SYLLABUS

DERGAON KAMAL DOWERAH COLLEGE(AUTONOMOUS)

FOUR YEARS UNDER GRADUATE PROGRAMME (FYUGP)
[AS PER NEP 2020]

MATHEMATICS

(Recommended by Board of Studies in Mathematics, D. K. D. C. (Autonomous), in its meetings held on 08.05.2026 and approved by the academic Council meeting held on 30.06.2026 and effective from the session 2026-2027)

PREAMBLE:

As recommended by Board of Studies and approved by the Academic Council of Dergaon Kamal Dowerah College (Autonomous), the Department of Mathematics works to implement the relevant components of New Education Policy (NEP), 2020 for Four Years Under Graduate Programmes (FYUGP) under Choice Based Credit System (CBCS). The following facts are taken into consideration when designing the basic structure of the FYUGP 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 Four Years Under Graduate Programme (FYUGP) syllabus of Mathematics in light of NEP-2020, consists of Major (MJ) disciplines, Minor (MN) disciplines, Multi-Disciplinary Generic Elective Courses (GEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Research Methodology (RM), Dissertation(D) (Collection of Data, Analysis and Preparation of Report) and Major Electives (MJE).

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

UG Certificate: Certificate course consists of two Major disciplines, two Minor disciplines, two GEC, two AEC, two VAC and two SEC.

UG Diploma: Diploma course consists of eight Major disciplines, four Minor disciplines, three GEC, two AEC, three VAC, three SEC.

3-year UG Degree: 3-year UG degree course consists of fifteen Major disciplines, six Minor disciplines, three GEC, two AEC, three VAC, three SEC, Community engagement (NCC/NSS/Adult Education/Student mentoring/ NGO/ Govt. Institutions, etc.) and Internship.

4-year Honours Degree: 4-year honours degree course consists of twenty Major disciplines, eight Minor disciplines, three GEC, two AEC, three VAC, three SEC, Community engagement (CE) (NCC/NSS/Adult Education/Student mentoring/ NGO/ Govt. Institutions, etc.), Internship(I), Research Methodology (RM), Dissertation/ two MJE.

AIM:

The FYUGP 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 FYUGP 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 programme covers broad range of topics on pure and applied mathematics. Also covers hands-on sessions in Computer Lab using various software, MATLAB, C etc. which enables students to corelate and compare with recent developments in various branches of mathematics in a variety of organisations worldwide.

The programme aims to increase students' skill in mathematics as well as other cross-disciplinary subjects like commerce, physics, computer sciences, economics, and statistics etc. Also aims students' flexibility to move from one discipline to another, to move one institution to another, to switch alternative modes of learning.

Programme Educational Objectives:

(PEO): PEO 1:

Fundamental Knowledge and Skills:

Graduates will be well-versed in mathematical theories, concepts, and techniques, enabling them to solve challenging problems and pursue advanced study in mathematics or related fields.

PEO 2:
Analytical and Critical Thinking

Graduates will acquire the analytical and critical thinking abilities needed to formulate, evaluate, and resolve real-world issues using logical reasoning and mathematical modelling.

PEO 3:
Application of Mathematics

Graduates will be adept at using computational tools and mathematical concepts to solve problems in a variety of sectors, including science, engineering, technology, and economics.

PEO 4:
Communication and Collaboration

Graduates will be able to effectively convey mathematical concepts, both orally and in writing, as well as collaborate in multidisciplinary teams to solve challenging problems.

PEO 5:
Ethical and Professional Responsibilities

Graduates will exhibit a dedication to moral behaviour and professional obligations, which include comprehending how mathematical solutions affect society and maintaining a high standard of professional development.

PEO 6:
Lifelong Learning and Adaptability

Graduates will pursue lifelong learning in order to keep up with new developments and trends in the mathematics and to adjust to the changing needs of both academia and the workforce.

PEO 7:
Research and Innovation:

Graduates will be equipped with the capacity to carry out autonomous research, enhancing their understanding of mathematics and stimulating their imagination in addressing abstract and practical issues.

PROGRAMME OUTCOMES ARE GRADUATE ATTRIBUTES STATED AS FOLLOWS:

PO1: 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.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: 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.

PO6: 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.

PO7: 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.

PO8: 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.

PO9: 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.

PO10: 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 Specific Outcomes:

The Programme Specific Outcomes of FYUGP programme in Mathematics are listed in the following. After completing the programme, the students will be able to-

PSO1: Demonstrate the acquisition of comprehensive knowledge and coherent understanding in chosen elective and core subjects in mathematics.

PSO2: Apply mathematical techniques and tools, such as mathematical modelling, computational methods, and statistical analysis, to solve real-world problems in various fields.

PSO3: Possess strong analytical and critical thinking skills, enabling them to construct rigorous logical arguments, develop proofs, and solve complex mathematical problems.

PSO4: Proficient in using modern mathematical software and computational tools such as MATLAB, C, and other relevant technologies to analyse data and solve mathematical problems.

PSO5: Communicate mathematical ideas and solutions to a variety of audiences, including mathematicians, scientists, engineers, and non-specialists, both orally and in writing.

PSO6: Formulate research questions, literature review, methodology, presentation of findings, and demonstrate dedication to lifelong learning and professional development.

PSO7: Utilize the skills that necessary for success in national level competitive exams, pursuing doctoral research degree, teaching and others

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 programme outcomes. Continuous evaluation will decide the final grade which include both in-semester evaluation and the final exam. In-semester 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.

STRUCTURE OF FOUR YEARS UNDER GRADUATE PROGRAMME (FYUGP) AS PER NEP-2020 IN MATHEMATICS FOR DERGAON KAMAL DOWERAH COLLEGE (AUTONOMOUS)

Semester	Course with Paper code	Title of the Paper	Credit
1 (FIRST)	MTH1MJ01	Classical Algebra and Calculus	4
	MTH1 MN01	Differential Calculus	4
	GEC1MTH01	(Any one) • Foundation in Mathematics-I • History of Mathematics	3
	AEC 1A/AEC1B	Any One: AEC1A: Assamese/ AEC1B: Alternative English	4
	SEC1MTH01	Computer Laboratory-I	3
	VAC 1	Any One: VAC1A: Understanding India/ VAC1B: Health and Wellness	2
	Total Credit		20
2 (SECOND)	MTH2MJ02	Real Analysis & Differential Equation	4
	MTH2MN02	Real Analysis	4
	GEC2MTH02	(Any one) • Foundation in Mathematics-II • Business Mathematics	3
	AEC 2	AEC: Language and Communication Skills (English) II	4
	SEC2MTH02	Computer Laboratory-II	3
	VAC 2	Value Added Course 2	2
	Total Credit		20

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF FIRST SEMESTER

Title of the Course : Classical Algebra and Calculus

Course Code : MTH1MJ01

Nature of the Course : MAJOR

Total Credits : 04 (L=3, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The primary objective of this course is to introduce: The basic tools of theory of equations, number theory. The course will introduce to the learners the concept of De Moivre's Theorem and its application in the expansion of some trigonometric functions. Students will learn the techniques of successive differentiation, Leibnitz theorem, and L' Hospital rule for evaluation of limit. The course will also introduce the basics of Vector space, the system of linear equation and how to solve such systems.

Units	**Contents**	L	T	P	Total Hours
Unit I (11 Marks)	**Theory of equations** General properties of polynomials and equations, Fundamental theorem of algebra, Relations between the roots and the coefficients, symmetric functions of roots, Theorems on imaginary, integral and rational roots; Descartes' rule of signs, Upper bounds for the real roots	09	03	-	12
Unit II (11 Marks)	De Moivre's Theorem with rational indices and its application to various problems, Expansion of $sinx$, $cosx$, $sinhx$ and $coshx$ and related problems. ***IKS:*** *Trigonometry in Classical India: Sine table, value of sin (x+ Ɛ) and approximate to first and*	09	03	-	12

	second derivative of sin x. Derivation of Rsine, first and second order differences for Rsines.				
Unit III (16Marks)	*Rank of matrix, System of linear equations, row reduction and Echelon form, Matrix equation Ax = b. Solution set of a linear system, Basics of Vector Space,* ***IKS:*** *A brief history of Bhaskaracharya. The Six rules for positive and negative numbers, The Six rules for Zero, The Six rules for algebraic numbers, Equation of the form $Ax + c = by$, Equation with one unknown. The ten questions.*	09	03	-	12
Unit IV (11 Marks)	Successive Differentiation, Leibnitz Theorem and its application, L'Hospital's Rule.	09	03	-	12
Unit V (11 Marks)	Well ordering property of positive integers, Division algorithm, Divisibility , GCD and LCM & Euclidean algorithm, Primes , Fundamental Theorem of Arithmetic. , Congruence relation between integers.	09	03	-	12
		45	15		60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Das B.C.& Mukherjee B.N., Higher Trigonometry, U N Dhur & Sons, 1933.

2. Thomas G.B. & Finney R.L., Calculus, Pearson Education, 2007.

3. Burton, D.M. Elementary Number Theory, McGraw Hill, 7th Ed., 2023.

4.W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press,1954.

IKS REFERENCE BOOK

1. *Was Calculus Invented in India? D Bressoud, he College Mathematics Journal, Vol. 33, No. 1 (Jan., 2002), pp. 2-13*

2. "Yuktibhāṣā of Jyeṣṭhadeva: Ganita (Volume I - Mathematics)" translated by K. V. Sarma, with notes by K. Ramasubramanian, M. D. Srinivas, and M. S. Sriram (Published by Hindustan Book Agency, 2008).

3. Hindu Mathematics, B Datta, A. N. Singh, Asia Public House, New Delhi.

REFERENCE BOOKS:

1. Arumugam S., Somasundaram A., & Isaac A.T., Differential Calculus, CBS Publishers, 2021.

2. Greenhill A.G., Differential and Integral Calculus, Alpha Edition, 2020.

3. Khanna V.K.& Bhambri S.K., Abstract Algebra, Vikash Publishing, 2017.

4. Lay David C., Lay S.R., & McDonald J.J., Linear Algebra and Its Application, Pearson, 2015.

5. Das B. & Maiti S.R., Higher Algebra 17th Revised Edition.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF FIRST SEMESTER

Title of the Course : Differential Calculus

Course Code : MTH1MN01

Nature of the Course : MINOR

Total Credits : 04 (L=3, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Description:

The course on Differential Calculus deals with the outline of basic concepts of differential calculus and its application in solving various problems.

COURSE OBJECTIVE:

The objectives of the course are

i. To introduce the important concept of calculus and their applications

ii. To apply Rolles theorem, mean value theorem etc. in various problems

Units	Contents	L	T	P	Total Hours
Unit-I (11 Marks)	Limit and Continuity (ε- δ definition), Types of discontinuity, Differentiability of functions, Indeterminate forms and L' Hospital's Rule.	09	03	-	12
Unit-II (11 Marks)	Successive differentiation and Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.	09	03	-	12
Unit-III (19 Marks)	Tangents and normals, Curvature, Basics of asymptotes, Singular points, Tracing of	12	04	-	16

	simple plane curves(Parametric curves and curves in polar coordinates).				
Unit-IV (19 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, $log(1+x)$, $(1+x)^m$, Maxima and Minima. ***IKS:*** *Dividing the circumference into arc-bits: Approximating the arc-bits by Jyardha-s (Rsines); Circumference in terms of the Karna-s; Calculation of the circumference; Conversion of the Rsine to arc; Construction of Sine tables, The power series expansion for sine.*	15	05	-	20
	Total	45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Anton H., Bivens I. & Davis S., Calculus, John Wiley and Sons Inc., 2002.

2. Thomas G.B. & Finney R.L., Calculus, Pearson Education, 2007.

IKS REFERENCE BOOK

1. "Yuktibhāṣā of Jyeṣṭhadeva: Ganita (Volume I - Mathematics)" translated by K. V. Sarma,with notes by K. Ramasubramanian, M. D. Srinivas, and M. S. Sriram, Hindustan Book Agency, 2008.

2. Kartz Victor J., A History of Mathematics: An Introduction, Pearson, 2009.

3. Was Calculus Invented in India? D Bressoud, he College Mathematics Journal,

REFERENCE BOOK:1. Arumugam S., Somasundaram A., & Isaac A.T., Differential Calculus, CBS Publishers,2021

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Foundation in Mathematics-I

Course Code : GEC1MTH01A

Nature of the Course : Generic Elective Course (GEC)

Total Credits : 03 (L=2, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The course on Foundation in Mathematics-I aims the students to achieve in a more practical and definite ways. This sets the stage for more advanced mathematical concepts and real-world applications. The goal is to capture from specific and numeric reasoning to general and abstract reasoning using the language and structure of algebra to investigate, represent, and solve problems.

Units	Contents	L	T	P	Total Hours
Unit I (11 Marks)	**Sets and Logic** Statements, Negation, Statements with quantifiers, compound statements, conditional and biconditional statements, converse, contrapositive, Sets, subsets, types of set, operations on sets, Cartesian product, power set. ***IKS:*** *Philosophical foundation of set theory in Indian logic.*	**06**	**03**	**-**	**09**
Unit II (19 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**
Unit III (15 Marks)	**Calculus** Limits, continuity, Differentiability of function, first and second order derivatives,	**08**	**04**	**-**	**12**

	rate of change of quantities, increasing and decreasing function, Maxima and Minima, Introduction to integrals, Applications of integrals. ***IKS:*** *Historical Foundations of Calculus in India, Explanations involving infinitesimal increments and convergence in Yuktibhasa, Siddhānta Shiromani by Bhāskara II, Mādhava's Series for π, sin(x), cos(x), and arctan(x)*				
Unit IV (15 Marks)	Origin of differential equations, formation of differential equations, Order and Degree of Differential Equations. Solutions of first order differential equations, Methods of separation of variables, Homogeneous equations, Linear differential Equations of first order.	**08**	**04**	**-**	**12**
	Total	**30**	**15**	**-**	**45**

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - 20 Marks

• Others (any two or more) - 20 Marks

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Kumar A., Kumaresan S., &Sarma, B.K., A Foundation Course in Mathematics, Narosa Publishing House, 2018.

1. Stewart I., Tall D., The Foundations of Mathematics. Oxford University Press, 2nd Ed., 2015.

IKS REFERENCES:

1.K. V. Sarma, A History of the Kerala School of Hindu Astronomy, Vishveshvarananda

Institute of Sanskrit and Indological Studies, Panjab University, Hoshiarpur

2.B.K. Matilal, Navya–Nyaya Doctrine of Negation– Semantics & Ontology of Negative

Statements: The Semantics and Ontology of Negative Statements in Navya- Nyaya Philosophy (Harvard Oriental Series) Harvard University Press,1990

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : History of Mathematics

Course Code : GEC1MTH01B

Nature of the Course : Generic Elective Course (GEC)

Total Credits : 03 (L=2, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Description:

The History of Mathematics course explores the development of mathematical concepts, theories, and practices from ancient civilizations to modern times. This course examines the contributions made by important historical eras and individuals to a variety of mathematical disciplines, including number theory, calculus, geometry, and algebra. The cultural and historical settings in which these mathematical concepts originated and developed will become more clear to the students. Students will understand mathematics' influence on science, technology, and society as well as its continuing influence on modern mathematical thought by exploring the discipline's historical development.

COURSE OBJECTIVE:

1. To develop a comprehensive understanding of the origins and development of mathematics in ancient India, medieval India, including the contributions of Hindu and Greek mathematicians.

2. To study the evolution of major mathematical concepts and theories in areas like

algebra, geometry, calculus, and number theory.

3. To analyze how the technological, social, and cultural environments shaped the

conceptualization of mathematics.

4. To gain an understanding of how mathematical discoveries have impacted society,

science, and technology.

Units	Contents	L	T	P	Total Hours

Unit-I (9 Marks)	**IKS :** A glimpse of ancient India; Hindus and mathematics; Scope and development of Hindu mathematics	**06**	**03**	**-**	**09**
Unit-II (15 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**
Unit-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**
Unit-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**
	Total	**30**	**15**	**-**	**45**

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

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. Burton David M., The History of Mathematics: An Introduction, Mc Graw Hill, 2011.

4. Berndt Bruce C., Ramanujan's Notebooks: Part I, Springer, 1985.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Computer Laboratory-I

Course Code : SECMTH01P

Nature of the Course : Skill Enhancement Course (SEC)

Total Credits : 03 (L=0, T=0, P=6)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives

1. Develop Mathematical Reasoning: Enhance students' ability to reason mathematically and understand fundamental mathematical axioms.

2. Comprehend and Expand Mathematical Concepts: Enable students to comprehend and build upon basic and advanced mathematical concepts.

3. Logical Analysis and Theorem Crafting: Equip students with skills to analyze and craft logical arguments to substantiate mathematical theorems.

4. Advanced Mathematical Knowledge: Provide deep insights into various mathematical domains, including fuzzy sets and parametric curves.

5. Problem-Solving Methodologies: Master diverse problem-solving methodologies applicable to mathematical issues.

6. Effective Communication: Develop proficiency in communicating mathematical ideas with precision and clarity.

7. Professional and Applied Mathematics Skills: Enhance professional mathematical skills and gain expertise in specialized areas of applied mathematics.

8. Computational and Research Skills: Acquire necessary mathematical and computational skills for engaging in independent research.

9. Real-Life Problem-Solving: Prepare students to address real-life and complex mathematical

problems using advanced techniques.

10. Technical Report Preparation: Train students to prepare clear and precise technical

mathematical reports, such as dissertations and theses.

Units	Contents	L	T	P	Total hours
Unit-I (19 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		00	15 × 2	30
Unit-II (11 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 $e^{ax+b}, log(ax+b),$ $\frac{1}{ax+b}, sin(ax+b), cos(ax+b), \lvert ax+b \rvert$ and to illustrate the effect of a and b on the graph. 6. Plotting the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and their comparison.			7 × 2	14
Unit-III (11 Marks)	Techniques of sketching conics, polar equation of conics 1. Sketching parametric curves (E.g., Trochoid, cycloid, epicycloids, hypocycloid).			8 × 2	16

	2. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using cartesian coordinates.				
Unit-IV (19 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).			15 × 2	30
	Total			45 × 2	90

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

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.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Real Analysis and Differential Equations

Course Code : MTH2MJ02

Nature of the Course : MAJOR

Total Credits : 04 (L=3, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The course on Real Analysis & Differential Equations is designed for the students to demonstrate theoretical knowledge and have problem solving skills on topics of Real Analysis & Differential Equations. The course will describe appropriate theorems, principles and concepts relevant to Real Analysis in the first section and Differential Equations in the second section. Both these sections provide a background for the study of mathematical analysis and also the application of differential equations in other branches of studies.

Units	Contents	L	T	P	Total hours
Unit-I (15Marks)	**(A) Real Analysis** Algebraic and Order Properties of R, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, , Existence of greatest integer function , Density of Rational (and Irrational) numbers in R, existence and uniqueness of nth roots of non-negative real numbers, *Intervals, neighborhood of a point in R, Limit points of a set, Isolated points, Illustrations of Bolzano Weierstrass theorem for sets, finite and infinite sets, countable sets, uncountable sets.*	09	03	-	12
Unit-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	09	03	-	12

	Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion. Statements of Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Comparison test, Root test, Ratio test, Leibnitz's test, Absolute convergency. ***IKS:*** *Summation of series: Sum of natural numbers; Summation of squares; Summation of third and fourth powers; General principle of summation; Repeated summations. Approximate to first and second derivative of* $\sin x$.				
Unit-III (10Marks)	*Reduction Formulae of the types* $\int \sin^n x dx, \int \cos^n x dx, \int \tan^n x dx, \int (\log x)^n dx$ *and* $\int \sin^m x \cos^n x dx$ *and their derivations. Rectification, volume and surface area of revolution of a curve.*	09	03	-	12
Unit-IV (11 Marks)	**(B) Differential Equations** 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
Unit-V (12 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 constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.	09	03	-	12
	Total	45	15		60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - 20 Marks

• Others (any two or more) - 20 Marks

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

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.& Kumaresan S., A Basic Course in Real Analysis, CRC Press, Reprint 2021.

3. Ross S.L., Differential Equations, 3rd Ed., John Wiley and Sons, India,2004.

IKS References

1*."Yuktibhāṣā of Jyeṣṭhadeva: Ganita (Volume I - Mathematics)" translated by K. V. Sarma, with notes by K. Ramasubramanian, M. D. Srinivas, and M. S. Sriram (Published by Hindustan Book Agency, 2008).*

2. Was Calculus Invented in India? D Bressoud, he College Mathematics Journal, Vol. 33, No. 1 (Jan., 2002), pp. 2-13.

REFERENCE BOOKS:

1. Thomas G.B. & Finney R.L., Calculus, 9th Ed., Pearson Education, Delhi, 2005.

2. Coddington E. A., An Introduction to Ordinary Differential Equation, Dover Publications,

3. Greenhill A.G., Differential and Integral Calculus, Alpha Edition, 2020.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED DRAFT SYLLABUS OF 2nd SEMESTER

Title of the Course : Real Analysis

Course Code : MTH2MN02

Nature of the Course : MINOR

Total Credits : 04 (L=3, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The course on Real Analysis is designed for the students to demonstrate theoretical knowledge and have problem solving skills on topics of Real Analysis. The course will describe appropriate theorems, principles and concepts relevant to Real Analysis and provide a background for the study of Functional Analysis, Measure Theory, Topology, etc. It will deal with problems relevant to topics related to Real Analysis using ideas and techniques some of which are at the forefront of the discipline.

Units	**Contents**	L	T	P	Total hours
Unit-I (15 Marks)	Finite and infinite sets, countable and uncountable sets, Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of limit points and statement of Bolzano-Weierstrass theorem.	09	03	-	12
Unit-II (19 Marks)	Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits, order preservation and Squeeze(Sandwich) theorem, monotone sequences and their convergence, monotone convergence theorem.	15	06	-	20
Unit-III (11 Marks)	Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, convergence of p-series, alternating series,	09	03	-	12

	IKS: *From Zero to Infinity: Mathematics in Jain and Buddhist Literature; The Ten Questions and Answers; Arithmetic of Fractions; Progression (series), AP series, GP series*				
Unit-IV (15 Marks)	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
		45	15	-	60

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Kumar A. & Kumaresan 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.

IKS References

1. Lilavati of Bhaskaracharya: Patwardhan, Naimpally, Singh. Motilal Banarassdass

2. "Yuktibhāṣā of Jyeṣthadeva: Ganita (Volume I - Mathematics)" translated by K. V. Sarma, with notes by K. Ramasubramanian, M. D. Srinivas, and M. S. Sriram (Published by Hindustan Book Agency, 2008)

REFERENCE BOOKS:

1. Fischer E., Intermediate Real Analysis, Springer Verlag,1983.

2. Ross K.A., Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

3. Greenhill A.G., Differential and Integral Calculus, Alpha Edition, 2020.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Foundation in Mathematics-II

Course Code : GEC2 MTH02A

Nature of the Course : Generic Elective Course (GEC)

Total Credits : 03 (L=2, P=0, T=1)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The course on Foundation in Mathematics-II aims the students to achieve in a more practical and definite ways. This sets the stage for more advanced mathematical concepts and real-world applications. The goal is to capture from specific and numeric reasoning to general and abstract reasoning using the language and structure of algebra to investigate, represent, and solve problems.

Units	Contents	L	T	P	Total hours
Unit-I (18 Marks)	**Counting Principles** Sum and Product rule of counting, permutation and combination, multinomial theorem, Pigeonhole principle, inclusion-exclusion principle, set partitions ***IKS:*** *From Zero to Infinity: Mathematics in Jain and Buddhist Literature; The Ten Questions and Answers; Arithmetic of Fractions; Progression (series), AP series, GP series*	08	04	-	12
Unit-II (18 Marks)	**Finite Differences and Interpolation** Introduction, forward difference operator, Operators E & D, backward differences, central differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula.	10	05	-	15
Unit-III	**Probability**	08	04	-	12

(15 Marks)	Introduction to probability, Random experiment, events, conditional probability, Multiplication theorem on probability, Bayes' theorem (Statement only with Applications), random variables and distributions				
Unit-IV (9 Marks)	**Statistics** Introduction to statistics, Measures of Central Tendency.	04	02	-	06
	Total	30	15	-	45

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - 2**0 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Rao, G. S., Numerical Analysis. New Age International Publishers, 2003.

2. Berge, C., Principles of Combinatorics. New York, 1971. *****

3. Stewart I., Tall D., The Foundations of Mathematics. Oxford University Press, 2015.

4. Shastry S.S., Introductory Methods of Numerical Analysis, PHI, 2012.

5. Ross, S. M., Introduction to probability and statistics for engineers and scientists, Elsevier, 2021.

IKS REFERENCES

1. Lilavati of Bhaskaracharya: Patwardhan, Naimpally, Singh. Motilal Banarassdass

2. "Yuktibhāṣā of Jyeṣṭhadeva: Ganita (Volume I - Mathematics)" translated by K. V. Sarma, with notes by K. Ramasubramanian, M. D. Srinivas, and M. S. Sriram (Published by Hindustan Book Agency, 2008).

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Business Mathematics

Course Code : GEC2MTH02B

Nature of the Course : Generic Elective Course (GEC)

Total Credits : 03 (L=2, T=1, P=0)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

COURSE OBJECTIVE:

1. To develop a solid understanding of fundamental mathematical concepts, including algebra, calculus, and finance, and their relevance to business applications.

2. To develop mathematical skills to solve real-world business problems using linear equations, functions, and matrices.

3. To enhance computational skills in differential calculus to optimize business functions and analyze changes in business environments.

4. To develop analytical and problem-solving skills by working through practical business scenarios and mathematical models.

5. To enhance mathematical and analytical skills to prepare for further studies in business, finance, and economics

Units	**Contents**	**L**	**T**	**P**	**Total hours**
Unit-I (15 Marks)	**Matrices** Definition of a matrix. Types of matrices, Algebra of matrices. Calculation of determinants up to third order; Adjoint of a matrix; Finding inverse of a matrix through adjoint; Applications of matrices to solve system of linear equations.	**08**	**04**	**-**	**12**
Unit-II (19 Marks)	**Differential Calculus** Mathematical functions and their types – linear, quadratic, polynomial; Concepts of limit and continuity of a function;	**08**	**04**	**-**	**12**

	Concept of differentiation; Rules of differentiation , 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				
Unit-III (15 Marks)	**Basic Mathematics of Finance** Simple and compound interest, Rates of interest – nominal, effective and continuous – their relationships; Compounding and discounting of a sum using different types of rates. ***IKS:*** *Fraction, commercial problem, simple interest, combination, progression.*	**08**	**04**	**-**	**12**
Unit-IV (11 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**

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - 20 Marks

• Others (any two or more) - 20 Marks

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

1. Vohra N.D., Business Mathematics and Statistics, McGraw Hill Education (India) Pvt. Ltd, 2012.

2. Singh J. K., Business Mathematics, Himalaya Publishing House, 2021.

IKS Reference

1. B. Datta, A. N. Singh, Hindu Mathematics.

2. Lilavati of Bhaskaracharya: Patwardhan, Naimpally, Singh. Motilal Banarassdass

Publishers, Delhi, 2001.

REFERENCE BOOKS:

1. Mizrahi A., Sullivan M., Mathematics for Business and Social Sciences: Applied approach. Wiley

and Sons, 1976.

2. Thukral J.K., Mathematics for Business Studies, Mayur Publications, 2009.

FOUR YEARS UNDER GRADUATE PROGRAMME IN MATHEMATICS

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Computer Laboratory-II

Course Code : SEC2MTH02P

Nature of the Course : Skill Enhancement Course (SEC)

Total Credits : 03 (L=0, T=0, P=6)

Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course Objectives:

The objectives of this course are:

1. To model various real-life problems, such as exponential decay models, lake pollution models, etc., using MATHEMATICA/MATLAB/Open-source software.

2. To plot recursive sequences and sequences of partial sums using MATHEMATICA/MATLAB.

Units	Contents	L	T	P	Total Hours
Unit-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 Practical** 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	15×2	30
Unit-II (9 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.		00	5×2	10

	2. Limited growth of population (with and without harvesting).				
Unit-III (15 Marks)	Predatory-prey model, epidemic model of influenza, battle model. **List of Practical** 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	10 × 2	20
Unit-IV (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 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.		00	15 × 2	30
	Total		-	45 × 2	90

Where, L: Lectures T: Tutorials P: Practical

MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)

• One Internal Examination - **20 Marks**

• Others (any two or more) - **20 Marks**

o Seminar presentation on any of the relevant topics

o Assignment

o Group Discussion

o Quiz

o Viva-Voce

TEXTBOOKS:

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. Abell Martha L., Braselton James P., Differential Equations with MATHEMATICA, 3rd Ed., Elsevier AcademicPress,2004.

REFERENCE BOOK:

1. Edwards C.H.& Penny D.E., Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005