FYUGP-CBCS

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: 30th June, 2023

Course & Credit Structure

SEM	Major (Maj)	Minor (Min)	Inter-Disciplinary	AEC	SEC	VAC (Any Two)	Summer Internship	Research Project/ Dissertation	Total
I	MATH-MAJ-1014 Algebra	MATH-MIN-1014 Algebra	MATH-IDC-1014 Algebra	ASSA/HIND/BENG-AEC-1012 Jugajogmulok Axomiya/ Vyakaran Evam Vyavaharik Hindi/Byowoharic Bangla – I	MATH-SEC-1014 LaTeX and HTML (Including Practical)	UNIN-VAC-1012 (Understanding India) ENSC-VAC-1012 (Environmental Science) NASS-VAC-1012 (National Service Scheme)	----	----	22
	Certificate after 1 Year								
II	MATH-MAJ-2014 Calculus	MATH-MIN-2014 Calculus	MATH-IDC-2014 Calculus	ASSA/HIND/BENG -AEC-2012 Byowoharic Axomiya/ Karyalayi Hindi /Byowoharic	MATH-SEC-2014 R Programming (Including Practical)	DITS-VAC-2012 (Digital Technological Solutions) YOMH-VAC-2012 (Yoga and Mental Health) NACC-VAC-2012 (National Cadet Corps)	----	----	22

				Bangla – II					
Diploma after 2 Years									
III	MATH-MAJ-3014 Differential Equation(Including Practical) MATH-MAJ-3024 Analytical Geometry	MATH-MIN-3014 Differential Equation	MATH-IDC-3014 Differential Equation	ENGL-AEC-3012 (English and Mass Communication)	MATH-SEC-3014 Programming in C (Including Practical)	----	----	----	22
IV	MATH-MAJ-4014 Real Analysis-I MATH-MAJ-4024 Group Theory MATH-MAJ-4034 Numerical Analysis	MATH-MIN-4014 Analytical Geometry		ENGL-AEC-4012 (Academic Writing)				----	22

	(Including Practical) MATH-MAJ-4044 Optimization Theory								
V	MATH-MAJ-5014 Ring Theory MATH-MAJ-5024 Partial Differential Equation (Including Practical) MATH-MAJ-5034 Multivariate Calculus	MATH-MIN-5014 Modern Algebra (Group Theory and Ring Theory)					MATH-INTE-5012 (Internship)		22

	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)								
	Degree after 3 Years (with Major/Minor)								
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	MATH-MIN-				(INPR-VAC-8012 (Intellectual		MATH-DISS-80112 (Dissertation)	22

	Real Analysis-III and Lebesgue Measures	8014 Complex Analysis				Property Right)		(Those who are undertaking 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)	
Degree after 4years (with Honours/by Research)									

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

2. 2 credit papers = 50 marks (30T+10IA+10P) & 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:: Algebra

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:: Calculus

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^{th}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^{th}ed.). Levant Publication

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SEMESTER-I
MATHEMATICS
Paper Code: MATH-IDC-1014
. Paper Name: 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^{th}ed.). Levant Publication

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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
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Unit 1: Higher order derivatives, Leibnitz rule and its applications to problems of type $\mathbf{e^{ax+b}sinx}$, $\mathbf{e^{ax+b}cosx}$, $\mathbf{(ax+b)^n sinx}$, $\mathbf{(ax+b)^n cosx}$.

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. Chandand 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
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Unit 1: Higher order derivatives, Leibnitz rule and its applications to problems of type $\mathbf{e^{ax+b}sinx,\ e^{ax+b}cosx, (ax+b)^n sinx, (ax+b)^n cosx}$.

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. Chandand co Ltd, ND

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SEMESTER-II
MATHEMATICS
Course Code: MATH-IDC-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
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Unit 1: Higher order derivatives, Leibnitz rule and its applications to problems of type $\mathbf{e^{ax+b}sinx,\ e^{ax+b}cosx, (ax+b)^n sinx, (ax+b)^n cosx}$.

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. Chandand co Ltd, ND

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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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