Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

BoS in Mathematics

Syllabus for

B.Sc.-I (Mathematics)

CBCS Pattern

Semester Pattern

w.e.f. 2022-2023

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
BoS in Mathematics

1. **Introduction:**

   The courses for the UG Programme are framed using time tested and internationally popular text books so that the courses are at par with the courses offered by any other reputed universities around the world.

   Only those concepts that can be introduced at the UG level are selected and instead of cramming the course with too many ideas the stress is given in doing the selected concepts rigorously. The idea is to make learning mathematics meaningful and an enjoyable activity rather than acquiring manipulative skills and reducing the whole thing an exercise in using thumb rules.

   As learning Mathematics is doing Mathematics, to this end, some activities are prescribed to increase student's participation in learning. Duration of the degree Programme shall be six semesters distributed in a period of three academic years.

2. **Title of the Course: B.Sc. (Mathematics)**

3. **Objectives of the Course:**

   Successful Mathematics students of this institute will gain lifelong skills, including following:

   ➢ To develop their mathematical knowledge and oral, written and practical skills in a way which encourages confidence and provides satisfaction and enjoyment.

   ➢ The development of their mathematical knowledge.

   ➢ Confidence by developing a feel for numbers, patterns and relationships.

   ➢ An ability to consider and solve problems and present and interpret results.

   ➢ Communication and reason using mathematical concepts.

   ➢ To develop an understanding of mathematical principles.

   ➢ To develop the abilities to reason logically, to classify, to generalize and to prove.

   ➢ To acquire a foundation appropriate to their further study of mathematics and of other disciplines.

4. Advantages of the Course:

Student will be getting highly motivated for higher studies in reputed institutes like IIT's, NIIT's, IISc's, CMI, HRI etc...

5. Duration of the Course:	Three years
6. Eligibility of the Course:	**For B.Sc. I :**12th Science with Mathematics
7. Strength of the Students:	60
8. Fees for Course:	As per UGC/University/College rules.
9. Period of the Course:	As per UGC/University/College rules
10. Admission / Selection procedure:	As per UGC/University/College rules
11. Teacher's qualifications:	As per UGC/University/College rules
12. Standard of Passing:	As per UGC/University/College rules

13. Nature of question paper with

   scheme of marking: As per UGC/University/College rules

14. List of books recommended: Included in syllabus

15. List of Laboratory Equipment's,

Instruments, Measurements etc.:   MATLAB /LATEX/R/Python Software with one computer Lab with 20 pcs

16. Rules and regulations and ordinance

   if any: As per UGC/University/College rules

17. Medium of the language:	English
18. Structure of the Course:	Attached as Annexure 'A'

19. Allotment of workload

   (Theory/Practical):   Attached as Annexure 'A'

20. Staffing pattern:	As per UGC/University/College rules.
21. Intake capacity of students:	As per UGC/University/College rules
22. Paper duration:	Each theory paper is of 30 clock hours having 40 lectures of duration 45 minutes
23. To be introduced from:	**B.Sc. I (CBCS) from June 2022.**

Chairman

Board of Studies Mathematics

(Dr. M. S. Wavare)

List of BoS Member (2021-2024)

1. Dr. Bhalchandra D. Karande (VC Nominee)

   HoD

   Department of Mathematics,

   Maharashtra Udaygiri Mahavidyalaya,Udaygiri Dist. Latur

2. Dr. S D Kendre (Subject Expert)

   Department of Mathematics,

   Savitribai Phule Pune University, Pune

3. Dr. M T Gophane (Subject Expert)

   Department of Mathematics

   Shivaji University, Kolhapur.

4. Dr. Nitin S Darkunde, (co-option)

   School of Mathematical Sciences, S R T M U Nanded

5. Dr. A A Yadav (Other members of the staff of the same faculty.)

   R S M, Latur

6. Prof. S M Shinde (Student Alumni)

   Government College of Engineering, Amravati, Dist. Amaravati

7. Mr. S. S. Ranmal (Industry Expert)

   Sungrace Computers Pvt Ltd, Pune

8. Prof. Nishank S. Pimple

   Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

9. Mr. Vishnu R. Sonwane

   Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

10. Miss. Shivkanya D. Shinde

    Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

11. Mr. Shubham B. Khose

    Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Program Outcomes:

On Successful UG Mathematics students of this institute will gain lifelong skills, including following:

➢ To develop their mathematical knowledge and oral, written and practical skills in a way which encourages confidence and provides satisfaction and enjoyment.

➢ Confidence by developing a feel for numbers, patterns and relationships.

➢ An ability to consider and solve problems and present and interpret results.

➢ Communication and reason using mathematical concepts.

➢ To understanding of mathematical principles and their applications.

➢ To develop the abilities to reason logically, to classify, to generalize and to prove.

➢ To acquire a foundation appropriate to their further study of mathematics and of other disciplines.

➢ They Can qualify IIT-JAM entrance in the subject of Mathematics.

➢ They will get admitted to ranked institute in India.

➢ They can do minor research in the field of Mathematics.

➢ They can solve problems independently.

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Department of Mathematics

B.Sc. I (Mathematics)Semester I

Curriculum Structure with effect from June, 2022

Course Code	Paper No	Title of the course	Lectures/ Week	Marks (50)		Credits
				In Sem	End Sem	
U-MAT-138	Paper-I	Core Course: Algebra	04	20	30	02
U-MAT-139	Paper-II	Core Course: Calculus	04	20	30	02
U-MAT-140	Laboratory Course -I	Core Course: Basics of MATLAB	03	20	30	01
		Total Credits				05

B.Sc. I (Mathematics) Semester II

Course Code	Paper No	Title of the course	Lectures/ Week	Marks (50)		Credits
				In Sem	End Sem	
U-MAT-239	Paper-III	Core Course: Analytical Geometry	04	20	30	02
U-MAT-240	Paper-IV	Core Course: Integral Calculus	04	20	30	02
U-MAT-241	Laboratory Course -II	Core Course: Algebra Using MATLAB	03	20	30	01
		Total Credits				05

B. Sc. – I [Mathematics] Semester I

Course Code: U-MAT-138

Paper-I

Algebra

Learning Objectives:

➢ Set, Relations and types of function

➢ Euclidian algorithm and Properties of congruence's

➢ Determinants, Cofactor, Minor Adjoint of matrix of square Matrix.

➢ Solutions to linear systems

➢ Applications of Caley Hamilton theorem.

Course Outcomes:

After successful completion of this course students can able to

❖ **Sort one-one, onto, into, many one types of functions**

❖ **Apply induction principle**

❖ **Apply Division Algorithm**

❖ **Handle Elementary linear algebra**

Unit I   Sets Relations and Functions   [12 Lectures]

Sets, Relations, Equivalence relations, Equivalence classes and partitions of set Functions, Basic terminology, Types of Functions, Inverse of a Function, Composition of Functions (Excluding theorems only examples).

Unit II   Elementary number theory   [12 Lectures]

Mathematical Induction, Well Ordering Principle, Archimedean Property, The Binomial theorem, Pascal's triangle. The Division Algorithm, the Greatest Common Divisor, the Euclidean Algorithm, Basic Properties of Congruences

Unit III   Rank of Matrix   [10 Lectures]

Minor of order k, Rank of Matrix, Elementary Rows, column operations, Elementary operations, Inverse of elementary operations. Equivalent Matrices, Row – Echelon Matrix row rank and column rank of a matrix.

Unit IV   System of Linear Equations   [11 Lectures]

Linear equations, equivalent system, system of homogeneous and non-homogeneous equations, Characteristic Roots & Caley Hamilton theorem (Statement only)

Recommended Book:

1. A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House

2. Elementary Number Theory, Sixth Edition David M. Burton, Tata McGraw – Hill Publishing Company Limited.

3. Topics in Algebra By Om. P. Chug, K. Prakash, A.D.Gupta Anmol Pub., Pvt Ltd New Delhi.

Reference Books:

1) A text books of matrices, By Shanti Narayan (S. Chand & Company Ltd) Ram Nagar, New Delhi 11055

2) Theory and Problems of linear Algebra, third edition by Seymor Lipschut z (Tata McGraw Hill)

3) Matrix & Linear Algebra by K.B. Datta, DHI Pub.

4) An Introduction to theory of numbers 5th Edition John Wiley & Sons By I. Niven, H. Zuckerman V.H.L. Mantgomery.

5) Introduction to analytical number theory by T.M.Apstol Springer Verlang,New York.

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Course Code: U-MAT-139

Paper-II

Calculus I

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Learning Objectives:

- Least upper bound axiom of R and its consequences

- Concepts of limit and Continuity through $\in - \delta$ notations

- Relation between continuity and uniform continuity

- Mean Value theorem and its applications.

Course Outcomes

After successful completion of this course students can able to

- Find limit points, interior points, exterior points, boundary points of sets

- Find LUB, GLB apply the definition of limit and continuity.

- Handle the problems on Continuity as well as uniform Continuity

- Apply Mean Value Theorems

Unit I: The Real Numbers: [13 lectures]

The Real numbers system: Introduction, R as complete order field Bounded and unbounded sets Supermom, Infimum, order completeness of R, Absolute Value of a Real Number, Limit points of a set, open and Closed sets: Closure of a set, Interior and exterior of a set, countable and uncountable sets.

Unit II: Real Functions, Limit and Continuity [14 lectures]

Algebraic operations on functions, bounded and unbounded functions, limit of a function, algebra of limits, one sided limit, limits at infinity and infinite limit's Continuous function discontinuity of a function, algebra of continuous function, Cauchy's criterion for finite limits, properties of functions continuous in closed finite intervals, Uniform continuity.

Unit III: The Derivatives [10 lectures]

Derivability of a function, Algebra of derivatives, geometrical meaning of derivative, sign of derivative at a point, Darboux's theorem,

Unit IV: Mean Value Theorems [08 lectures]

Rolle's Mean value theorem, Lagrange's mean value theorem. Increasing and decreasing functions, monotonic functions, Cauchy's mean value theorem, generalized mean value theorem.

Recommended Book:

1. Elements of Real Analysis, By Shanti Narayan and M.D. Raisinghania. (Revised edition) S. Chand and company Ltd.

References Books:

1. Introduction to Real Analysis by Robert G. Bartle and Donald R.Sherbert, Third Edition, John Wiley and Sons, 2002

2. A Course in Calculus and Analysis By Sudhir Ghorpade and Balmohan Limaye, Springer 2006.

3. Principles of Mathematical Analysis, W. Rudin, Third Edition, Mc Graw Hill, 1976

4. Real Analysis by N. P. Bali Golden math series

5. Mathematical Analysis by S.C. Malik & Savita Arrora S. Chand and company Ltd. (Second Edition)

6. Mathematical analysis and applications by J V. Deshpande, Narosa publishing House.

Course Code: U-MAT-140

Laboratory Course-I

Basics of MATLAB

Learning Objectives

➢ Introduction of MATLAB

➢ Symbolic calculations using MATLAB

➢ Matrix and Array Operations

➢ Plotting of Graphs

Course Outcomes

After successful completion of this course students can able to

➢ Perform basic MATLAB commands.

➢ Arithmetic Operations of Arrays

➢ plot 2-D graphics

➢ do various styling options in 2-D plots

Section I. MATLAB Introduction:

What is MATLAB? , Symbolic calculations , MATLAB run on my Computer ,Basics of MATLAB , MATLAB Windows , On-line help , Input-output , File types Platform dependence , General commands Matrices and Vectors : Input , Indexing (or subtracting) ,Matrix manipulation , Creating Vectors , Matrix and Array Operations : Arithmetic operations ,Relational operations ,Logical operations , Elementary math functions , Matrix functions ,Character string Array operations : Vectorization ,Inline functions , Anonymous functions

Section II. Plotting of 2-D Graphs

Plotting Simple graphs: Basic 2-D Plots, Style options, Labels, title, legend, and text objects, Axis control, zoom in and zoom out, modifying plots with the plot editor, overlay   plots, specialized 2-D plots, Using subplot for Multiple Graphs.

Note:

➢ Record book consisting set of 16 problems (08 from section 1 and 08 from section 2)

➢ Practical Examination will be held on at the end of first semester.

➢ List of Practical's is enclosed separately.

Recommended Book:

1) **Getting Started with MATLAB 7. - Rudra Pratap, Oxford University Press**

U-MAT-140
List of Practical's

Section I: MATLAB Introduction

1. To do simple arithmetic calculations
2. To calculate Exponential and logarithms
3. To calculate values of Trigonometric function
4. Creating and working with arrays of numbers
5. To use the trigonometric functions with array arguments
6. To find sum of Geometric series
7. To compute dot product of vectors
8. To compute cross product of vectors
9. To compute box and vector triple product
10. To Compute angle between two vectors
11. To calculate interest of your money

Section I: Symbolic Mathematics, Calculus, Plotting of Graphs

1. To define the function using variable as symbol
2. To find out left and right limit of a given function
3. To find limit of a function
4. To find derivative of a function
5. To find integration when limits are not given
6. To find integration when limits are given
7. To find values of Beta and Gamma functions
8. To find roots of equation
9. Simple 2-D plots
10. Plotting with function fplot, ezplot
11. Multiple plotting in one window

B. Sc. – I [Mathematics] Semester II
Course Code: U-MAT-239
Paper-III
Analytical Geometry

Learning Objectives:

- Shift of origin concept, Equation of the locus
- Geometrical Interpretation of first-degree equation in three variables
- Symmetric and unsymmetrical form of a line
- Equations of a Sphere, Cone, Right circular cone, Cylinder and right
- Circular Cylinder.

Course Outcomes

After successful completion of this course students can able to

- Study Geometry of two dimensions
- Analyze geometry of two dimensions
- Find angle between two spheres
- Distinguish equations of different types of conics

Unit I: Analytical Geometry of Two Dimensions   **[12 Lectures]**

Change of axes: translation and rotation. Conic Sections: General equation of second degree in two variables. Reduction to standard form. Centre of conic. Nature of conic.

Unit II: **The Plane**   **[12 Lectures]**

The plane: First degree equation, converse, transformation to normal form, plane under given condition, system of planes, length of perpendicular from a point

Unit III: **The Right Line**   **[11 Lectures]**

Right line: equation of line, line through a point and given direction, line through two points, Angle between line and plane, conditions to lie in plane, coplanar lines, number of constants in equation of line, shortest distance.

Unit IV: Sphere, Cones and Cylinder   **[10 Lectures]**

The sphere: Equation of a sphere, general equation, plane section of sphere, intersection of two sphere, sphere with given diameter, equations of a circle, sphere through given circle, intersection of a sphere and a line, equation of tangent plane, Angle between two spheres, conditions of orthogonality

Cones and Cylinders: Cone, equation of cone, right circular cone and equation, Cylinder and its equation.

Recommended Books:

1. Analytical Geometry of Two and Three Dimensions, Qazi Zameeruddin;(Narosa Publ.)

2. Analytical Solid Geometry, By Shanti Narayan, S. Chand and Co.

Reference Books:

1) Text Book on Coordinate Geometry, By Gorakh Prasad, H.C. Gupta. Pothishala Pvt. Ltd.
2) Lectures on Vector Analysis and Geometry, By T.M. Karade and M.S. Bendre.
3) A text book of Analytical Geometry of two dimensions, By P.K Jain and Khalil Ahmed, (Wiley Eastern Ltd, 1994)
4) A text book of Analytical Geometry of three dimensions, By P. K Jain and Khalil Ahmed, (Wiley Eastern Ltd, 1999.)
5) Analytical Solid Geometry by Shantinarayan.

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Course Code: U-MAT-240

Paper-IV

Integral Calculus

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Learning Objectives

➢ To Know about Upper and Lower Darboux's sums

➢ To know Geometrical Interpretation of Riemann Upper and Lower Integral.

➢ To know the conditions of Riemann Inerrability.

➢ Different types of bounded integrable functions.

➢ Fundamental Theorem of Integral Calculus

➢ To solve Improper Integral with finite and unbounded range.

➢ Beta and Gamma functions as a application of Improper Integral.

Course Outcomes:

After successful completion of this course students can able to

➢ Students can learn integration through infinite sum.

➢ They can solve improper integral of any kind using the known methods

➢ Applications of fundamental theorem of calculus

➢ Solving beta and gamma functions

Unit I Riemann Integration   [12 Lectures]

Introduction, Partition of a closed interval, Norm of partition, upper and lower Darboux's sums, oscillatory sum, upper and lower Riemann integrals, Riemann integrals, Darboux's theorem, Necessary and sufficient condition of Integrability (only statement)

Unit II Classes and Properties of   Riemann Integral   [10 Lectures]

Some classes of bounded integrable functions. Riemann sum integral as the limit of sum, examples using Riemann sum, Properties of Riemann Integral and First Fundamental Theorem of Integral Calculus (only statement).

Unit III Improper integrals   **[13 Lectures]**

Finite and infinite intervals, bounded functions, proper integral, improper integral, improper integral as the limit of proper integral, test of convergence of at x=a, general test for convergence, Cauchy's test, absolute convergent.

Unit IV Beta and Gamma functions   **[10 Lectures]**

Beta functions, convergence of Beta functions, properties of beta function, Gamma function, convergence of gamma functions, recurrence formula for gamma function, relation between beta and gamma functions (only statements), and duplication formula.

Recommended Book:

1. Real Analysis by N.P. Bali Golden Math's Series

Reference Books:

1) Introduction to real analysis by Robert G. Bartle, Donald R Sherbert Third edition John wiley & sons' publications.

2) Advanced Engineering Mathematics by H.K. Das S. Chand and company ltd.

3) Elements of real analysis by Shanti Narayan &M.D.Raisinghania ,revised edition S.Chand and company Ltd

4) Mathematical Analysis by S.C.Malik& Savita ArroraS.Chand and company ltd.

5) Methods of Real Analysis by R.R.Goldberg

6) Mathematical analysis and applications by J .V.Deshpande, Narosa publishing House.

7) Advanced Calculus by David Widder

8) Lectures on Analysis By T.M.Karade, J.N.Salunke, K.S.Adhav, M.S.Bendre (Sonu Nilu Publication)

Course Code: U-MAT-241
Laboratory Course-II
Algebra using MATLAB

Learning Objectives:

➢ Introduction MATLAB with input-output files types.

➢ MATLAB programming using M-files

➢ MATLAB in Elementary Number Theory.

➢ Matrix Algebra Using MATLAB.

Course Outcomes

After successful completion of this course students can able to

➢ Apply MATLAB for elementary number theory problem.

➢ Write program code in MATLAB for matrix algebra

➢ Compute Eigen values of Matrix

➢ Find rank, determinant, inverse, etc. of Matrix

Section – I   Elementary Algebra

MATLAB Programming language in functions, Graphics, Computations external interface and tool boxes

Basics of MATLAB: MATLAB windows, desktop command window, workspace figure and editor windows input-output file types.

Using MATLAB code

1) Finding remainder after division.

2) Integer division with rounding option.

3) Return row vector containing the prime factors of n.

4) Factorial function.

5) Greatest common divisor and Least common multiple.

6) Binomial coefficients or all Combinations and Permutations

7) General list of prime numbers.

8) Complex numbers its arithmetic operations, Modulus and Argument.

Section – II   Matrix Algebra:

Arrays & Matrices, determinant, transpose, rank, reduced row echelon,

Trace, linear equation, eigen values, characteristic polynomial.

Recommended Book:

1. **Getting Started with MATLAB 7. - Rudra Pratap, Oxford University Press**

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Course Code: U-MAT-241

Laboratory Course-II

Algebra using MATLAB

List of Practical's

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Section – I Elementary Algebra

1. Finding remainder after division.

2. To round off a given number

3. To find factorial of given number

4. To find prime factors of given numbers

5. To find greatest common divisor

6. To find Least common multiple

7. To generate integer m and n such that gcd(a,b)=ma+nb

8. To find binomial coefficients i.e. Pascal triangle

9. To generate the list of prime numbers

10. To study complex numbers and its arithmetic operations.

11. To find modulus and argument of given complex numbers

Section – II Matrix Algebra

1. To input row, column or any order matrix

2. To pick out any entry of given matrix

3. To input zero matrix, matrix with all entries equal of any order

4. To enter identity matrix of any order

5. To check singularity and non-singularity of a given square matrix

6. To find row reduced echelon form

7. To find rank of matrix

8. To find trace of matrix

9. To solve given system of linear equations

10. To find Characteristic polynomial of a square matrix

11. To find eigen values and eigen vectors of a square matrix.