DEBRAJ ROY COLLEGE (AUYONOMOUS)

FOUR YEAR UNDER GRADUATE PROGRAM (F.Y.U.G.P)

SYLLABUS
OF

MATHEMATICS

Choice Based Credit System (C.B.C.S)

Department of Mathematics
Debraj Roy College
(An Autonomous College under Dibrugarh University)
Circuit House Road, Golaghat-785621(Assam)

PREAMBLE

As recommended by the University Grants Commission (UGC) and proposed for implementation by Debraj Roy College (Autonomous), the Department of Mathematics works to implement the relevant components of New Education Policy (NEP), 2020 for Four Year Under Graduate Program (FYUGP). The following facts are taken into consideration when designing the basic structure of the Under Graduate (UG) programme :

a) Flexibility to switch between disciplines of study,
b) Opportunity for learners to select the courses of their interest across all disciplines,
c) Flexible entry and exit options with UG certificates, UG diplomas, or Bachelor degrees depending on the number of credits earned,
d) Flexibility for students to switch between institutions so they can engage in multi- and/or interdisciplinary learning,
e) Flexibility to switch to alternative modes of learning,
f) Knowledge required for self-employment initiatives and entrepreneurship mindset,
g) Ability for complex critical thinking and real-life problem solving,
h) Capability to understand global issues, multicultural competence and digital literacy,
i) Capable on research skills, communication skills, community based engagement, environment awareness, responsibility and accountability.

INTRODUCTION

The Under Graduate (UG) syllabus of Mathematics in light of New Education Policy (NEP), 2020 consists of Major (Core) disciplines, Minor disciplines, Multi-Disciplinary Generic Elective Courses (MDGEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Based Engagement (NCC/NSS/Adult Education/Student Mentoring/NGO/Govt. institutions, etc.), Digital and Technological Solutions/Digital Fluency (DTS/DF), Internship, Project, Research Ethics and Methodology, Research Project (Development of Project/Research Proposal, Review of related literature), Dissertation (Collection of Data, Analysis and Preparation of Report) and Discipline Specific Electives (DSE).

The UG degree programme offers certificates, diplomas and degrees as follows:

UG Certificate: Certificate course consists of two Major disciplines, two Minor disciplines, two MDGEC, two AEC, two VAC, two SEC, YOGA and Environmental Education with emphasis on community-based activities.

UG Diploma: Diploma course consists of six Major disciplines, four Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities and Digital and Technological Solutions/Digital Fluency and Community engagement. 3-year UG Degree: 3-year UG degree course consists of fourteen Major disciplines, six Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship and Project.

4-year UG Degree (Honours with Research): 4-year UG degree course consists of twenty Major disciplines, eight Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship, Project, Research Ethics and Methodology,
Research Project or one DSE and Dissertation or two DSE.

AIM

The UG Programme in mathematics is designed to teach students how to think critically, logically, and analytically, which enables them to employ mathematical reasoning in real-world situations. A UG degree

in mathematics will expose students to a variety of intriguing and practical concepts that will help them in their preparation for a variety of mathematics-oriented jobs in industry, government, business, commerce, finance and research. The program covers broad range of topics on pure and applied mathematics. Also covers hands-on sessions in Computer Lab using various software, MATLAB, Mathematica, C etc. which enables students to correlate and compare with recent developments in various branches of mathematics in a variety of organizations worldwide. The programme aims to increase students' skill in maths as well as other cross-disciplinary subjects like commerce, physics, computer sciences, economics, and statistics etc. By choosing papers from the MDGEC, AEC, SEC, VAC, YOGA, EE, DTS, DSE, Community based engagement etc., they are able to apply the skills they have learned to situations that happen in the real world. Also aims students' flexibility to move from one discipline to another, to move one institution to another, to switch alternative modes of learning.

GRADUATE ATTRIBUTES

Disciplinary Knowledge

Being able to demonstrate comprehensive knowledge and coherent understanding of both the theoretical and applied components of mathematics as well as chosen interdisciplinary areas of study in a broad multidisciplinary context; ability to connect relevant disciplines, as well as recent innovations, with the learning disciplines of choice.

Communication Skills

Capability to express various mathematical ideas clearly through computational methods, graphical methods, examples and their geometrical representations; ability to use mathematics effectively as a precise language of communication in other fields; ability to pay close attention, read texts and research papers critically, and communicate complicated information clearly and concisely to a variety of organisations and audiences.

Moral and Ethical Awareness/Reasoning

Ability to recognise ethical issues that are pertinent to one's work and pledge not to engage in unethical behaviour such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one’s research with honesty and integrity in all aspects.

Multicultural Competence

Ability to corelate and compare recent developments in various branches of mathematics in a variety of organisations worldwide; ability to collaborate research in various fields of mathematics with other researchers from a variety of communities and organisations; ability to effectively participate in a multicultural group or society and interact politely with diverse groups, and the acquisition of knowledge of the values and beliefs of multiple cultures, and a global viewpoint to honour diversity.

Information/Digital Literacy

Ability to access, asses and utilize Information and Communications Technology (ICT) tools. Ability to understand, read and write programming language/packages/modules (MATLAB; C) for computation, simulation, graphs and solutions.

Reflective Thinking

An understanding of how a researcher or an investigator influences and shapes the information one creates;
ability to formulate appropriate questions pertaining to the ideas in various branches of mathematics in order to propose new solutions using the domain knowledge of mathematics; ability to interpret the findings

and use them to solve a variety of problems found in numerous fields of mathematics and real-life.

Cooperation/Team Work

Ability to collaborate with diverse teams in an effective and respectful manner; capacity to cooperate with people from varied backgrounds in the interests of a common goal.

Research Related Skills

The ability to formulate appropriate questions, problems, and hypotheses by analysing and interpreting the ideas from various branches of mathematics; ability to demonstrate the results, theories, techniques and proofs using the concepts of various fields of mathematics; ability to develop methodology and design research proposals.

Problem Solving

Ability to work independently and do in-depth study to find ways that mathematics is used in various industries and in daily life to improve job possibilities in a wide range of fields and academic study; ability to use innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence; ability to tackle various challenges in both familiar and unfamiliar circumstances, then apply what they've learned to actual scenarios.

Critical Thinking

Capability to analyse and synthesise theoretical and applied problems, as well as acquire knowledge and skills through logical reasoning, analytical thinking and evaluations; ability to find gaps and logical faults in arguments; inculcate a healthy attitude to be a lifelong learner.

Programme Learning Outcomes:

The Learning Outcomes of Undergraduate Programme in Mathematics are listed in the following.
After completing the programme the students will be able to

i. Apply Mathematics as a tool to solve problems of other disciplines viz., Science and Technology, Commerce and Management, Humanities, Soft-computing etc.

ii. Pursue higher studies in the subject to take part in the academic upliftment of the subject and society as a whole.

iii. Develop new techniques/methods for solving the unsolved problems of the other disciplines.

iv. Construct Mathematical models to mimic real life problems and make their predictions, estimations, and regression.

Teaching Learning Process:

The outcome-based approach demands a considerable transition from teacher centric to learner centric pedagogies, as well as from passive to active/participatory pedagogies, especially in the context of undergraduate study. This course promotes the systematic and sequential acquisition of knowledge and skills. It also focuses on practical abilities, as well as an awareness of the link between theory and practice.

Teaching strategies involve discussions, presentations, use of required textbooks, e-learning tools, other self-study materials; project, internship, exploring industrial needs and other research activities and so on.

Assessment Methods:

A variety of assessment procedures appropriate for the Mathematics discipline will be used to determine how well students are progressing keeping in view of the course/program learning outcomes. Continuous

evaluation will decide the final grade which include both in-semester evaluation and the final exam. Insemester evaluation will consist of class exams, mid-term exams, homework assignments, etc. as determined by the concerned teacher of the course of study. The following techniques will be used to evaluate how successfully students are meeting their goals: tutorials, timed exams, problem-based assignments, lab reports for practical assignments, observations of practical skills, individual project reports, team project reports, oral presentations, including seminar presentations, viva voce interviews, group discussions, quiz and so on.

DRAFT STRUCTURE OF FOUR YEAR UNDER GRADUATE PROGRAMMES (FYUGP) IN MATHEMATICS FOR DIBRUGARH UNIVERSITY AND ITS AFFILIATED COLLEGES (AS PER NEP-2020 GUIDELINES)

Semester	**Course**	**Title of the paper & paper code**	**Credit**
I(First)	C - 1	Calculus and Classical Algebra	4
	Minor 1	Differential Calculus	4
	GEC - 1 (Any one)	☐ Foundation in Mathematics-I ☐ History of Mathematics	3
	AEC 1	AEC Language: MIL/ Regional Language	4
	VAC 1 Value Added Course 1:	Understanding India	2
	SEC 1	Computer Laboratory-I	3
	TOTAL		**20**
II(SECOND)	C - 2	Real Analysis & Differential Equation	4
	Minor 2	Real Analysis	4
	GEC 2 (Any one)	☐ Foundation in Mathematics-II ☐ Business Mathematics	3

	AEC 2	AEC: Language and Communication Skills (English) II	4
	VAC 2	Environmental Education with emphasis on community based activities (more emphasis on practical)	2
	SEC 2	Computer Laboratory-II	3
	TOTAL		**20**
III(THIRD)	C - 3	Theory of Real functions	4
	C - 4	Group Theory I	4
	Minor 3	Differential Equations	4
	GEC – 3 (Any one)	☐ Financial Mathematics ☐ Combinatorial Mathematics	2
	VAC 3	Digital and Technological Solutions / Digital Fluency	3
	SEC – 3	Mathematical Logic	3
	TOTAL CREDIT		**20**

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER
Title of the Course : Calculus and Classical Algebra
Course Code : MTHC1
Nature of the Course : MAJOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are-

☐ To introduce the concept of De Moivre's Theorem and its application in the expansion of some trigonometric functions.

☐ To learn the techniques of successive differentiation, Leibnitz theorem, and L'Hospital rule for evaluation of limit.

☐ To explain various types of reduction formula for integration of trigonometric function and applications in finding the volume and surface area of revolution of curve.

☐ To introduce the system of linear equation, solution of linear equation.

UNITS	CONTENTS	L	T	P	Total Hours
I (10 Marks)	De Moivre's Theorem with rational indices and its application to various problems, Expansion of sinx, cosx, sinhx and coshx and related problems.	09	03	-	12
II (10 Marks)	Successive Differentiation, Leibnitz Theorem and its application, L'Hospital's Rule, Applications of maxima & Minima.	09	03	-	12
III (12 Marks)	Reduction Formulae of the types $\int \sin x dx$, $\int \cos x dx$, $\int \tan x dx$, $\int (\log x)\ dx$ and $\int \sin x \cos x dx$ and their derivations. Rectification, volume and surface area of revolution of a curve.	09	03	-	12
IV (12 Marks)	Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differential formulae, Partial derivatives of vectors and related problems, Vector differential operator del, Gradient, Directional derivative, Divergence and Curl, Laplacian operator ∇^2, Vector identities and related problems	09	03	-	12
V (16 Marks)	Algebraic equations: Deduction from Fundamental Theorem of Classical Algebra, Descartes' rule of signs, relation between roots and coefficients of a polynomial equation of degree n, symmetric functions of roots, Transformation of equations, Cardon's method of solution of a cubic equation, Euler's method	09	03	-	12

	of solution of a biquadratic equation.				
(60 MARKS)	TOTAL	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals
MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:
After the completion of this course, the learner will be able to:

☐ Apply Calculus in real life problems

☐ Formulate mathematical models

☐ Identify the algebraic aspects present in different branches of sciences

SUGGESTED READINGS:

1. Das B.C.& Mukherjee B.N., Higher Trigonometry, U N Dhur & Sons, 1933.
2. Arumugam S., Somasundaram A., & Isaac A.T., Differential Calculus, CBS Publishers, 2021.
3. Greenhill A.G., Differential and Integral Calculus, Alpha Edition, 2020.
4. Khanna V.K.& Bhambri S.K., Abstract Algebra, Vikash Publishing, 2017.
5. Lay David C., Lay S.R., & McDonald J.J., Linear Algebra and Its Application, Pearson, 2015.
6. Thomas G.B. & Finney R.L., Calculus, Pearson Education, 2007.

7.A text book of vector calculus; Shanti Narayan , J.N. Kapur , S. Chand and Company, N. Delhi

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER
Title of the Course : Differential Calculus
Course Code : MINMTH1
Nature of the Course : MINOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the important concept of calculus, namely, limits, continuity, differentiability of functions and their various applications.

☐ To apply the Rolle's theorem, mean value theorem and Taylor's theorem in various problems.

UNITS	CONTENTS	L	T	P	Total Hours
I (12 Marks)	Limit and Continuity (ε- δ definition), Types of discontinuity, Differentiability of functions, Successive differentiation.	09	03	-	12
II (10 Marks)	Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.	09	03	-	12
III (16 Marks)	Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.	09	03	-	12
IV (10 Marks)	Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differential formulae, Partial derivatives of vectors and related problems, Vector differential operator del, Gradient, Directional derivative, Divergence and Curl, Laplacian operator ∇^2, Vector identities and related problems	09	03	-	12
IV (12 Marks)	Systems of Linear Equations, row reduction and echelon forms, vector equations, the matrix equation Ax =b, solution sets of linear systems, linear independence, introduction to linear transformations, the matrix of a linear transformation; Matrix operations, inverse of a matrix, characterizations of invertible matrices; Determinants, Cramer's rule.	09	03	-	12
(60 MARKS)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ differentiate functions

☐ find tangent, normal, curvature, asymptotes etc., of a given curve.

☐ address the criteria of changing functions

SUGGESTED READINGS:

1. Anton H., Bivens I. & Davis S., Calculus, John Wiley and Sons Inc., 2002.
2. Arumugam S., Somasundaram A., & Isaac A.T., Differential Calculus, CBS Publishers, 2021.
3. Thomas G.B. & Finney R.L., Calculus, Pearson Education, 2007

4. David C. Lay, Linear Algebra and its Applications(3rdEdition), Pearson Education Asia, Indian print, 2007.

5. A text book of vector calculus; Shanti Narayan , J.N. Kapur , S. Chand and Company, N. Delhi

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER
Title of the Course : Foundation in Mathematics-I
Course Code : GECMTH1A
Nature of the Course : Generic Elective Course (GEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) +40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the basic concepts of sets and mathematical logic in order to develop the critical and logical thinking in solving the problems.

☐ To explain the key concepts of calculus, namely, limits, continuity, differentiability of functions and their various applications.

UNITS	CONTENTS	L	T	P	Total Hours
I (12 Marks)	Sets and Logic Sets, subsets, types of set, operations on sets, Cartesian product, Statements, truth values and truth table, negation, conjunction and disjunction, Statements with quantifiers,compound statements, implications, biconditional proposition, converse, contrapositive and inverse proposition, propositional equivalence, predicates and quantifier, tautology and contradiction.	06	03	-	9
II (16 Marks)	Relation and Functions Relation and functions, types of relation and functions,graphs of functions, compositions of functions and invertible function, Binary operations.	08	04	-	12
III (16 Marks)	Calculus Limits, continuity, Differentiability of function, Derivatives of different types of functions, second order derivatives, rate of change of quantities, increasing and decreasing function, Maxima and Minima, introduction to Integrals, Applications of integrals.	08	04	-	12
IV (16 Marks)	General and particular solutions of differential equations, separation of variables, Homogeneous equations, Linear Differential Equations of first order, General and particular solutions of homogeneous and non-homogeneous linear differential equations of second order with constant coefficients.	08	04	-	12
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ Use the critical and rational approach for the solution of a problem.

☐ Identify the Mathematical objects to describe social and physical systems

☐ Describe various algebraic structures onsets

☐ Apply Calculus in real life problems

SUGGESTED READINGS:

1. Kumar A., Kumaresan S., &Sarma, B.K., A Foundation Course in Mathematics, Narosa Publishing House, 2018.
2. Stewart I., Tall D., The Foundations of Mathematics. Oxford University Press, 2nd Ed., 2015

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER
Title of the Course : History of Mathematics
Course Code : GECMTH1B
Nature of the Course : Generic Elective Course (GEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the historical perspective of mathematics such as numerical symbol, word numerals, place value notation.

☐ To explain the arithmetic algorithms, construction of sine tables and Diophantine equation in ancient and medieval India.

UNITS	CONTENTS	L	T	P	Total Hours
I (8 Marks)	A glimpse of ancient India; Hindus and mathematics; Scope and development of Hindu mathematics.	06	03	-	09
II (16 Marks)	Numeral terminology; The development of Numerical Symbol; The decimal place-value system; Persistence of the old system; Word numerals; Alphabetic notations; The zero symbol; The place-value notation in Hindu literature.	08	04	-	12
III (18 Marks)	Euclid: Introduction to the Elements; Book I and Pythagorean Theorem; Book II and Geometric Algebra.Archimedes; Estimating the values of pi. Ramanujan's view on Magic square.	08	04	-	12
IV (18 Marks)	Ancient and Medieval India: Arithmetic algorithms; Geometry; Linear congruence; Construction of Sine tables; Transmission to and from India. Diophantine Equations in Greece and India; Early Mathematics in India. Linear Equations in One and Two unknown. The Rule of three	08	04	-	12
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ Explain how mathematics has evolved in India.

☐ Analyze and critically reflect on ancient and modern mathematical issues.

☐ Conduct historical research on ancient Indian mathematical ideas with the texts of classical mathematics and their historical interpretation.

☐ explain some of the mathematical concepts developed in ancient time and evaluate the relevance in modern mathematics and sciences.

SUGGESTED READINGS:

1. Datta B., Narayan Singh A., History of Hindu Mathematics (Part I), Gyan Publishing House, 2021.
2. Kartz Victor J., A History of Mathematics: An Introduction, Pearson, 2009
3. Berndt Bruce C., Ramanujan's Notebooks: Part I, Springer, 1985.
4. Burton David M., The History of Mathematics: An Introduction, Mc Graw Hill, 2011.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER
Title of the Course : Computer Laboratory-I
Course Code : SEC115
Nature of the Course : Skill Enhancement Course (SEC)
Total Credits : 03 (L=0, T=0, P=6)
Distribution of Marks : 60 (End Sem) +40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the concept of MATLAB or MATHEMATICA or Open Source Softwares and its applications.

☐ To plot different types of graphs and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB or any other software.

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Basic commands of Matlab or Mathematica, Evaluation of different mathematical Expressions, Solutions of algebraic equation. List of Practicals 1. Basic commands of Matlab or Mathematica: clc, help, clear, format, exit, line space, zeros, ones, meshgrid, eye, rand, real, imag, angle, conj, commands for trigonometric and inverse trigonometric function, abs, exp, sqrt, log, log2, log10, mod, plot, title, legend, hold on, axis, grid on, figure, clf, close all. 2. Evaluation of arithmetic expression, exponential and logarithms, trigonometric functions, computation of complex numbers. 3. Solution of algebraic equation, simultaneous linear equations.	-	00	15x2	30
II (10 Marks)	Parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. List of Practicals 1. Plotting of graphs of function e ax + b , log(ax + b), 1/(ax + b), sin(ax + b), cos(ax +b), |ax + b| and to illustrate the effect of a and b on the graph. 2. Plotting the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.	-	00	07x2	14
III (10 Marks)	Techniques of sketching conics, polar equation of conics 1. Sketching parametric curves (E.g.,	-	00	08x2	16

	Trochoid, cycloid, epicycloids, hypocycloid). 2. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using cartesian coordinates.				
IV (20 Marks)	Surface and volume of revolution, polar equation of conics , Matrix operations. List of Practicals 1 Obtaining surface of revolution of curves. 2 Tracing of conics in Cartesian coordinates/ polar coordinates. 3 Matrix operations (addition, multiplication, inverse, transpose).	-	00	15x2	30
(60 Marks)	Total			45X2	90

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ the basic knowledge about MATLAB or Mathematica through command window or creating programing files.

SUGGESTED READINGS:

1. Pratap Rudra, Getting started with MATLAB: A quick Introduction for Scientist and Engineers, Oxford University Press, 2010.
2. Wolfram S., The Mathematica, Cambridge University Press, 2003.
3. Thomas G.B. & Finney R.L., Calculus, 9th Ed., Pearson Education, Delhi, 2005.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER
Title of the Course : Real Analysis and Differential Equations
Course Code : MTHC2
Nature of the Course : MAJOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To explain the deep understanding of real line and of important terms to prove the results about convergence and divergence of sequences and series of real numbers.

☐ To introduce the concept of Differential Equations, and develop the skill to solve differential equation of different order.

UNITS	CONTENTS	L	T	P	Total Hours
	(A) Real Analysis				
I (12 Marks)	Review of Algebraic and Order Properties of R, -neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.	10	03	-	13
II (12 Marks)	Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences,Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	10	03	-	13
III (6 Marks)	Statements of Infinite series, convergence and divergence of infinite series, Cauchy Criterion.	06	02		08
	(B) Differential Equations				
IV (15 Marks)	Concepts and definition of General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.	09	03	-	12
V (15 Marks)	General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with	10	04	-	14

	constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.				
(60 Marks)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals
MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:
4 Identify the properties of the number system.
5 Describe various analytical properties of the real number system
6 Use the techniques to solve differential equations.
7 Apply these techniques in various mathematical models used in real life problems.

SUGGESTED READINGS:

1. Bartle R.G. & Sherbert D.R., Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore,2002.
2. Kumar A.& Kumarasen S., A Basic Course in Real Analysis, CRC Press, Reprint 2021.
3. Thomas G.B. & Finney R.L., Calculus, 9th Ed., Pearson Education, Delhi,2005
4. Ross S.L., Differential Equations, 3rdEd., John Wiley and Sons, India,2004.
5. Coddington E. A., An Introduction to Ordinary Differential Equation, Dover Publications, 1989
6. Bilodeau Gerald G., Thie Paul R., & Keough G.E., An Introduction to Analysis, 2nd Ed., Jones & Bartlett,2010.
7. Thomson Brian S., Bruckner Andrew M., & Bruckner Judith B., Elementary Real Analysis, Prentice Hall, 2001.
8. Berberian S.K., A First Course in Real Analysis, Springer Verlag, New York, 1994.
9. Raisinghania M.D., Ordinary and Partial Differential Equations, 19th Ed., S. Chand and company, 2017.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER
Title of the Course : Real Analysis
Course Code : MINMTH2
Nature of the Course : MINOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To develop a deep understanding of real line R and of important terms to prove the results about convergence and divergence of sequences and series of real numbers.

☐ To study different types of infinite series and their convergency test.

UNITS	CONTENTS	L	T	P	Total Hours
I (10 Marks)	Finite and infinite sets, examples of countable and uncountable sets, Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.	09	03	-	12
II (15 Marks)	Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theoremwithout proof).	12	04	-	16
III (15 Marks)	Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, convergence of p series, alternating series, Comparison test, Root test, Ratio test, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.	12	04	-	16
IV (20 Marks)	Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e_x, log(l+x), $(l+x)_m$, Maxima and Minima, Indeterminate forms.	12	04	-	16
(60 Marks)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment

- Group Discussion
- Quiz
- Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

8 Analyse the properties of the number line

9 Describe various analytical properties of the real number system

SUGGESTED READINGS:

1. Kumar A. & Kumarasen S., A Basic Course in Real Analysis, CRC Press, Reprint, 2021.
2. Bartle R.G. & Sherbert D.R., Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore,2002.
3. Fischer E., Intermediate Real Analysis, Springer Verlag,1983.
4. Ross K.A., Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in
5. Mathematics, Springer Verlag, 2003.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER
Title of the Course : Foundation in Mathematics-II
Course Code : GECMTH2A
Nature of the Course : Generic Elective Course (GEC)
Total Credits : 03 (L=2, P=0, T=1)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are-

☐ To introduce the basic concept of difference operator with their relation and interpolation of function for the set of tabulated points.

☐ To study the basic concepts of probability, random variables and the measure of central tendency.

UNITS	CONTENTS	L	T	P	Total Hours
I (18 Marks)	Counting Principles Sum and Product rule of counting, permutation and combination, multinomial theorem, Pigeon hole principle, inclusion-exclusion principle, set partitions.	08	04	-	12
II (18 Marks)	Finite Differences and Interpolation Introduction, forward difference operator, Operators E & D,backward differences, central differences, Newton' forward and backward interpolation formulae, Lagrange's interpolation formula.	10	05	-	15
III (16 Marks)	Probability Introduction to probability, Random experiment, event, axiomatic approach to probability, conditional probability,Multiple theorem on probability, Bayes' theorem (Statement Only with Applications), random variables and distributions.	08	04	-	12
IV (8 Marks)	Statistics Introduction to statistics, Measure of Central Tendency.	04	02	-	06
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment

- Group Discussion
- Quiz
- Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ To build up a strong foundation of the basic Mathematical tools

☐ Identify the Mathematical objects to describe social and physical systems

SUGGESTED READINGS:

1. Kumar A., Kumaresan S., Sarma B.K., A Foundation Course in Mathematics, Narosa publishing house, 2018.
2. Rao, G. S., Numerical Analysis. New Age International Publishers, 2003.
3. Berge, C., Principles of Combinatorics. New York, 1971.
4. Stewart I., Tall D., The Foundations of Mathematics. Oxford University Press, 2015.
5. Shastry S.S., Introductory Methods of Numerical Analysis, PHI, 2012.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER
Title of the Course : Business Mathematics
Course Code : GECMTH2B
Nature of the Course : Generic Elective Course (GEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)
Course Objectives: The objectives of this Course are-

☐ To introduce the basic concept of matrix and determinant with their applications in business and economic problems.

☐ To explain the graphical solution of linear programming problem with two variables.

UNITS	CONTENTS	L	T	P	Total Hours
I (15 Marks)	Matrices Definition of a matrix. Types of matrices; Algebra of matrices. Calculation of values of determinants up to third order; Adjoint of a matrix; Finding inverse of a matrix through ad joint; Applications of matrices to solution of simple business and economic problems	08	04	-	12
II (20 Marks) .	Differential Calculus Mathematical functions and their types – linear, quadratic, polynomial; Concepts of limit and continuity of a function; Concept of differentiation; Rules of differentiation – simple standard forms. Applications of differentiation – elasticity of demand and supply; Maxima and Minima of functions (involving second or third order derivatives) relating to cost, revenue and profit	08	04	-	12
III (15 Marks)	Basic Mathematics of Finance Simple and compound interest Rates of interest – nominal, effective and continuous – their inter relationships; Compounding and discounting of a sum using different types of rates.	08	04	-	12
IV (10 Marks)	Linear Programming Sketching of graphs of (i) Linear equation ax + by + c=0 and (ii) Linear inequalities. Formulation of linear programming problem (LPP). Graphical solution to LPP.	06	03	-	09
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ familiarize students with the applications of mathematics in business decision-making.

SUGGESTED READINGS:

1. Mizrahi A., Sullivan M., Mathematics for Business and Social Sciences: Applied approach. Wiley and Sons, 1976.
2. Vohra N.D., Business Mathematics and Statistics, McGraw Hill Education (India) Pvt. Ltd, 2012.
3. Thukral J.K., Mathematics for Business Studies, Mayur Publications, 2009.
4. Singh J. K., Business Mathematics, Himalaya Publishing House, 2021.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER
Title of the Course : Computer Laboratory-II
Course Code : SEC214
Nature of the Course : Skill Enhancement Course (SEC)
Total Credits : 03 (L=0, T=0, P=6)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)
Course Objectives: The objectives of this Course are-

☐ To model the various real-life problems namely exponential decay model, lake pollution model etc. using MATHEMATICA /MATLAB/Open-source softwares etc.

☐ To plot the recursive sequences, sequence of partial sum using Mathematica /MATLAB.

UNITS	CONTENTS	L	T	P	Total Hours
I (18 Marks)	Introduction to compartmental model, exponential growth of population, exponential decay model, lake pollution model (case study of Lake Burley Griffin). List of Practicals 1. Plotting of second order solution family of differential equation. 2. Plotting of third order solution family of differential equation. 3. Growth model (exponential case only). 4. Decay model (exponential case only). 5. Lake pollution model (with constant/seasonal flow and pollution concentration).	-	00	15x2	30
II (10 Marks)	Drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), limited growth of population, limited growth with harvesting. List of Practicals 1. Case of single cold pill and a course of coldpills. 2. Limited growth of population (with and without harvesting).	-	00	5x2	10
III (14 Marks)	Predatory-prey model, epidemic model of influenza, battle model. List of Practicals 1. Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two preyone predator). 2. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers). 3. Battle model (basic battle model, jungle warfare, long range weapons).	-	00	10x2	20
III (18 Marks)	Plotting recursive sequences, convergence sequences, convergent subsequences, divergent sequences and infinite series 1. Plotting of recursive sequences. 2. Study the convergence of sequences through	-	00	15x2	30

	plotting. 3. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot. 4. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.				
(60 Marks)	Total			45X2	30

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ use MATLAB or Mathematica software through command window or creating programing files for various mathematical modelling problem.

SUGGESTED READINGS:

1. Barnes B., Fulford Glenn R., Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and NewYork,2009.
2. Edwards C.H.& Penny D.E., Differential Equations and Boundary Value problems Computingand Modeling, Pearson EducationIndia,2005.
3. Abell Martha L., Braselton James P., Differential Equations with MATHEMATICA, 3rd Ed., Elsevier AcademicPress,2004.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Theory of Real Functions
Course Code : MTHC3
Nature of the Course : MAJOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)
Course Objectives: The objectives of this Course are-

☐ To explain in-depth concepts of function, namely, limits, continuity, differentiability and their applications.

☐ To study Rolle's theorem, mean value theorem.

UNITS	CONTENTS	L	T	P	Total Hours
I (10 Marks)	Limit of a function, Sequential Criterion of limits, Divergence criteria, Statement of Limit theorems & their applications. Statements of the theorems of one sided limits, Infinite Limits and limits at infinity and statements of therelated theorems.	06	02	-	08
II (10 Marks)	Continuous Functions and sequential criterion of continuity and discontinuity. Algebra of continuous functions (statements only) & their application to problems, Continuity on an interval, intermediate value theorem, Location Root Theorem, Preservation of interval theorem. Uniform Continuity, Statement of Non uniformity criteria, Uniform Continuity Theorem.	09	03	-	12
III (20 Marks)	Differentiability of a function at a point and in an interval, Caratheodory's Theorem, Algebra of differentiable functions (statements only) and their applications. Relative Extrema, Interior Extremum Theorem. Rolle's Theorem, Mean Value Theorem, Intermediate Value property of derivatives, Darboux's Theorem, Application of Mean Value Theorem to inequalities.	15	05	-	20
IV (20 Marks)	Cauchy's Mean Value Theorem, Taylor's Theorem with Lagrange's form of remainder & Cauchy's form of remainder, Application of Taylor's theorem to convex function. Taylor & Maclaurin series and their applications to simple problems.	15	05	-	20
(60 Marks)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ Discuss limit, continuity and differentiability of real valued functions

☐ Expand functions in series and different form of remainders

SUGGESTED READINGS:

1. Bartle R. G. & Sherbert D. R., Introduction to Real Analysis, 4th Ed., Wiley, 2021
2. Fitzpatrick P. M., Advance Calculus, 2nd Edition, AMS Indian Edition, 2010
3. Carothers N. L., Real Analysis, Cambridge University Press, Indian Edition, 2009.
4. Fischer E., Intermediate Real Analysis, Springer Verlag, 1983.
5. Ross K.A., Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag,2003.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Group Theory I
Course Code : MTHC4
Nature of the Course : MAJOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are-

☐ To introduce the concept of fundamental theory of groups with its various types and their homomorphisms.

☐ To study the Fermat's Little theorem as a consequence of the Lagrange's theorem on finite groups.

UNITS	CONTENTS	L	T	P	Total Hours
I (10 Marks)	Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices),elementary properties of groups.	09	03	-	12
II (12 Marks)	Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	09	03	-	12
III (14 Marks)	Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	09	03	-	12
Unit IV (12 Marks)	External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.	09	03	-	12
Unit V (12 Marks)	Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems	09	03	-	12
(60 Marks)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment

o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐Describe various group structures onsets.

☐Identify the group structures present in different branches of sciences.

SUGGESTED READINGS:

1. Gallian J.A., Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, NewDelhi,1999.
2. Dummit D.S. & Foote R. M., Abstract Algebra 3rd Ed., Wiley, 2011.
3. Rotman J. J., An Introduction to the Theory of Groups, 4th Ed., Springer Verlag,1995.
4. Herstein, I.N., Topics in Algebra, Wiley, India,2006.
5. Fraleigh J. B., A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Differential Equations
Course Code : MINMTH3
Nature of the Course : MINOR
Total Credits : 04 (L=3, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the concept of Differential Equations, Mathematical Modeling and their applications.

☐ To expalin solution technique of ordinary and partial differential equations.

UNITS	CONTENTS	L	T	P	Total Hours
I (12 Marks)	First order exact differential equations. Integrating factors, rules to find an integrating factor.	09	03	-	12
II (16 Marks)	First order higher degree equations solvable for x, y, p.Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.	09	03	-	12
III (12 Marks)	Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.	09	03	-	12
IV (12 Marks)	Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.	09	03	-	12
V (8 Marks)	Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	09	03	-	12
(60 Marks)	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ describe various methods for solving differential equations.

SUGGESTED READINGS:

1. Ross S. L., Differential Equations, 3rd Ed., John Wiley and Sons,1984.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equation and Boundary Value Problems, 7th Edition, John Wiley & Sons (Asia), 2001.
3. Sneddon I.N., Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.
4. Raisinghania M.D., Ordinary and Partial Differential Equations, 19thEd., S. Chand and Company, 2020

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Mathematical Finance
Course Code : GECMTH3A
Nature of the Course : Generic Elective Course (GEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To introduce the concept of finance in mathematics.

☐ To apply mathematics in the financial world, which enables the student to understand some computational and quantitative techniques required for working in the financial markets.

UNITS	CONTENTS	L	T	P	Total Hours
I (12 Marks)	Mathematical models in economics: Introduction, A model of the market, Market equilibrium, Excise tax. The elements of finance: Interest and capital growth, Income generation, The Interval of compounding.	06	03	-	09
II (12 Marks)	The Cobweb model: How stable is market equilibrium? An example, The general linear case, Economic interpretation.	06	03	-	09
III (12 Marks) .	The derivative in economics: Elasticity of demand, profit maximization, Competition versus monopoly, The efficient small firm, startup and breakeven points	06	03	-	09
IV (12 Marks)	Introduction to investment Science: Cash flow, investment and markets, comparison principle, arbitrage, risk aversion. Typical investment problems: Pricing, Hedging, pure investment.	06	03	-	09
V (12 Marks)	Basic theory of interest: Principal and interest, compound interest, compounding at various intervals, continuous compounding, present value, present and future values of streams, internal rate of return, Evaluation criteria. The market for future cash: Savings deposits, money market instruments, various bonds, Bond details, Yield, duration, Macaulay duration.	06	03	-	09
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ apply models to financial mathematics/industries

☐ ability to use mathematical tools to market economy.

SUGGESTED READINGS:

1. Anthony M. & Biggs N., Mathematics for Economics and Finance: Methods and Modelling, Cambridge University Press: Reprinted 2009.

2. Luenberger David G., Investment Science, Stanford University: 1998.

3. Ross S., An elementary Introduction to Mathematical Finance, 2nd Ed., Cambridge University Press, USA, 2003.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Combinatorial Mathematics
Course Code : GECMTH3B
Nature of the Course : Generic Elective Course (MDGEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are-

☐ To analyze Binomial theorem, Multinomial theorem, Necklace problem, Burnside's lemma, Poly's theorem and application.

☐ To study the principles of counting, principles of inclusion and exclusion, permutations and combinations, generating functions, recurrence relations, partition etc.

UNITS	CONTENTS	L	T	P	Total Hours
I (12 Marks)	Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers	06	03	-	09
II (12 Marks)	Principle of Inclusion and Exclusion, Derangements, Inversion formulae	06	03	-	09
III (12 Marks)	Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions.	06	03	-	09
IV (12 Marks)	Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.	06	03	-	09
V (12 Marks)	Integer partitions, Systems of distinct representatives. Polya theory of counting: Necklace problem and Burnside's lemma, Polya's theorems and their immediate applications	06	03	-	09
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment

o Group Discussion
o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ Use combinatorial approach in solving algebraic problems

☐ Explain counting principles.

SUGGESTED READINGS:

1. Lint J.H. van & Wilson R.M., A Course in Combinatorics, 2nd Ed., Cambridge University Press,2001.
2. Krishnamurthy V., Combinatorics, Theory and Applications, East-West Press 2008.
3. Brualdi R.A., Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.
4. Cameron P. J., Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Mathematical Ability
Course Code : AECMTH3
Nature of the Course : Ability Enhancement Course (AEC)
Total Credits : 02 (L=2, T=0, P=0)
Distribution of Marks : 30 (End Sem) + 20 (Internal Assessment)

Course Objectives: The objectives of this Course are -

☐ To enhance the basic mathematics skills and logical reasoning which required in day-to-day life.

☐ To analyze and draw conclusions from the data, which may be presented in the form of tables or graphs.

UNITS	CONTENTS	L	T	P	Total Hours
I (10 Marks)	Number, letter and symbol series, Coding-decoding, Calendar and clocks, Distance and directions, Venndiagrams, Binary logic, Ranking and seating arrangement, Logical sequence, Logical matching, Power of reasoning, Logical thinking, relationship, data accuracy, missing numbers, Logic puzzles, Odd Man out and Series, Graphical representation (Bar-chart, Histogram, Table-chart and Line chart)	11	-	-	11
II (10 Marks)	Number system, Percentage, Square Root& Cube roots, Average, Factors and Multiples, HCF and LCM of numbers, Division algorithm, Divisibility, Test of prime numbers, Profit & loss, Problems based on Age, Time, speed & distance, Time & work, Partnership, Ratio & Proportions, Simple Interest and Compound Interest, Pipes and Cisterns, Mixture and Alligation, Boats and Streams.	11	-	-	11
III (10 Marks)	Surds and Indices, Quadratic equation, Progression, Probability, Trigonometry, Permutation and Combination, Mensuration, Volume, Surface area and Perimeter.	08	-	-	08
(30 Marks)	**Total**	30	-	-	30

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

☐ Internal Examination - 10 Marks

☐ Attendance - 05 Marks

☐ Others (any one or more) - 05 Marks

- o Seminar presentation on any of the relevant topics
- o Assignment
- o Group Discussion
- o Quiz
- o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ solve the problem based on critical thinking with logic and reasoning.

☐ use basic mathematics as a tool to understand and solve the real-life problems.

☐ use basic mathematics for competitive examinations

SUGGESTED READINGS:

1. Jaikishan, Premkishan, How to crack Test of Reasoning, Arihant Publishers, 2018.
2. Agarwal R.S., Quantitative aptitude for competitive examinations, S. Chand Publishers, 2017.
3. Verma R., Fast track objective arithmetic, Arihant Publishers, 2018.
4. Agarwal R. S., A modern approach to verbal and non-verbal reasoning, S. ChandPublisher,2018.

B. A/B.SC. IN MATHEMATICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER
Title of the Course : Mathematical Logic
Course Code : SEC315
Nature of the Course : Skill Enhancement Course (SEC)
Total Credits : 03 (L=2, T=1, P=0)
Distribution of Marks : 60 (End Sem) + 40 (Internal Assessment)

Course Objectives: The objectives of this Course are-

☐ To introduce the basic concept of sets and mathematical logic

☐ To develop the critical and logical thinking in solving the problems.

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.	10	05	-	15
II (15 Marks)	Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set.	08	04	-	12
III (10 Marks)	Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.	04	02	-	06
IV (15 Marks)	Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-array relations.	08	04	-	12
(60 Marks)	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

☐ Internal Examination - 20 Marks

☐ Attendance - 10 Marks

☐ Others (any one or more) - 10 Marks

o Seminar presentation on any of the relevant topics
o Assignment
o Group Discussion

o Quiz
o Viva-Voce

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

☐ Analyze the truth and falsity of a logical statement

☐ Differentiate between a logical statement and an ordinary statement

☐ Define and describe various properties of sets.

SUGGESTED READINGS:

1. Srivastava S.M., A Course on Mathematical Logic, Springer, 2012
2. Halmos P.R., Naive Set Theory, Springer,1974.
3. Kamke E., Theory of Sets, Dover Publishers,1950.
4. Grimaldi R.P., Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.

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