I & II**

Programme Outcomes :

(1) The main objective of this course is to introduce mathematics and statistics to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

(2) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of in-numerous power of mathematical ideas and tools and know how to use them by modelling, solving and interpreting.

(3) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

(4) Enhancing student's overall development and to equipthem with mathematical modelling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.

(5) A student should get adequate exposure to global and local concerns that explore them many aspects of mathematical Sciences.

(6) To introduce mathematics and statistics to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

Course Outcomes:

1. Student's Knowledge skills and concept will get enhanced and they will get confidence and interest in mathematics.
2. Student's thinking abilities and positive attitudes will increase towards learning mathematics and tutorials will improve their logical and analytical meaning through their lifetime.

Semester I
Course: UBCOMFSI.6
Mathematical and Statistical Techniques-I

[A] MATHEMATICS: (40 marks)

Unit I: Shares and Mutual Funds

a. Shares: Concept of share, face value, market value, dividend, equity shares, preferential shares, bonus shares. Simple examples.

b. 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.)

Unit II: Permutation, Combination and Linear Programming Problems:
a. 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.
b. 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.

[B] STATISTICS: (60 marks)

Unit III: Summarization Measures:
a. Measures of Central Tendencies: Definition of Average, Types of Averages: Arithmetic Mean, Median, and Mode for grouped as well as ungrouped data. Quartiles, Deciles and Percentiles. Using Ogive locate median and Quartiles. Using Histogram locate mode. Combined and Weighted mean.
b. Measures of Dispersions: Concept and idea of dispersion. Various measures Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Combined Variance.

Unit IV: Elementary Probability Theory:
a. 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. Independence of Events: $P(A \cap B) = P(A) P(B)$. Simple examples.
b. Random Variable: Probability distribution of a discrete random variable; Expectation and Variance of random variable, simple examples on probability distributions.

Unit V: Decision Theory:
Decision making situation, Decision maker, Courses of Action, States of Nature, Pay-off and Pay-off matrix; Decision making under uncertainty, Maximin, Maximax, Minimax regret and Laplace criteria; simple examples to find optimum decision. Formulation of Payoff Matrix. Decision making under Risk, Expected Monetary Value (EMV); Decision Tree; Simple Examples based on EMV. Expected Opportunity Loss (EOL), simple examples based on EOL.

Semester II
Course: UBCOMFSII.6
Mathematical and Statistical Techniques-II

[**A] MATHEMATICS : (40 marks)**

Unit I : Functions, Derivatives and Their Applications
a. Concept of real functions: constant function, linear function, xn , ex , ax , log x. Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break-even point.
b. Derivative of functions:
i. Derivative as rate measure, Derivative of xn , ex , ax , log x.
ii. Rules of derivatives: Scalar multiplication, sum, difference, product, quotient (Statements only), Simple problems. Second order derivatives.

iii. Applications: Marginal Cost, Marginal Revenue, Elasticity of Demand. Maxima and Minima for functions in Economics and Commerce. (Examination Questions on this unit should be application oriented only.)

Unit II: Interest and Annuity:
a. Interest: Simple Interest, Compound Interest (Nominal & Effective Rate of Interest),. Calculations involving upto 4 time periods.
b. 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.

[B] STATISTICS: (60 marks)

Unit III: Bivariate Linear Correlation and Regression
a. Correlation Analysis: Meaning, Types of Correlation, Determination of Correlation: Scatter diagram, Karl Pearson's method of Correlation Coefficient (excluding Bivariate Frequency Distribution Table) and Spearman's Rank Correlation Coefficient.
b. Regression Analysis: Meaning, Concept of Regression equations, Slope of the Regression Line and its interpretation. Regression Coefficients (excluding Bivariate Frequency Distribution Table), Relationship between Coefficient of Correlation and Regression Coefficients , Finding the equations of Regression lines by method of Least Squares.

Unit IV : Time series and Index Numbers
a. Time series: Concepts and components of a time series. Representation of trend by Freehand Curve Method, Estimation of Trend using Moving Average Method and Least Squares Method (Linear Trend only). Estimation of Seasonal Component using Simple Arithmetic Mean for Additive Model only (For Trend free data only). Concept of Forecasting using Least Squares Method.
b. 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)

Unit V: Elementary Probability Distributions Probability Distributions:
i. Discrete Probability Distribution: Binomial, Poisson (Properties and applications only, no derivations are expected)
ii. Continuous Probability distribution: Normal Distribution. (Properties and applications only, no derivations are expected).

Examination:

Semester End Examination: 100 marks At the end of each semester, there will be a Semester End Examination of 100 marks , 3 hours duration and question paper pattern as shown below.

Question Paper Pattern : (Course: UBCOMFSI.6 and Course: UBCOMFSII.6)
1. In Section I (based on Mathematics), Two questions carrying 20 marks each. First question should be on Unit I and Second question should be from Unit II.
2. In each question there should be five sub-questions carrying 5 marks each. Students should be asked to answer any 4 sub questions from each question.

3. In Section II (based on Statistics), Three questions carrying 20 marks each. First question should be on Unit III, Second question should be from Unit IV and third question should be from Unit V.
4. In each question there should be five sub-questions carrying 5 marks each. Students should be asked to answer any 4 sub questions from each question.

Reference Books:

1. Mathematics for Economics and Finance Methods and Modelling by Martin Anthony and Norman Biggs, Cambridge University Press, Cambridge low-priced edition, 2000, Chapters 1, 2, 4, 6 to 9 & 10.
2. Applied Calculus: By Stephen Waner and Steven Constenoble, Brooks/Cole Thomson Learning, second edition, Chapter 1 to 5

QUESTION PAPER – SET I
MARKS:- 100 TIME:- 3 HRS

N.B : (1) ALL QUESTION ARE COMPALSORY
(2) ALL QUESTION CARRY EQUAL MARKS
(3) FIGURES TO THE RIGHT INDICATES MARKS TO A SUB-QUESTION.
(4) GRAPGH PAPER WILL BE SUPPLIED ON REQUEST.
(5) USE OF NON-PROGRAMMABLE CALCULATOR IS ALLOWED.

SECTION-I

Q.1 ATTEMPT ANY FOUR OF THE FOLLOWING
(a) 5 Marks (b) 5 Marks (c) 5 Marks (d) 5 Marks (e) 5 Marks 20 Marks

Q.2 ATTEMPT ANY FOUR OF THE FOLLOWING
(a) 5 Marks (b) 5 Marks (c) 5 Marks (d) 5 Marks (e) 5 Marks 20 Marks

SECTION-II

Q.3 ATTEMPT ANY FOUR OF THE FOLLOWING
(a) 5 Marks (b) 5 Marks (c) 5 Marks (d) 5 Marks (e) 5 Marks 20 Marks

Q.4 ATTEMPT ANY FOUR OF THE FOLLOWING
(a) 5 Marks (b) 5 Marks (c) 5 Marks (d) 5 Marks (e) 5 Marks 20 Marks

Q.5 ATTEMPT ANY FOUR OF THE FOLLOWING
(a) 5 Marks (b) 5 Marks (c) 5 Marks (d) 5 Marks (e) 5 Marks 20 Marks