

EGRA S. S. B. COLLEGE
DEPARTMENT OF MATHEMATICS

**PROGRAMME OUTCOME (PO), COURSE OUTCOME (CO) AND
PROGRAMME SPECIFIC OUTCOME (PSO) FOR END SEMESTER
STUDENTS UNDERGRADUATE COURSE: 2022-2023**

Programme Name: B. SC. HONS (MATHEMATICS)

PROGRAMME OUTCOMES:

PO1: Disciplinary Knowledge To acquire comprehensive and sufficient knowledge of understanding in Mathematics

PO2: Critical Reasoning & Problem Analysis: To acquire the ability of deep study and then critically to think and analyze the subject of mathematics in its different areas.

PO3: Develop Interdisciplinary Knowledge: To enable students in developing an effective approach to Interdisciplinary study and enable them to build their own interdisciplinary pathway by choosing courses which make sense to them.

PO4: Communication skill and attitudes: Excellent communication of mathematics in geometrical realization, documentation, makes effective presentation to develop other branches of sciences, to think existing open programme in mathematics.

PO5: Self- directed Learning: Ability to work independently, study the subjects in depth and apply thoughts for solving the problems in various field.

PO6: Experimental learning and Employability options: Students are able to identify problems, use constructive reasoning to make viable arguments, and applying mathematics in real-life problems Also they will be able to find job in different sectors of mathematics and mathematics related subjects.

PO7: Develop Research Related Skill: Capability of thinking about the various fields of Mathematics advances in those fields and clear concept about them so that appropriate questions are formed on related fields.

PROGRAMME SPECIFIC OUTCOME:

PSO 1: Thinking about every topic in a critical manner.

PSO 2: When there arises situation to provide information about any problem students are able to identify it, locate, evaluate and use the information effectively.

PSO 3: Realize, evaluate, and formulate different quantitative models arising in socialscience, business and other fields.

PSO 4: Apply mathematical and logical arguments to develop and formulate every problem in a unique way.

PSO 5: Acquire clear concepts and knowledge to understand every problem and use mathematical and statistical methods by the students through the course.

PSO 6: Aware about the responsibility to become a citizen of society and promise to scatter the scope of acquired knowledge.

EGRA S. S. B. COLLEGE
DEPARTMENT OF MATHEMATICS

Course Outcomes (CO) for End Semester Students: 2022-

**2023 CO17: (Paper CC13 - Metric Spaces and
Complex Analysis)**

CO17:1: Learn the concept of Metric space, Mapping, compactness and Connectedness, Heine-Borel property, contraction, Banach fixed point Theorem related to Metric space.

CO17:2: Concept of various properties of Complex Number, Differentiability and Analyticity of Complex Valued function, Formation of Cauchy-Reimann equation. Idea about Contour and Contour Integral, Learn related theorem like Cauchy- Goursat theorem and Cauchy Integral formulae.

CO18: (Paper CC14 – Ring Theory and Linear Algebra-II)

CO18:1: -Study of polynomial rings, division algorithm and consequences.

CO18:2: Idea about dual spaces, dual basis, Cayley-Hamilton theorem and minimal polynomial for a linear operator. Inner product space and its properties. Concept of Least square approximation, Normal and self-adjoint operator, orthogonal projections and Spectral theorem.

CO19: (Paper DSE 3 – Number Theory)

CO19:1: -Learn about linear Diophantine equation, prime counting function, Goldbach conjecture, Chinese Remainder theorem, Fermat's and little son theorem

CO19:2--Concept of Dirichlet's Product, Mobius Inversion formulae, Euler phi function and residues. Learn about integer modulo n, Legendre Symbol, Fermat's Last Theorem.

CO20: (Paper DSE4 – Mathematical Modelling)

CO20:1: -Learn Legendre and Bessel's equation and find their power series solution.

CO20:2: --Learn about Laplace transform, inverse Laplace transform and its applications to second order PDE and ODE.

CO20:3: --Concept of simulation used in Monte Carlo Simulation Modelling, over viewing optimization modelling, Learn LPP model and use sensitivity analysis.

EGRA S. S. B. COLLEGE
DEPARTMENT OF MATHEMATICS

DETAILED SYLLABUS OF END SEMESTER UG (HONOURS) COURSES

DEPARTMENT OF MATHEMATICS

CC-13: Metric Spaces and Complex Analysis: Credits -06

Content(a) Metric spaces: sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem.

(b) Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Connectedness connected subsets of \mathbb{R} .

Compactness: Sequential compactness, Heine-Borel property, totally bounded spaces, finite intersection property, and continuous functions on compact sets.

Homeomorphism. Contraction mappings. Banach fixed point theorem and its application to ordinary differential equation.

(c) Limits, limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

(d) Analytic functions, examples of analytic functions, exponential function, logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

(e) Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.

(f) Laurent series and its examples, absolute and uniform convergence of power series.

C14T: Ring Theory and Linear Algebra II: Credits-06
Course Content

(a) Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in $\mathbb{Z}[x]$. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

(b) Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.

(c) Inner product spaces and norms, Gram-Schmidt orthogonalization process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator. Least squares approximation, minimal solutions to systems of linear equations. Normal and self-adjoint operators. Orthogonal projections and Spectral theorem.

DSE -3: (Anyone from the three)

Credits 06

DSE-3A: Mechanics

OR

DSE-3B: Number Theory

OR

DSE-3C: Industrial Mathematics

DSE-4: (Anyone from the three)

Credit: 06

DSE-4A: Mathematical Modeling

OR

DSE-4B: Differential Geometry

OR

DSE-4C: Bio- Mathematics

EGRA S. S. B. COLLEGE
DEPARTMENT OF MATHEMATICS

MAPPING OF CO, PO, PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO2	PSO 3	PSO4	PSO 5	PSO6
CO17.1	✓	✓	✓	✓	✓		✓	✓	✓		✓		
CO17.2	✓	✓	✓	✓	✓		✓	✓	✓		✓		
CO18.1	✓	✓			✓		✓	✓	✓		✓		
CO18.2	✓	✓	✓		✓		✓	✓	✓		✓		
CO19.1	✓	✓			✓		✓	✓			✓		
CO19.2	✓	✓	✓		✓		✓	✓	✓		✓		
CO20.1	✓		✓		✓	✓	✓			✓		✓	
CO20.2	✓		✓		✓	✓	✓			✓		✓	
CO20.3	✓	✓	✓	✓	✓		✓			✓		✓	

JUSTIFICATION MATRIX OF CO WITH PO & PSO (High: 3, Medium: 2, Low: 1)

	Mapping	Correlation	Justification
CO17.1	PO1	HIGH	Students will acquire sufficient knowledge about basics of metric spaces.
	PO2	HIGH	Students will be able to learn how to analyze the problem critically and solve the problem.
	PO3	HIGH	Students will learn to understand the behavior of differentiability of different domains (real and complex) and relate another subject like Physics.
	PO4	MODERATE	Students can think in advance about topics related to this subject and apply various methods in the real field.
	PO5	MODERATE	Students able to analyze the problem on fixed point related with metric space and can be handle by independently.
	PO7	MODERATE	Students will be able to identify and formulate the problems of metrics space in a unique Way.
	PSO1	HIGH	Student will acquire the knowledge for critical analysis different problem.
	PSO2	HIGH	Information of various property of metric space will help to identify the connectedness, compactness of metric space
	POS4	MODERATE	Students will gather knowledge logically to solve the problem.
CO17.2	PO1	HIGH	Students will be able to obtain vast knowledge on Cauchy-Riemann equation
	PO2	HIGH	Students learn about the questioning on differentiability, C-R equation
	PO3	HIGH	Student will have capability to solve various problem related to it in different field of science.
	PO4	MODERATE	Students will think the topics of contour integral C-R equation etc. In a critical manner
	PO5	MODERATE	Students apply the knowledge of differentiability, Contour integration, in a self-direct way.
	PO7	HIGH	There are so many research problems in this field. So student will be encouraged to pursue themselves into research field.
	PSO1	HIGH	Students will acquire knowledge to think different complex problem in critical manner.

	PSO2	MODERATE	Students realize how to evaluate the problem by figures and models.
	PSO4	LOW	Students will be able to analyze complex problems and acquire clear concepts to handle those.
CO18.1	PO1	HIGH	Students obtain a vivid knowledge on polynomial Ring, consequences
	PO2	HIGH	Acquire knowledge of questioning and reasoning on Ring theory
	PO5	HIGH	Student will identify the problems and solve them using constructive reasoning on this course.
	PO7	MODERATE	This course will help student as a gateway to do research on Number theory.
	PSO1	HIGH	Students will acquire knowledge to think different problem in critical manner on polynomial ring and division algorithm
	PSO2	MODERATE	Students will share this knowledge to find out the gcd of two numbers.
	PSO4	MODERATE	Students will think and solve the problem logically.
CO18.2	PO1	HIGH	Students learn the concept of ideal, dual space, inner product space.
	PO2	HIGH	Acquire knowledge of questioning and reasoning on ideal, dual spaces, etc.
	PO3	MODERATE	Students apply their knowledge of various problems from ideal, dual space perspective.
	PO5	MODERATE	Students will be able to think about critical problems related to this course independently.
	PO7	HIGH	Students learn to identify the problems and analyze to find information correctly in this Course.
	PSO1	HIGH	Student will acquire knowledge on advance linear algebra.
	PSO2	MODERATE	Students will share their knowledge to identify and solve various type of problem of advance linear algebra.
CO19.1	PSO4	MODERATE	Student will be able to identify and formulate the problems of dual spaces, inner product space in a unique way
	PO1	HIGH	Learn vividly about conjecture, Fermat's theorem, prime counting etc.
	PO2	HIGH	To understand how to make appropriate questions and reasoning in number theory
	PO5	HIGH	Students learn to understand the problem using concepts of different aspects of this course.
	PO7	MODERATE	Students will be able to think about critical problems related to this course.
	PSO1	MODERATE	Students realize how to evaluate the problem by figures and models of this course.
	PSO2	MODERATE	Students will be able to identify and formulate the problems of number theory space in unique way.
CO19.2	POS4	LOW	Students will learn logical way to use Chinese Remainder theorem, Fermat's theorem and Diophantine equation.
	PO1	HIGH	Obtain knowledge on Mobius Inversion, residues, Dirichlet's product
	PO2	HIGH	Acquire knowledge about critical reasoning and questioning in Mobius Inversion, residues
	PO3	MODERATE	Students learn to communicate with other using concept of different aspect of this course
	PO5	HIGH	Student able to think in advance topics related this subject and improve research skill
	PO7	HIGH	Students learn to identify the problems and analyze to find information correctly in this course
	PSO1	HIGH	Student will be able to identify and formulate the problems of metric space in a unique way
	PSO2	LOW	Knowledge of different method of number theory will be shared by students to various problem of different related field like Cryptography.
CO20.1	PSO4	MODERATE	Student will acquire knowledge on this field to solve the problem using mathematical method and logic.
	PO1	HIGH	Learn Legendre, Bessel's equation and their power series efficiently
	PO3	HIGH	Students make questioning and reasoning to enrich in specific subject
	PO5	MODERATE	Students apply the knowledge of differentiability, Contour integration, in self-directed way.
	PO6	MODERATE	Students will be able to think critical problems related to this course

	PO7	HIGH	Students learn to identify the problems and analyze to find information correctly in this course that enables them towards research mind.
	PSO3	MODERATE	This method will be very helpful to student for forming various model on Social science, Business and other fields of science.
	PSO5	LOW	Student will be able to create awareness and scope of applying this course
CO20.2	PO1	HIGH	Acquire knowledge on Laplace transform & its application on ODE, PDE
	PO3	HIGH	Students make questioning and reasoning to enrich in LT & its application on ODE, PDE
	PO5	MODERATE	Students able to find their scope of job real life problem learning application of this course
	PO6	MODERATE	Students will be able to use research methods for this specified course.
	PO7	HIGH	Students will be able to think of critical problems related to Laplace and Inverse LT.
	PSO3	MODERATE	This method will be very helpful to student for forming various model on Social science, Business and other fields of science.
	PSO5	LOW	Students realize to evaluate the problem of this course by mathematical & statistical method.
CO20.3	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	MODERATE	Students make questioning and reasoning to enrich in subject of this course.
	PO3	HIGH	Students apply the knowledge of LPP, Simulation...etc. in self-directed way.
	PO4	MODERATE	Student able to think in advance topics related this subject and improve research skill
	PO5	MODERATE	Students learn to identify the problems and analyze to find information correctly in this course.
	PO7	HIGH	Different optimization technique of this course will be helpful to student for various research problem related to different applied field of science.
	PSO3	MODERATE	This method will be very helpful to student for forming various model on Social science, Business and other fields of science.
	PSO5	MODERATE	Student will acquire the knowledge vividly to understand different problem to build a robust model using mathematical method and testifying its robustness using statistical method.