**Enclosure - III**

**Yogi Divine Society inspired,**
**Sarvodaya Kelavani Samaj managed**

**Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot**

**(Autonomous)**

**Affiliated to Saurashtra University, Rajkot**

Re-Accredited at 'A' Level by NAAC
STAR college Scheme & Status by MST-DBT
UGC- College with Potential for Excellence (CPE)
UGC-DDU KAUSHAL Kendra
GAAA – Highest Grade A-1 by KCG, Government of Gujarat
GPCB-Government of Gujarat approved Environment Audit Center
UGC-Autonomous College

# DEPARTMENT OF MATHEMATICS

## SYLLABI FOR THE COURSES OF THE 3RD & 4TH SEMESTERS OF

# 5 Year Integrated B.Sc. - M.Sc. Mathematics

# Integrated B.Sc. - M.Sc. Mathematics

| Semester – III | | | |
|---|---|---|---|
| **16IMTCC09** | **CORE 5: REAL ANALYSIS** | **5hrs/week** | **5Credits** |

**Objectives:-**

Upon completion of the course students will be able to

1. Define and utilize the sequence, Understand bounded sequence, convergence sequence. State and prove Bolzano-Weierstrass Theorem.
2. Define series of positive terms, Choose and apply tests for convergence of series including p-test, Comparison test, Cauchy's Root test, D'Alembert's Ratio test, Logarithmic Test, Raabe's test, Integral Test.
3. Define and analyse Partitions and Riemann sums. Understand Upper and lower R-integrals, R-integrability, Properties of R-integrable function.
4. State, prove and apply the Fundamental theorem of integral calculus and Mean value theorem of integral calculus.

**Unit 1: Sequences** **(12 Hrs )**

- Definition of a sequence
- Bounded sequences.
- Convergence of a sequence.
- Limit point of a sequence.
- Limits Inferior and Superior.
- Bolzano-Weierstrass Theorem.
- Convergent sequences.

**Unit 2: Sequences [contd...]** **(12 Hrs )**

- Cauchy's sequence.
- General principle of convergence of sequence.
- Algebra of sequences.
- Subsequence.
- Monotonic sequences.
- Some important sequences including $\left\{\sqrt[n]{n}\right\}; \left\{\frac{a_1 + a_2 + \ldots + a_n}{n}\right\}$

**Unit 3: Infinite Series** **(12 Hrs )**

- Series of non-negative terms.
- Geometric series, p-test.
- Comparison test.
- Cauchy's Root test.
- D'Alembert's Ratio test.
- Raabe's test.
- Logarithmic Test.
- Integral Test.
- Alternating series.
- Absolute and conditional convergence.

- Convergence of power series.

**Unit 4: Riemann Integral: (12 Hrs )**

- Partitions and Riemann sums.
- Upper and lower R-integrals.
- R-integrability.
- The integral as limit.
- Some classes of integrable functions.
- Properties of R-integrable function.
- Statement of Darboux's theorem.

**Unit 5: Fundamental and Mean value theorem of integral calculus (12 Hrs )**

- Continuity.
- Derivability of the integral functions.
- Fundamental theorem of integral calculus.
- Mean value theorem of integral calculus.

**TEXT BOOKS: -**


1. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International(P) Ltd, Publishers, 2nd Edition.
2. S. C. Malik, Principles of Real Analysis, New Age International (P) Ltd, Publishers, 2nd Edition.


**REFERENCE BOOKS:-**


1. Shantinarayan, A course of Mathematical Analysis, S. Chand & Sons.
2. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Walter Rudin, Principle of Mathematical Analysis, MC Graw-Hill Book & Company, 2nd Edition.
4. Gerald G. Bilodeau, Paul R. Thie and G. K. Keough. Jones and Bartlett, An Introduction to Analysis, Student edition.

| Semester – III | | | |
|---|---|---|---|
| **16IMTCC10** | **CORE 6: LINEAR ALGEBRA-I** | **4hrs/week** | **4Credits** |

## Objective:

Upon completion of the course students will be able to

1. Understand and define the concept of a vector space.
2. Understand and define the concept of linear combination and span and subspace
3. Solve the problems based on linear combination and span and subspace.
4. Understand, identify and critically analyse the linear dependence and independence of vectors, basis of a vector space, dimension of vector space.
5. Solve the problems based on linear dependence and independence of vectors, basis of a vector space, dimension of vector space.

**Unit 1: Concept of a Vector space: (10hrs)**

- Introduction of Vector space and vectors in $R^n$ & $C^n$.
- Definition of a Field.
- Definition of Vector space.
- Properties of Vector space.
- Some Standard Vector space.
- Examples of Vector space.
- Linear Combination and Span and Subspace
- Concept of Linear combination and its examples.
- Concept of Linear span and its examples
- Concept of Subspaces ,Sum and Direct sum of subspaces and their examples
- Complementary subspace, Disjoint subspace, Quotient space
- Theorem related to subspaces and Linear span.

**Unit 2: Linear Dependence and Independence of Vectors: (10 hrs)**

- Linearly dependence of vectors.
- Linearly independence of vectors.
- Theorem and Examples based on this.
- Geometrical Representation of Linearly Dependence and Independence of vectors.

**Unit 3: Basis of a Vector space: (10 hrs)**

- Basis of a vector space, Co-ordinates of vectors respect to basis.
- Existence theorem for basis.
- Invariance of the number of the elements of a basis set.
- Examples and theorem of basis.

**Unit 4: Dimension of a Vector space: (11 hrs)**

- Definition of a dimension of Vector space.
- Existence of Complementary subspace of subspace of finite dimensional vector space.
- Dimension of sum of subspaces.
- Example based on dimension.
- Theorem based on dimension.

**Unit 5: Linear Transformation: (7 hrs)**

- Concept of Linear Transformation, Zero and Identity Linear Transformation
- Properties of Linear Transformation.
- Example based on Linear Transformation
- Range space of Linear Transformation
- Nullity and rank of Linear Transformation
- Theorem and Example based on Linear Transformation

**TEXT BOOKS:**

1. V. Krishnamurthy, V.P. Mainra, & J. L. Arora, **An Introduction to Linear Algebra**, East-West Publications Pvt. Ltd.
2. H. Anton, Elementary Linear Algebra, Jhon Wiley & Sons. 10th Edition.

**REFERENCE BOOKS:**

1. S. Kumaresan, **Linear Algebra(A Geometrical Approach)**, PHI learning Pvt. Ltd. New Delhi.
2. Serge Lang, **Introduction to Linear Algebra (2nd Edition)**, Springer Publication.
3. David C. Lay, Linear Algebra & Its Applications, Addition Wesley Publishing Company.

| Semester – III | | | |
|---|---|---|---|
| **16IMTCC11** | **CORE PRACTICAL 5: REAL ANALYSIS PRACTICAL** | **6 hrs/week** | **3 Credits** |

**Objectives:-**

Upon completion of the course students will be able to

1. Understand and use Cauchy's criterion to determine convergence of a sequence.
2. Solve the problems involving concept of convergence of series using tests including p-test, Comparison test, Cauchy's Root test, D'Alembert's Ratio test and Raabe's test, Logarithmic Test, Integral Test.
3. Solve problems involving the definition of Riemann Integration, Mean value theorem of integral calculus and the limit of sum using working rule of integral.

**List of Practical**

1. Problems involving Cauchy's criterion to determine convergence of a sequence
2. Problems involving the sequence of partial sums of the series to determine convergence of a series.
3. Problems involving the concept of convergent, divergent and oscillatory series.
4. Problems involving the concept of the sum of series and its radius of convergence.
5. Problems involving the concept of the convergence of series including p-test, Comparison test, Cauchy's Root test, D'Alembert's Ratio test and Raabe's test.
6. Problems involving the concept of the convergence of series including Logarithmic Test, Integral Test, Alternating series, Absolute and conditional convergence.
7. Problems involving the concept of the convergence of series using power series.
8. Problems involving the definition of Riemann Integration.
9. Problems involving the Mean value theorem of integral calculus.
10. Problems involving the limit of sum using working rules of integral.

**TEXT BOOKS: -**


1. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International(P) Ltd, Publishers, 2nd Edition.
2. S. C. Malik, Principles of Real Analysis, New Age International (P) Ltd, Publishers, 2nd Edition.


**Note: Use of non Programmable scientific calculator is allowed for practical.**

| Semester – III | | | |
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| **16IMTCC12** | **CORE PRACTICAL 6: INTRODUCTION TO SCILAB PRACTICAL** | **4hrs/week** | **3 Credits** |

**Objectives:**

Upon completion of the course students will be able to

1. Understand the concept of open source mathematical software including SCILAB.
2. Understand and utilize the user interface of SCILAB including console, file browser, variable browser, the command history and general commands including clc & clear
3. Utilize pre-defined mathematical constants and variables, operators of Scilab, Input and utilize inbuilt matrix commands including ones(), zeros(), eye(), spac(), diag(), inv(), det(), spec().
4. Plot graphs of mathematical functions including Cartesian form, parametric form and polar forms of equations
5. Perform matrix operation including operators +, -,*, /, \, :, ^ and over-loaded operators including .+, .-,*, ./, .\, .^, in Scilab.
6. Find and analyze the sub matrices of given matrices

**List of Practical**

1. Introduction to user interface of SCILAB including console, file browser, variable browser and the command history and general commands including clc, clear, … etc .
2. Introduction and practice of usage of the pre-defined mathematical constants and variables, operators including arithmetic operators and comparison operators, complex numbers, precedence of operators .
3. Introduction and practice of creating variable names, integer and real variables. Introduction and practice of Booleans, Integers and Floating point integers. Introduction and practice of the ans variable and strings.
4. Inputting matrices including row vectors, column vectors, square matrix and rectangular matrix and processing those matrices. Inputting and utilizing inbuilt matrix commands including ones(), zeros(), eye(), spac(), diag(), inv(), det(), spec(). Practical based on matrix operation including +, -,*, /, \, :, ^ and over-loaded operators including .+, .-,*, ./, .\, .^,
5. Finding sub-matrices including the cofactors, minors, adjoint, inverse of a matrix.
6. Introduction to 2D plotting and plotting commands including linspace(), plot(), plot2D( ).
7. Plotting and plotting commands including clf( ), xlabel( ), ylabel( ), title( ) , xgrid(), legend( ), getcolor(), axis editor, scf( ) … etc.
8. Plotting of curve when equations are of in polar or parametric form.
9. Graphical solution of equations using plotting commands of Scilab.

10. Introduction to sci-notes and its interface including its toolbar and menu-bar writing and executing small Scilab scripts using sci-notes using back ground of previous practical.

**TEXT BOOKS: -**


1. Scilab Group, SCILAB REFERENCE MANUAL, On-line Documentation, INRIA Meta2 Project / ENPC Cergrene, INRIA.


**Reference Book:-**


2. Vinu V. Das, Programming in Scilab, New Age International (P) Limited, 2008
3. Domaine de Voluceau - Rocquencourt – B, INTRODUCTION TO SCILAB Consortium SCILAB, November 2010.
4. Gilberto E. Urroz, Programming with SCILAB, September 2002.
5. Tejas Sheth, SCILAB: A Practical Introduction to Programming and Problem Solving, 25 August 2016.
6. Perrine Mathieu, Philippe Roux, Scilab, from theory to practice, Scilab: I. Fundamentals, 2016, ISBN: 978-2-8227-0293-5
7. Dr. M. Affouf, Scilab by example, 2012, ISBN: 978-1479203444.


Websites:-

| | |
|---|---|
| 1. http://www.scilab.org/ | Main website of Scilab |
| 2. http://www.scilab.org/support/documentation | Official documentation of Scilab |
| 3. http://www.scilab.org/products/scilab/download | Download Scilab software |
| 4. http://help.scilab.org/docs/5.4.0/en_US/ | Help on Scilab |
| 5. http://ekalavya.it.iitb.ac.in/contents.do?topic=Scilab | IIT, Bombay portal |
| 6. http://spoken-tutorial.org/Study_Plans_Scilab/ | Spoken-tutorial |
| 7. http://scilab.in/ | Scilab India |

| Semester – IV | | | |
|---|---|---|---|
| **16IMTCC13** | **DSE-Core 7: Discrete Mathematics** | **3hrs/week** | **3Credits** |

## Objective:

Upon completion of the course students will be able to

1. Understand and utilize the fundamental concepts of Discrete Mathematics and understand and verify the different types of relations.
2. Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, and binary relations.
3. Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems.
4. Understand and apply the concepts of Boolean Algebra and it forms.

**Unit 1: Relations** **(5Hrs)**

- Different types of relations.
- Binary relations, Equivalence relations and partitions.
- Partial order relations, Posets.
- Hasse diagram.
- Lattices as posets.
- Properties of lattices.

**Unit 2: Lattices as algebraic systems** **(5 Hrs)**

- Lattices as algebraic systems.
- Sub lattices.
- Direct product of two lattices.
- Homomorphism.
- Order isomorphism of two posets.
- Isomorphic lattices.

**Unit 3: Some special Lattices** **(6 Hrs)**

- Complete lattices.
- Bounded lattices.
- Distributive lattices.
- Complemented lattices.

**Unit 4: Boolean algebra** **(12 Hrs)**

- Definition.
- Examples Boolean Algebra.
- Direct product of two Boolean Algebra.
- Homomorphism.
- Atoms of Boolean Algebra.
- Stone's representation theorem.
- The set A(x) of all atoms of Boolean Algebra and its properties.
- Isomorphism of a finite of finite Boolean Algebra and $P(A)$.

**Unit 5: Boolean expressions And Canonical forms** **(8Hrs)**

- Boolean expressions.
- Minterms.
- Maxterms.
- Sum of product Canonical form.
- Product of sum Canonical form.
- Minimization of a Boolean expression by cube array representation.
- Boolean Algebra of switches and circuits.
- Karnaugh map.

## TEXT BOOKS: -

1. J. R. Trembley and R. Manohar , Discrete Mathematical Structures with applications to computer science, Macgraw-Hill International Editions.

## REFERENCE BOOKS:-

1. L. Liu, Elements of Discrete Mathematics by Computer Science series, Macgraw-Hill International Editions, , 1986(2nd edition).
2. Vatsa, Discrete Mathematics, Vikas Publications.
3. K. D. Joshi, Foundation of Discrete Mathematics, New Age International Ltd. Publishers.
4. Dugragi, Discrete Mathematics Structure, Narora Publications.
5. J.E.Whitesitt, Boolean Algebra And its Application, Addison-Wesley Publishing Co.Inc.

| Semester – IV | | | |
|---|---|---|---|
| **16IMTCC14** | **CORE 8: LINEAR ALGEBRA-II** | **3hrs/week** | **3Credits** |

**Objectives:-**

Upon completion of the course students will be able to

1. Understand the concept and properties of linear transformation and solve the problems based on the concept of linear transformation.
2. Understand the concept of range space, nullity and rank of a linear transformation
3. Identify and classify the linear transformations based on its types including concepts of invertible, nilpotent, idempotent, reflection, projection, rotation, dilation, contraction linear transformations.
4. Understand the concept of representation of transformations by matrices, eigen value and eigen vectors of linear transformation, eigen basis and diagonalization of a linear transformation.
5. Understand the concept of inner product space, its properties and problems involving the same.
6. Define and utilize the concept of orthogonal and orthonormal vectors including orthgonal and orthonormal basis, cauchy schwartz's inequality, triangle inequality.
7. Define and utilize the Gram-Schmidt Orthogonalization and Orthonormalization Process and solve the problems based on this process.

**Unit 1: Quick review of Linear Transformation (8 hrs)**

- One –to-One and Onto Linear Transformation
- Concept of Singular and Non-singular Linear Transformation
- Concept of Linear Operator, Invertible, Nilpotent, Idempotent Linear transformations
- Types of Linear Operators(Reflection ,Projection, Rotation, Dilation, Contraction)
- Algebra of Linear Transformations
- Example and Theorems.

**Unit 2: Representation of Transformations by Matrices : (7 hrs)**

- Concept of Linear functional , Dual of a vector space
- Adjoint of a Linear Transformation
- Eigen value and Eigen vectors of Linear Transformation
- Eigen basis and Diagonalization of a Linear Transformation

**Unit 3:Important Topics on Linear Transformation (8 hrs)**

- Change of Basis(Transition) Matrix
- Similarity of Linear Transformation
- Triangularization of Linear Transformation.
- Theorems and Example

**Unit 4: Inner Product Space: (6 hrs)**

- Concept of Inner Product Space , Properties and their examples
- Concept of Euclidean space , Unitary space and Unit vector
- Norm of a vector and their Properties
- Angle and Adjoint Operator
- **Norm of a vector and their Properties**

**Unit5: Orthogonality of vectors: (7 hrs)**

- Orthogonal and Orthonormal vectors and Orthgonal and Orthonormal basis
- Cauchy Schwartz's inequality, Triangle inequality
- Gram-Schmidt Orthogonalization and Orthonormalization Process and their example
- Theorem and Example of this.
- Least Square Approximation.

**TEXT BOOKS: -**


1. V. Krishnamurthy, V.P. Mainra, & J.L. Arora , **An Introduction to Linear Algebra**, East-West Publications Pvt. Ltd.
2. H. Anton, **Elementary Linear Algebra,** Jhon Wiley & Sons. 10th Edition.


**REFERENCE BOOKS:**


1. S. Kumaresan , **Linear Algebra(A Geometrical Approach)**, PHI learning Pvt. Ltd. New Delhi.
2. Serge lang, **Introduction to Linear Algebra (2nd Edition)**, Springer Publication.
3. David C. Lay, **Linear Algebra and Its Applications,** Addition Wesley Publishing Company.
4. Seymour Lipschutz, **Linear Algebra,** Mc Graw Hill Book & Company.

| Semester –IV | | | |
|---|---|---|---|
| **16IMTCC15** | **CORE 09: COMPLEX VARIABLE** | **3hrs/week** | **3Credits** |

**OBJECTIVES:-**

Upon completion of the course students will be able to-

1. Utilize the concept of Complex Numbers , Complex plane.
2. Solve problems using the concepts and techniques of complex function theory.
3. Understand and verify the differentiability, continuity and limit of function of a complex variable.

**Unit 1: Basic Concepts (6Hrs)**

- Limit involving the point at infinity
- Continuity
- Functions of Complex Variable

**Unit 2: Properties of Complex numbers (4Hrs)**

- Addition, Subtraction, Multiplication, Division of Complex Number
- Modulus of Complex Number
- Amplitude/Argument of Complex Number
- Geometric representation of Complex Number

**Unit 3: De' Moivres Theorem (12Hrs)**

- De' Moivres Theorem And it's application
- Expantion of $\cos n\theta, \sin n\theta, \tan n\theta$ in terms of $\cos\theta, \sin\theta, \tan\theta$
- Examples using De' Moivres Theorem

**Unit 4: Differentiability And Continuity of Complex Number (10Hrs)**

- Differentiable Function of Complex variable
- Geometric Representation of Derivative
- Differentiability And Continuity
- Elementary rules of Differentiation of Complex variable function

**Unit 5: Analytic Function (4Hrs)**

- Introduction of Analytic function
- Cauchy- Riemann equation in Cartesian form

**TEXT BOOKS: -**

1. Shanti Narayan and Dr. P. K. Mittal , Theory of Functions of a Complex variable
2. Dennis G. Zill and Patrick D. Shanahan, A First Course in Complex Analysis with Applications.

**REFERENCE BOOKS:-**

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed.,McGraw – Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, *Complex Analysis,* 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

| Semester – IV | | | |
|---|---|---|---|
| **16IMTCC16** | **CORE PRACTICAL 7 : Advanced GEOGEBRA Practical** | **4hrs/wk** | **2 Credits** |

**Objectives:-**

Upon completion of the course students will be able to

1. Understand and utilize the interface of the software GeoGebra including slider tools from the tool bar.
2. Obtain the skill to draw various geometric figures including lines, functions and conics.
3. Understand the concept and usage of the slider in GeoGebra.
4. Understand and use the futures of the input bar in order to draw various graphs and utilize the input bar to enter various ready-made commands of GeoGebra.

## List of Practical

1. Advanced slider usage for problems involving Trigonometry and Geometry.
2. Advanced slider usage for problem involving Algebra and Calculus.
3. Further usage of sliders to make the figures interactive and verify theorems of Algebra, Geometry and Calculus.
4. Introduction and practice of usage of Animation in basic Geometric figures.
5. Introduction and practice of usage of Animation in Algebra, Trigonometry and Calculus.
6. Introduction to commands for Linear Algebra and its basic usage.
7. Advanced commands of input bar, advanced formatting using these commands and interactive usage these commands.
8. Introduction to construction of interactive worksheets of GeoGebra models based on mathematical concepts.
9. Practical to calculate statistical parameters including mean, median, mode and plotting bar chart, histogram etc, based on usage of spreadsheet and input bar.
10. Inserting and analysing pictures (of real life objects) and applying GeoGebra to find length, area, equation of curve, volume and other measurements.

## TEXT BOOKS: -

1. Judith Hohenwarter and Markus Hohenwarter, Introduction to GeoGebra

## REFERENCE BOOKS:-

1. Judith Hohenwarter and Markus Hohenwarter, The official manual of GeoGebra.

Gerard A. Venema, Exploring Advanced Euclidean Geometry with GeoGebra, Mathematical Association of America, ISBN-13: 978-0883857847, 2013.

| Semester – IV | | | |
|---|---|---|---|
| **16IMTCC17** | **Core Practical 8: Introduction to MAXIMA** | **6hrs/week** | **3 Credits** |

## Objectives:

Upon completion of the course students will be able to

1. Understand the user interface and components of the software MAXIMA/ wxMAXIMA.
2. Utilize the software maxima to compute derivative and integration
3. Analyze the mathematical functions using commands of Maxima.
4. Plot the 2D and 3D graphs of mathematical functions using Maxima.
5. Determine the convergence and divergence of the given sequence and series using Maxima.

## List of Practical

1. Introduction to the user interface and components of the software MAXIMA/ wxMAXIMA.
2. Introduction to the inbuilt constants variables and library functions of MAXIMA.
3. Utilizing the command for solution of linear equations, polynomial equations, system of linear equations.
4. Creating a Maxima program (simple examples).
5. Introduction to Maxima commands for calculus including commands for derivatives and nth derivatives, partial derivative, definite integration, indefinite integration, numerical integration. Maxima commands for reduction formula with or without limits.
6. Maxima commands for 2D and 3D plotting, including formatting of plotted figures.
   -Plotting of standard Cartesian curves using Maxima.
   -Plotting of standard Polar curves using Maxima.
   -Plotting of standard parametric curves using Maxima.
7. Solution of Differential equation using Maxima plotting the solution.
8. Illustration of convergent, divergent and oscillatory sequences using Maxima.
9. Maxima programs to find the sum of the series and its radius of convergence.
10. Using Cauchy's criterion to determine convergence of a sequence (simple examples).
11. Maxima programs to illustrate continuity of a function. Maxima programs to illustrate differentiability of a function and unequal left hand and right hand limits for discontinuous functions.
12. Maxima programs to verify Rolle's theorem, Lagrange's theorem and to verify Cauchy's mean value theorem and for finding Taylor's expansion of a given function.

13. Evaluation of limits by L'Hospital's rule using Maxima. Finding maxima/minima of functions of two variables.
14. Method of solving ordinary differential equations
15. Introduction to the MAXIMA commands and tools for Statistical calculation including commands for mean, median, variance, standard deviation, histogram, bar plot, pie chart etc.

**Note:** The above list may be changed annually with the approval of the BOS in UG (Mathematics). Any other mathematical software may also be used in place of Maxima.

## Text Books: -


1. Maxima 5.24.0 Manual


## Reference Books: -


1. Gurpreet Singh Tuteja, Practical Mathematics Using Maxima: An Open Source Computer Algebra System, IBH, 2010.
2. Zachary Hannan, wxMaxima for Calculus I and II, Solano Community College
3. Leon Q. Brin, Maxima (5.18.1) and the Cal ulus, 2010
4. Robert Dodier, Minimal Maxima, 2005.
5. Richard H. Rand, Introduction to Maxima, Cornell University
6. Eleftherios Gkioulekas, Introduction to Maxima, University of Texas-Pan American , Edinburg, TX, United States
7. Edwin L. Woollett, Maxima by Example, August 11, 2009.
8. Paulo Ney de Souza, Richard J. Fateman, Joel Moses The Maxima Book, Cliff Yapp, 2003.


## Websites and links:-

1. wxmaxima.sourceforge.net
2. http://sourceforge.net/projects/maxima
3. http://maxima.sourceforge.net/
4. http://en.wikipedia.org/wiki/Maxima_%28software%29
5. http://wxmaxima.sourceforge.net/wiki/index.php/Howto
6. http://math-blog.com/2007/06/04/a-10-minute-tutorial-for-solving-math- problems-with-maxima/
7. http://mathscitech.org/articles/finite-summations-2