

Syllabus

# Mathematics (Regular)

submitted to



Gauhati University

under the

Choice Based Credit System

By

Department of Mathematics

Gauhati University

## Credits allocation for the Regular courses:

<b>Course</b>	<b>*Credits</b>	<b>*Credits</b>
<b>Theory + Practical</b>	<b>Theory + Tutorial</b>	<b>Theory + Practical</b>
<b>I. Core Course (6 Credits)</b>		
<b>(12 Papers)</b>	12×4= 48	12×5=60
04 Courses from each of the 03 disciplines of choice		
<b>Core Course Practical / Tutorial*</b>		
<b>(12 Practical/Tutorials*)</b>	12×2=24	12×1=12
04 Courses from each of the 03 disciplines of choice		
<b>II. Elective Course (6 Credits)</b>		
<b>(6 Papers)</b>	6×4=24	6×5=30
Two papers from each discipline of choice including paper of interdisciplinary nature		
<b>Elective Course Practical / Tutorial*</b>	6 × 2=12	6×1=6
Two papers from each discipline of choice including paper of interdisciplinary nature		
<b>Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6<sup>th</sup> Semester</b>		
<b>III. Ability Enhancement Courses</b>		
<b>1. Ability Enhancement Compulsory Courses (AECC) (2 Papers of 4 credit each)</b>	2 × 4=8	2 × 4=8
Environmental Science		
English Communication		
<b>2. Skill Enhancement Courses (SEC) (4 Papers of 4 credit each)</b>	4 × 4=16	4× 4=16
<b>Total credit</b>	<b>132</b>	<b>132</b>

\* wherever there is a practical there will be no tutorial and vice-versa

**CBCS Course Structure for Under -Graduate BA, BSc, BCom  
Programme (Regular)  
SEMESTER WISE PLACEMENT OF THE COURSES**

Semester	Core Course (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (4)	Discipline Specific Elective (DSE) (6)
I	<b>MAT-RC-1016: Calculus</b>			
II	<b>MAT-RC-2016: Algebra</b>			
III	<b>MAT-RC-3016: Differential Equations</b>		<b>SEC-1 MAT-SE-3114: Computer Algebra Systems and Related Software</b>	
IV	<b>MAT-RC-4016: Real Analysis</b>		<b>SEC-2 MAT-SE-4114: R Programming</b>	
V			<b>SEC-3 MAT-SE-5114: Combinatorics and Graph Theory</b>	<b>DSE-1 MAT-RE-5116: Number Theory MAT-RE-5126: Discrete Mathematics</b>
VI			<b>SEC-4 MAT-SE-6114: LaTeX and HTML</b>	<b>DSE-2 MAT-RE-6116: Numerical Analysis MAT-RE-6126: Programming in C</b>

Legends:

RC: Regular Core  
SE: Skill Enhancement Course

RE: Regular Discipline Specific Elective

## **Core papers (Mathematics):**

1. MAT-RC-1016: Calculus
2. MAT-RC-2016: Algebra
3. MAT-RC-3016: Differential Equations
4. MAT-RC-4016: Real Analysis

## **Skill Enhancement Course (SEC) papers**

### **SEC-1**

MAT-SE-3014: Computer Algebra Systems and Related Software

### **SEC-2**

MAT-SE-4014: R Programming

### **SEC-3**

MAT-SE-5014: Combinatorics and Graph Theory

### **SEC-4**

MAT-SE-6014: LaTeX and HTML

## **Discipline Specific Elective (DSE) papers**

### **DSE-1 (Choose one)**

MAT-RE-5116: Number Theory

MAT-RE-5126: Discrete Mathematics

### **DSE-2 (Choose one)**

MAT-RE-6116: Numerical Analysis

MAT-RE-6126: Programming in C

**Mathematics Courses Details for the B.Sc. Programme (Regular)**  
**SEMESTER-I**  
**MAT-RC-1016: Calculus**

Total Marks: 100 (Theory 80, Internal Assessment 20)

Per week; 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

**Unit 1:** Graphs of simple concrete functions such as polynomial, Trigonometric, Inverse trigonometric, Exponential and logarithmic functions

[1] Chapter 1 (Sections 1.1 to 1.3), and Chapter 7 (Sections 7.2, 7.3, and 7.6)

**Unit 2:** Limits and continuity of a function including approach, Properties of continuous functions including Intermediate value theorem;

[2] Chapter 1

**Unit 3** Differentiability, Successive differentiation, Leibnitz theorem, Recursion formulae for higher derivatives

[2] Chapter 3 (Sections 3.2, 3.3, and 3.6), and Exercise 26, page 184.

**Unit 4** Rolle's theorem, Lagrange's mean value theorem with geometrical interpretations and simple applications, Taylor's theorem, Taylor's series and Maclaurin's series, Maclaurin's series expansion of functions such as their use in polynomial approximation and error estimation

[1] Chapter 4 (Sections 4.2, and 4.3), [2] Chapter 9 (Sections 9.8, and 9.9)

**Unit 5** Functions of two or more variables, Graphs and level curves of functions of two variables, Partial differentiation up to second order.

[2] Chapter 13 (Sections 13.1, and 13.3)

**Text book:**

1. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). *Thomas' Calculus* (13th ed). Pearson Education, Delhi. Indian Reprint 2017.

2. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi

## SEMESTER-II

### MAT-RC-2016: Algebra

Total Marks: 100 (External: 80, Internal Assessment: 20)

Per week 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

#### **Unit 1: Theory of Equations and Expansions of Trigonometric Functions:**

Fundamental Theorem of Algebra, Relation between roots and coefficients of  $n$ th degree equation, Remainder and Factor Theorem, Solutions of cubic and biquadratic equations, when some conditions on roots of the equation are given, Symmetric functions of the roots for cubic and biquadratic; De Moivre's theorem (both integral and rational index), Solutions of equations using trigonometry and De Moivre's theorem, Expansion for in terms of powers of in terms of cosine and sine of multiples of  $x$ .

[2] Chapter 3, Chapter 4 [3] Chapter 7 (Sections 7.6, and 7.7)

**Unit 2: Matrices:** Types of matrices, Rank of a matrix, Invariance of rank under elementary transformations, Reduction to normal form, Solutions of linear homogeneous and nonhomogeneous equations with number of equations and unknowns up to four; Cayley-Hamilton theorem, Characteristic roots and vectors.

[4] Chapter 3 (Sections 3.2, 3.5, 3.7, 3.9) Chapter 2 (Sections 2.1 to 2.5) Chapter 7 (Section 7.1, and Example 7.2.2)

**Unit 3: Groups, Rings and Vector Spaces:** Integers modulo  $n$ , Permutations, Groups, Subgroups, Lagrange's theorem, Euler's theorem, Symmetry Groups of a segment of a line, and regular  $n$ -gons for  $n = 3, 4, 5$  and  $6$ ; Rings and subrings in the context of  $C[0,1]$  and Definition and examples of a vector space, Subspace and its properties, Linear independence, Basis and dimension of a vector space.

[1] Chapter 1 (Section 1.4), and Chapter 2 (Section 2.3) Chapter 3 (Sections 3.1, 3.2, 3.3 and 3.6), and Chapter 5 (Section 5.1) [4] Chapter 4 (Sections 4.1, 4.3 and 4.4)

#### **Text Books:**

1. Beachy, John A., & Blair, William D. (2006). *Abstract Algebra* (3rd ed.). Wavel and Press, Inc.
2. Burnside, William Snow (1979). *The Theory of Equations*, Vol. 1 (11th ed.) S. Chand & Co. Delhi. Fourth Indian Reprint.
3. Gilbert, William J., & Vanstone, Scott A. (1993). *Classical Algebra* (3rd ed.). Waterloo Mathematics Foundation, Canada.
4. Meyer, Carl D. (2000). *Matrix Analysis and Applied Linear Algebra*. Society for Industrial and Applied Mathematics (Siam).

#### **Reference Books:**

1. Dickson, Leonard Eugene (2009). *First Course in The Theory of Equations*. The Project Gutenberg EBook (<http://www.gutenberg.org/ebooks/29785>)
2. Gilbert, William J. (2004). *Modern Algebra with Applications* (2nd ed.). Wiley Interscience, John Wiley & Sons.

**SEMESTER-III**  
**MAT-RC-3016: Differential Equations**

**Total Marks: 100** (Theory 80, Internal Assessment 20)

Per week 5 Lectures, 1 Tutorial, Credits: 6

*Each unit carry equal credit*

**Unit 1: First Order Ordinary Differential Equations**

First order exact differential equations, Integrating factors, Rules to find an integrating factor

[1] Chapter 1 (Section 1.1,1.2 1.4)

[2] Chapter 1 (Sections 1.1, and 1.2)Chapter 2 (Sections 2.1, and 2.2)

Linear equations and Bernoulli equations, Orthogonal trajectories and oblique trajectories; Basic theory of higher order linear differential equations, Wronskian, and its properties; Solving differential equation by reducing its order.

[2] Chapter 2 (Sections 2.3, and 2.4), Chapter 3 (Section 3.1), and Chapter 4 (Section 4.1)

**Unit 2: Second Order Linear Differential Equations**

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation; Simultaneous differential equations.

[1] Chapter 2 (Section 2.2)

[2] Chapter 4 (Sections 4.2, 4.3, 4.4, 4.5and 4.6) Chapter 7 (Sections 7.1, and 7.3)

**Text Books:**

1. Kreyszig, Erwin (2011). *Advanced Engineering Mathematics* (10th ed.). John Wiley & Sons, Inc. Wiley India Edition 2015.
2. Ross, Shepley L. (1984). *Differential Equations* (3rd ed.). John Wiley & Sons, Inc

**SEMESTER-IV**  
**MAT-RC-4016: Real Analysis**

Total Marks: 100 (Theory 80, Internal Assessment 20)

Per week 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

**Unit 1:** Order completeness of Real numbers, Open and closed sets, Limit of functions, Sequential criterion for limits, Algebra of limits, Properties of continuous functions, Uniform continuity.

[1] Chapter 2 (Sections 2.1, and 2.2, Sections 2.3, and 2.4) Chapter 11 (Section 11.1, Definition and Examples only)

**Unit 2:** Sequences, Convergent and Cauchy sequences, Subsequences, Limit superior and limit inferior of a bounded sequence, Monotonically increasing and decreasing sequences, Infinite series and their convergences, Positive term series, Comparison tests, Cauchy's nth root test, D'Alembert's ratio test, Raabe's test, Alternating series, Leibnitz test, Absolute and conditional convergence.

[1] Chapter 3, (Sections 3.1, and 3.2,3.3,3.4,3.5,3.7), Chapter 9 [Section 9.1(excluding grouping of series) Sections 9.2 (Statements of tests only), 9.3 (9.3.1, and 9.3.2) Chapter 4 (Sections 4.1 to 4.3).Chapter 5 (Sections 5.1, 5.3 and 5.4 excluding continuous extension and approximation)

**Text Book:**

1. Bartle, Robert G., & Sherbert, Donald R. (2015). *Introduction to Real Analysis* (4th ed.) Wiley India Edition.

**Reference Books:**

1. Ross, Kenneth A. (2013). *Elementary Analysis: The Theory of Calculus* (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian Reprint
2. Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). *An Introduction to Analysis* (2nd ed.). Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.



**SEMESTER-III**  
**MAT-RE-3116: Number Theory**

Total Marks: 100 (Theory 80, Internal assessment 20)

Per week: 5 lectures 1 Tutorial, Credits 6

*Each unit carry equal credit*

**Unit 1:** Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

[1] Chapter 2 (Section 2.5), [2] Chapter 2 (Section 2.2, 2.3), Chapter 4 (Sections 4.2, 4.4) Chapter 5:Section 5.2

**Unit 2:** Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

[1] Chapter 6 (Sections 6.1 to 6.2, 7.2M 7.3, and 7.4)

**Text Books:**

1. David M. Burton, *Elementary Number Theory*, 6th Ed., Tata McGraw Hill, Indian reprint, 2007.
2. Jones, G. A., & Jones, J. Mary. (2005). *Elementary Number Theory*. Undergraduate Mathematics Series (SUMS). First Indian Print.

**Reference Book:**

1. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.

## MAT-RE-3126: Discrete Mathematics

Total Marks: 100 (Theory 80, Internal Assessment 20)

Per week 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

### Unit 1: Ordered Sets

Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, Dual of an ordered set, Duality principle, Maximal and minimal elements, Building new ordered sets, Maps between ordered sets.

[1] Chapter 1 (Sections 1.1 to 1.5 and 1.14 to 1.26, and 1.34 to 1.36)

[3] Chapter 1 [Section 1 (1.1 to 1.3)]

### Unit 2: Lattices

Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, Examples and properties of modular and distributive lattices, The M3 – N5 Theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice. homomorphisms.

[1] Chapter 2 (Sections 2.1 to 2.19)Chapter 4 (Sections 4.1 to 4.9)(Sections 4.10, and 4.11)

[3] Chapter 1 [Section 1 (1.5 to 1.20)]Chapter 1 [Section 2 (2.1 to 2.6) Chapter 1 [Section 2 (2.7 to 2.14)]

### Unit 3: Boolean Algebras and Switching Circuits

Boolean Algebras, De Morgan's laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive normal form and conjunctive normal form, Minimal forms of Boolean polynomial, Quinn-McCluskey method, Karnaugh diagrams, Switching circuits and applications of switching circuits.

[3] Chapter 1 (Sections 3, and 4) Chapter 1 (Section 6)Chapter 2 (Sections 7, and 8).

### Text Books:

1. Davey, B. A., & Priestley, H. A. (2002). *Introduction to Lattices and Order* (2nd ed.). Cambridge University press, Cambridge
2. Goodaire, Edgar G., & Parmenter, Michael M. (2011). *Discrete Mathematics with Graph Theory* (3rd ed.). Pearson Education (Singapore) Pvt. Ltd. Indian Reprint.
3. Lidl, Rudolf & Pilz, Gunter. (2004). *Applied Abstract Algebra* (2nd ed.), Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint.

## **SEMESTER-IV**

### **MAT-RE-4116: Numerical Analysis**

Total Marks: 100 (Theory 80, Internal Assessment 20)

Per week 5 Lecture, 1 Tutorial, Credits 6

*Each unit carry equal credit*

**Unit 1:** Gaussian elimination method (with row pivoting), Gauss-Jordan method; Iterative methods: Jacobi method, Gauss-Seidel method; Interpolation: Lagrange form, Newton form, Finite difference operators, Gregory-Newton forward and backward difference interpolations, Piecewise polynomial interpolation (Linear and Quadratic).

[2] Chapter 3 (Sections 3.1, and 3.2), Chapter 6 (Sections 6.1, and 6.2) Chapter 8 (Section 8.1, Section 8.3 (8.3.1, and 8.3.2)

[3] Chapter 3 (Sections 3.2, and 3.4) Chapter 4 (Section 4.2) Chapter 4 (Sections 4.3, and 4.4)

[1] Chapter 18 (Sections 18.1 to 18.3)

**Unit 2:** Numerical differentiation: First and second order derivatives; Numerical integration: Trapezoid rule, Simpson's rule; Extrapolation methods: Richardson extrapolation, Romberg integration; Ordinary differential equation: Euler's method, Modified Euler's methods (Heun and Mid-point).

[2] Chapter 11 [Sections 11.1 (11.1.1, 11.1.2, 11.1.4), and 11.2 (11.2.1, 11.2.2, 11.2.4)]

[1] Chapter 22 (Sections 22.1, and 22.2, 22.3)

#### **Text Books:**

1. Chapra, Steven C. (2018). *Applied Numerical Methods with MATLAB for Engineers and Scientists* (4th ed.). McGraw-Hill Education.
2. Fausett, Laurene V. (2009). *Applied Numerical Analysis Using MATLAB*. Pearson. India
3. Jain, M. K., Iyengar, S. R. K., & Jain R. K. (2012). *Numerical Methods for Scientific and Engineering Computation* (6th ed.). New Age International Publishers. Delhi.

## **MAT-RE-4126: Programming in C**

Total Marks: 100 (Theory 50, Internal 20, Practical 30)

Per week: 4 Lectures, 2 Tutorials, Credits 6(4+2)

*Each unit carry equal credit*

**Unit 1:** Variables, constants, reserved words, variable declaration, initialization, basic data types, operators and expression (arithmetic, relational, logical, assignment, conditional, increment and decrement), hierarchy of operations for arithmetic operators, size of and comma operator, mixed mode operation and automatic (implicit) conversion, cast (explicit) conversion, library functions, structure of a C program, input/output functions and statements.

**Unit 2 :** Control Statements : if-else statement (including nested if-else statement), switch statement. Loop control Structures (for and nested for, while and do-while). Break, continue, go to statements, exit function.

**Unit 3 :** Arrays and subscripted variables : One and Two dimensional array declaration, accessing values in an array, initializing values in an array, sorting of numbers in an array, addition and multiplication of matrices with the help of array.

Functions : function declaration, actual and formal arguments, function prototype, calling a function by value, recursive function.

[1] Chapters 3, 4, 5, 6, 7 and 9

### **Text Book:**

1. T. Jeyapoovan, A First Course in Programming with C T. Jeyapoovan, Vikash Publishing House Pvt. Ltd.

### **Reference books:**

1. E. Balaguruswamy-Programming with C, Schaum Series.
2. Y. Kanetkar, *Let us C*, B.P. Publication.

## SEMESTER-III

### SEC-1

#### MAT-SE-3114: Computer Algebra Systems and Related Software

Total marks: 100 (Project 30, Internal assessment 20, Practical 50)

Per week: 2 Lectures, 2 Practical, Credits 4(2+2)

*Each unit carry equal credit.*

#### **Unit 1: Introduction to CAS and Applications:**

Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Plotting functions of two variables using Plot3D and Contour Plot, Plotting parametric curves surfaces, Customizing plots, Animating plots, Producing tables of values, working with piecewise defined functions, Combining graphics.

[1] Chapter 12 (Sections 12.1 to 12.5)

[2] Chapter 1, and Chapter 3 (Sections 3.1 to 3.6, and 3.8) Chapter 6 (Sections 6.2, and 6.3)

#### **Unit 2: Working with Matrices:**

Simple programming in a CAS, Working with matrices, Performing Gauss elimination, operations (transpose, determinant, inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, eigenvector and diagonalization.

[2] Chapter 7 (Sections 7.1 to 7.8)

#### **Practical:**

*List of the practical to be done using Matlab / Mathematica / Maple / Scilab / Maxima etc.*

Six practicals should be done by each student. The teacher can assign practical from the exercises from [1].

#### **Text Book:**

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.

#### **Reference Book:**

1. Martin J. Erickson and Donald Bindner, *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*, CRC Press, Boca Raton, FL, 2011.

**SEMESTER-IV**  
**SEC-2**  
**MAT-SE-4214: R Programming**

Total marks: 100 (Project 30, Internal assessment 20, Practical 50)

Per week: 2 Lectures, 2 Practical, Credits 4(2+2)

*Each unit carry equal credit.*

**Unit 1: Getting Started with R - The Statistical Programming Language**

Introducing **R**, using **R** as a calculator; Explore data and relationships in **R**; Reading and getting data into **R**: combine and scan commands, viewing named objects and removing objects from **R**, Types and structures of data items with their properties, Working with history commands, Saving work in **R**; Manipulating vectors, Data frames, Matrices and lists; Viewing objects within objects, Constructing data objects and their conversions.

[1] Chapter 14 (Sections 14.1 to 14.4)

[2] Chapter 2, Chapter 3

**Unit 2: Descriptive Statistics and Tabulation**

Summary commands: Summary statistics for vectors, Data frames, Matrices and lists; Summary tables.

[2] Chapter 4

**Unit 3: Distribution of Data**

Stem and leaf plot, Histograms, Density function and its plotting, The Shapiro-Wilk test for normality, The Kolmogorov-Smirnov test.

[2] Chapter 5

**Unit 4: Graphical Analysis with R**

Plotting in **R**: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts, Bar charts; Copy and save graphics to other applications.

[1] Chapter 14 (Section 14.7)

[2] Chapter 7

**Practical** to be done in the Computer Lab using Statistical Software R:

[1] Chapter 14 (Exercises 1 to 3)

[2] Relevant exercises of Chapters 2 to 5, and 7

**Note:** The practical may be done on the database to be downloaded from <https://data.gov.in/>

**Text books:**

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Gardener, M. (2012). *Beginning R: The Statistical Programming Language*, Wiley Publications.

**SEMESTER-V**  
**SEC-3**  
**MAT-SE-5314: Combinatorics and Graph Theory**

Total marks: 100 (Theory 80, Internal Assessment 20)

Per week: 4 Lectures, Credits 4

*Each unit carry equal credit*

**Unit 1:** Elementary combinatorics, Rules of sum and product, two models of counting, sample and distribution model of counting. Examples and solution. Integer solution of an equilateral problem.

[1] Chapter 3

**Unit 2:** Graphs, Diagraphs, Networks and subgraphs, Vertex degree, Paths and cycles, Regular and bipartite graphs, Four cube problem, Social networks, Exploring and traveling, Eulerian and Hamiltonian graphs, Applications to dominoes, Diagram tracing puzzles, Knight's tour problem, Gray codes.

[2] Chapter 1 (Section 1.1) and Chapter 2

**Text Books:**

1. C.L. Liu and [D. Mohapatra](#) Elements of discrete mathematics, Mc Graw Hill, Computer Science Series. 2017
2. Aldous, Joan M., & Wilson, Robin J. (2007). *Graphs and Applications: An Introductory Approach*. Springer. Indian Reprint.

**Reference Books:**

1. Michael Towusend, Discrete Mathematics; Applied Combinatorics and Graph Theory, Benjamin-Cummings Pub Co (March 1, 1987)
2. K.R. Parthasarathi, Basic Graph Theory, Tata McGraw-Hill, 1994.

**SEMESTER-VI**  
**SEC-4**  
**MAT-SE-6414: LaTeX and HTML(P)**

Total marks: 100 (Project 30, Internal assessment 20, Practical 50)

Per week: 2 Lectures, 2 Practicals, Credits 4(2+2)

*Each unit carry equal credit*

**Unit 1:** Elements of LaTeX; Hands-on-training of LaTeX; graphics in LaTeX; PSTricks; Beamer presentation

[1] Chapters 9,10, 11.

**Unit 2:** HTML, creating simple web pages, images and links, design of web pages.

[1] Chapter 9-11, 15

**Practical:** Six practical should be done by each student. The teacher can assign practical from the exercises from [1].

**Text Book:**

1. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.

Reference Book:

2. L. Lamport, LATEX: A Document Preparation System, User's Guide and Reference Manual. Addison-Wesley, New York, second edition, 1994



**GENERIC ELECTIVE (GE) COURSES  
OFFERED TO B.A./B.Com. Programme**

(Students who are not having Mathematics as a discipline Subject can opted for such courses)

Semester	Core Course (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (4)	Discipline Specific Elective (DSE)(4)	Generic Elective (GE) (2) Credits: 6 each
I					
II					
III					
IV					
V					<b>GE-1: MAT-RG-5016 General Mathematics-I</b>
VI					<b>GE-2: MAT-RG-6016 General Mathematics-II</b>

## SEMESTER-V

### MAT-RG-5016: General Mathematics-I

Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Per week: 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

**Unit 1: Biographies of Ancient Indian Mathematicians:** A brief introduction to the lives and information on the works of the following Mathematicians: Aryabhata, Varahamihira, Brahmagupta, Bhaskara I & II, Mahavira, Madhava, and Paramesvara.

[3] Chapters 5, 6, 7, 9, 11 and 13 for brief statements and examples on the works of the above Mathematicians.

[4] Sections 30, 31, 35, 41 to 44, 54 to 56, 59 to 61, 67 and 68 for brief introduction of the Mathematicians.

**Unit 2: Number Systems:** An overview of number systems, Algebraic and transcendental numbers with some historical background, Fundamental arithmetic operations, Rules of divisibility, Hierarchy of operations and Modular arithmetic, Euclidean algorithm, Prime numbers, The sieve of Eratosthenes, Fundamental theorem of arithmetic, Euclid's lemma, Fermat numbers, Mersenne numbers and Mersenne primes, prime testing method of Fermat, Statement and significance of the prime number theorem, Goldbach conjectures, Twin primes, Uses of prime numbers, Perfect and amicable numbers, Pythagoreans triplets and its properties, Statement and historic background of Fermat's Last Theorem, Multiplication principle, Permutation and combinations, Latin squares and magic squares.

[2] Chapter 3 (Sections 3.0, 3.1, and 3.4), and Chapter 4 (Section 4.2 up to page 128) Chapter 3 (Section 3.2) Chapter 3 (Section 3.3), and Chapter 9 (Section 9.9, pages 332 to 334). Chapter 5 (Sections 5.1 to 5.4, and 5.6 up to page 212)

**Unit 3: Matrices and Determinants:** Matrices, Basic concepts and algebraic operations, Types of matrices, Transpose of a matrix, Symmetric and skew-symmetric matrices, Matrix multiplication and its properties, Powers of square matrices, Inverse square matrix and its properties, Determinant and its properties, Expansion by rows and columns, Cofactors, Matrix singularity, Adjoint matrix and calculation of inverse, Cramer's rule.

[1] Chapter 1 (Sections 1.4, and 1.5) Chapter 2 (Section 2.4 up to Example 3, page 138), and Chapter 3 (Sections 3.1 to 3.3)

#### **Text Books:**

1. Andrilli, S., & Hecker, D. (2016). *Elementary Linear Algebra* (5th ed.). Academic Press, Elsevier India Private Limited.
2. Gulberg, Jan. (1997). *Mathematics from the Birth of Numbers*. W. W. Norton & Company.
3. Puttaswamy, T.K. (2012). *Mathematical Achievements of Pre-modern Indian Mathematicians* Elsevier Inc. USA.
4. Srinivasiengar, C. N. (1988). *The History of Ancient Indian Mathematics*. The World Press Private Ltd. Calcutta. Digitized Book (2009).

#### **Reference Book:**

1. Divakaran, P. P. (2018). *The Mathematics of India: Concepts, Methods, Connections*. Springer Singapore. Indian Print by Hindustan Book Agency, New Delhi.

## SEMESTER-VI

### MAT-RG-6016: General Mathematics – II

**Total Marks: 100** (Theory 80, Internal Assessment 20)

Per week: 5 Lectures, 1 Tutorial, Credits 6

*Each unit carry equal credit*

#### **Unit 1: Biographies of Remarkable Mathematicians:**

A brief introduction to the lives and information on the works of the following Mathematicians: Euler, Lagrange, Gauss, Cauchy, Abel, Galois, Riemann, Hardy, Noether, Ramanujan, Neumann, Wiles, and Bhargava.

[2] Pages 41, 126, 161, 207, 280, 346, and 579-580.

[4] Chapter 1 (pages 1–7), Chapter 5 (pages 182 – 189), Chapter 8 (pages 299 – 306), Chapter 9 (pages 357 – 362), and Chapter 10 (pages 412 – 416).

#### **Unit 2: Functions, Perspective Geometry, Symmetry and Fractals**

Basics of Graph Theory, The Königsberg Bridge problem, The four-color map problem, The Möbius strip and the Klein bottle.

Introduction of functions, Graphs of functions, Increasing and decreasing functions, Even and odd functions, Location of points of extrema, Inflection, Periodic functions – all via graphs. Perspective and Projection, Perspective geometry: Lines and points in 2D and 3D, Fundamental trigonometric functions, Use of perspective in drawing, Historic background, Common tools adopted by artists for such representations, Analysis of some paintings to spot use of perspective and techniques. Types of symmetry, Concrete examples of symmetry groups, Study of symmetry and patterns by looking at monuments/buildings/ornamental art, Fibonacci sequences in nature, Golden Ratio, Golden triangle. Shapes and solids, Basic tiling, The regular polyhedron, Importance of Platonic solids and mystical significance to the ancient Greeks; Fractals in nature, Snowflake curves, and Sierpinski triangle.

[3] Chapter 5 (Section 5.5), and Chapter 11 (Section 11.5) Chapter 10 (Sections 10.0, and 10.1 up to page 344) Chapter 11 (Section 11.2), Chapter 13 (Section 13.1), and Chapter 15 (Section 15.1)

[2] Chapter 1. [3] Chapter 8 (Section 8.5), and Chapter 12 (Pages 418 and 419).

[3] Chapter 12 (Sections 12.0, and 12.1 up to page 399), and Chapter 17 (Sections 17.0 to 17.4)

#### **Unit 3: Solving Systems of Linear Equations using Matrix**

Solving systems of linear equations, Gaussian elimination method and row operations, Consistent and inconsistent system, Gauss-Jordan row reduction and reduced row echelon form, Homogenous system, Equivalent systems and row equivalence of matrices, Rank of a matrix, Relation between homogenous system and rank.

[1] Chapter 2 (Sections 2.1 to 2.3).

#### **Text Books:**

1. Andrilli, S., & Hecker, D. (2016). *Elementary Linear Algebra* (5th ed.). Academic Press, Elsevier India Private Limited.
2. Gallian, Joseph. A. (2013). *Contemporary Abstract Algebra* (8th ed.). Cengage Learning India Private Limited. Delhi. Fourth impression, 2015.
3. Gulberg, Jan. (1997). *Mathematics from the Birth of Numbers*. W. W. Norton & Company.
4. James, Ioan. (2002). *Remarkable Mathematicians: From Euler to von Neumann*. The Mathematical Association of America. Cambridge University Press.