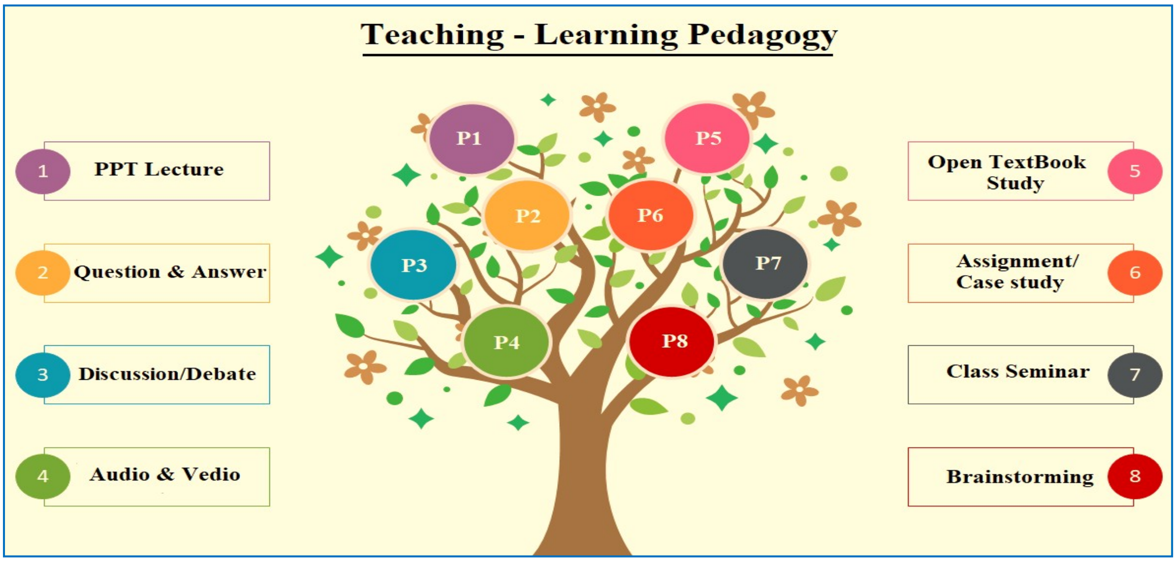
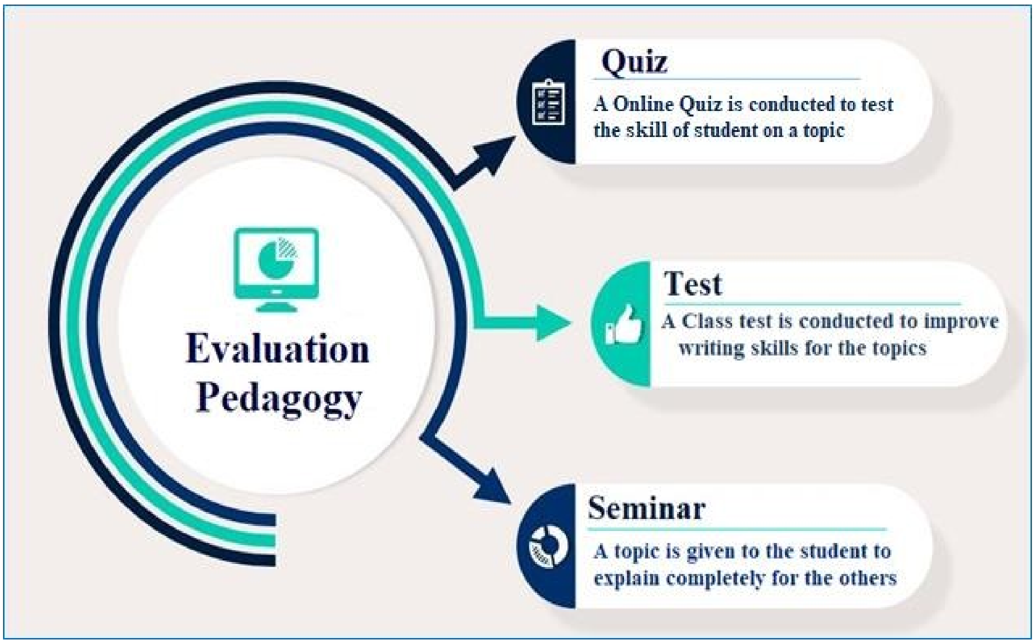
ESTD - 1996
CHAITANYA DEGREE & PG COLLEGE FOR WOMEN
Affiliated to Andhra University
Chaitanya Nagar, Old Gajuwaka, VSP - 26
0891-2747250 / 2757592 9247569901 principal.chaitanyacollege@gmail.com

DEPARTMENT OF MATHEMATICS
Teaching Plan – 2022-2023





Academic-Pedagogical-Evaluation: Course Overview

Course: MATHEMATICS	Year: I	Semester: I
Subject:	ALGEBRA-I	
Units:	1. GROUPS &NORMAL SUBGROUPS 2. NORMAL SUBGROUPS &PERMUTATION GROUPS 3. STRUCTURE THEOREM OF GROUPS 4. IDEALS &HOMOMORPHISMS 5. UNIQUE FACTORIZATION DOMAINS&EUCLIDEANDOMAINS	
Duration:	60hours	
Learning Objectives	**After completing this course, the student shall beable to:** • The study of powerful concepts like conjugacy and G-sets, permutation groups and Sylow theorems introduces to new proof techniques. • The study on structure theorems on groups based on the study of cyclic groups motivatesanalogous study on other algebraic structures. • The study on structure theorems of rings usingthe study of ideals gives more insight on the study of ideals • The study on UFD as a generalization of fundamental theorem of arithmetic ,PID based on ideals and ED is division algorithm applied onpolynomials introduces to fundamental techniques adapted in advanced algebra	

Resource Material:	**Study Material:** Basic Abstract Algebra: P. B. Bhattacharya, S. K. Jain and S. R. Nagapaul, Second edition, reprinted in India 1997, 2000, 2001. **Reference Books:** 1. Topics in Algebra : I. N. Herstein, 2nd Edition, John Wiley &Sons 2. Algebra : Thomas W. Hungerford, Springer 3. Algebra : Serge Lang, Revised Third Edition, Springer **YouTube Links:** https://youtu.be/hYSkxaM8F5Y

Academic-Pedagogical-Evaluation :Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	**Groups:**Homomorphisms-Subgroups and cosets. **Normal subgroups**: Normal Subgroups and Quotient groups-Isomorphism thorems- Automorphisms.	P1,P2,P3	PQ,P6,PT
II	**Normal Subgroups**: Conjugacy and G-sets. **Permutation Groups**: Cyclic decomposition-Alternating group ⍰$_n$-Simplicity of ⍰$_n$.	P1,P2,P3,P5	P6,PT
III	**Structure thorems of groups**: Direct products-Finitely generated abelian groups-Invariants of a finite abelian group-Sylow theorems.	P1,P2,P3,P5	PQ,PT
IV	**Ideals and Homomorphisms**: Ideals-Homomorphisms-Sums and direct sums of ideals- Maximal and prime ideals-Nilpotent and nil ideals-Zorn's lemma.	P1,P2,P4	PQ,P6,PT
V	**Unique factorization domains and Euclidean domains**: Unique factorization domains-Principal ideal domains-Euclidean domains-Polynomial rings over UFD	PQ,P6,PT,**P8**	PQ,PT

REAL ANALYSIS-I LESSON PLAN

Course: B.SC	Year: I	Semester: I
Subject	REALANALSIS-I	
Units	1. BASIC TOPOLOGY 2. CONTINUITY 3. DIFFERENTIATION 4. THE RIEMANN-STIELTJES INTEGRAL 5. THE RIEMANN-STIELTJES INTEGRAL CONTINUED	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To identify the closed sets, open sets, compact sets, perfect sets connected sets, and properties of respective sets. • To understand the basic theory of continuous functions, images of compact sets, images of connected sets, types of discontinuities. • To understand the significance of differentiable functions, their properties, mean value theorems and Taylor's theorem. • To recognize Riemann-Stieltjes integral as a generalization of Riemann integral, and to know about various sufficient conditions for the existence of Riemann-Stieltjes integral and their properties. • To understand the differentiation of integrals, the fundamental theorem of calculus, integration by parts which are useful to evaluate integrals of certain functions. Further ,to understand the integration of vector valued functions and to find the length of a rectifiable curve.	

Resource Material:	**Study Material(Handouts):** Walter Rudin, Principles of Mathematical Analysis, International Student Edition, 3rd Edition, 1985. **Reference Books:** Reference: Tom M. Apostal, Mathematical Analysis, Narosa Publishing House, 2nd Edition, 1985. **YouTube Links:** https://youtu.be/ny4ToB8Pgyw

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Basic Topology: Metric spaces, Compact sets, Perfect sets, Connected sets.	P1,P2,P3	PQ,P6,PT
II	Continuity: Limits of functions, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotone functions, Infinite limits and Limits at Infinity.	P1,P2,P3,P5	P6,PT
III	Differentiation: The Derivative of a Real Function, Mean value theorems, the Continuity of Derivatives, L'Hospital's Rule, Derivatives of Higher order, Taylor's theorem, Differentiation of vector-valued functions.	P1,P2,P3,P5	PQ,PT
IV	The Riemann-Stieltjes integral: Definition and Existence of the Integral, Properties of the integral, Change of variable.	P1,P2,P4	PQ,P6,PT
V	The Riemann-Stieltjes integral continued: Integration and Differentiation, The Fundamental theorem of Calculus, Integration by parts, Integration of vector-valued functions, Rectifiable curves.	PQ,P6,PT,**P8**	PQ,PT

TOPOLOGY-I LESSON PLAN

Course: B.SC	Year: I	Semester: I
Subject	TOPOLOGY-1	
Units	1. SETS AND FUNCTIONS 2. METRIC SPACES 3. METRIC SPACES (CONTINUED) 4. TOPOLOGICAL SPACES (CONTINUED) 5. COMPACTNESS (CONTINUED)	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • students Will be able to handle operations on sets and functions and their properties • To understand the concepts of Metric spaces, open sets, closed sets, convergence, some important theorems like Cantor's intersection theorem and Baire's theorem • To be familiar with the concept of Topological spaces, continuous functions in more general and characterize continuous functions in terms of open sets, closed sets etc. • To explain the concept of compactness in topological spaces • To characterise compactness in metric spaces and their properties	

ResourceMaterial:	Study Material(Handouts): Introduction to Topology and Modern Analysis by G. F. Simmons International Student edition – McGraw – Hill Kogakusha, Ltd. You tube links: https://youtu.be/p8y89alEo3M

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Sets and Functions: Sets and Set inclusion – The algebra of sets – Functions – Products of sets – Partitions and equivalence relations – Countable sets – Uncountable sets – Partially ordered sets and lattices.	P1,P2,P3	PQ,P6,PT
II	. Metric spaces: The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire's theorem .	P1,P2,P3,P5	P6,PT
III	Metric spaces (Continued): Continuous mappings, Spaces of continuous functions – Euclidean and Unitary spaces Topological spaces: The definition and some examples – Elementary concepts	P1,P2,P3,P5	PQ,PT
IV	Topological spaces (continued): Open bases and open sub bases, Weak Topologies, The function algebras C(X, R) and C(X, C). Compactness: Compact spaces – Heine – Borel theorem	P1,P2,P4	PQ,P6,PT
V	Compactness (continued): Product of Spaces – Tychonoff's theorem and locally Compact spaces – Compactness for metric spaces – Ascoli's theorem.	PQ,P6,PT,**P8**	PQ,PT

DIFFERENTIAL EQUATIONS LESSON PLAN

Course: B.SC	Year: I	Semester: I
Subject	DIFFERENTIAL EQUATIONS	
Units	1. ESSENTIAL CONCEPTS FROM REAL FUNCTION THEORY 2. DEPENDENCE OF SOLUTIONS ON INITIAL CONDITIONS 3. INTRODUCTION TO THE THEORY OF LINEAR DIFFERENTIAL SYSTEMS 4. THEORY OF NON HOMOGENEOUS LINEAR SYSTEMS 5. THEORY OF NTH ORDER NON HOMOGENEOUS LINEAR EQUATIONS	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To comprehend the bridge between the real function theory and theory of ordinary differential equations • To understand the basic theory behind existence, uniqueness, continuity of solutions of ordinary differential equations • To realize the dependence of solutions on various parameters involved in the differential equations • To recognise the significance studying differential systems and its utility in understanding higher order differential equations • To figure out qualitative behavior of solutions of differential equations of various orders.	

Resource Material:	**StudyMaterial(Handouts):** Shepley L. Ross (2007). Differential Equations (3rd edition), Wiley India **Reference Books:** George F. Simmons (2017). Differential Equations with Applications and Historical Notes (3rd edition). CRC Press. Taylor & Francis. **YouTube Links:** https://youtu.be/2AyyEATVpTo

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Essential concepts from Real Function Theory – The basic problem -The fundamental existence and uniqueness theorem –examples to demonstrate the theory- continuation of solutions	P1,P2,P3	PQ,P6,PT
II	Dependence of solutions on initial conditions – dependence of solutions on parameters (causal function f) - Existence and Uniqueness theorems for systems – existence and uniqueness theorems for Higher order equations – examples	P1,P2,P3,P5	P6,PT
III	Introduction to the theory of Linear differential systems – Theory and properties of Homogeneous linear systems	P1,P2,P3,P5	PQ,PT
IV	Theory of non homogeneous linear systems – Theory and properties of the nth order homogeneous linear differential equations	P1,P2,P4	PQ,P6,PT
V	Theory of nth order Non homogeneous Linear equations – Sturm theory – Sturm Liouville Boundary value problems	PQ,P6,PT,**P8**	PQ,PT

LINEAR ALGEBRA LESSON PLAN

Course: B.SC	Year: I	Semester: I
Subject	LINEAR ALGEBRA	
Units	1. Characteristic Values and Cayley – Hamilton Theorem 2. Invariant sub spaces 3. Direct-sum decomposition 4. Cyclic sub spaces 5. The Jordan forms	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To bridge the relation between matrix theory and vector spaces. • To understand the applications of Cayley-Hamilton Theorem. • To find an inverse of a linear transformation (a matrix) using Cayley-Hamilton Theorem. • To find the Jordan forms of a complex matrix with a given characteristic polynomial. • To understand the relation between semi-simple operators and diagonalizable operators.	

Resource Material:	**StudyMaterial(Handouts):** https://examupdates.in/linear-algebra-books/ **Reference Books:** Linear Algebra by Kenneth Hoffman and Ray Kunze, Prentice- Hall India Pvt. Ltd, 2nd Edition, New Delhi. **YouTube Links:** https://youtu.be/_ERfdnm4Mio

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Introduction, Characteristic Values, Similar Matrices, Diagonalizable Operators, Annihilating Polynomials, Minimal Polynomials, Cayley – Hamilton Theorem .	P1,P2,P3	PQ,P6,PT
II	Invariant Subspaces, T-conductor of a vector, T-annihilator of a vector, Simultaneous Triangulation; Simultaneous Diagonalization.	P1,P2,P3,P5	P6,PT
III	Direct – Sum Decompositions, Projections, Invariant Direct Sums,The Primary Decomposition Theorem.	P1,P2,P3,P5	PQ,PT
IV	Cyclic Subspaces and Annihilators, T-cyclic Subspace Generated by a Vector, Companion Matrices, Complementary Subspaces, I-admissible Subspaces, Cyclic Decompositions and Rational form, Generalized Cayley – Hamilton Theorem Invariant Factors.	P1,P2,P4	PQ,P6,PT
V	The Jordan Forms, Elementary Jordan Matrix with Characteristic Value, Computation of Invariant Factors, Elementary Matrices, Smith Normal Forms, Summary; Semi-Simple Operators.	PQ,P6,PT,**P8**	PQ,PT

ALGEBRA-II LESSON PLAN

Course: B.SC	Year: I	Semester: II
Subject	ALGEBRA-II	
Units	1. ALGEBRAIC EXTENSION OF FIELDS 2. NORMAL AND SEPARABLE EXTENSIONS 3. NORMAL AND SEPARABLE EXTENSIONS 4. GALOIS THEORY 5. APPLICATIONS OF GALOIS THEORY TO CLASSICAL PROBLEMS	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • Introduces to various methods for testing of irreducibility of polynomials over fields. • Study of multiplicity of roots of polynomial fields introduces to classification studies according to characteristics of fields • The study of finite field theory forms a basis for fundamental research in algebra. • The study of Galois theory introduces to new proof techniques.	

Resource Material:	**StudyMaterial(Handouts):** Basic Abstract Algebra: P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Second edition, Cambridge University Press, printed and bound in India at Replika Press Pvt. Ltd., 2001. **Reference Books:** 1. Topics in Algebra : I.N.Herstein, 2nd Edition, John Wiley &Sons 2. Algebra : Serge Lang, Revised Third Edition, Springer 3. Algebra : Thomas W. Hungerford, Springer **YouTube Links:** https://youtu.be/100Im_72xl4

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Algebraic extension of fields: Irreducible polynomials and Eisenstein's criterion-Adjunction of roots-Algebraic extensions- Algebraically closed fields.	P1,P2,P3	PQ,P6,PT
II	Normal and separable extensions: Splitting fields-Normal extensions-multiple roots-finite fields.	P1,P2,P3,P5	P6,PT
III	Normal and separable extensions: Separable extensions. Galois Theory: Automorphism groups and fixed fields-fundamental theorem of Galois Theory.	P1,P2,P3,P5	PQ,PT
IV	Galois Theory: Fundamental theorem of algebra. Galois Theory and Applications of Galois Theory to Classical problems: Roots of unity and cyclotomic polynomials-Cyclic extensions	P1,P2,P4	PQ,P6,PT
V	Applications of Galois Theory to Classical problems: Polynomials solvable by radicals-symmetric functions-Ruler and compass constructions.	PQ,P6,PT,**P8**	PQ,PT

REAL ANALYSIS-II LESSON PLAN

Course: B.SC	Year: I	Semester: II
Subject	ALGEBRA-II	
Units	1. Sequences and Series of Functions 2. Sequences and Series of Functions continued 3. Some Special Functions 4. Functions of several variables 5. Functions of several variables continued	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To understand the behaviour of inter change property of limits. • Approximation of continuous function and Stone-Weierstrass theorem, convergence of power series. • Identification of exponential and logarithmic functions, Trigonometric functions and Fourier series and their properties. • To understand Linear operator properties, existence of derivative of functions of several • Able to understand the method of solving implicit equations, rank theorem, derivatives of higher order and differentiation of integrals	

Resource Material:	**StudyMaterial(Handouts):** Walter Rudin, Principles of Mathematical Analysis, International Student Edition, 3rd Edition, 1985. **Reference Books:** Tom M. Apostal, Mathematical Analysis, Narosa Publishing House, 2nd Edition, 1985. **YouTube Links:** https://youtu.be/Rmp6al-K9H0

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Sequences and Series of Functions: Discussion of Main problem, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform convergence and differentiation.	P1,P2,P3	PQ,P6,PT
II	Sequences and Series of Functions continued: The Stone-Weierstrass Theorem.	P1,P2,P3,P5	P6,PT
III	Sequences and Series of Functions continued: The Stone-Weierstrass Theorem.	P1,P2,P3,P5	PQ,PT
IV	Functions of several variables: Linear transformations, Differentiation, The Contraction principle, The Inverse Function theorem.	P1,P2,P4	PQ,P6,PT
V	Functions of several variables continued: The implicit Function theorem, The Rank theorem, Determinants, Derivatives of higher order, Differentiation of integrals.	PQ,P6,PT,**P8**	PQ,PT

TOPOLOGY-II LESSON PLAN

Course: B.SC	Year: I	Semester: II
Subject	TOPOLOGY-II	
Units	1. Separation 2. Separation (continued) 3. Connectednedness (continued) 4. Approximation 5. Approximation (continued)	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • will be able to understand various toplogical spaces like T 1 spaces, Hausdorff spaces, Completely regular spaces, normal spaces • will be able to prove the existence of continuous functions on normal spaces • To characterize connected subsets of Real number system , understand local connectedness and totally disconnected spaces • The student will be able to prove various approximation theorems for continuous functions	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Topology and Modern Analysis by G. F. Simmons, International Student edition – McGraw – Hill Kogakusha, Ltd. **YouTube Links:** https://youtu.be/eg2yKCpUxAI

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Separation: T_1 spaces and Hausdorff spaces – Completely regular spaces and normal spaces – Urysohn's lemma and the Tietze's extension theorem.	P1,P2,P3	PQ,P6,PT
II	Separation (continued): The Urysohn imbedding theorem – The Stone – Chech compactification. Connectedness: Connected spaces– connectedness of R^n and C^n.	P1,P2,P3,P5	P6,PT
III	Connectednedness (continued): The components of a space – Totally disconnected spaces – Locally connected spaces.	P1,P2,P3,P5	PQ,PT
IV	Approximation: The Weierstrass approximation theorem - The Stone-Weierstrass theorems	P1,P2,P4	PQ,P6,PT
V	Approximation (continued): –-Locally compact Hausdorff spaces – The extended Stone-Weierstrass theorems.	PQ,P6,PT,**P8**	PQ,PT

COMPLEX ANALYSIS LESSON PLAN

Course: B.SC	Year: I	Semester: II
Subject	COMPLEX ANALYSIS	
Units	1. Power series 2. Power series representation of analytic functions 3. Cauchy's theorem and integral formula 4. Classification of singularities 5. The maximum principle	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To be able to solve problems using the properties of analytic functions like power series expansion, Cauchy-Riemann equations etc. • To be able to analyze the properties of power series and apply them to understand properties of analytic functions. • To be able to apply the Cauchy integral formula to solve problems. • To be able to analyze the zeros of analytic functions. • To identify and analyze the nature of singularities and behavior of functions near the singularities. • To be able to apply maximum principle and Schwartz lemma etc to solve problems.	

Resource Material:	**StudyMaterial(Handouts):** Functions of one complex variable by J.B.Conway : Second edition, Springer International student Edition, Narosa Publishing House, New Delhi. **YouTube Links:** https://youtu.be/He0b7Fg-6GY

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Power series- Analytic functions - Analytic functions as mappings, Mobius transformations	P1,P2,P3	PQ,P6,PT
II	Power series representation of analytic functions- zeros of an analytic function - The index of a closed curve	P1,P2,P3,P5	P6,PT
III	Cauchy's theorem and integral formula- Counting zeros, the Open mapping theorem	P1,P2,P3,P5	PQ,PT
IV	Classification of singularities – residues and related results	P1,P2,P4	PQ,P6,PT
V	The maximum principle – Schwarz's lemma and related results.	PQ,P6,PT,**P8**	PQ,PT

DISCRETE MATHEMATICS LESSON PLAN

Course: B.SC	Year: I	Semester: II
Subject	DISCRETE MATHEMATICS	
Units	1. Connectivity 2. Trees 3. Traversability 4. Poset Definition 5. Modular and Distributive Lattices	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To learn the applications of graph theory in other subjects. • To understand representations of different problems by means of graphs. • To learn the relation between bipartite graphs and odd cycles. • To learn the concepts of forest, binary trees, eccentricity of a vertex and radius of connected graphs. To learn the importance of multi graphs in other subjects like physics and chemistry. • To learn different characterizations of modular and distributive lattices.	

Resource Material:	**StudyMaterial(Handouts):** **Text Book 1** : Graph Theory Applications by L.R.Foulds, Narosa Publishing House, New Delhi. **Text Book 2** : Discrete Mathematical Structures by Kolman and Busby and Sharen Ross, Prentic Hall of India – 2000, 3rd Edition **Text Book 3** : Applied Abstract Algebra by Rudolf Lidl and Gunter Pilz , Published by Springer-Verlag. **YouTube Links:** https://youtu.be/wGLTV8MgLlA

Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Basic Ideas, History, Initial Concepts, Summary, Connectivity , Elementary Results, Structure Based on Connectivity .	P1,P2,P3	PQ,P6,PT
II	Trees,Characterizations, Theorems on Trees, Tree Distances, Binary trees, Tree Enumeration, Spanning trees, Fundamental Cycles, Summary.	P1,P2,P3,P5	P6,PT
III	Traversability, Introduction, Eulerian Graphs, Hamiltonian Graphs, Minimal Spanning Trees, J.B.Kruskal's Algorithm, R.C.Prim's Algorithm.	P1,P2,P3,P5	PQ,PT
IV	Poset Definition, Properties of Posets, Lattice Definition, Properties of Lattices.	P1,P2,P4	PQ,P6,PT
V	Definitions of Modular and Distributive Lattices and its Properties.	PQ,P6,PT,**P8**	PQ,PT

FUNCTIONAL ANALYSIS LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	**FUNCTIONAL ANALYSIS**	
Units	1. BANACH SPACES 2. Banach Spaces continued 3. HILBERT SPACES 4. Hilbert Spaces continued 5. FINITE-DIMENSIONAL SPECTRAL THEORY	
Duration	**60hours**	

Learning Objectives	**After completing this course, the students hall be able to:** • Understand that a Banach space is richly supplied with continuous linear functions, and makes possible an adequate theory of conjugate spaces. • The open mapping theorem enables us to give a satisfactory description of the projections on a Banach space, and has the important closed graph theorem as one of its consequences. • Enable to understand that a Hilbert space is a special type of a Banach space and it is concerned solely with the geometric implications, when two vectors are orthogonal vectors. • Understand the natural correspondence between the vectors in H and the functions in H*, and the adjoint of an operator on a Hilbert space and its properties. • Enable to understand about the spectral resolution of a normal operator on finite dimensional Hilbert spaces.

Resource Material:	**StudyMaterial(Handouts):** G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, International Student Edition, 1963. **Reference Books:** Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 2001. **YouTube Links:** https://youtu.be/11cuVi_IqhQ

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	BANACH SPACES: The definition and some examples, Continuous linear transformations, The Hahn-Banach theorem.	P1,P2,P3	PQ,P6,PT
II	Banach Spaces continued: The natural imbedding of N in N^{**}, Then open mapping theorem, The Conjugate of an operator.	P1,P2,P3,P5	P6,PT
III	HILBERT SPACES: The definition and some simple properties, Orthogonal complements, Orthonormal sets.	P1,P2,P3,P5	PQ,PT
IV	Hilbert Spaces continued: The Conjugate space H^{*}, The adjoint of an operator, Self-adjoint operators, Normal and unitary operators, Projections	P1,P2,P4	PQ,P6,PT
V	FINITE-DIMENSIONAL SPECTRAL THEORY: Matrices, Determinants and the spectrum of an operator, The spectral theorem, A survey of the situation.	PQ,P6,PT,**P8**	PQ,PT

CALCULUS OF VARIATIONS LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	CALCULUS OF VARIATIONS	
Units	1. Variation and its properties 2. Variational problems in parametric form 3. Extremals with corners 4. Field of extremals 5. Constraints of the form Φ(x,Y)	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To appreciate the transition between functions and functionals in terms of calculus. • To comprehend the theory behind Calculus of variations • To realise the potential applications to real world problems • To be able to apply the knowledge to optimal control problems pertaining to fields such as Mathematical biology, Mathematical Economics and Mathematical Bio Economic etc.	

Resource Material:	**StudyMaterial(Handouts):** Differential Equations and the Calculus of Variations, L. Elsgolts, 1977, Mir Publications **Reference Books:** A.S. Gupta, Calculus of Variations with Applications, PHI Learning Private Limited, 2009 **YouTube Links:** https://youtu.be/uT50hM_I8kM

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Variation and its properties- Euler's equation- Functionals of the form $\int_{x_2}^{x_1} F(x, Y, Y')dx$- Functionals dependent on higher order derivatives-Functionals dependent on the functions of several independent variables	P1,P2,P3	PQ,P6,PT
II	Variational problems in parametric form – some applications – An elementary problem with moving boundaries-Moving boundary problem for a functional of the form $\int_{x2}^{x1} F(x, Y, Y')$	P1,P2,P3,P5	P6,PT
III	Extremals with corners –one sided variations and related problems	P1,P2,P3,P5	PQ,PT
IV	Field of extremals – The function E(x,y,p,y') – Transforming the Euler equations to the canonical form	P1,P2,P4	PQ,P6,PT
V	Constraints of the form Φ(x,Y) = 0 – Constraints of the form Φ(x,Y,Y') = 0 – Isoperimetric problems	PQ,P6,PT,**P8**	PQ,PT

NUMBER THEORY-I LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	NUMBER THEORY	
Units	1. ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION 2. AVERAGES OF ARITHMETICAL FUNCTIONS 3. SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMBERS 4. CONGRUENCES 5. FINITE ABELIAN GROUPS AND THEIR CHARACTERS	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • The study on arithmetical functions enables understanding the study of divisibility of integers and distribution of primes. • The study on congruences enables understanding modular arithmetic. • The study on properties of congruences helps in the study of Diophantine equations • The study on Prime number theorem introduces to fundamental research in Number theory.	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Analytic Number Theory, By T.M.APOSTOL-Springer Verlag-New York, Heidalberg-Berlin-1976. **Reference Books:** 1. An Introduction to the theory of numbers, 5th edition by Ivan Niven Herbert S. Zuckerman and Huge L. Montgomery, John Wiley & Sons INC. publications, U.K., 2008. 2. Elementary Number Theory, 7th edition by David M. Burton, 2011. **YouTube Links:** https://youtu.be/IA40GpqqnOs

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION: Introduction- The Mobius function μ (n) – The Euler totient function φ (n)- A relation connecting μ and φ -A product formula for φ (n)- The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt function Λ (n)- multiplicative functions- multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Liouville's function $\lambda(n)$ - The divisor functions $\sigma_\alpha(n)$ -Generalized convolutions.	P1,P2,P3	PQ,P6,PT
II	AVERAGES OF ARITHMETICAL FUNCTIONS: Introduction- The big oh notation. Asymptotic equality of functions- Euler's summation formula- Some elementary asymptotic formulas-The average order of d(n)- The average order of the divisor functions $\sigma_\alpha(n)$ - The average order of φ (n)-An application to distribution of lattice points visible from the origin. The average order of μ (n) and Λ (n). The partial sums of a Dirichlet product- Applications to μ (n) and Λ (n).	P1,P2,P3,P5	P6,PT
III	SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMBERS: Introduction- Chebyshev's functions $\psi(x)$ and $\theta(x)$ - Relations connecting $\theta(x)$ and $\pi(x)$ - Some equivalent forms of the prime number theorem-Inequalities for $\pi(n)$ and p_n - Shapiro's Tauberian theorem- Applications of Shapiro's theorem- An asymptotic formula for the partial sums $\sum_{p\le x}(1/p)$ - The partial sums of the Mobius function – The partial sums of the Mobius function. Brief sketch of an elementary proof of prime number theorem.	P1,P2,P3,P5	PQ,PT
IV	CONGRUENCES: Definition and basic properties of congruences- Residue classes and complete residue systems- Linear congruences- Reduced residue systems and the Euler- Fermat theorem- Polynomial congruences modulo p. Lagrange's theorem- Applications of Lagrange's theorem- Simultaneous linear congruences. The Chinese remainder theorem- Applications of the Chinese remainder theorem.	P1,P2,P4	PQ,P6,PT

V	FINITE ABELIAN GROUPS AND THEIR CHARACTERS: Characters of finite abelian groups- The character group- The orthogonality relations for characters- Dirichlet characters- Sums involving Dirichlet characters-The nonvanishing of L(1,) for real nonprincipal DIRICHLET’S THEOREM FOR PRIMES IN ARITHMETIC PROGRESSION Introduction- Dirichlet’s theorem for primes of the form 4n-1 and 4n+1- The plan of the proof of Dirichlet’s theorem	PQ,P6,PT,**P8**	PQ,PT

LATTICE THEORY-I LESSON PLAN

Course: B.SC	**Year: II**	**Semester: III**
Subject	**LATTICE THEORY**	
Units	1. Set Theoretical Notations 2. Algebras 3. Bound Elements of Lattices 4. Complete Lattices 5. Subalgebra Lattice of an Algebra	
Duration	**60hours**	
Learning Objectives	**After completing this course, the students hall be able to:** • To understand maximum and minimum conditions in posets. • To learn irreducible and prime elements of a lattice. • To learn the property of homomorphism of a lattices. • To study complete sublattices of a complete lattice. • To learn Galois Connections, Dedekind Cuts in complete lattices.	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Lattice Theory, by Gabor Szasz, Academic Press, New York. . **YouTube Links:** https://youtu.be/-fU3oGashQ0

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Set Theoretical Notations, Relations, Partly Ordered Sets, Diagrams, Special Subsets of a Partly Ordered Set, Length, Lower and Upper Bounds, The Minimum and Maximum Condition, The Jordan Dedekind Chain Condition, Dimension Functions.	P1,P2,P3	PQ,P6,PT
II	Algebras, Lattices, The Lattice Theoretic Duality Pinciple, Semilattices, Lattices as Partly Ordered Sets, Diagrams of Lattices, Sublattices and Ideals.	P1,P2,P3,P5	P6,PT
III	Bound Elements of Lattices, Atoms and Dual Atoms, Complements, Relative Complements, Semicomplements, Irreducible and Prime Elements of a Lattice, The Homomorphism of a Lattice, Axioms Systems of Lattices.	P1,P2,P3,P5	PQ,PT
IV	Complete Lattices, Complete Sublattices of a Complete Lattice, Conditionally Complete Lattices, σ-Lattices, Compact Elements, Compactly Generated Lattices.	P1,P2,P4	PQ,P6,PT
V	Subalgebra Lattice of an Algebra, Closure Operations, Galois Connections, Dedekind Cuts, Partly Ordered Sets as Topological Spaces.	PQ,P6,PT,**P8**	PQ,PT

COMMUTATIVE ALGEBRA-I LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	COMMUTATIVE ALGEBRA	
Units	1. Rings and ring homomorphisms 2. Operations on Ideals 3. Modules and Module Homomorphism 4. Exact Sequences 5. Rings and Modules of Fractions	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To understand the relation between ideals and quotient rings. • To learn the difference between prime ideals and maximal ideals by means of examples. • To learn the properties of finitely generated modules. • To figure out the exactness properties of tensor products. • To realize local properties of rings and modules of fractions.	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Commutative Algebra, By M.F. ATIYAH and I.G. MACDONALD, Addison-Wesley Publishing Company, London. . **YouTube Links:** https://youtu.be/QOTf8KfrZFU

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Rings and ring homomorphisms, Ideals, Quotient rings, Zero divisors, Nilpotent Elements, Units, Prime Ideals and Maximal Ideals, Nilradical and Jacobson Radical.	P1,P2,P3	PQ,P6,PT
II	Operations on Ideals, Extension and Contraction.	P1,P2,P3,P5	P6,PT
III	Modules and Module Homomorphism, Submodules and Quotient Modules, Operations on Submodules, Direct Sum and Product, Finitely Generated Modules.	P1,P2,P3,P5	PQ,PT
IV	Exact Sequences, Tensor Poduct of Modules, Restriction and Extension of Scalars, Exactness Properties of the Tensor Product, Algebras, Tensor Product of Algebras.	P1,P2,P4	PQ,P6,PT
V	Rings and Modules of Fractions, Local Properties, Extended and Contracted Ideals in Rings of fractions.	PQ,P6,PT,**P8**	PQ,PT

MEASURE AND INTEGRATION LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	MEASURE AND INTEGRATION	
Units	1. Lebesgue Measure 2. Lebesgue Measure Continued 3. The Lebesgue Integral 4. Differentiation and Integration 5. The Classical Banach spaces	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To understand the fundamental concepts, namely outer measure, measurable sets and Lebesgue measure. • Very interesting fact of the existence of nonmeasursble set and understanding of measurable functions. • To recognise the importance of Lebesgue integral as a generalization of Riemann integral. • To understand the differentiation of monotone functions, differentiation of an integral and convex functions. • To understand the L^p spaces as Banach spaces for $1 \leq p \leq \infty$ and bounded linear functional on the L^p spaces.	

Resource Material:	**StudyMaterial(Handouts):** H.L.Royden, Real Analysis, Macmillan Publishing Company, New York, 3rd Edition, 1988. **Reference Books:** . Inder K.Rana, An Introduction to Measure and Integration, 2nd Edition, Narosa Publishing House, 2002. **YouTube Links:** https://youtu.be/6Px5l8QAs-g

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Lebesgue Measure: Introduction, Outer measure, Measurable sets and Lebesgue Measure, Littlewood's first principle.	P1,P2,P3	PQ,P6,PT
II	Lebesgue Measure Continued: A nonmeasurable set, Measurable functions, Littelwood's second principle, Littlewood's third principle.	P1,P2,P3,P5	P6,PT
III	The Lebesgue Integral: The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of a nonnegative function, The general Lebesgue integral.	P1,P2,P3,P5	PQ,PT
IV	Differentiation and Integration: Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions.	P1,P2,P4	PQ,P6,PT
V	The Classical Banach spaces: The L^pspaces, The Minkowski and Hölder inequalities, Convergence and Completeness, Approximation in L^p, Boinded linear functional on the L^p spaces.	P1,P2,P3,P5	PQ,PT

PARTIAL DIFFERENTIAL EQUATIONS LESSON PLANS

Course: B.SC	Year: II	Semester: III
Subject	PARTIAL DIFFERENTIAL EQUATIONS	
Units	1. First Order Partial Differential Equations 2. Nonlinear first order PDEs 3. Hyperbolic Equations 4. Elliptic equations 5. Parabolic Equations	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To comprehend the basic structure of partial differential equations and their categorisation • To understand the basic methods to compute solutions of simple partial differential equations. • To be aware of the theory behind existence of solutions of a few well known problems associated with partial differential equations • To recognise the significance classifying second order partial differential equations into cannonical forms • To figure out qualitative behaviour of solutions of initial and boundary value problems associated with partial differential equations of various orders.	

Resource Material:	**StudyMaterial(Handouts):** Partial Differential Equations through Examples and Exercises, Endre Pap, Arpad Takaci and Djurdjica Takaci, Kluwer Texts in Mathematical Sciences, Volume 18, 1997 Springer Science+Business Media, Dordrecht **Reference Books:** Elements of Partial Differential Equations, Ian Sneddon, McGraw-Hill International editions, New Delhi **YouTube Links:** https://youtu.be/WxwPNVEZP2o

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Partial First Order Differential Equations – Quasi linear PDEs – Pfaff's Equations	P1,P2,P3	PQ,P6,PT
II	Nonlinear first order PDEs-Classification of the second order PDEs in two independent variables – wave, potential and Heat equations	P1,P2,P3,P5	P6,PT
III	Hyperbolic Equations – Cauchy problem for one dimensional wave equation – The Fourier method of Separation of variables	P1,P2,P3,P5	PQ,PT
IV	Elliptic equations – Dirichlet problems involving Cartesian coordinates	P1,P2,P4	PQ,P6,PT
V	Parabolic Equations – Cauchy problem – Mixed type problems	PQ,P6,PT,**P8**	PQ,PT

NUMBER THEORY-II LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	NUMBER THEORY	
Units	1. quadratic residues and the quadratic reciprocity law 2. primitive roots 3. dirichlet series and euler products 4. dirichlet series and euler products 5. Analytic proof the Prime Number Theorem	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • The study on Quadratic residues and primitive roots introduces to several new techniques adapted in the proofs. • The study on Quadratic residues and primitive roots motivates towards the study of their applications in Number theory and other areas in mathematics • The study properties of Dirichlet series introduces to ingenious methods and develops the connection with continuous quantities for set of discrete set of integers. • The study on prime number theory introduces to unsolved problem called Riemann hypothesis and motivates towards fundamental research in Number theory	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Analytic Number Theory, By T.M.APOSTOL-Springer Verlag-New York, Heidalberg-Berlin-1976. **Reference Books:** 1. An Introduction to the theory of numbers, 5th edition by Ivan Niven Herbert S. Zuckerman and Huge L. Montgomery, John Wiley & Sons INC. publications, U.K., 2008. 2. Elementary Number Theory, 7th edition by David M. Burton, 2011. **YouTube Links:** https://youtu.be/uWkkpWk_73I

I. Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	QUADRATIC RESIDUES AND THE QUADRATIC RECIPROCITY LAW: Quadratic residues- Legendre's symbol and its properties- Evaluation of (-1/p) and (2/p)- Gauss Lemma- The quadratic reciprocity law-Applications of the reciprocity law- The Jacobi symbol-Applications to Diophantine equations.	P1,P2,P3	PQ,P6,PT
II	PRIMITIVE ROOTS: The exponent of a number mod m. Primitive roots- Primitive roots and reduced residue systems-The nonexistence of primitive roots mod 2^{α} for $\alpha \geq 3$ - The existence of primitive roots and p for odd primes p. Primitive roots and quadratic residues- The existence of primitive roots mod p^{α} - The existence of primitive roots mod 2 p^{α} - The nonexistence of primitive roots in the remaining cases- The number of primitive roots mod m.	P1,P2,P3,P5	P6,PT
III	DIRICHLET SERIES AND EULER PRODUCTS: Introduction-The half- plane of absolute convergence of a Dirichlet series, The function defined by Dirichlet series, Multiplication of Dirichlet series, Euler Products, The half-plane of convergence of a Dirichlet series	P1,P2,P3,P5	PQ,PT
IV	DIRICHLET SERIES AND EULER PRODUCTS: Analytic properties of Dirichlet series- Dirichlet series with nonnegative coefficients- Dirichlet series expressed as exponential of Dirichlet series-Mean value formulas for Dirichlet series-An integral formula for the coefficients of a Dirichlet series-An integral formula for the partial sums of a Dirichlet series.	P1,P2,P4	PQ,P6,PT
V	Analytic proof the Prime Number Theorem: The plan of the proof, lemmas, A contour integral representation of $\psi_1(x)/x^2$, Upper bounds for $\|\zeta(s)\|$ and $\|\zeta'(s)\|$ near the line $\sigma = 1$, The non vanishing of ζ(s) on the line $\sigma = 1$, Inequalities for $\|1/\zeta(s)\|$ and $\|\zeta'(s)/\zeta(s)\|$, Completion of the proof of the prime number theorem	PQ,P6,PT,**P8**	PQ,PT

LATTICE THEORY-II LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	LATTICE THEORY-II	
Units	1. Distributive Lattices 2. Ddistributive Sublattices of Modular Lattices 3. Boolean Algebras 4. The Algebra of Relations 5. Ideals and Dual Ideals	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To comprehend the relation between distributive and modular lattices. • To learn the properties of distributive sublattices of modular lattices. • To study Boolean algebras and De-Morgan's Laws. • To learn algebra of relations. • To recognize the significance of ideal lattices.	

Resource Material:	**StudyMaterial(Handouts):** Introduction to Lattice Theory by Gabor Szasz, Academic Press, New York. Books for reference: General Lattice Theory by G. Gratzer, Academic Press, New York. **YouTube Links:** https://youtu.be/21IzHN9-CjE

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Distributive Lattices, Infinitely Distributive and Completely Distributive Lattices, Modular Lattices, Characterization of Modular and Distributive Lattices by their Sublattices.	P1,P2,P3	PQ,P6,PT
II	Ddistributive Sublattices of Modular Lattices, The Isomorphism Theorem of Modular Lattices, Covering Conditions, Meet Representations in Modular and Distributive Lattices.	P1,P2,P3,P5	P6,PT
III	Boolean Algebras, De Morgan Formulae, Complete Boolean Algebras, Boolean Algebras and Boolean Rings.	P1,P2,P3,P5	PQ,PT
IV	The Algebra of Relations, The Lattice of Propositions, Valuations of Boolean Algebras.	P1,P2,P4	PQ,P6,PT
V	Ideals and Dual Ideals, Ideal Chains, Ideal Lattices, Distributive Lattices and Rings of Sets.	PQ,P6,PT,**P8**	PQ,PT

COMMUTATIVE ALGEBRA-II LESSON PLAN

Course: B.SC	Year: II	Semester: III
Subject	COMMUTATIVE ALGEBRA-II	
Units	1. Primary Decomposition 2. Integral Dependence 3. Chain Conditions 4. Noetherian Rings 5. Artin Rings.	
Duration	60hours	
Learning Objectives	**After completing this course, the students hall be able to:** • To understand the importance of primary decomposition in rings. • To learn the relation between integral dependent and integrally closed integral domains. • To learn the relation between exact sequences and quotient modulus. • To learn The Hilbert Basis Theorem. • To recognize the importance of The Structure Theorem for Artin rings.	

Resource Material:	StudyMaterial(Handouts): Introduction to Commutative Algebra by M.F.Atiya and I.G. Macdonald, Addison-Wesley Publishing Company, London YouTube Links: https://youtu.be/YHA9W2KqAGw

I.Academic-Pedagogical-Evaluation: Unit-wise Pedagogy

UNIT	DESCRIPTION	PEDAGOGY	INTERNAL EVALUATION
I	Primary Decomposition, The First Uniqueness Theorem, The Second Uniqueness Theorem.	P1,P2,P3	PQ,P6,PT
II	Integral Dependence, The Going-Up Theorem, Integrally Closed Integral Domains, The Going-Down Theorem, Valuation Rings.	P1,P2,P3,P5	P6,PT
III	Chain Conditions.	P1,P2,P3,P5	PQ,PT
IV	Noetherian Rings, Hilbert's Basis Theorem, Primary decomposition of Noetherian rings.	P1,P2,P4	PQ,P6,PT
V	Artin Rings.	PQ,P6,PT,**P8**	PQ,PT