

NOWGONG COLLEGE  
(Autonomous)



SYLLABUS

Department of Mathematics  
Learning Outcome-based Curriculum Framework (LOCF) of  
Four Year Undergraduate Programme  
Choice-based Credit System with flexibility  
Effective from Academic Year 2023-24

Syllabus is approved in Academic Council, Nowgong College (Autonomous)

Dated: 30<sup>th</sup> June, 2023

### Course & Credit Structure

SEM	Major (Maj)	Minor (Min)	Inter- Disciplinary	AEC	SEC	VAC  (Any Two in each Semester)	Research project/ Dissertation/ Internship	Total
I	MATH-MAJ-1014  Algebra	MATH-MIN-1014  Algebra	MATH-IDC-1014  Computer Basics	ASSA/HIND/ BENG-AEC-1012  Jugajogmulok Axomiya/ Vyakaran Evam Vyavaharik Hindi/Byowoharic Bangla – I  Business English: Networking  (Online)	MATH-SEC-1014  LaTeX and HTML (Including Practical)	UNIN-VAC-1012 (Understanding India)  ENSC-VAC-1012 (Environmental Science)  NASS-VAC-1012 (National Service Scheme)  Online Courses: 1. OUFU-VAC-1012 Our Energy Future 2. PHSR-VAC-1012 Philosophy, Science and Religion 3. MOTH-VAC-1012 Model Thinking <b>(Any Two)</b>	Students exiting the program after securing 44 credits will be awarded UG certificate in the relevant discipline/ subject provided they secure additional 4 credits in work based Vocation Courses offering during summer term for internship/ apprenticeship in addition to 6 credits from Skill based Courses earned during 1 <sup>st</sup> & 2 <sup>nd</sup> Semester	22
II	MATH-MAJ-2014	MATH-MIN-2014	MATH-IDC-2014  Computer	<b>Offline Courses:</b>	MATH-SEC-2014  R	<b>Offline Courses:</b> DITS-VAC-2012 (Digital Technological Solutions)		22

	Calculus	Calculus	Basic Applications	ENGL-AEC-2012 (English and Mass Communication)  <b>Online Courses:</b> Business English: Management and Leadership (Infosys Springboard )	Programming (Including Practical)  <b>Online Courses:</b> Fundamental Skills on Python Programming & IoT (Infosys Springboard)	YOMH-VAC-2012 (Yoga and Mental Health)  NACC-VAC-2012 (National Cadet Corps)  <b>Online Courses:</b> Fundamental of Artificial Intelligence (Infosys Springboard)  <b>(Any Two)</b>			
<b>Certificate after 1 year (Total Credit = 44)</b>									
III	MATH-MAJ-3014	MATH-MIN-3014	MATH-IDC-3014	ASSA/HIND/BENG - AEC-3012	MATH-SEC-3014	---	Students exiting the program after securing 88 credits will be	22	

	Differential Equation(Including Practical) MATH-MAJ-3024 Analytical Geometry	Differential Equation	Differential Equation	Byowoharic Axomiya/ Karyalayi Hindi /Byowoharic Bangla – II	Programmin g in C (Including Practical)		awarded UG Diploma in the relevant discipline/ subject provided they secure additional 4 credits in Skill based Vocation Courses offered 2 <sup>nd</sup> year summer term.	
IV	MATH-MAJ-4014 Real Analysis-I MATH-MAJ-4024 Group Theory MATH-MAJ-4034 Numerical Analysis (Including Practical) MATH-MAJ-4044 Optimization	MATH-MIN-4014 Analytical Geometry		ENGL-AEC-4012 (Academic Writing)				22

	Theory							
<b>Diploma after 2 years (Total Credit = 88)</b>								
V	MATH-MAJ-5014 Ring Theory	MATH-MIN-5014 Modern Algebra (Group Theory and Ring Theory)					MATH-INTE-5012 (Internship)	22
	MATH-MAJ-5024 Partial Differential Equation (Including Practical)							
	MATH-MAJ-5034 Multivariate Calculus							

	MATH-MAJ-5044 Mechanics							
VI	MATH-MAJ-6014 Linear Algebra MATH-MAJ-6024 Metric Space and Topology MATH-MAJ-6034 Particles and Rigid Dynamics MATH-MAJ-6044 Complex Analysis (Including Practical)	MATH-MIN-6014 Linear Algebra						22

	MATH-MAJ-6052  (Project/ Dissertation)							
<b>Degree after 3 years (with Major/Minor) (Total Credit = 132)</b>								
VII	MATH-MAJ-7014 Number Theory  MATH-MAJ-7024 Probability and Statistics  MATH-MAJ-7034 Real Analysis- II	MATH-MIN-7014  Real Analysis				REET-VAC-7012  (Research Ethics)	REME-MAJ-7044  (Research Methodology)	22
VIII	MATH-MAJ-8014 Real Analysis- III and	MATH-MIN-8014  Complex				(INPR-VAC-8012  (Intellectual Property Right)	MATH-DISS-80112 (Dissertation)  (Those who are undertaking	22

	Lebesgue Measures	Analysis						Research Project or Dissertation) OR MATH-MAJ-8024 Graph Theory and Combinatorics MATH-MAJ-8034 Mathematical Methods MATH-MAJ-8044 Hydromechanics (Those who are not undertaking Research Project or Dissertation)	
<b>Degree after 4 years (with Honours/ by Research) (Total Credit = 176)</b>									176

N.B.: 1. 4 credit papers = 100 marks (60T+20IA+20P)

2. 2 credit papers (except AEC) = 50 marks (30T+10IA+10P)

3. 2 credit papers (Only AEC) = 50 marks (40T+10IA)

Question Pattern:

- For 100 marks papers [ 1 marks x 7 (no option) , 2 marks x 4(no option) , 5 marks x 3 (5 options), 10 marks x 3 ( 5 options) ]
- For 50 marks papers [ 1marks x 4 (no option), 2 marks x 3 (no option), 5 marks x 2 (4 options), 10 marks x 1 ( 2 options ) ]
- For AEC 50 marks papers [ 1 marks x 4 ( no options) , 2 marks x 3 ( no options), 5 marks x 2 ( 4 options), 10 marks x 2 (4 options) ]



## SEMESER-WISE DISTRIBUTION OF COURSES

- SEM-I:: 1.MATH-MAJ-1014 :: Algebra  
 2. MATH-MIN-1014:: Algebra  
 3. MATH-IDC-1014:: Computer Basics  
 4. MATH-SEC-1014::LaTeX and HTML (Including Practical)
- SEM-II:: 1. MATH-MAJ-2014:: Calculus  
 2.MATH-MIN-2014:: Calculus  
 3. MATH-IDC-2014:: Computer Basic Applications  
 4. MATH-SEC-2014::R Programming(Including Practical)
- SEM-III::1. MATH-MAJ-3014:: Differential Equation(Including Practical)  
 2. MATH-MAJ-3024:: Analytical Geometry  
 3. MATH-MIN-3014::Differential Equation  
 4. MATH-IDC-3014::Differential Equation  
 5. MATH-SEC-3014::Programming in C (Including Practical)
- SEM-IV::1. MATH-MAJ-4014:: Real Analysis- I  
 2.MATH-MAJ-4024::Group Theory  
 3. MATH-MAJ-4034:: Numerical Analysis (Including Practical)  
 4. MATH-MAJ-7044::Optimization Theory  
 5. MATH-MIN-4014:: Analytical Geometry
- SEM-V:: 1. MATH-MAJ-5014 :: Ring Theory  
 2. MATH-MAJ-5024::Partial Differential Equation (Including Practical)  
 3. MATH-MAJ-5034::Multivariate Calculus  
 4. MATH-MAJ-5044::Mechanics  
 5. MATH-MIN-5014:: Modern Algebra (Group Theory and Ring Theory)
- SEM-VI:: 1. MATH-MAJ-6014::Linear Algebra  
 2. MATH-MAJ-6024::Metric Space and Topology  
 3. MATH-MAJ-6034::Particles and Rigid Dynamics  
 4. MATH-MAJ-6044::Complex Analysis (Including Practical)  
 5. MATH-MIN-6014:: Linear Algebra
- SEM-VII::1. MATH-MAJ-7014::Number Theory  
 2. MATH-MAJ-7024::Probability and Statistics  
 3. MATH-MAJ-7034::Real Analysis- II  
 4. REME-MAJ-7044 (Research Methodology)  
 5. MATH-MIN-7014::Real Analysis
- SEM-VIII::1. MATH-MAJ-8014::Real Analysis-III and Lebesgue Measures

2. MATH-DISS-80112 (Dissertation) (Those who are undertaking Research Project or Dissertation)
3. MATH-MAJ-8024:: Graph Theory and Combinatorics (Those who are not undertaking Research Project or Dissertation)
- 4 . MATH-MAJ-8034:: Mathematical Methods (Those who are not undertaking Research Project or Dissertation)
4. MATH-MAJ-8044:: Hydromechanics (Those who are not undertaking Research Project or Dissertation)
5. MATH-MIN-8014:: Complex Analysis

**SEMESTER-I****MATHEMATICS****Course Code: MATH-MAJ-1014****Course Paper: Algebra****PAPER CREDIT: 4(3L+1P)****Total No. of Lectures-60(45L+15P)****Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, matrices, determinant and solution of linear equations

**Learning Outcomes:** This course will enable the students to:

- i) Learn how to solve the cubic and biquadratic equations, also learn about symmetric functions of the roots for cubic and biquadratic
- ii) Employ De Moivre's theorem in a number of applications to solve numerical problems.
- iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix.

**CONTENTS:****Theory**

**Unit 1: Theory of Equations :** 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.

**Unit 2: Expansions of Trigonometric Functions:** De Moivre's theorem (both integral and rational index), Solutions of equations using trigonometry and De Moivre's theorem, Expansion of sine and cosine multiple of  $x$  in terms of power of  $x$ .

**Unit 3: Matrices:** Types of matrices, Rank of a matrix, idea of elementary transformations, Invariance of rank under elementary transformations, Reduction to echelon and normal form and rank.

**Unit-4: Solution of Linear Equations:** Solutions of linear homogeneous and nonhomogeneous equations with number of equations and unknowns up to four, Gauss elimination method.

**Practical/ Presentation:** Topics to be selected based on course content of the theory

**Suggested Readings:**

1. Beachy, John A., & Blair, William D. (2006). *Abstract Algebra* (3rd ed.). Waveland Press, Inc.
2. Burnside, William Snow (1979). *The Theory of Equations*, Vol. 1 (11th ed.) S. C
3. S. K. Mappa, Higher Algebra, (9<sup>th</sup>ed.). Levant Publication

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**SEMESTER-I  
MATHEMATICS**

**Course Code: MATH-MIN-1014**

**Course Paper: Algebra**

**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, matrices, determinant and solution of linear equations

**Learning Outcomes:** This course will enable the students to:

- i) Learn how to solve the cubic and biquadratic equations, also learn about symmetric functions of the roots for cubic and biquadratic
- ii) Employ De Moivre's theorem in a number of applications to solve numerical problems.
- iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix.

**CONTENTS:**

**Theory**

**Unit 1: Theory of Equations :** 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.

**Unit 2: Expansions of Trigonometric Functions:** De Moivre's theorem (both integral and rational index), Solutions of equations using trigonometry and De Moivre's theorem, Expansion of sine and cosine multiple of  $x$  in terms of power of  $x$ .

**Unit 3: Matrices:** Types of matrices, Rank of a matrix, idea of elementary transformations, Invariance of rank under elementary transformations, Reduction to echelon and normal form and rank.

**Unit-4: Solution of Linear Equations:** Solutions of linear homogeneous and nonhomogeneous equations with number of equations and unknowns up to four, Gauss elimination method.

**Practical/ Presentation:** Topics to be selected based on course content of the theory

**Suggested Readings:**

1. Beachy, John A., & Blair, William D. (2006). *Abstract Algebra* (3rd ed.). Waveland Press, Inc.
2. Burnside, William Snow (1979). *The Theory of Equations*, Vol. 1 (11th ed.) S. C
3. S. K. Mappa, Higher Algebra, (9<sup>th</sup>ed.). Levant Publication

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**SEMESTER-I  
MATHEMATICS**

**Paper Code: MATH-IDC-1014**

**Paper Name: Computer Basics**

**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The purpose of this course is to acquaint students with fundamentals of computer system and the latest type writing in Microsoft word.

**Learning Outcomes:** After studying this course the student will be able to operate the basic needs of computer.

**CONTENTS:**

**Theory**

**Unit I: Fundamentals of computer:**

What is computer: - History, types, Block diagram of computer, I/O devices, CPU, Memory, Hardware, Software- Application and System Operating system - definition, introduction to various OS, Linux OS such as RedHat, Ubuntu, Scientific Linux.

**Unit II: Memory:**

Volatile and nonvolatile memory, Primary memory, Secondary Memory, RAM, ROM, Cache memory, Virtual Memory, Memory Units.

**Unit III: Computer Network and Network Topology:**

LAN, MAN, WAN, PAN, advantage and disadvantage, Router, Bridge, Hub, modem.

Topology: Bus, Ring, mesh, star etc., Components of LAN -Media, NIC, NOS, Bridges, HUB, Routers, Repeater and Gateways. Characteristics

**Unit IV: Word Processing and Spreadsheet**

Word Processing: Basics of Editing and Word processing, examples of scientific word processors. Introduction to - MS Office.

**Practical/ Presentation:**

**MS-WORD**

1. Create a document using the concept of header footer, color, font style.
2. Mail Merge
3. Insert picture, videos, chart, clip-art, pi diagram, bar diagram.
4. Creating mathematical expression, mathematics equation in MS-word.
5. Printing the document.

**Suggested Readings:**

1. Mastering MS Office, Bittu Kumar, V & S Publishers.
2. Learn to use Computer MS Word, Power Point and Excel, 1<sup>st</sup> edition 2019, Indrajeet Singh.

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**SEMESTER-I  
MATHEMATICS**

**Course Code: MATH-SEC-1014**

**Course Paper: LaTeX and HTML (Including Practical)**

**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The purpose of this course is to acquaint students with the latest type setting skills, which shall enable them to prepare high quality typesetting, beamer presentation and webpages.

**Learning Outcomes:** After studying this course the student will be able to:

- i) Create and typeset a LaTeX document.
- ii) Typeset a mathematical document using LaTeX.
- iii) Learn about pictures and graphics in LaTeX.
- iv) Create beamer presentations.
- v) Create web page using HTML.

**CONTENTS:**

**Theory**

**Unit 1:** Elements of LaTeX; Hands-on-training of LaTeX.

**Unit 2:** Graphics in LaTeX; PS Tricks; Beamer presentation.

**Unit 3:** HTML, creating simple web pages.

**Unit 4:** Images and links, design of web pages.

**Practical/ Presentation:** Topics to be selected based on course content of the theory. Six practical should be done by each student.

**Suggested Readings:**

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

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**SEMESTER-II****MATHEMATICS****Paper Code: MATH-MAJ-2014****Paper Name: Calculus****PAPER CREDIT: 4(3L+1P)****Total No. of Lectures-60(45L+15P)****Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real world problems.

**Learning Outcomes:** This course will enable the students to:

- i) Learn first and second derivative tests for relative extremum and apply the knowledge in problems in business, economics and life sciences.
- ii) Sketch curves in a plane using its mathematical properties in different coordinate systems.
- iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross sectional areas.

**CONTENTS:****Theory**

**Unit 1:** Higher order derivatives, Leibnitz rule and its applications to problems of type  $e^{ax} \sin bx$ ,  $e^{ax} \cos bx$ .

**Unit-2:** Tangent and normal, Concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L' Hospital's rule, applications in business, economics and life sciences.

**Unit 3:** Reduction formulae, derivations and illustrations of reduction formulae of the type  $\int \sin^n dx$ ,  $\int \cos^n dx$ ,  $\int \tan^n dx$ ,  $\int \sec^n dx$ ,  $\int \sin^m \cos^n dx$  (Definite and indefinite)

**Unit-4:** Volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length (Cartesian and polar form), area of surface of revolution.

**Practical/ Presentation:** Topics to be selected based on course content of the theory.

**Suggested Readings:**

1. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. H. Anton, I. Bivens and S. Davis, Calculus (10th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2011.
3. Shanti Narayan, Differential Calculus (15th Edition), S. Chand and co Ltd., ND
4. Shanti Narayan, Integral Calculus, S. Chand and co Ltd, ND

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**SEMESTER-II**  
**MATHEMATICS**  
**Course Code: MATH-MIN-2014**  
**Course Paper: Calculus**  
**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real world problems.

**Learning Outcomes:** This course will enable the students to:

- i) Learn first and second derivative tests for relative extremum and apply the knowledge in problems in business, economics and life sciences.
- ii) Sketch curves in a plane using its mathematical properties in different coordinate systems.
- iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross sectional areas.

**CONTENTS:**

**Theory**

**Unit 1:** Higher order derivatives, Leibnitz rule and its applications to problems of type  $e^{ax} \sin bx$ ,  $e^{ax} \cos bx$ .

**Unit-2:** Tangent and normal, Concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L' Hospital's rule, applications in business, economics and life sciences.

**Unit 3:** Reduction formulae, derivations and illustrations of reduction formulae of the type  $\int \sin^n dx$ ,  $\int \cos^n dx$ ,  $\int \tan^n dx$ ,  $\int \sec^n dx$ ,  $\int \sin^m \cos^n dx$  (Definite and indefinite)

**Unit-4:** Volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length (Cartesian and polar form), area of surface of revolution.

**Practical/ Presentation:** Topics to be selected based on course content of the theory.

**Suggested Readings:**

1. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. H. Anton, I. Bivens and S. Davis, Calculus (10th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2011.
3. Shanti Narayan, Differential Calculus (15th Edition), S. Chand and co Ltd., ND
4. Shanti Narayan, Integral Calculus, S. Chand and co Ltd, ND

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**SEMESTER-II**  
**MATHEMATICS**  
**Course Code: MATH-IDC-2014**  
**Course Paper: : Computer Basic Applications**

**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Course Objectives:** The primary objective of this course is to introduce the basic applications of computer on MS power point presentations, MS excel and its applications.

**Course Learning Outcomes:** This course will enable the students to:

- i) Learn to create MS power point presentation in different modes
- ii) Learn to create MS Excel sheets

**Unit 1: MS Power Point::**Explore PowerPoint, 2013, work with Slides, slides text, Format slides, add simple visual enhancements, Review and deliver presentation, add tables, fine-tune visual elements, add sound and movies, animation, share and reviews presentation. Create custom presentation elements.

**Unit 2: MS Excel::** Starting excel 2010, using help. Workbook management, cursor management, manipulating data, using formulae and functions. Formatting spreadsheet, Printing and Layout. Creating charts and graphs.

**Suggested Readings:**

1. Microsoft PowerPoint 2013 step by step, Joan Lambert, Pub. PHI Learning, 2016.
2. Learning Microsoft Excel 2013, Ramesh Bangia, Kanna Publishers, 2014.
3. EXCEL Formula and Functions, SIMA ALEX, Publisher, Caprioru, 2019.

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**SEMESTER-II  
MATHEMATICS**

**Course Code: MATH-SEC-2014**

**Course Paper: R Programming (Including Practical)**

**PAPER CREDIT: 4(3L+1P)**

**Total No. of Lectures-60(45L+15P)**

**Total Marks: 100(60T+20 IA+20P)**

**Objectives:** The purpose of this course is to help you begin using **R**, a powerful free software program for doing statistical computing and graphics. It can be used for exploring and plotting data, as well as performing statistical tests.

**Learning Outcomes:** This course will enable the students to:

- i) Be familiar with **R** syntax and use **R** as a calculator.
- ii) Understand the concepts of objects, vectors and data types.
- iii) Know about summary commands and summary table in **R**.
- iv) Visualize distribution of data in **R** and learn about normality test.
- v) Plot various graphs and charts using **R**.

**CONTENTS:**

**Theory**

**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.

**Unit 2: Descriptive Statistics and Tabulation**

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

**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.

**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.

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

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

**Practical/ Presentation:** Topics to be selected based on course content of the theory.

**Suggested Readings:**

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.

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