॥ विद्या विनयने शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: B.Sc.

Revised Syllabus of F.Y.B.Sc. Mathematics (Major)

Choice Based Credit System (CBCS) as Per NEP-2020 (60:40)
w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

F.Y.B.Sc.

Preamble:

The institute has brought into force the revised syllabi as per the Choice Based Credit System (CBCS) for the First year B. Sc. Programme in Mathematics from the academic year 2022-2023. Mathematics has been fundamental to the development of science and technology. In recent decades, the extent of application of Mathematics to real world problems has increased by leaps and bounds. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects like Physics, Statistics and Computer Sciences, the board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to University of Mumbai has prepared the syllabus of F.Y.B. Sc. Mathematics. The present syllabi of F. Y. B. Sc. for Semester I and Semester II has been designed as per U. G. C. Model curriculum so that the students learn Mathematics needed for these branches, learn basic concepts of Mathematics and are exposed to rigorous methods gently and slowly. The syllabi of F. Y. B. Sc. would consist of two semesters and each semester would comprise of two courses for F. Y. B. Sc. Mathematics. Course I is 'Calculus I and Calculus II'. Calculus is applied and needed in every conceivable branch of science. Course II, 'Algebra I and Discrete Mathematics' develops mathematical reasoning and logical thinking and has applications in science and technology.

Introduction:

Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Many of the developments and decisions made in our community rely to an extent on the use of mathematics. Besides foundation skills and knowledge in mathematics for all citizen in the society, it is important to widen mathematical experience for those who are mathematically inclined.

Aims and Objectives:

1. Giving students sufficient knowledge of fundamental principles, methods and a clear perception of boundless power of mathematical ideas and tools and knowing how to use them by analysing, modeling, solving and interpreting.

2. Reflecting on 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 by looking at many aspects of mathematical Sciences

Outcomes:

1. Students' Knowledge and skills will get enhanced and they will get confidence and interest in mathematics, so that they can master mathematics effectively and will be able to formulate and solve problems from a mathematical perspective.

2. Students' thinking ability and attitude will change towards learning mathematics and practicals will improve their logical and analytical thinking.

Teaching Pattern for Semester-I

1. Two lectures per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

Teaching Pattern for Semester-II

1. Two lectures per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

List of Courses for Semester-I

PAPER I: CALCULUS-I

Course Code	Unit	Topic	Credit	Lecture per Week
USC1MT1	Unit I	Real Number System and Sequences in R	02	02
	Unit II	First Order and First Degree Differential Equations		

PAPER II: ALGEBRA-I

Course Code	Unit	Topic	Credit	Lecture per Week
USC1MT2	Unit I	Sets and functions	02	02
	Unit II	Divisibility & Congruences		

List of Courses for Semester-II

PAPER I: CALCULUS-II

Course Code	Unit	Topic	Credit	Lecture per Week
USC2MT1	Unit I	Limits and Continuity	02	02
	Unit II	Differentiability of a function		

PAPER II: DISCRETE MATHEMATICS

Course Code	Unit	Topic	Credit	Lecture per Week
USC2MT2	Unit I	Recurrence Relation	02	02
	Unit II	Counting Methods		

Syllabus for Semester-I

USC1MT1: CALCULUS I

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: After completing the course, Students will be able to:
1. *define* Bounded set, Supremum and Infimum of a set
2. *determine* the convergence of sequences of real numbers
3. *examine* the properties of sequences of real numbers
4. *classify* the first order differential equation

Unit I: Real Number System and Sequences in R (15 Lectures)

1. Properties of R, absolute value and its properties.
2. AM-GM inequality, Cauchy-Schwarz inequality, Intervals, and neighbourhoods, Hausdorff property.
3. Bounded sets, statements of l.u.b. axiom and its consequences, Supremum and Infimum, Maximum and Minimum, Archimedean property and its applications, density of rationals.
4. Definition of a sequence and examples, Convergence of sequences, every convergent sequence is bounded. Limit of a convergent sequence and uniqueness of limit, Divergent sequences.
5. Algebra of convergent sequences, sandwich theorem, monotone sequences, theorems and examples.

Unit II: First order and First-degree differential equations (15 Lectures)

1. Solutions of homogeneous and non-homogeneous differential equations of first order and first degree, Notion of partial derivative, solving exact differential equations.
2. Rules for finding integrating factor (I.F) (without proof) for non-exact equations
3. Finding solutions of first order differential equations of the type $\frac{dy}{dx} + P(x)y = Q(x)y^n$. $for\ n \geq 0$.
4. Applications to orthogonal trajectories, population growth, and finding the current at a given time.

Reference Books

1. Daniel, First order First degree ODE and Applications, 2009
2. K.G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
3. R.R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
4. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill.
5. E. A. Coddington, An introduction to ordinary differential equations, Dover Books.
6. R. G. Bartle- D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.

Additional Reference Books

1. T.M. Apostol, Calculus Volume I, Wiley & Sons (Asia) Pte, Ltd.
2. Richard Courant-Fritz John, An Introduction to Calculus and Analysis, Volume I, Springer.
3. Ajit kumar- S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
4. James Stewart, Calculus, Third Edition, Brooks Cole Publishing Company, 1994.
5. Ghorpade, Sudhir R.-Limaye, Balmohan V., A Course and Real Analysis, Springer International Ltd.2000.

USC1MT1: ALGEBRA-I

Note: All topics have to be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: After completing the course, Students will be able to:
1. *explain* the basic concepts of set theory.
2. *examine* the properties of functions and relations.
3. *apply* well-ordering properties, Induction theorems and Binomial theorem.
4. *analyse* properties of the divisibility and congruence relations.

Unit I: Sets and functions (15 Lectures)

1. Definition of function, Domain, Co-domain, Range, Composite functions, Direct and Inverse image.
2. Injective Function, Surjective Function, Bijective Function, Invertible function
3. Graph of some standard functions.

4. Well Ordering Principle, Properties of non-negative integers and Principles of finite induction.
5. Binomial theorem for nonnegative exponents, Pascal Triangle.

Unit II: Divisibility and Congruence's (15 Lectures)

1. Divisibility in integers, Division algorithm, GCD and LCM,

2. Basic properties of GCD and LCM, Euclidean algorithm.

3. Prime, Euclid's lemma, Fundamental theorem of arithmetic, Number of primes are infinite,

4. Euler Phi function, Congruence, Definition and elementary properties of an con

Reference Books

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd.
2. S. Kumaresan, Ajit Kumar and Bhaba Kumar Sarma, A foundation course in Mathematics, 2018 edition, Narosa publication house.
3. David M. Burton, Elementary number theory, seventh edition, Tata McGraw-Hill edition.

Additional Reference Books

1. Ivan Niven, Herbert S. Zuckerman, Introduction to the theory of numbers, fifth edition, Wiley eastern limited.
2. R.G. Bartle and D.R. Sherbert, Introduction to real analysis, third edition, John Wiley and Sons.
3. Jones and Jones, Elementary number theory, second edition, Springer
4. I.S. Luthar, Sets, functions and numbers, 2005 edition, Narosa publishing house.
5. Thomas Koshy, Elementary number theory with applications, Academic press

USC1MTP: MATHEMATICS PRACTICAL-I

Course Outcomes: After completing the course, Students will be able to:
1. *explain* the properties of real number
2. *solve* the first order first degree differential equation
3. *examine* the properties of sets, functions and relations.
4. *solve* the problems by using Induction theorems, well ordering principle, binomial theorems and congruence relations

(A) **Practical's for USC1MT1**

(I) Application based examples of Archimedean property, intervals, neighbourhood. Consequences of l.u.b axiom, infimum and supremum of sets.
(II) Problems on convergent sequences, sub sequences and Cauchy sequences
(III) Solving exact and non- exact differential equations.
(IV) Solving Linear and Bernoulli's differential equations.
(V) Miscellaneous Theoretical Questions based on a full paper.

(B) **Practical's for USC1MT2**

(I) Problems on Functions(image and inverse image), injective, surjective, bijective functions, finding inverses of bijective functions.
(II) Problems on Mathematical induction, Division Algorithm and Euclidean algorithm in Z, Fundamental theorem of arithmetic, GCD, LCM
(III) Problems on congruences, Euler's function,

(IV) Miscellaneous Theoretical Questions based on a full paper.

Syllabus for Semester-II

USC2MT1: CALCULUS II

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes: After completing the course, Students will be able to:

1. *evaluate* limit of a function
2. *examine* Continuity of a function
3. *identify* the differentiable function
4. *find* successive differentiation

Unit I : Limits and Continuity (15 Lectures)

Brief review: Domain and range of a function, injective function, surjectiove function, bijective function, composite of two functions, (when defined) Inverse of a bijective function

1. Definition of Limit of a function, evaluation of limit of simple functions using the $\epsilon - \delta$ definition, uniqueness of limit if it exists, algebra of limits, limits of composite function, sandwich theorem, left-hand-limit, Right hand limit

2. Continuous functions: Continuity of a real valued function on a set-in term of limits, examples, Continuity of a real valued function at end points of domain, Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.

3. If $f : [a, b] \to R$ is continuous at $x_0 \in [a, b]$ and $f(x_0) > 0$ then there exists a neighbourhood N of x_0 such that $f(x) > 0\ \forall x \in N$, If $f : [a, b] \to R$ is continuous function then the image $f([a; b])$ is a closed interval, Intermediate value theorem and its applications, Bolzano- Eigenstress theorem (statement only): A continuous function on a closed and bounded interval is bounded and attains its bounds.

Unit II : Differentiability of a function (15 Lectures)

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

2. Higher order derivatives, Leibnitz rule, Derivative of inverse functions, Implicit differentiation (only examples)

3. Rolle's theorem, Lagrange and Cauchy's mean value theorems, applications and examples, Monotone increasing and decreasing function, examples

4. Definition of local maximum and local minimum, necessary condition, stationary points, second derivative test

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. Ltd.

Additional Reference Books

1. Richard Courant- Fritz John, An Introduction to Calculus and Analysis, Volume-I,Springer.
2. Ajit Kumar- S.Kumaresan, A Basic course in Real Analysis, CRC Press, 2014.
3. Ghorpade, Sudhir R, -Limaye, Balmohan V, A course in Calculus and Real Analysis, Springer International Ltd, 2000.
4. K.G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
5. G.B.Thomas, Calculus, 12 th Edition 2009
6. Straus, Bradly and Smith, Calculus, 2002

USC2MT2: DISCRETE MATHEMATICS

Note: All topics have to be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: After completing the course, Students will be able to:

1. *analyse* the properties of functions, relations and recurrence relations.
2. *solve* the recurrence relations.
3. *make use of* the preliminary counting to solve the problems.
4. *apply* the Pigeonhole principle to solve the problems.

Unit I: Recurrence Relation (15 Lectures)

1. Review of Functions and relations.
2. Recurrence Relations, definition of homogeneous, non-homogeneous, linear, nonlinear recurrence relation, obtaining recurrence relations of Tower of Hanoi, Fibonacci sequence, etc. in counting problems
3. 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.

Unit II: Counting Methods (15 Lectures)

1. Addition and multiplication Principle, counting sets of pairs, two ways counting.
2. Permutation and combination of sets and multisets, circular permutations, emphasis on solving problems.
3. Pigeonhole principle: simple and strong form and examples, its applications.
4. Binomial and Multinomial Theorem, Pascal identity, examples of some standard identities
5. Non-negative integer solutions of equation $x_1 + x_2 + \cdots + x_k = n$
6. Principal of inclusion and exclusion, its applications, deriving formula for Euler's function $\varphi(n)$.

Reference 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. Schaums outline series, Discrete mathematics,
6. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
7. Sharad Sane, Combinatorial Techniques, Springer

USC2MTP: MATHEMATICS PRACTICAL-II

Course Outcomes: After completing the course, Students will be able to:
1. *find* limit and continuity of a function
2. *apply* second derivative test to find local extrema
3. *make use of* the preliminary counting to solve the problems.
4. *apply* the recurrence relation to solve the problems.

(A) **Practical is for USC2MT1**

(I) Calculating limits of sequences, Cauchy sequences, monotone sequences.

(II) Limits of function and Sandwich theorem, continuous and discontinuous functions, Properties of continuous and differentiable functions. Higher order derivatives, Leibnitz theorem. Mean value theorems and its applications

(III) Extreme values, increasing and decreasing functions. Applications of Taylors theorem and Taylor's polynomials.

(IV) Miscellaneous Theoretical Questions based on full paper

(B) **Practical for USC2MT2**

(I) Function, Relation, and Recurrence relation.

(II) Counting principles, two way counting, Pigeon hole principle.

(III) Multinomial theorem, identities, permutation, and combination of multi-set, inclusion-Exclusion principle, Euler phi function.

(IV) Miscellaneous Theoretical Questions based on full paper

Scheme of Examination

Faculty of Science

(Undergraduate Programmes)

Choice Based Credit System (CBCS)

❖ **Revised Scheme of Examination**

1. For Major Courses (100 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 40 Marks

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks
02	Test based on practical skills/tutorials	15 Marks
03	Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibition of leadership qualities in organizing related academic activities	05 Marks

Question Paper Pattern

(Periodical Class Test)

Maximum Marks: 20 Duration: 40 Minutes
Questions to be set: 02
All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination (SEE): 60 % 60 Marks

- Duration: The examination shall be of 2 hours duration.

Question Paper Pattern

Theory question paper pattern

Sr. No.	Particular
1.	There shall be three questions each of 20 marks.
2.	On each unit there will be one question and the third question will be based on entire syllabus.
3.	All questions shall be compulsory with internal options.
4.	Question may be subdivided into sub-questions a, b, c, · · · and the allocation of marks depends on the weightage of the unit.

- **Passing Standard**

  The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Continuous Internal Assessment (CIA) and 40% marks in Semester End Examination (SEE) (i.e. 24 out of 60) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Continuous Internal Assessment (CIA) and Semester End Examination (SEE).

❖ Practical Examination (PE) for Major Courses: 100 Marks

The Practical Examination (PE) shall be of 100 marks for Major Courses
At the end of the Semesters I & II Practical examinations of three hours duration and 100 marks shall be conducted for the courses USC1MT1, USC1MT2.
In semester I, the Practical examinations for USC1MT1 and USC1MT2 are held together.
In Semester II, the Practical examinations for USC2MT1 and USC2MT2 are held together.

Practical question paper pattern

There shall be two sections.
Section-I for USC1MT1/USC2MT1 and Section-II for USC1MT2/USC2MT2.

Section I

Q.1: Objective Questions- Attempt any 8 out of 12 multiple choice questions.(8×3 = 24)
Q.2 : Problems- Attempt any two out of Three. (8 × 2 = 16)

Section II

Q.1: Objective Questions- Attempt any 8 out of 12 multiple choice questions.(8×3 = 24)
Q.2 : Problems- Attempt any two out of Three. (8 × 2 = 16)
Marks for Journals and Viva:
For each course USC1MT1, USC1MT2 and USC2MT1, USC2MT2

1. Journals: 05 marks.
2. Viva:05 marks.

- **Passing Standard**

  The learners shall obtain a minimum of 40% marks in Practical Examination (PE) (i.e. 40 out of 100), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.

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'Best College Award' by University of Mumbai

Program: B.Sc.

Syllabus of F.Y.B.Sc. IKS: Introduction to Vedic Mathematics

Choice Based Credit System (CBCS) as Per NEP-2020
w.e.f. Academic Year 2023-24

List of Courses for Semester-I

IKS- Introduction to Vedic Mathematics

Course Code	Unit	Topic	Credit	Lecture per Week
UIKS1VM1	Unit I	Contribution of Indian Mathematicians, High Speed Addition and Subtraction	02	02
	Unit II	Miracle Multiplication and Excellent Division		

UIKS1VM1: Introduction to Vedic Mathematics

Course Outcomes: After completing the course, Students will be able to:
(1) *solve* basic maths speedily.
(2) *explain* the contributions of Indian Mathematicians.
(3) *understand* the concept of mathematical operations using various sutras.
(4) *find* squares and cubes using Vedic sutras.

Unit I: Contribution of Indian Mathematicians, High Speed Addition and Subtraction. (15 Lectures)

1. Varahmihir, Aryabhatta ,Srinivasa Ramanujan, Neelkanth Somayya, Bharti Krishna Tirtha
2. Vedic Maths: History of Vedic Maths and its Features
3. Vedic Maths formulae: Sutras and Upsutras
4. Addition in Vedic Maths: Without carrying, Dot Method
5. Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah (All from 9 last from 10)
6. Fraction -Addition and Subtraction

Unit II: Miracle Multiplication and Excellent Division (15 Lectures)

1. Multiplication in Vedic Maths: Base Method (any two numbers upto three digits)
2. Multiplication by Urdhva Tiryak Sutra
3. Miracle multiplication: Any three-digit number by series of l's and 9's
4. Division by Urdhva Tiryak Sutra (Vinculum method)
5. Squares of any two-digit numbers: Base method
6. Square of numbers ending in 5: Ekadhikena Purvena Sutra
7. Easy square roots: Dwandwa Yoga (duplex) Sutra
8. Square root of 2: Baudhayana Shulbasutra
9. Cubing: Yavadunam Sutra

Reference Books

1. Vedic Mathematics Made Easy, Dahaval Bathia, Jaico Publishing, New Delhi 2011
2. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi.
3. The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi 2019.
4. Learn Vedic Speed Mathematics Systematically, Chaitnaya A. Patil 2018.

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Indian Knowledge System (IKS) **50 Marks**

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations (SEE) are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks

Question Paper Pattern

(Periodical Class Test)

Maximum Marks: 20 Duration: 40 Minutes
Questions to be set: 02
All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

- **Passing standard**: Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE). A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE) together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE).

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Program: B.Sc.

Syllabus of F.Y.B.Sc. Mathematics (Minor)

Choice Based Credit System (CBCS) as Per NEP-2020
w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

Teaching Pattern for Semester-II

1. One lecture per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

List of Courses for Semester-II

DIFFERENTIAL EQUATIONS

Course Code	Unit	Topic	Credit	Lecture per Week
USC2DE1M	Unit I	First order and First-degree differential equations, Second order linear differential equations	02	03

Syllabus for Semester-II

USC2DE1M: DIFFERENTIAL EQUATIONS

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: After completing the course, Students will be able to
1. *Understand* basic concepts of Differential Equations
2. *Classify* the first order differential equation.
3. *Solve* second order linear differential equations by using variation of parameter

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Unit I:

First order and First-degree differential equations (15 Lectures)

1. Solutions of homogeneous and non-homogeneous differential equations of first order and first degree, Notion of partial derivative, solving exact differential equations.
2. Rules for finding integrating factor (I.F) (without proof) for non-exact equations
3. Finding solutions of first order differential equations of the type $\frac{dy}{dx} + P(x)y = Q(x)y^n$. $for\ n \geq 0$, Applications to orthogonal trajectories, population growth, and finding the current at a given time.

Second order Linear Differential equations

Homogeneous and second order linear differentiable equations: The space of solutions of the homogeneous equation as a vector space. The general solution of a non-homogeneous second order equation. Complementary functions and particular integrals. Wronskian and linear independence of the solutions. The general solution of homogeneous differential equations.

Reference Books

1. Daniel, First order First degree ODE and Applications, 2009
2. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill.
3. E. A. Coddington, An introduction to ordinary differential equations, Dover Books.
4. M.K. Venkataraman, Engineering Mathematics volume 3, National Publishing Co.

Practical for USC2DE1M:

1. Solve differential equations using variable separable method.
2. Solve homogenous differential equations.
3. Solve non-homogenous differential equations.
4. Solve exact differential equations.
5. Solve non-exact differential equations
6. Solve linear differential equations.
7. Solve Bernoulli's differential equations.
8. Solve second order linear differential equations.
9. Find Wronskian and linear independence of the solutions.
10. Solve homogeneous equation with constant coefficients.

Scheme of Examination

Faculty of Science

(Undergraduate Programmes)

For Minor Courses (50 Marks)

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Practical Examinations (PE)/Field Work (FW): 40 % 20 Marks

Journal/Lab book/workbook, Viva Voce	05 Marks
Practical/Laboratory Work/field work/Test based on tutorials	15 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

- **Passing standard**: For Minor courses: Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE)/ Practical Examination (PE). A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE)/ Practical Examination together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE)/ Practical Examination (PE).

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Program: B.Sc.

Revised Syllabus of F.Y.B.Sc. VSC: Numerical Analysis

Choice Based Credit System (CBCS) as Per NEP-2020
w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

Teaching Pattern for Semester-I

1. One lecture per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

Teaching Pattern for Semester-II

1. One lecture per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

List of Courses for Semester-I

VSC: Numerical Analysis – I

Course Code	Unit	Topic	Credit	Lecture per Week
UVSC1NA1	Unit I	Solutions of Algebraic and Transcendental Equations, Interpolation	2	1

List of Courses for Semester-II

VSC: Numerical Analysis – II

Course Code	Unit	Topic	Credit	Lecture per Week
UVSC2NA2	Unit I	Numerical solution of 1st and 2nd order differential equations, Numerical Integration	2	1

Syllabus for Semester-I

UVSC1NA1: Numerical Analysis – I

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: Student will be able to

1. **Solve** algebraic, transcendental and simultaneous systems of equations using numerical methods.
2. **Find** numerical solutions of interpolating methods

Unit I:

Solutions of Algebraic and Transcendental Equations: The Bisection Method, The Newton-Raphson Method, the Regula-falsi method, The Secant Method. Rate of convergence

Solution of simultaneous algebraic equation (linear) using iterative methods: Gauss Elimination Method, Gauss Jacobi Method

Interpolation: Forward Difference, Backward Difference, Central Differences, Different Types of operators, Relation between operators, Newton's Forward Difference Interpolation, Newton's Backward Difference Interpolation, Divided Differences, Newton's Divided Difference Interpolation, Lagrange's Interpolation.

Reference Books:

1. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical Methods (Problems and Solutions), Second Edition, New Age International Pvt Ltd Publishers, Mumbai
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, Prentice Hall India Learning Private Limited, New Delhi (2012)
3. H.C. Saxena, Finite Differences and Numerical Analysis, S. Chand & Company Ltd. (2005)
4. Dr. B. S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers

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Practicals for UVSC1NA1

1. Find roots of a given algebraic or transcendental equation by using Bisection Method
2. Find roots of a given algebraic or transcendental equation by using Newton's Raphson Method
3. Find roots of a given algebraic or transcendental equation by using Regula-falsi Method
4. Find roots of a given algebraic or transcendental equation by using Secant Method
5. Gauss Elimination Method
6. Gauss Jacobi Method
7. Newton's Forward Difference Interpolation
8. Newton's Backward Difference Interpolation
9. Newton's Divided Difference Interpolation
10. Lagrange's Interpolation

Syllabus for Semester-II

UVSC2NA2: Numerical Analysis – II

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: Students will be able to

(1) Solve differential equations by using numerical methods.

(2) Solve integration by using numerical methods.

(3) Apply triangularization method, LU decomposition, cholesky method, power and inverse power method.

Unit I:

Numerical solution of 1st and 2nd order differential equations: Euler's Method, Modified Euler's Method, Runge-Kutta Method for 1st and 2nd Order Differential Equations.

Numerical integration: Trapezoidal Rule, Simpson's 1/3rd and 3/8th rules,

Direct Method: Triangularization Method, LU Decomposition, Cholesky Method

Eigen value Problem: Power Method, Inverse Power Method

Reference Books:

1. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical Methods (Problems and Solutions), Second Edition, New Age International Pvt Ltd Publishers, Mumbai

2. S. S. Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, Prentice Hall India Learning Private Limited, New Delhi (2012)

3. H.C. Saxena, Finite Differences and Numerical Analysis, S. Chand & Company Ltd. (2005)

4. Dr. B. S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers

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Suggested Practical's for UVSC2NA2

1. Find the solution of Ordinary Differential Equation by using Euler's Method
2. Find the solution of Ordinary Differential Equation by using Modified Euler's Method
3. Find the solution of Ordinary Differential Equation by using Runge-Kutta Method
4. Trapezoidal Rule
5. Simpson's 1/3rd Rule
6. Simpson's 3/8th Rule
7. LU Decomposition
8. Cholesky Method
9. Power Method
10. Inverse Power Method

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Vocational Skill Courses (VSC) (50 Marks)

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Practical Examinations (PE)/Field Work (FW): 40% **20 Marks**

Journal/Lab book/workbook, Viva Voce	05 Marks
Practical/Laboratory Work/field work	15 Marks

B) Semester End Examination (SEE): 60 % **30 Marks**

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

॥ विद्या विनयने शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: B.Sc.

Revised Syllabus of F.Y.B.Sc. SEC: Data Analytics

Choice Based Credit System (CBCS) as Per NEP-2020
w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

Teaching Pattern for Semester-I

1. One lecture per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

Teaching Pattern for Semester-II

1. One lecture per week per course. Each lecture is of 60 minutes duration.

2. One Practical (2L) per week per batch for course (the batches to be formed as prescribed by the University). Each practical session is of 120 minutes duration.

List of Courses for Semester-I

SEC: Data Analytics – I

Course Code	Unit	Topic	Credit	Lecture per Week
USEC1DA1	Unit I	Introduction to Data and Probability	2	1

List of Courses for Semester-II

SEC: Data Analytics – II

Course Code	Unit	Topic	Credit	Lecture per Week
USEC2DA2	Unit I	Testing of Hypothesis and Estimation	2	1

Syllabus for Semester-I

USEC1DA1: Data Analytics – I

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: Student will be able to

1. **Describe** various data and its types
2. **Describe** the measures of central tendency and dispersion
3. **Classify** discrete and continuous probability distribution to various problems

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Unit I:

Chapter 1: Introduction to Data:

Type of data, Scale, Representation of data graphically

Measures of central Tendency, Dispersion

Chapter 2: Introduction to Probability

Definition of Probability, Mutually exclusive and inclusive events, Independent events,

Conditional Probability Probability distributions: Binomial, Poisson, Normal

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Reference Books:

1. 1. STATISTICS, Murray R Spiegel, Larry J. Stephens, McGRAW –HILL ITERNATIONAL, Fourth edition.
2. FUNDAMENTAL OF MATHEMATICAL STATISTICS S.C. GUPTA and V.K. KAPOOR, SULTAN CHAND and SONS, ELEVENTH EDITION.

Practical for USEC1DA1

1. Using R execute the basic commands, array, list and frames, sequences and repetition.
2. Create a Matrix using R and perform the operations: addition, multiplication
3. Create a Matrix using R and perform the operations inverse
4. Create a Matrix using R and perform the operation: transpose
5. Using R generating graphs: line plots and pie chart
6. Using R generating graphs: histogram, bar chart
7. Using R Execute the statistical function: mean. Median, mode

8. Using R Execute the statistical functions: range, quartiles

9. Using R import the data from Excel / .CSV file and perform standard deviation, variance

10. Using R compute the probability and examples using normal, binomial distribution

Syllabus for Semester-II

USEC2DA2: Data Analytics – II

Note: All topics must be covered with proof in detail (unless mentioned otherwise) and with examples.

Course Outcomes: Students will be able to

1. **Apply** sampling techniques
2. **Estimate** the parameters
3. **Apply** testing of hypothesis tools

Unit I:

Chapter 1: Concept of sample and population, Sampling techniques, Sampling Distributions(Student t distribution, Chi Square distribution), Probability Distribution of Sampling

Chapter 2: Concept of estimation

Point Estimation and interval estimation, properties of estimator, Testing of Hypothesis:

Normal Z test, P test , Chi Square test

Reference Books:

1. STATISTICS, Murray R Spiegel, Larry J. Stephens, McGRAW –HILL ITERNATIONAL, Fourth edition.
2. FUNDAMENTAL OF APPLIED STATISTICS S.C. GUPTA and V.K. KAPOOR, SULTAN CHAND and SONS, ELEVENTH EDITION

Suggested Practical's for USEC2DA2

1. Using R, generating sample and sample statistics
2. USING R, Calculation of Correlation and regressioncoefficient along with their test of significance.
3. Using R Application of t test for single mean,

4. Using R t-test forindependent samples, paired t test,
5. Using R application of F-test,
6. Using R application of Chi-square test
7. Using R Analysis of variance : an example of one way and two way ANOVA
8. Using R, estimation of parameters
9. Using R, generating linear regression model

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Skill Enhancement Courses (SEC) (50 Marks)

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Practical Examinations (PE)/Field Work (FW): 40% **20 Marks**

Journal/Lab book/workbook, Viva Voce	05 Marks
Practical/Laboratory Work/field work	15 Marks

B) Semester End Examination (SEE): 60 % **30 Marks**

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: B.Com.

Revised Syllabus of F.Y.B.Com. VSC: Business Mathematics and Statistics

Choice Based Credit System (CBCS) as Per NEP-2020
w.e.f. Academic Year 2023-24

F.Y.B.Com.

Introduction:

There is a rapid expansion of knowledge in subject matter areas and improved instructional method during last decade. There are considerable curricular revisions happening at the high school level. Applications of Mathematics and Statistics are widely used in industry and business. Keeping this in mind, a revision required in accordance with the growth of subject of at the high school level and emerging needs of industry and its application.

Objectives:

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. To familiarize students with the concept of Matrices and Determinants.
3. To familiarize students with the concept of index number, time value of money, mathematical operations etc.
4. To understand the tools and techniques like measures of central tendencies and dispersion.
5. To equip the students with the ability to analysis Interpret data by using statistical techniques.
6. To motivate the students to apply statistical techniques for critical decision making and for research studies.
7. To enrich students for application of modern Statistical tools and techniques.

Learning Outcomes:

This course will help students to learn about the theoretical concept relating Mathematics and Statistics, Matrices, Determinant, Index Number, Measures of central tendencies, Dispersion, Probability etc. It will further help to apply the statistical tools and techniques for decision making and for research studies.

Teaching Pattern for Semester-I & II

1. Two lectures per week for course. Each lecture is of 60 minutes duration.
2. One Practical/ Tutorial (1L) per week per batch for course. (The batches to be formed as pre scribed by the University).

Revised Syllabus of Courses of B.Com. Programme at Semester I With Effect from the Academic Year 2023-2024

Vocational Skill Course (VSC)

UCM1BM1: Business Mathematics

After completing the course, Student will be able to:	
CO1	**Find** the derivatives of the functions
CO2	**Determine** the interest and annuity
CO3	**Solve the** problems by using matrices, determinant, inverse of the matrices

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1	Elementary Financial Mathematics	15
2	Matrices and Determinants	15

Note:

One Practical/ Tutorial per batch per week in addition to number of lectures stated above. (Batch size as per the University norms)

Sr. No.	Modules / Units
1	**Elementary Financial Mathematics**
	• Simple and Compound Interest: Interest compounded once a year, more than once a year, continuous, nominal and effective rate of interest • **Depreciation of Assets:** Equated Monthly Instalments (EMI)-using flat interest rate and reducing balance method. • **Functions:** Algebraic functions and the functions used in business and economics, Break Even and Equilibrium point. • **Derivatives:** Derivatives of constant function, logarithmic functions, polynomial and exponential function. • **Rules of derivatives:** Addition, multiplication and quotient rule.
2	**Matrices and Determinants**
	• **Matrices:** Some important definitions and some important results. Matrix operation (Addition, scalar multiplication, matrix multiplication, transpose of a matrix), Inverse of a Matrix (up to order three) using ad-joint of a matrix and matrix inversion method. • **Determinants of a matrix of order two or three**: properties and results of Determinants. • Solving a system of linear equations using Cramer's rule.

Revised Syllabus of Courses of B.Com. Programme at Semester I With Effect from the Academic Year 2023-2024

Vocational Skill Course (VSC)

UCM2BS1: Business Statistics

After completing the course, Student will be able to:	
CO1	**Explain** the data by using graphs
CO2	**Apply** Summarization Measures to solve the examples.
CO3	**Predict the** future values by using time series methods and will able to find index numbers.
CO4	**Determine** the probability

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1	Introduction to Statistics	15
2	Forecasting Techniques	15

Note:

One tutorial per batch per week in addition to number of lectures stated above (Batch size as per the University norms)

Sr. No.	Modules / Units
1	**Introduction to Statistics**
	• **Introduction to data** • Type of data (Primary & Secondary), Method of Collection and Presentation of data (primary, secondary, qualitative, quantitative and graphs) • **Measures Of Central Tendency:** Mean(A.M, Weighted, Combined), Median(Calculation and graphical using Ogives), Mode(Calculation and Graphical using Histogram),Comparative analysis of all measures of Central tendency • **Measures Of Dispersion:** Range with C.R(Co-Efficient Of Range), Quartiles & Quartile deviation with CQ (Co-Efficient Of Quartile), Mean Deviation from mean with CMD (Co-Efficient Of Mean Deviation), Standard deviation with CV(Co-Efficient Of Variance).
2	**Forecasting Techniques**
	• **Time Series and Index Number** Least Square Method, Moving Average Method, Determination of Season • **Index Number:** Simple(un weighted) Aggregate Method, Weighted Aggregate Method, Simple Average of Price Relatives, Weighted Average of Price Relatives, Chain Base Index Numbers, Base Shifting, Splicing and Deflating, Cost of Living Index Number • **Elementary Probability:** Concept of Sample space, Concept of Event, Definition of Probability, Addition & Multiplication laws of Probability.

List of Practical's/ Tutorial for Business Mathematics (Semester-I)

Practical/Tutorial No	Topic
01	Practical on Simple and Compound Interest
02	Practical on Depreciation of Assets
03	Practical on Functions
04	Practical on Derivatives
05	Practical on Rules of derivatives
06	Practical on Matrix operations
07	Practical on Inverse of a Matrix using ad-joint of a matrix
08	Practical on Inverse of a Matrix using matrix inversion method
09	Practical on Determinants of a matrix of order two or three
10	Practical on Solving a system of linear equations using Cramer's rule

List of List of Practical's/ Tutorial for Business Statistics (Semester-II)

Practical No	Topic
01	Practical on Mean and Median
02	Practical on Mode
03	Practical on Range with C.R(Co-Efficient Of Range),
04	Practical on Quartiles & Quartile deviation with CQ
05	Practical on Mean Deviation Standard deviation
06	Practical on Least Square Method
07	Practical on Inverse Moving Average Method, Determination of Season
08	Practical on Index Number
09	Practical on Chain Base Index Numbers, Base Shifting, Splicing and Deflating, Cost of Living Index Number
10	Practical on Elementary Probability

Reference Books

Mathematical and Statistical Techniques

- *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.*
- *Applied Calculus: By Stephen Waner and Steven Constenoble, Brooks/Cole Thomson Learning, second edition, Chapter 1 to 5.*
- *Business Mathematics By D. C. Sancheti and V. K. Kapoor, Sultan Chand & Sons, 2006, Chapter 1, 5, 7, 9 &10.*
- *Mathematics for Business Economics: By J. D. Gupta, P. K. Gupta and Man Mohan, Tata Mc- Graw Hill Publishing Co. Ltd., 1987, Chapters 9 to 11 & 16.*
- *Quantitative Methods-Part-I By S. Saha and S. Mukerji, New Central Book Agency, 1996, Chapters 7 & 12.*
- *Mathematical Basis of Life Insurance By S.P. Dixit, C.S. Modi and R.V. Joshi, Insurance Institute of India, Chapters 2: units 2.6, 2.9, 2.20 & 2.21.*
- *Securities Laws & Regulation of Financial Market : Intermediate Course Paper 8, Institute of Company Secretaries of India, Chapter 11.*
- *Investments By J.C. Francis & R.W. Taylor, Schaum's Outlines, Tata Mc-Graw Hill Edition 2000, Chapters 2,4 & section 25.1.*
- *Indian Mutual Funds Handbook : By Sundar Shankaran, Vision Books, 2006, Sections 1.7,1.8.1, 6.5 & Annexures 1.1to 1.3.*
- *STATISTICS by Schaum Series.*
- *Operations Research by Gupta and Kapoor*
- *Operations Research by Schaum Series*
- *Fundamentals of Statistics - D. N. Elhance.*
- *Statistical Methods - S.G. Gupta (S. Chand & Co.*
- *Statistics for Management - Lovin R. Rubin D.S. (Prentice Hall of India)*
- *Statistics - Theory, Method & Applications D.S.Sancheti & V. K. Kapoor.*
- *Modern Business Statistics - (Revised}-B. Pearles & C. Sullivan –Prentice Hall of India.*
- *Business Mathematics & Statistics: B Aggarwal, Ane Book Pvt. Limited*
- *Business Mathematics: D C Sancheti & V K Kapoor, Sultan Chand & Sons*
- *Business Mathematics: A P Verma, Asian Books Pvt. :Limited.*

Scheme of Examination (Amended)
Faculty of Commerce
(Under-graduate Programmes)

Vocational Skill Courses (VSC) 50 Marks

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Practical Examinations (PE)/Field Work (FW)/Test Based on Tutorials: 40 % 20 Marks

Journal/Lab book/workbook, Viva Voce	05 Marks
Practical/Laboratory Work/field work/Test based on tutorials	15 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks.
2. All questions shall be compulsory with internal options.
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

॥ विद्या विनयने शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: B.Com. & B.A.

Syllabus of F.Y.B.Com. & F.Y.B.A. Open Elective: Mathematics and Statistics for Competitive Examinations

Choice Based Credit System (CBCS) as Per NEP-2020

w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

Teaching Pattern for Semester I and II

1. Two lectures per week per course. Each lecture is of 60 minutes duration.

List of Courses for Semester-I

Maths and stats for competitive exams- I

Course Code	Unit	Topic	Credit	Lecture per Week
UOE1MSC1	Unit I	Quantitative Ability -I	02	02
	Unit II	Reasoning-I		

List of Courses for Semester-II

Maths and stats for competitive exams- II

Course Code	Unit	Topic	Credit	Lecture per Week
UOE2MSC2	Unit I	Quantitative Ability -II	02	02
	Unit II	Reasoning-II		

Syllabus for Semester-I

Mathematics and Statistics for Competitive Examinations- I

Course outcomes: After completing the course, Students will be able to:

1. *Develop* quantitative skills.
2. *Interpret* logical reasoning.

Unit I: Quantitative Ability -I

Simplification, Profit & Loss, Mixtures & Allegations, Simple Interest & Compound Interest, Surds, Indices, Work & Time

Unit II: Reasoning-I

Logical Reasoning, Alphanumeric Series, Ranking/Direction/Alphabet Test, Data Sufficiency, Inequalities

REFERENCE BOOKS:

1) Quantitative Aptitude for Competitive Examinations by S. Chand
2) A Modern Approach To Verbal & Non-Verbal Reasoning by R.S. Aggarwal
3) R. S. Aggarwal, Quantitative Aptitude (Fully solved), Reprint 2016, S. Chand.

Syllabus for Semester-II

Mathematics and Statistics for Competitive Examinations- II

Course outcomes: After completing the course, Students will be able to:

1. Solve numerical problems for competitive exams.
2. Apply logical thinking

Unit-I Quantitative Ability -II

Time & Distance, Mensuration – Cylinder, Cone, Sphere, Data Interpretation, Ratio & Proportion, Percentage, Number Systems, Sequence & Series, Permutation, Combination & Probability

Unit-II Reasoning-II

Seating Arrangement, Puzzle, Tabulation, Blood Relations, Input-Output, Coding-Decoding, Syllogism

REFERENCE BOOKS:

1) Quantitative Aptitude for Competitive Examinations by S.Chand
2) A Modern Approach To Verbal & Non-Verbal Reasoning by R.S. Aggarwal
3) R. S. Aggarwal, Quantitative Aptitude (Fully solved), Reprint 2016, S. Chand.

Scheme of Examination

Faculty of Arts & Commerce

(Undergraduate Programmes)

Open Elective Courses (OE) 50 Marks

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

Sr. No.	Particular	Marks
01	One project / case study / Test based on Practical skills/test based on tutorials (Workbook)/ Open book test based on curriculum to be assessed by the teacher concerned	20 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

- **Passing standard**: For OE courses: Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE).A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE) together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE).

University of Mumbai

॥ विद्या विनयेन शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: B.Sc.

Revised Syllabus of S.Y.B.Sc. Mathematics

Choice Based Credit System (CBCS) (60:40)
w.e.f. Academic Year 2023-24

JANARDAN BHAGAT SHIKSHAN PRASARAKSANSTHA'S

CHANGU KANA THAKUR

ART'S, COMMERCE AND SCIENCECOLLEGE, NEW PANVEL

AUTONOMOUS

BOARD OF STUDIES IN MATHEMATICS

FROM THE ACADEMIC YEAR 2023-2024

S.Y.B.Sc.

Introduction:

Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Many of the developments and decisions made in our community rely to an extent on the use of mathematics. Besides foundation skills and knowledge in mathematics for all citizen in the society, it is important to widen mathematical experience for those who are mathematically inclined.

Aims and Objectives:

1. Giving students sufficient knowledge of fundamental principles, methods and a clear perception of boundless power of mathematical ideas and tools and know how to use them by analysing, modeling, solving and interpreting.

2. Reflecting on 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 by looking at many aspects of mathematical Sciences

Outcomes:

1. Students knowledge and skills will get enhanced and they will get confidence and interest in mathematics, so that they can master mathematics effectively and will be able to formulate and solve problems from mathematical perspective.

2. Students thinking ability and attitude will change towards learning mathematics and practicals will improve their logical and analytical thinking.

Teaching Pattern for Semester-III

1. Three lectures per week per course. Each lecture is of 48 minutes duration.

2. One Practical (2L) per week per batch for courses USC3MT1, USC3MT2 combined and one Practical (3L) per week for course USC3MT3 (the batches to be formed as prescribed by the University). Each practical session is of 48 minutes duration.

Teaching Pattern for Semester-IV

1. Three lectures per week per course. Each lecture is of 48 minutes duration.

2. One Practical (2L) per week per batch for courses USC3MT1, USC3MT2 combined and one Practical (3L) per week for course USC3MT3 (the batches to be formed as prescribed by the University). Each practical session is of 48 minutes duration.

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Choice Based Credit System (CBCS)

The performance of the learners shall be evaluated into two components. The learner's Performance shall be assessed by Internal Assessment with 40% marks in the first component by conducting the Semester End Examinations with 60% marks in the second component. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

A) Internal Assessment: 40 % (40 Marks)

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks
02	Test on Practical Skills/ Case studies /Group/ Individual Survey Project/Presentation and write up on the selected topics of the subjects/ Test based on tutorials /Book Review / Open Book Test	15 Marks
03	Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05 Marks

Question Paper Pattern
(Periodical Class Test)

Maximum Marks: 20
Duration: 40 Minutes
Questions to be set: 02
All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination: 60 % (60 Marks)

- Duration: The examination shall be of 2 hours duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be four questions of 15 marks each (30 marks with internal options). 2. On each unit there will be one question and fourth question will be based on entire syllabus. 3. All questions shall be compulsory with internal options. 4. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

➢ Passing Standard

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Semester End Practical Examinations

At the end of the Semesters III & IV, Practical examinations of three hours duration and 150 marks shall be conducted for the courses USC3MTP, USC4MTP.

In semester III, the Practical examinations for USC3MT1 and USC3MT2 are held together by the college. The Practical examination for USC3MT3 is held separately by the college.

In semester IV, the Practical examinations for USC4MT1 and USC4MT2 are held together by the college. The Practical examination for USC4MT3 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
USC3MTP	Questions from USC3MT1	Questions from USC3MT2	Questions from USC3MT3	120	03
USC4MTP	Questions from USC4MT1	Questions from USC4MT2	Questions from USC4MT3	120	03

Marks for Journals and Viva

For each course USC3MT1, USC3MT2, USC3MT3 and USC4MT1, USC4MT2, USC4MT3

1. Journals: 05 Marks.

2. Viva: 05 Marks.

List of Courses for Semester-III

PAPER I: CALCULUS-III

Course Code	Unit	Topic	Credit	Lecture per Week
USC3MT1	Unit I	Functions of several variables	02	03
	Unit II	Differentiation		
	Unit III	Applications		

PAPER II: LINEAR ALGEBRA-I

Course Code	Unit	Topic	Credit	Lecture per Week
USC3MT2	Unit I	Vector spaces over $\mathbb{R}$	02	03
	Unit II	Linear Transformations and Matrices		
	Unit III	Determinants		

PAPER III: DISCRETE MATHEMATICS-II

Course Code	Unit	Topic	Credit	Lecture per Week
USC3MT3	Unit I	Graphs	02	03
	Unit II	Trees		
	Unit III	Algorithms		

PRACTICAL-III

Course Code	Part	Paper	Credit	Lecture per Week
USC3MTP	A	USC3MT1	03	05
	B	USC3MT2		
	C	USC3MT3		

List of Courses for Semester-IV

PAPER I: CALCULUS-IV

Course Code	Unit	Topic	Credit	Lecture per Week
USC4MT1	Unit I	Riemann Integration	02	03
	Unit II	Indefinite Integrals and Improper Integrals		
	Unit III	Applications		

PAPER II: LINEAR ALGEBRA-II

Course Code	Unit	Topic	Credit	Lecture per Week
USC4MT2	Unit I	Inner Product Spaces	02	03
	Unit II	Eigenvalues and Eigenvectors		
	Unit III	Diagonalization		

PAPER III: ORDINARY DIFFERENTIAL EQUATIONS

Course Code	Unit	Topic	Credit	Lecture per Week
USC4MT3	Unit I	Second order differential equations	02	03
	Unit II	Power Series solution of ordinary differential equations		
	Unit III	Laplace Transform		

PRACTICAL-IV

Course Code	Part	Paper	Credit	Lecture per Week
USC4MTP	A	USC4MT1	03	05
	B	USC4MT2		
	C	USC4MT3		

Syllabus for Semester - III

USC3MT1: CALCULUS-III

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:

(1) Evaluate limit of a functions of several variables

(2) Examine continuity of a functions of several variables

(3) Identify the differentiable functions

(4) Apply multivariable calculus in optimization problems

Unit I: Functions of several variables **(15 Lectures)**

(a) The Euclidean inner product on $\mathbb{R}^n$ and Euclidean norm function on $\mathbb{R}^n$, distance between two points, open ball in $\mathbb{R}^n$, definition of an open subset of $\mathbb{R}^n$, neighborhood of a point in $\mathbb{R}^n$, sequences in $\mathbb{R}^n$, convergence of sequences-these concepts should be specically discussed for n = 2 and n = 3.

(b) Functions from $\mathbb{R}^n \to \mathbb{R}$ (scalar fields) and from $\mathbb{R}^n \to \mathbb{R}^m$ (vector fields), limits, continuity of functions, basic results on limits and continuity of sum, difference, scalar multiples of vector fields, continuity and components of a vector fields.

(c) Directional derivatives and partial derivatives of scalar fields.

(d) Mean value theorem for derivatives of scalar fields.

Unit II: Differentiation **(15 Lectures)**

(a) Differentiability of a scalar field at a point of $\mathbb{R}^n$ (in terms of linear transformation) and on an open subset of $\mathbb{R}^n$, the total derivative, uniqueness of total derivative of a differentiable function at a point, simple examples of finding total derivative of functions such as $f(x, y) = x^2 + y^2$, $f(x, y) = x + y + z$, differentiability at a point of a function f implies continuity and existence of directional derivatives of f at the point, the existence of continuous partial derivatives in a neighborhood of a point implies differentiability at the point.

(b) Gradient of a scalar field, geometric properties of gradient, level sets and tangent planes.

(c) Chain rule for scalar fields.

(d) Second order partial derivatives, mixed partial derivatives, sufficient condition for equality of mixed partial derivative.

Unit III: Applications **(15 lectures)**

(a) Second order Taylors formula for scalar fields.

(b) Differentiability of vector fields, definition of differentiability of a vector field at a point, Jacobian matrix, differentiability of a vector field at a point implies continuity. The chain rule for derivative of vector fields (statements only).

(c) Mean value inequality.

(d) Second derivative test for extrema of functions of two variables.

(e) Hessian matrix, Maxima, minima and saddle points of functions of two variables.

(f) Method of Lagrange Multipliers.

Recommended Text Books:

1. T. Apostol: Calculus, Vol. 2, John Wiley.

2. J. Stewart, Calculus, Brooke/ Cole Publishing Co.

Additional Reference Books:

1. G.B. Thoman and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley, 1998.

2. Sudhir R. Ghorpade and Balmohan V. Limaye, A Course in Multivariable Calculus and Analysis, Springer International Edition.

3. Howard Anton, Calculus- A new Horizon, Sixth Edition, John Wiley and Sons Inc, 1999.

Practicals for USC3MT1

1. Sequences in $\mathbb{R}^2$ and $\mathbb{R}^3$ limits and continuity of scalar fields and vector fields, using definition and otherwise, iterated limits.

2. Computing directional derivatives, partial derivatives and mean value theorem of scalar fields.

3. Total derivative, gradient, level sets and tangent planes.

4. Chain rule, higher order derivatives and mixed partial derivatives of scalar fields.

5. Taylors formula, differentiation of a vector field at a point, Hessian/Jacobean matrix, Mean Value Inequality.

6. Finding maxima, minima and saddle points, second derivative test for extrema of functions of two variables and method of Lagrange multipliers.

7. Miscellaneous Theoretical Questions based on full paper.

USC3MT2: LINEAR ALGEBRA-I

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:
(1) Define vector spaces and subspaces

(2) Relate Matrices and linear transformations

(3) Find basis and dimension of a vector space over $\mathbb{R}$

(4) Evaluate the determinant

Unit I: Vector Spaces over $\mathbb{R}$ **(15 Lectures)**

(a) Definition of a Vector Spaces over $\mathbb{R}$ and examples.

(b) Subspaces - definition and examples.

(c) The sum and intersection of subspaces, direct sum of vector spaces.

(d) Linear combination of vectors, linear span of a subset of a vector space.

(e) Linear dependence and independence of a set.

(f) Basis of a vector space, basis as a maximal linearly independent set and a minimal set of generators. Dimension of a vector space.

Unit II: Linear Transformations and Matrices **(15 Lectures)**

(a) Linear transformations: definition, properties and examples, Kernel and image of a linear transformation, Rank-Nullity theorem (with proof), Linear isomorphisms, inverse of a linear isomorphism, Matrix representation of a linear transformation.

(b) The matrix units and elementary matrices.

(c) Row space, column space of an m×n matrix, row rank and column rank of a matrix.

(d) Equivalence of rank of an m × n matrix A and rank of the linear transformation $L_A: \mathbb{R}^n \to \mathbb{R}^m$ $(L_A(A) = AX)$. The dimension of solution space of the system of linear equations AX = 0 equals n − rank (A).

(e) The solutions of non-homogeneous systems of linear equations represented by AX = B and the general solution of the homogeneous system.

Unit III: Determinants **(15 Lectures)**

(a) Definition of determinant as an n-linear skew-symmetric function. Determinant of a matrix as determinant of its column vectors (or row vectors).

(b) Existence and uniqueness of determinant function via permutations.

(c) Laplace expansion of a determinant, Vandermonde determinant, determinant of upper triangular and lower triangular matrices.

(d) Linear dependence and independence of vectors in $\mathbb{R}^n$ using determinants, The existence and uniqueness of the system AX = B, where A is an n × n matrix with det(A) ≠ 0.

(e) Cofactors and minors of a matrix, Adjoint of an n × n matrix A.

(f) Cramer's rule.

(g) Determinant as area and volume.

Recommended Books:

1. Serge Lang: Introduction to Linear Algebra, Springer Verlag.

2. S. Kumaresan: Linear Algebra A geometric approach, Prentice Hall of India Private Limited.

Additional Reference Books:

1. M. Artin: Algebra, Prentice Hall of India Private Limited.

2. K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw-Hill, New Delhi.

3. Gilbert Strang: Linear Algebra and its applications, International Student Edition.

4. L. Smith: Linear Algebra, Springer Verlag.

5. A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Tata McGrawHill, New Delhi.

6. T. Banchoff and J. Wermer: Linear Algebra through Geometry, Springer Verlag Newyork, 198

7. Sheldon Axler : Linear Algebra done right, Springer Verlag, Newyork.

8. Klaus Janich : Linear Algebra.

9. Otto Bretcher: Linear Algebra with Applications, Pearson Education.

10. Gareth Williams: Linear Algebra with Applications, Narosa Publication.

Practicals for USC3MT2

1. Subspaces: Determine whether a given subset of a vector space is a subspace.
2. Linear dependence and independence of subsets of a vector space.
3. Rank-Nullity Theorem.
4. System of linear equations.
5. Determinant, calculating determinants of 2×2 matrices, n×n diagonal, upper triangular matrices using definition and laplace exapansion.
6. Finding inverses of Finding inverses of n × n matrices using adjoint
7. Determinant, calculating determinants of 2 × 2 matrices, 3 × 3 matrices using adjoint.
8. Miscellaneous Theoretical Questions based on full paper

USC3MT3: DISCRETE MATHEMATICS-II

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:

(1) Define the basic concepts of graph theory

(2) Examine the properties and applications of graph

(3) Analyze the properties of permutation functions, Pascal's Identity, Circular Permutation and Stirling numbers.

(4) Apply Pigeonhole Principle, Binomial Theorem, Inclusion and Exclusion Principle.

Unit I: Graphs **(15 Lectures)**

A. Introduction to graphs: Types of graphs: Simple graph, directed graph, (One example/graph model of each type to be discussed).

B. (a) Graph Terminology: Adjacent vertices, degree of a vertex, isolated vertex, pendant vertex in an undirected graph.

(b) The handshaking Theorem for an undirected graph (statement only), Theorem: An undirected graph has an even number of odd vertices (statement only).

C. Some special simple graphs (by simple examples): Complete graph, cycle, wheel in a graph, Bipartite graph, regular graph.

D. Representing graphs and graph isomorphism:

(a) Adjacency matrix of a simple graph.

(b) Incidence matrix of an undirected graph.

E. Connectivity:

(a) Paths, circuits, simple paths, simple circuits in a graph (simple examples).

(b) Connecting paths between vertices (simple examples).

(c) Euler paths and circuits, Hamilton paths and circuits, Dirac's Theorem (statement only), Ore's Theorem (statement only)

(d) Planar graphs, planar representation of graphs, Euler's formula. Kuratowski's Theorem (statement only).

Unit II: Trees **(15 Lectures)**

A. (a) Trees: Definition and Examples.

(b) Forests, binary trees

(c) Trees as models.

(d) Properties of Trees (no proofs).

B. Application of Trees:

(a) Binary Search Trees, Algorithm for locating an item in or adding an item to a Binary Search Tree.

(b) Decision Trees (simple examples).

(c) Algorithm for Huffman's coding, construction of Huffman's code by examples.

Unit III. Algorithms **(15 Lectures)**

A) Definition of an algorithm, characteristics of an algorithm, Selection and iteration constructs in pseudocode

B. Searching and sorting algorithms including the following:

(a) Finding maximum and/or minimum element in a finite sequence of integers,

(b) The linear search and binary search algorithms of an integer x in a finite sequence of distinct integers,

(c) Sorting of a finite sequence of integers in ascending order, selection sort.

B. Algorithms on integers:

(a) Modular exponent,

(b) Euclidean algorithm to find the g.c.d of two non-zero integers.

C. Complexity of algorithm: Big O notation, Growth of functions, Time complexity, Best case, Average case, Worst Case complexity. Using big O notation to express the best, average and worst case behaviour for sorting and searching algorithms.

D. Shortest path problem: Construction of Eulerian path by Fleury's Algorithm, The shortest path algorithm - Dijkstra's Algorithm, Floyd's Algorithm to find the length of the shortest path.

E. Minimum Spanning Trees, Prims Algorithm, Kruskal's Algorithm (The Proofs of the results

in this unit are not required and may be omitted).

Recommended Books:

1. R. Wilson, Introduction to Graph theory, Fourth Edition, Prentice Hall.

2. K. H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill Edition.

3. B. Kolman, Robert Busby, Sharon Ross: Discrete Mathematical Structures, Prentice-Hall India.

4. N. Biggs, Discrete Mathematics, Oxford.

5. Norman Biggs: Discrete Mathematics, Oxford University Press.

6. Richard Brualdi: Introductory Combinatorics, John Wiley and sons.

7. V. Krishnamurthy: Combinatorics-Theory and Applications, Affiliated East West Press.

8. Discrete Mathematics and its Applications, Tata McGraw Hills.

9. Schaums outline series: Discrete mathematics,

10. Applied Combinatorics: Allen Tucker, John Wiley and Sons

Additional Reference Books:

1. D. B. West, Introduction to graph Theory, Pearson.

2. F. Harary, Graph Theory, Narosa Publication.

3. Graham, Knuth and Patashnik, Concrete Mathematics, Pearson Education Asia Low Price Edition.

Practicals for USC3MT3

1. Drawing a graph, counting the degree of vertices and number of edges.

2. Representing a given graph by an adjacency matrix and drawing a graph having given matrix as adjacency matrix.

3. Determining whether the given graph is connected or not. Finding connected components of a graph. Finding strongly connected components of a graph. Finding cut vertices.

4. Problems based Trees.

5. Problems on Algorithm of Graph

7. Problems on Algorithm of Trees

8. Miscellaneous Theoretical Questions based on full paper

Syllabus for Semester-IV

USC4MT1: CALCULUS-IV

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:

(1) Identify Riemann integrability of functions

(2) Apply fundamental theorem to definite integrals

(3) Define Beta and Gamma functions

(4) Examine convergence of Improper Integrals

Unit I: Riemann Integration **(15 Lectures)**

Approximation of area, Upper/Lower Riemann sums and properties, Upper/Lower integrals, Definition of Riemann integral on a closed and bounded interval, Criterion of Riemann integrability, if $a < c < b$, then $f \in R[a, b]$ if and only if $f \in R[a, c]$ and $f \in R[c, b]$ and $\int_a^b f = \int_a^c f + \int_c^b f$, Properties:

(a) $f, g \in R[a, b] \Longrightarrow f + g, f - g, \lambda f \in R[a, b]$

(b) $\int_a^b (f + g) = \int_a^b f + \int_a^b g$

(c) $\int_a^b \lambda(f) = \lambda \int_a^b f$

(d) $f \in R[a, b] \Rightarrow |f| \in R[a, b]$ *and* $\left|\int_a^b f\right| \leq \int_a^b |f|$

(e) If f $\geq$ 0 and $f \in C[a, b] \Rightarrow f \in R[a, b]$

(f) If f is bounded with finite number of discontinuities, then $f \in R[a, b]$ generalize this if f is monotone, then $f \in R[a, b]$

Unit II : Indefinite and improper integrals **(15 lectures)**

Continuity of F(x) = $\int_a^x f(t)\, dt$, where f ∈ R[a, b], Fundamental theorem of calculus, Mean value theorem, Integration by parts, Leibnitz rule, Improper integrals type 1 and type 2,

Absolute convergence of improper integrals, Comparison tests, Abels and Dirichlets tests (without proof).

Unit III : Applications **(15 lectures)**

(a) β and Γ functions and their properties, relationship between β and Γ functions (without proof).

(b) Applications of definite Integrals : Area between curves, finding volumes by slicing, volumes of solids of revolution Disks and Washers, Cylindrical Shells, Lengths of plane curves, Areas of surfaces of revolution.

References:

1. Calculus Thomas Finney, ninth edition section 5.1, 5.2, 5.3, 5.4, 5.5, 5.6.
2. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
3. Ajit Kumar, S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
4. T. Apostol, Calculus Vol.2, John Wiley.
5. K. Stewart, Calculus, Booke/Cole Publishing Co, 1994.
6. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic multivariable calculus.
7. Bartle and Sherbet, Real analysis.

Practicals for USC4MT1

1. Calculation of upper sum, lower sum and Riemann integral.
2. Problems on properties of Riemann integral.
3. Problems on fundamental theorem of calculus, mean value theorems, integration by parts, Leibnitz rule.
4. Convergence of improper integrals, applications of comparison tests, Abels and Dirichlets tests, and functions.
5. Beta Gamma Functions
6. Problems on area, volume, length.
7. Miscellaneous Theoretical Questions based on full paper

USC4MT2: LINEAR ALGEBRA-II

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:

(1) Explain properties of inner product space

(2) Determine orthogonality in inner product space

(3) Find eigenvalues and eigenvectors

(4) Identify diagonalizable matrix

Unit I: Inner Product Spaces **(15 Lectures)**

(a) Dot product in $\mathbb{R}^n$, Definition of general inner product on a vector space over $\mathbb{R}$ and examples

(b) Norm of a vector in an inner product space. Cauchy-Schwarz inequality, Triangle inequality, Orthogonality of vectors, Pythagoras theorem and geometric applications in $\mathbb{R}^2$, Projections on a line, The projection being the closest approximation, Orthogonal complements of a subspace, Orthogonal complements in $\mathbb{R}^2$ and $\mathbb{R}^3$. Orthogonal sets and orthonormal sets in an inner product space, Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process, Simple examples in $\mathbb{R}^3$, $\mathbb{R}^4$.

Unit II: Eigenvalues and eigenvectors **(15 Lectures)**

(a) Eigenvalues and eigenvectors of a linear transformation T : V → V , where V is a finite dimensional real vector space, Eigenvalues and eigenvectors of linear transformations examples.

(b) Eigenvalues of n × n real matrices.

(c) The linear independence of eigenvectors corresponding to distinct eigenvalues of a linear transformation.

(d) The characteristic polynomial of an n × n real matrix, characteristic roots.

(e) Similar matrices, characteristic polynomials of similar matrices.

(f) The characteristic polynomial of a linear transformation T : V → V , where V is a finite dimensional real vector space.

Unit III: Diagonalization **(15 Lectures)**

(a) Diagonalizability of an n×n real matrix and a linear transformation of a finite dimensional real vector space to itself. Definition: Geometric multiplicity and Algebraic multiplicity of eigenvalues of an n × n real matrix and of a linear transformation.

(b) An n × n matrix A is diagonalisable if and only if $\mathbb{R}^n$ has a basis of eigenvectors of A if and only if the sum of dimension of eigenspaces of A is n if and only if the algebraic and geometric multiplicities of eigenvalues of A coincide. Examples of non diagonalizable matrices.

(c) orthogonal diagonalization and Quadratic Forms.

(d) orthogonal diagonalization of n × n real symmetric matrices.

Recommended Books:

1. Serge Lang: Introduction to Linear Algebra, Springer Verlag.

2. S. Kumaresan: Linear Algebra A geometric approach, Prentice Hall of India Private Limited.

Additional Reference Books:

1. M. Artin: Algebra, Prentice Hall of India Private Limited.

2. K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw-Hill, New Delhi.

3. Gilbert Strang: Linear Algebra and its applications, International Student Edition.

4. L. Smith: Linear Algebra, Springer Verlag.

5. A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Tata McGrawHill, New Delhi.

6. T. Banchoff and J. Wermer: Linear Algebra through Geometry, Springer Verlag Newyork, 198

7. Sheldon Axler : Linear Algebra done right, Springer Verlag, Newyork.
8. Klaus Janich : Linear Algebra.
9. Otto Bretcher: Linear Algebra with Applications, Pearson Education.
10. Gareth Williams: Linear Algebra with Applications, Narosa Publication.

Practicals for USC4MT2

1. Inner Product Spaces, examples. Orthogonal complements in $\mathbb{R}^2$ and $\mathbb{R}^3$
2. Gram-Schmidt method.
3. Finding characteristic polynomial, eigenvalues of 2×2 and 3×3 matrices.
4. Eigenvalues and eigenvectors of linear transformation.
5. Diagonalization and orthogonal diagonalization.
6. Orthogonal Diagonalization Forms
7. Miscellaneous Theoretical Questions based on full paper

USC4MT3: ORDINARY DIFFERENTIAL EQUATIONS

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and with examples.

Course Outcomes:

Student will be able to:

(1) Recall the methods to solve the first order differential equations.

(2) Solve second order linear differential equations by using variation of parameter, reduction method and method of undetermined coefficients

(3) Apply the power series method to find the solution of second order differential equations.

(4) Solve second order differential equations by using Laplace Transform

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Unit I: Second order Linear Differential equations (15 Lectures)

(a) Prerequisites: First order and first degree differential equations

(b) Homogeneous and second order linear differentiable equations: The space of solutions of the homogeneous equation as a vector space. The general solution of a non-homogeneous second order equation. Complementary functions and particular integrals. Wronskian and linear independence of the solutions. The general solution of homogeneous differential equations.

(c) The homogeneous equation with constant coefficients, Auxiliary equation. The general solution corresponding to real and distinct roots, real and equal roots and complex roots of the auxiliary equation.

(d) Non-homogeneous equations: The method of undetermined coefficients. The method of variation of parameters.

Unit II: Power Series solution of ordinary differential equations (15 Lectures)

(a) An introduction to power series.

(b) Power series solutions of first order ordinary differential equations.

(c) Regular singular points of second order ordinary differential equations.

(d) Frobenius series solution of second order ordinary differential equations with regular singular points.

Unit III: Laplace Transforms **(15 Lectures)**

(a) Introduction, Properties of Laplace transform

(b) Laplace transform of elementary functions Problems using properties-Laplace transform of special function, unit step function and Dirac delta function

(c) Laplace transform of derivatives and Integrals, Evaluation of integral using Laplace Transform, Initial Value Theorem, Final Value Theorem and problems, Laplace Transform of periodic function

(d) Introduction, Properties of inverse Laplace transform, Problems (usual types)

(e) Convolution Theorem, Inverse Laplace Transform using Convolution theorem

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Recommended Books:

1. G. F. Simmons, Differential Equations with Applications and Historical Notes, McGraw Hill, 1972.

2. E. A. Coddington , An Introduction to Ordinary Differential Equations. Prentice Hall, 1961.

3. W. E. Boyce, R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiely, 2013.

4. D. A. Murray, Introductory Course in Differential Equations, Longmans, Green and Co., 1897.

5. A. R. Forsyth, A Treatise on Differential Equations, MacMillan and Co., 1956.

6. Dr. S. Sreenath, S.Ranganatham, Dr. M.V.S.S.N.Prasad and Dr. V. Ramesh Babu, Fourier Series and Integral Transforms, S.Chand and Company Ltd

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Additional Reference Books:

1. M.K. Venkataraman, Engineering Mathematics volume 3,National Publishing Co.

2. P.Kandasamy and others, Engineering Mathematics volume 3,S.Chand and Co.

3. Stanley Grossman and William R.Devit, Advanced Engineering Mathematics, Harper and Row publishers

4. Murray R Spiegel, Schaum's Outline of Laplace Transforms

Practicals for USC4MT3

1. Finding general solution of homogeneous and non-homogeneous equations, use of known solutions to find the general solution of homogeneous equations.

2. Solving equations using method of undetermined coefficients and method of variation of parameters.

3. Power series solutions of first order ordinary differential equations.

4. Frobenius series method for second order ordinary differential equations.

5. Laplace transform of elementary functions

6. Laplace transform of derivatives and Integrals

7. Inverse Laplace transform & Convolution theorem

8. Miscellaneous
