Bachelor of Science- Mathematics
UNIVERSITY OF KOTA
MBS Marg, Swami Vivekanand Nagar,
Kota - 324 005, Rajasthan, India
Website: uok.ac.in
1. The Ordinances Governing the examination in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce, Management, Engineering, Education and Law are contained in separate booklet. The students are advised to refer to the same.

2. Changes in Statutes/ Ordinances/ Rules/ Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

**Note**: The decision taken by the Academic Council shall be final.
MATHEMATICS

Scheme of study: there shall be six semesters in three consecutive years and two semester in each year. Each semester shall contain two papers.

Scheme of Examinations 2018-21

Each Question paper is divided into 5 units and There will be 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to attempt 5 questions by taking one question from each unit.
# Bachelor of Science (B.Sc.)  
(Mathematics Group)  

Subject Combination: Chemistry, Mathematics, Physics (CMP)

## B.Sc. 1st Year: First and Second Semesters  
Semester Scheme of Examination

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B.Sc. Semester -I
MATHEMATICS
Detailed syllabus
MATH 111 - Abstract Algebra I and Vector Calculus

The Question paper shall be divided into 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks). Students have to attempt 5 questions by taking one question from each unit.

Divisibility theory: Division algorithm, Greatest Common divisor (GCD) and its algorithm, Linear diophantine equations of two variables (using Euclid algorithm and Bhaskaracharya’s Kuttaka method) Fundamental theorem of arithmetic, congruences, Chinese Remainder Theorem, Euler’s Ø-function, primitive roots.

Unit II
Binary operation. Addition and multiplication modulo operations. Definition of a group with examples and simple properties. Permutation group, cycle, transpositions, even and odd permutations and alternating group. Order of an element of a group and its properties.

Unit III
Subgroups of a group with its properties, Cyclic groups and their properties, Cosets. Index of a subgroup, Lagrange’s theorem and its applications.

Unit – IV
Normal subgroups with properties. Simple groups, Quotient groups. Group homomorphism with its kernel and properties. Isomorphism, Cayle’s theorem, automorphism, Fundamental theorem of homomorphism.

Unit V
Vector differentiation and integration, Problems based on Gradient, divergence and curl. Vector identities, Line and surface integrals. Theorems of Gauss, Green, Stokes (without proof) and problems based on these.
इकाई – I
विभाजनीयता: विभाजनीयता प्रक्रम (एल्गोरिथ्म) महत्तम समाप्तत्व एवं एल्गोरिथ्म, पूर्णक हल वाली दो चरों की रेखीक समीकरण (यूक्लिड एवं भास्कराचार्य की कट्टक विधि) अंकगणित की मूलभूत प्रमेय, तुलनीयता (congruence’s), वायनीयज शेषफल प्रमेय, आयलर का $\phi$- फलन, पूर्व मूल (primitive roots).

इकाई – II
हिंदीदारी संक्रिया, योग गुणन मोड़यूलो संक्रिया, समूह की परिभाषा, उदाहरण एवं सामान्य गुणधर्म (समूह की वैकल्पिक परिभाषा सहित) क्रमचय समूह, चक्र, पक्षान्तरण, सम एवं विषम क्रमचय एकान्तर समूह, समूह के अभ्यास की कोटि तथा गुणधर्म।

इकाई – III
उपसमूह तथा उसके गुण, चक्रीय समूह एवं उसके गुणधर्म, सहसमुच्चय, उपसमूह का सूचकांक, लेग्रांज प्रमेय एवं इसके अनुप्रयोग, आयलर प्रमेय।

इकाई – IV
प्रसामान्य उपसमूह एवं उसके गुणधर्म, सरल समूह तथा विभाग समूह, समूह समाकरिता, समाकरिता की अट्ठि और गुणधर्म एवं तुल्यकरिता, केली प्रमेय, सकारिता, समाकरिता की मूल प्रमेय।

इकाई – V
सदिशों का अवकलन एवं समाकलन, ग्रेडिएंट, अपसरण एवं कुंतल तथा सर्वसंभव八大以来 गौस, स्टोक एवं श्रीन के प्रमेय (प्रभावरहित) तथा उन पर आधारित समस्यायें।
The Question paper shell be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).
Students have to be attempt 5 questions by taking one question from each unit.

**Unit – I**

Polar coordinates, angle between radius vector and tangent, polar sub tangent and subnormal. Perpendicular from pole on tangent. Pedal equation of a curve. Derivative of length of an arc in Cartesian and polar coordinates. Curvature, Radius of curvature and its formula in various forms. Centre of curvature, chord of curvature.

**Unit – II**

Partial differential coefficients of a function of two or more variables. Total differential coefficient. Composite function, Euler’s theorem on homogeneous functions of two, three and m-variables. First and second differential coefficients of an implicit function. Taylor’s theorem for a function of two variables.

**Unit III**

Jacobians with properties. Maxima, minima and saddle points of functions of two and three variables. Lagrange’s method of undetermined multipliers.

**Unit – IV**

Asymptotes, envelopes and evolutes.

**Unit V**

Test for points of inflexion and multiple points. Test for concavity and convexity. Tracing of curves in Cartesian and polar coordinates.
इकाई – I

ध्वनि निर्देशांक, ध्वनि रेखा एवं स्पर्श रेखा के मध्य कोण, ध्वनि अधिक स्पर्शी एवं अधोलम्ब, स्पर्श रेखा पर ध्वन से लम्ब की लम्बाई। वक्र का पादिक समीकरण चाप की लम्बाई का आकलन (कार्यात्मक एवं ध्वनि निर्देशांको में) वक्रता त्रिज्या एवं विभिन्न सूत्र, वक्रता केन्द्र, वक्रता जीवा।

इकाई – II

do व do से अधिक चरों के आंशिक अवकलन, सम्पूर्ण अवकलन गुणांक do, तीन तथा ऊर्ध्व चरों के समघात फलनों के लिए आयतर प्रमेय, संयुक्त फलन, अलग फलनों के लिये प्रथम व द्वितीय अवकल गुणांक। do चरों के फलन के लिये टेलर प्रमेय,

इकाई III

जेकोडियन एवं उनके गुणधर्म, do व तीन चरों के लिये उच्च, निम्न एवं फल्याण बिनंदु, अनिम्न गुणांकों की लागू विधि।

इकाई – IV

अन्तर्गत परिवर्तन बिनंदु एवं अनुवंदन विनंदु, उत्तलता व अवतलता हेतु परीक्षण। कार्यात्मक एवं ध्वनि वक्रो का अनुरेखण।

Practical

B.Sc. (SEM-I) (Total Marks- 50)

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Name of Practical (one practical from each part)

Use of SCILAB

Question 1 is Compulsory (any five operations)
1. Introductory knowledge: matrix formation for real and complex numbers, addition, subtraction, multiplication, division element wise multiplication, division of two matrices, element wise division of two matrices, unit matrix, zero matrix, diagonal matrix, rank of matrix, trace of matrix,

Part I

Use of .sce file
1. Use of if – else statements, for loop.
2. Roots of simultaneous linear equation.
3. Roots of quadratic equation.
4. Roots of polynomial Equations
5. Factorization of algebraic expression
6. Derivative of polynomials
7. Integration of elementary function
8. Plotting of graph using array
9. Use of Boolean and logic functions
10. Fitting of binomial distribution
B.Sc. semester II

Detailed syllabus

MATH - 121 Abstract Algebra II and Integral Calculus

Scheme of Examination 2018

The Question paper shall be divided into 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to attempt 5 questions by taking one question from each unit.

Unit I


Unit II


Unit III

Beta and Gamma functions. Differentiation under the sign of integration. Double integrals and their evaluation by change of order.

Unit IV

Dirichlet’s theorem with their Liouville’s extension. Double and Triple integrals.

Unit V

Quadrature, Rectification, Volumes and surfaces of solids of revolution.

इकाई I
The Question paper shell be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to be attempt 5 questions by taking one question from each unit.

**Unit – I**

Parabola: Standard equation, parametric co-ordinates, length of chord, tangent, normal and its properties, two tangents from a point, chord of contact, polar, pole, chord with a given middle point, diameter and three normals from a point.

Ellipses: standard equation, auxiliary circle, eccentric angle, tangent, normal, two tangents from point, chord of contact, pole, polar, chord whose mid point given, diameter, conjugate diameters and four normals from a point.

**Unit – II**

Hyperbola: Standard equation, parametric co-ordinates, asymptotes, equation referred to asymptotes as axes, conjugate diameters and rectangular hyperbola.

Polar Equation: Standard equation, directrix, tangent, normal, asymptotes.
**Unit – III**

Sphere: standard equations in various forms, plane section, sphere through the circle of intersection of two spheres, power of a point, tangent plane, polar plane, polar line, angle of intersection of two spheres, length of tangent, radical plane, radical axis, co-axial system of spheres and limiting points.

**Unit IV**

Cone: Homogeneous equation in x, y, z, cone with a given vertex and given base, enveloping cone, condition for the general equation to represent a cone, tangent plane, reciprocal cone, angle between the two lines, in which a plane cuts a cone, three mutually perpendicular generators and right circular cone.

Cylinder: Right circular cylinder and enveloping cylinder.

**Unit V**

Central Conicoids: Standard equation, tangent plane, condition of tangency, director sphere, polar plane, polar lines, section with a given center, enveloping cone, enveloping cylinder.

Ellipsoid: Normal, six normals from a point, cone through six normals, conjugate diameters and their properties.
गोला : विभिन्न रूप से मानक समीकरण, समतलीय परिभाषित, दो गोलों के परिभाषित से गुजरने वाले गोले का समीकरण, बिन्दु की शक्ति, स्पर्श तल, द्विविद्य तल, द्विविद्य रेखाएँ, दो मूल रेखा, समाक्ष गोलों का निकाय तथा सीमान्त बिन्दु।

इकाई IV

शंकु : $x,y,z$ निर्देशांकों में समघात समीकरण, जिसका शीर्ष व निर्देशक ब्रह्म इंगित हो, अन्वालोपी शंकु, द्विधात समीकरण द्वारा एक शंकु को प्रदर्शित करने का प्रतिवेच, स्पर्श तल, युक्तनेत्र शंकु, शंकु को एक समतल द्वारा काटने पर प्राप्त दो रेखाओं के मध्य कोण, तीन परस्पर समकोणिक जनक रेखाओं का प्रतिवेच, तथा लम्ब वृत्तीय शंकु।

बेलन: लम्ब वृत्तीय बेलन तथा अन्वालोपी बेलन।

इकाई V

केन्द्रीय शंकवज़ : मानक समीकरण, स्पर्श तल, स्पर्शता का प्रतिवेच, नियामक गोला, द्विविद्य तल, द्विविद्य रेखाएँ, दिये केन्द्र वाला परिभाषित, अन्वालोपी बेलन एवं अन्वालोपी शंकू, दीर्घवृत्त प्रमाण प्रतिवेच, एक बिन्दु से छ: अभिलंब छ: अभिलंबों से जाने वाला शंकू, संयुक्त रेखाएँ एवं उनके गुणधर्म।

दीर्घवृत्त : अभिलंब, एक बिन्दु से जाने वाले छ: अभिलंब, छ: अभिलंबों से जाने वाला शंकू संयुक्त रेखाएँ एवं उनके गुणधर्म।

Practicals

B.Sc. (semester II) (Total Marks- 50)

बी.एस.सी. (सेमेस्टर II) के प्रयोगों की सूची

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Name of Practicals

Use of SCILAB

Question 1 is Compulsory

1. Operations on Matrices  Revision of Experiments of Semester I, remainder after division of two polynomials, hyper matrices,

Writing script in .sce file to find (any two practical)
1. To find LCM of numbers.
2. To find GCD of number.
3. To find factorial
4. To find permutations
5. To find prime number less than or equal to given number
6. Lower and upper triangular matrix of a matrix
7. Roots of simultaneous linear equation.
8. Roots of polynomial Equations
9. Factorization of algebraic expression
10. Plotting of graph using array
11. Derivative of polynomials
12. Integration of elementary function
13. Geometric, harmonic and arithmetic Means
# Scheme of Examinations

## Bachelor of Science (B.Sc.)
(\textit{Mathematics Group})

\textit{Subject Combination: Chemistry, Mathematics, Physics (CMP)}

### B.Sc. 2nd Year: Third and Fourth Semesters

#### Semester Scheme of Examination

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<th>Code or ID of Paper</th>
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B.Sc. Semester III
MATHEMATICS

Paper – MATH 231  Real Analysis

The Question paper shall be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to attempt 5 questions by taking one question from each unit.

UNIT – I

The set of real numbers as a complete ordered field, incompleteness of Q, Archimedean and denseness properties of R, Modulus, Intervals.

UNIT – II

Definition of a sequence, Theorems on limit of sequence, bounded and monotonic sequences, nested interval theorem, Cauchy’s sequence, Cauchy’s convergence criterion.

UNIT – III

Convergence of series of non-negative terms, Cauchy’s criterion, their various tests: Comparison; D’Alembert’s ratio, Raabe’s test, Logarithmic test, De-Morgan and Bertrand’s test, Cauchy’s nth root test, Cauchy’s condensation test, Gauss test, (without proof of tests) for convergence.

UNIT – IV

Topological properties of Real numbers, Open and closed set, Derivable set, compact set, Equivalent sets. Finite and infinite set, denumerable set, Countable and uncountable set. Interior point of a set, limit point of a set, Bolzano –Weierstress theorem, Heine Borel theorem. Alternating series, Leibnitz’s test, Series of arbitrary terms, absolute and conditional convergence, Abel’s and Dirichlet’s tests.

UNIT – V

Fourier series: Fourier series in the interval (-\pi, \pi), (0,2\pi), (-l,l). (a,b), Fourier series for even and odd functions.
Paper – MATH 232 DIFFERENTIAL EQUATIONS

The Question paper shall be divided into 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to attempt 5 questions by taking one question from each unit.

UNIT-I

Order and Degree of a differential equation. Differential equations of first order and first degree, variables separable, homogeneous equations.

UNIT-II

Linear differential equations and equations reducible to linear form. Exact differential equations and equations reducible to exact forms.

UNIT-III


UNIT-IV

Linear differential equations with constant coefficients, Homogeneous linear differential equations, Total differential equations.

UNIT-V

Linear differential equations of second order. Transformation by changing the dependent / independent variable. Method of variation of parameters, Exact differential equations and certain particular forms of equations.
Books recommended for reference:


Practical

B.Sc. (Semester III) (Total Marks- 50)

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Practicals

1. revision of practicals of Semester I and II
2. open and closing a file in SCILAB
3. Formatted output.
3. Writing, appending data into file
4. Formatted output.
7. Numerical solution of simultaneous differential equations of first degree and first order using initial values.
8. 3D graphs,

Semester IV
Paper – 241  Real Analysis and Partial Differential Equation

There will be 2 descriptive questions from each unit containing equal marks (total 10 questions).

Students have to be attempt 5 questions by taking one question from each unit.

UNIT-I

Unit II
Rolle’s theorem, Lagrange’s and Cauchy’s mean value theorems and their geometrical interpretations. Taylor’s theorem with various forms of remainders. Darboux’ s intermediate value theorem for derivatives.
UNIT -III
Improper integrals and their convergence comparison tests. Abel’s and Dirichlet’s tests.

Unit IV

UNIT-V

Books recommended for reference :-
5. Hari Kishan, Real Analysis, Pragati Prakashan Meerut.

**Paper- II Mechanics**

**UNIT-I**
Analytical Conditions of equilibrium of a rigid body under coplanar forces. Friction.

**UNIT-II**
Center of Gravity, Common Catenary

**UNIT-III**
Velocity and acceleration along radial and transverse directions and along tangential and normal directions. Projectiles : Motion on horizontal and inclined planes.

**UNIT-IV**
Rectilinear motion in a resisting medium: .Simple harmonic motion. Motion under repulsion varying as the distance from a point, motion under inverse square law. Hooke’s Law, Motion under Horizontal and vertical elastic strings.

**UNIT-V**
Constrained Motion- Circular and Cycloidal.

एकाइ १
अनेक समतलीय बलों के अन्तर्गत एक पिण्ड की साम्यावस्था की विश्लेषणात्मक शास, घर्षण।
एकाइ— II
गुरुत्व केन्द्र, साधारण कैटेनरी
एकाइ— III
अरीय एवं अनुप्रस्थ दिशा में तथा स्फंद रेखा एवं असिलम्ब की दिशा में वेग एवं त्वरण, प्रक्षेप, क्षेत्रित तथा नत तलों पर गति।
Books recommended for reference :-

Practical

B.Sc. (SEM-IV) (Total Marks- 50)

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List of Practicals for B.Sc. semester IV

Name of Practicals
1. Revision of practicals of Semester III
2. introduction of XCOS applications in Physics viz. LCR circuits projectiles etc., solutions of ordinary differential equations up to II order different types of outputs(scopes).
3. Numerical solution of Partial differential equations (first degree and first order) Using Xcos

### Scheme of Examinations 2018 and onward

**Bachelor of Science (B.Sc.)**
(Mathematics Group)
*Subject Combination: Chemistry, Mathematics, Physics (CMP)*

**B.Sc. 3rd Year - Fifth and Sixth Semesters**

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| 3rd Year | Paper-6.1 | CHEM-351 | Chemistry-I | 3 | 3 | 3 | 3 | 60 | 24 | 75 | 30 |
| VI Semester | Paper-6.2 | CHEM-362 | Chemistry-II | 3 | 3 | 3 | 3 | 60 | 24 | 75 | 30 |
|          | Paper-6.3 | CHEM-363 | Chemistry Practical | 6 | - | 4 | 2 | -- | -- | 50 | 25 |
|          | Paper-6.4 | MATH-361 | Mathematics-I | 3 | 3 | 3 | 3 | 60 | 24 | 75 | 30 |
|          | Paper-6.5 | MATH-362 | Mathematics-II | 3 | 3 | 3 | 3 | 60 | 24 | 75 | 30 |
|          | Paper-6.6 | MATH-363 | Mathematics Practical | 6 | - | 4 | 2 | -- | -- | 50 | 25 |
|          | Paper-6.7 | PHY-361 | Physics-I | 3 | 4 | 4 | 2 | -- | -- | 50 | 25 |
|          | Paper-6.8 | PHY-362 | Physics-II | 3 | 3 | 4 | 2 | -- | -- | 50 | 25 |
|          | Paper-6.9 | PHY-363 | Physics Practical | 6 | - | 4 | 2 | -- | -- | 50 | 25 |
|          | Total (VI Semester) | | | 36 | 30 | 24 | | 510 | 219 | 600 | 195 |
Semester – V
Paper - I
LINEAR ALGEBRA AND COMPLEX ANALYSIS

The Question paper shell be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks ).

Students have to be attempt 5 questions by taking one question from each unit.

Unit I
Definition and examples of a vector space, Subspace of a vector space,

Unit II
Linear combination and Linear span, Linear dependence and independence of vectors, direct sums of subspaces.

Unit III
Basis and dimension of finitely generated spaces. Quotient space,

Unit IV
Linear transformation, Rank and nullity of linear transformation.

Unit V

इकाई— I (रेखीक बीजावली)
सदिश समष्टि (परिभाषा एवं उदाहरण), उपसदिश समष्टि

इकाई—II (रेखीक बीजावली)
, सदिशों का एकघात संचय, एकघात विस्तृति , रेखीक आश्रितता, रेखीक स्वतंत्रता, उपसमष्टियों का डाइरेक्ट योग।

इकाई—III (रेखीक बीजावली)
परिमित समष्टि के आधार एवं विमा, विमाग समष्टि
References:
1. Shanti Narayan: A course of Mathematical Analysis, S.Chand & Co., New Delhi
3. Mullick, Arora: Mathematical Analysis, New Age Publications Delhi
5. I. N. Herstien, Topics in Linear Algebra, Wiley Eastern.
6. S. Lang, Linear Algebra

Paper II
C-Programming and Linear programming Problems

The Question paper shall be divided into 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to attempt 5 questions by taking one question from each unit.

Unit I
Principles of C Programming: Algorithms, Flowcharts, Constants, Variables, Data type, Declaration of storage class, assigning values of variables, symbolic constant. Operators and Expressions. Common I/O operators decision making, branching and loops: if, if-else, Nested if-else, WHILE, DO, for loop, while statement, switch-case statement.

Unit – II

Array: One dimensional, Two dimensional. Initialization of two dimensional arrays.

User defined function in C: function declaration, calling a function, Category of function, nesting of functions recursion, Pointers.

Unit III


Unit IV


Unit V

List of Practicals for B.A./B.Sc. (Pt.-III)

List of Practicals:

- Types of declarations, Use of if-else and nested if-else ladder, for loop, do-while loop, switch-case-beak
- 1. To solve the quadratic Equation.
- 2. Evaluation of Binomial Coefficients Using do and while loops
- 3. To print a grouped frequency table using switch case statements.
- 4. To find minimum cost of operation which consists two components using Break and continue statements.
- 5. To Calculate the average of numbers.
- 6. To show a matrix using array.
- 7. To sort a list and calculate its median using array, If - then - else.
8. To find the Area of curve using trapezoidal rule.
9. To copy one string into another string.
10. To form a grouped frequency table using array and for loop.
14. To calculate the standard deviation of given data using array, If and break statements.
15. Introduction of pointers.
16. To open a file and appending using pointers.

Semester VI
Paper - I Mathematical Statistics

The Question paper shell be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks).

Students have to be attempt 5 questions by taking one question from each unit.

NOTE : Non programmable Scientific Calculator is allowed in this paper

Unit I
Random experiment. Sample space, Event, Types of events, Probability and Conditional probability of an event. Independent events, Theorems of compound and total probabilities, Baye’s Theorem and its simple applications.

Unit II
Central moments, First four central moments in terms of raw moments and vise-versa. Karl-Pearson’s Beta and Gamma coefficients. Measure of skewness and kurtosis.

Unit III
Random variable, discrete and continuous random variables, Probability distribution of a discrete random variable, Probability density function of a continuous random variable. Distribution functions,

Unit IV
Mathematical expectation of a random variable and of a function of random variable, Moments and Moment generating function, Cumulant generating function and cumulants, Characteristic functions.

Unit V
Discrete and continuous distributions with properties: Bernoulli, Binomial, Poisson and Normal,
Semester VI

Paper - II - NUMERICAL ANALYSIS

The Question paper shell be divided in to 5 units and 2 descriptive questions from each unit containing equal marks (total 10 questions of equal marks ).

Students have to be attempt 5 questions by taking one question from each unit.

Unit - I

Operators : forward difference , backward difference, Shift E, Inverse shift E , Differentiation D, Central -Difference , Mean difference , Central sum , Divided difference, Inter relation between various operators, Forward and backward difference table. Factorials notation.

Unit - II

Interpolation with equal and unequal intervals, Central difference(Gauss’s forward, backward,sterling and ,bassel’s formulae)and interpolation, inverse interpolation.

Unit – III

Numerical Differentiation : differentiation of formulae for equal ,unequal differences and central difference formulae and their applications.

Unit IV

Unit - V

Solution of ordinary differential equations: Picard’s method and Euler’s method.

**Book Recommended:**


**REFERENCES:**

1. SAXENA H.C. - FINITE DIFFERENCE AND NUMERICAL ANALYSIS  S.CHAND AND COMPANY
Practicals
1. Solving problems related to statistics (mean, mode, s.d., median)
2. User defined functions.
3. Introduction of Structures and union
4. Fitting binomial, normal and poisson distributions
5. s.d., covariance, correlation. Using SCILAB.
6. Solving LP Problems Using SCILAB.