Far Western University
Mahendranagar, Kanchanpur
Faculty of Education
B.Ed. in Mathematics Education

Far Western University
Faculty of Education
B.Ed. in Mathematics Education

Semester-First

1. Calculus I (Math.Ed.101) Credit: 3

Semester-Second

1. Basic Linear Algebra (Math.Ed.121) Credit: 3
2. Roads to Geometry (Math.Ed.122) Credit: 3

Semester-Third

1. Analytical Geometry (Math.Ed.231) Credit: 3
2. Discrete Mathematics (Math.Ed.232) Credit: 3

Semester-Fourth

1. Teaching Algebra (Math.Ed.241) Credit: 3
2. Real Analysis I (Math.Ed.242) Credit: 3
3. Probability and Statistics (Math.Ed.243) Credit: 3

Semester-Fifth

1. Real Analysis II (Math.Ed.351) Credit: 3
2. Calculus II (Math.Ed.352) Credit: 3
3. History of Mathematics (Math.Ed.353) Credit: 3
4. Teaching Arithmetic (Math.Ed.354) Credit: 3

Semester-Sixth

1. Abstract Algebra (Math.Ed.361) Credit: 3
2. Professional Development of Mathematics Teacher (Math.Ed.362) Credit: 3
3. Teaching Mathematics in Secondary Level (Math.Ed.363) Credit: 3
4. Vector Analysis (Math.Ed.364) Credit: 3

Semester-Seventh

1. Number Theory (Math.Ed.471) Credit: 3
2. Graph Theory (Math.Ed.472) Credit: 3
3. Enrichment of Mathematics Teachers (Math.Ed.473) Credit: 3

Semester-Eighth

1. Mathematical Analysis (Math.Ed.481) Credit: 3

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B.Ed. in Mathematics Education

Course Title: **Calculus I**

Course No. : Maths.Ed.101 | Level: B. Ed.
Semester: First | Full marks: 100
Credit Hour: 3 (45 hours) | Pass marks: 45

- **Course Introduction**

This course is designed for undergraduate students to develop acquaintance with fundamental principles, approaches and techniques of calculus. Starting with the basic concepts of limits, continuity and derivatives, the course covers key Mean Value Theorems and their applications, partial differentiations, and different dimensions of integral calculus. Whilst the due emphasis is given to conceptual understanding and problem investigation, students will experience some key application areas in the learning process of this course.

- **General Objectives**

General objectives of this course are as follows:

- To help the students develop understandings of various techniques, principles and approaches of differential calculus
- To make them apply differential calculus in solving problems of other branches of mathematics
- To help them use differential calculus whilst studying the properties of tangent and normal of a curve
- To provide them an understanding of various techniques, principles and application of integral calculus
- To make the use integral calculus to evaluate the area of plane curves, length of arc.
- To help them use differential equation as an alternative form for representing different types of family of curves
- To make them apply differential equations so as to derive geometrical properties of the curve in the process of solving problems.
- To help the students develop understanding of asymptotes, definite and indefinite integrals.
- To make them apply Beta and Gama functions.

- **Contents in Detail with Specific Objectives**

Specific Objectives	**Contents**
• define the concept of limit in a standard form	**Unit 1: Limit, Continuity and Derivatives (3 hours)**
• use algebraic techniques to evaluate limits	1.1 The limit of a function (- definition)
• define continuity and discontinuity, and determine whether a function is continuous at a point and on an interval	1.2 Calculating limits using the limit laws, limit at infinity 1.3 Continuity and discontinuity of a function
• define a derivative and find the differential	1.4 The derivatives of functions

coefficient of different types of function.	1.5 derivatives of polynomials, exponentials, trigonometric, logarithmic function, hyperbolic function 1.6 The product, quotient, chain rules 1.7 The implicit function
• define and use the notation of higher order derivatives • find the higher order derivatives of some functions. • state and prove the Leibnitz theorem; solve the problems using Leibnitz theorem.	**Unit 2: Higher Order Derivatives (2 hours)** 2.1. Definition and notation in higher order derivatives 2.2. Derivatives (nth order) of the functions such as: x^n, $(ax + b)^n$, sin(ax + b), log (ax +b) etc. 2.3 Leibnitz theorem and its application
• state and prove Roll's theorem; verify it for some functions • state and prove Lagrange's mean value theorem; verify it for some functions • state and prove Cauchy's mean value theorem; verify it for some functions	**Unit 3: Mean Value Theorem and its applications (5 hours)** 3.1 Roll's Theorem 3.2 Lagrange's mean value theorem 3.3 Cauchy's mean value theorem
• state different types of indeterminate forms • state, prove and generalize the L'hospital's theorem • calculate the limits of functions of various indeterminate forms	**Unit 4: Indeterminate forms (3 hours)** 4.1 Different indeterminate forms 4.2 L'hospital's theorem 4.3 Limits of functions of indeterminate forms
• state the condition under which the functions of two variables become continuous. • define partial derivatives with examples • interpret geometrically the partial derivatives of first order of two variables • calculate partial derivatives of higher order • state, verify and use the Euler's theorem on homogeneous function s • find the derivatives of composite functions • find the derivatives of implicit functions	**Unit 5: Partial Differentiation (5 hours)** 5.1 Limits and continuity of functions of two variables 5.2 Definition of partial derivatives 5.3 Geometrical interpretation of partial derivatives of first order 5.4 Partial derivatives of higher order 5.5 Homogeneous function, Euler's theorem on homogeneous functions on two variables 5.6 Derivatives of composite functions 5.7 Derivatives of implicit functions
• derive equation of tangents and normal of curves in different forms (explicit, implicit and parametric forms) • find the angle of intersection of two curves in Cartesian and polar forms • find the length of sub/tangent, sun/normal in Cartesian and polar forms • calculate the derivatives of arc length in	**Unit 6: Tangent and Normal (6 hours)** 6.1 Equation of tangent and normal 6.2 Angle of intersection of two curves (Cartesian and polar forms) 6.3 Length of sub/tangent, sub/normal (Cartesian and polar forms) 6.4 Derivatives of arc length (Cartesian and polar forms)

Cartesian and polar forms	
• define and identify the increasing and decreasing functions, concavity and convexity, stationary points, point of inflections and saddle points • state and prove the conditions for maximum and minimum of the functions in the process of solving related problems • state the various constraints for extreme values while solving problems • use Lagrange's methods of undetermined multipliers whilst calculating maximum/minimum values	**Unit 7: Maxima and Minima (6 hours)** 7.1 Increasing and decreasing functions, concavity and convexity, stationary points, point of inflections and saddle points 7.2 Conditions for maximum and minimum of functions (up to three variables) 7.3 Extreme values under various constraints 7.4 Lagrange's methods of undetermined multipliers
• define asymptotes and represent in a graph • determine horizontal, vertical and oblique asymptotes • find the asymptotes of some algebraic and polar curves	**Unit 8: Asymptotes (3 hours)** 8.1 Definition of asymptotes, its representation in graph 8.2 Horizontal, vertical and oblique asymptotes 8.3 Asymptotes of algebraic and polar curves
• illustrate the properties of the curve while sketching it • sketch the curves of some functions	**Unit 9: Curve Sketching (3 hours)** 9.1 Properties for curve Sketching (symmetry, origin, noticeable points, tangents at origin, points of inflections, concavity and convexity, asymptotes) 9.2 Curve Sketching of some functions
• integrate different types of function of standard forms by different methods	**Unit 10: Indefinite Integral (2 hours)** 10.1 Integration of some standard integrals
• define integration with examples • provide geometrical interpretation of the definite integral • state and use the properties of definite integral to solve the problems	**Unit 11: Definite Integral (4 hours)** 11.1 Integration as the limit of sum 11.2 Geometrical interpretation of the definite integral 11.3 General properties of definite integral
• define Beta and Gamma functions • state and apply the properties of Beta and Gamma functions to evaluate some integrals	**Unit 12: Beta and Gamma Function (3 hours)** 12.1 Definition of Beta and Gamma Functions 12.2 Properties and applications of Beta and Gamma Functions

Recommended books

- Koirala, S. P, Pandey, U. N, Pahari, N and Pokhrel, P (2008). *A textbook on differential calculus*. Vidyarthi Prakashan: Kathmandu (Unit 1,2,3,4,5,6,7, 8, 9)

- Koirala, S. P, Pandey, U. N, Pahari, N and Pokhrel, P (2008*). A textbook on integral calculus*. Vidyarthi Prakashan: Kathmandu (Unit 10,11, 12)

References

- Spivak, M. (2008). *Calculus*. New York: Cambridge University Press. (for all units)
- Larson, R., & Edwards, B. H. (2009). *Calculus* (9th ed.). New York: Brooks/Cole. (for all units)
- Thomas, G.B. & Finney, R.L. (2001). *Calculus* (9th edition). Singapore: Pearson Education (for units dedicated to differential calculus)

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Course Title: **Basic Linear Algebra**

Course No. : Math.Ed.121	Nature of course: Theory
Level: B. Ed. (Mathematics)	Semester: Second
Total periods: 45	Time per period: 1 hour

Course Introduction

This course on linear algebra is related to the basic concepts and problems related to matrices and vector space. This course aims to prepare for different applications of linear algebra and matrices. There are nine chapters in the course starting from linear equations. Then the liner geometry will be introduced to make the notion of vector in spaces. The role of matrices will be then introduced and formal vector space will be systematized. Different properties of determinants will also be discussed in the course. The maps between spaces will be introduced to look at the structures of different spaces like homomorphic and isomorphic. Finally the concept and application of eigenvalue and eigenvector are discussed in the similarities of matrices reducing into diagonalizable and Zordan Canonical form.

Course Objectives

At the end of the course students are expected to achieve the following objectives.

a) To apply the concepts of matrices in solving linear equations.
b) To be familiar with the basics of linear algebra.
c) To know the Gram-Schmidt orthogonalization and orthonormalization processes;
d) To use different properties of matrices and determinant in solving different problems.
e) To transform matrices in order to realize different forms of matrices.
f) To calculate eigen-value and eigen-vector of a given matrix.
g) To convert matrices into similar matrices: Diagonalizable and Canonical forms.

Course Contents

The following 9 units are selected for the course.

Unit 1 Linear Equations [3]

Introduction to linear equations
Solving linear equations
The Gauss–Jordan algorithm
Systematic solution of linear systems
Homogeneous systems

Unit 2 Linear Geometry [3]

Vectors in Space
Length and Angle Measures
Reduced Echelon Form
Gauss-Jordan Reduction
The Linear Combination Lemma

Unit 3 Matrices [3]

Matrix arithmetic
Linear transformations
Recurrence relations
Non–singular matrices
Least squares solution of equations

Unit 4 Vector Spaces [6]
Definition of Vector Space
Subspaces and Spanning Sets
Linear Independence
Basis and Dimension
Vector Spaces and Linear Systems
Combining Subspaces
Rank and nullity of a matrix

Unit 5 Determinants [6]
Exploration
Properties of Determinants
The Permutation Expansion
Determinants Exist
Geometry of Determinants
Determinants as Size Functions
Laplace's Expansion
Laplace's Expansion Formula

Unit 6 Maps between Spaces [6]
Isomorphisms
Dimension Characterizes Isomorphism
Homomorphisms
Computing Linear Maps
Representing Linear Maps with Matrices
Any Matrix Represents a Linear Map

Unit 7 Matrix Operations [6]
Sums and Scalar Products
Mechanics of Matrix Multiplication
Change of Basis
Changing Representations of Vectors
Changing Map Representations
Orthogonal Projection into a Line
Gram-Schmidt Orthogonalization
Projection into a Subspace

Unit 8 Eigenvalues and Eigenvectors [6]
Definitions and examples
Identifying second degree equations

The eigenvalue method
Classification algorithm

Unit 9 Similarity [6]

Diagonalizability
Nilpotence
Self-Composition
Strings
Jordan Form
Polynomials of Maps and Matrices
Jordan Canonical Form

Textbooks

Hefferon, J. (2012). *Linear algebra*.
Matthews, K. R. (2012). *Elementary linear algebra*.

References

Chakrabarti, A. (2010). *A first course in linear algebra.* New Delhi, India:Tata McGraw Hill.
Datta, K. B. (2002). *Matrix and linear algebra*. New Delhi, India: Prentice-Hall.
DeFrantz, J. &Gagliardi, D. (2008).*Introduction to linear algebra.* New Delhi, India:Tata McGraw Hill.
Lipschutz, S.(2000). *Linear algebra.* New Delhi, India:Tata McGraw Hill.

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Faculty of Education

Course Title: Roads to Geometry
Course No. : Math.Ed.122 | **Nature of course: Theory**
Level: B.Ed. (Mathematics) | **Semester: 2nd**
Total periods: 45 | **Time per period: 1 hour**

Course Introduction
Geometry is one of the fundamental courses of mathematics study. There are several approaches and perspectives on studying geometric properties. The course tries to see geometric properties in different perspectives. Euclidian and non-Euclidean geometries are the main basics to make such distinctions. The saying “There is no royal road in geometry” may be an absolute in post modern era. This course also gives illustrations for the contextual reality. The contextual discourse is termed as a road in the course.

Course Objectives
At the end of the course the students are expected to achieve the following objectives:

a) To prepare the "Rules of the Road" with the properties of axiomatic systems and the application of the axiomatic method to investigation of these systems.
b) To generate idea about "Many Ways to Go." within a historical perspective, through plane geometry by investigating different axiomatic approaches to the study of Euclidean plane geometry.
c) To develop the notion of "Traveling Together," to investigate the content of Neutral Geometry.
d) To develop skills to move towards "One Way to Go" as a traveler through Euclidean Plane Geometry.
e) To develop the competency of having a "Side Trips" through analytical and transformational approaches to geometry.
f) To seek alternative in geometric tour as "Other Ways to Go" non-Euclidean Geometry.
g) To prove different properties of Projective geometry as all roads have destination to one.

Course Contents

Unit One: Rules of the Road: Axiomatic Systems [6]

Historical Background
Axiomatic Systems and their Properties
Finite Geometries
Axioms for Incidence Geometry.

Unit Two: Many Ways to Go [6]

Euclid's Geometry and Euclid's *Elements*
An Introduction to Modern Euclidean Geometries
Hilbert's Model for Euclidean Geometry
Birkhoff's Model for Euclidean Geometry
SMSG Postulates for Euclidean Geometry
Non-Euclidean Geometries.

Unit Three: Traveling Together (Neutral Geometry) [6]

Preliminary Notions
Congruence Conditions
The Place of Parallels
The Saccheri-Legendre Theorem
The Search for a Rectangle.

Unit Four: One Way to Go (Euclidean Geometry of the Plane) [6]

The Parallel Postulate and Some Implications
Congruence and Area
Similarity
Euclidean Results Concerning Circles
Some Euclidean Results Concerning Triangles
More Euclidean Results Concerning Triangles
The Nine-Point Circle
Euclidean Constructions

Unit Five: Side Trips (Analytic and Transformational Geometry) [6]

Analytic Geometry
Transformational Geometry
Analytic Transformations
Inversion

Unit Six: Other Ways to Go (Non-Euclidean Geometries) [9]

A Return to Neutral Geometry: The Angle of Parallelism
The Hyperbolic Parallel Postulate
Hyperbolic Results Concerning Polygons
Area in Hyperbolic Geometry
Showing Consistency: A Model for Hyperbolic Geometry
Classifying Theorems.
Elliptic Geometry: A Geometry with No Parallels? Geometry in the Real World

Unit 7 All Roads Lead to Projective Geometry [6]

Introduction
Real Projective Plane

Prescribed Texts

Wallace, E. C. &West, S.F. (1998). *Roads to geometry*.(2nd edition).Prentice Hall.(For all units as main text).
Eves, H. (1995). *College geometry.*New Delhi: Narosa (for all units as supportive text).

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Course Title: Analytical Geometry

Course No. : Math.Ed.231 | **Nature of course: Theory**

Level: B.Ed. (Mathematics) | **Semester: Third**

Total periods: 48 | **Time per period: 1 hour**

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1. Course Introduction

This course is designed for undergraduate students to develop acquaintance with fundamental principles, approaches and techniques of analytic geometry of two and three dimensions. The course starts with the basic concepts of coordinate systems. The course includes several curves, lines, planes and solids situated in different forms. The due emphasis is given to conceptual understanding and problem solving skills. The students will experience some key application areas in the learning process. Thus the course will provide students with the basic concepts, and mathematical techniques of analytic geometry and students will be equipped with the skills necessary to solving problems in analytic geometry.

2. General Objectives

The general objectives of this course are as follows:

1. To develop understandings of various techniques, principles and approaches of the analytic geometry of two dimensions.
2. To apply two dimensional analytical geometry in solving problems of other branches of mathematics
3. To use algebraic approach whilst studying the properties of tangent and normal of a curve.
4. To develop understandings of various techniques, principles and application of analytic geometry of three dimensions.
5. To use algebraic approach in geometrical reasoning and problem solving of three dimensional situations.

3. Contents in Detail with Specific Objectives

Specific Objectives	**Contents**
• To establish the necessary of conics through history. • To illustrate conics by different means visualization. • To explore the occurrence of conics in different	**Unit 1 Visualization of conics [3 hours]** 1.1 History of conics 1.2 Illustrations of conics 1.3 Occurrence of conics

situation.	
• To conceptualize the ellipse algebraically. • To establish different terms of ellipse. • To establish the equation of tangent and focal properties. • To use different properties in solving related problems.	**Unit 2 Ellipse [3 hours]** 2.1 Visualization of ellipse 2.2 Canonical equation of an ellipse 2.3 The eccentricity and directrices of an ellipse 2.4 The property of directrices 2.5 The equation of a tangent line to an ellipse 2.6 Focal property of an ellipse 2.7 Applications of ellipse
• To conceptualize the hyperbola algebraically. • To establish different terms of hyperbola. • To establish the equation of tangent and focal properties. • To use different properties in solving related problems.	**Unit 3 Hyperbola [3 hours]** 3.1 Visualization of hyperbola 3.2 Canonical equation of a hyperbola 3.3 The eccentricity and directrices of a hyperbola 3.4 The property of directrices 3.5 The equation of a tangent line to a hyperbola 3.6 Focal property of a hyperbola 3.7 Asymptotes of a hyperbola 3.8 Applications of hyperbola
• To conceptualize the Parabola algebraically. • To establish different terms of Parabola. • To establish the equation of tangent and focal properties. • To use different properties in solving related problems.	**Unit 4 Parabola [3 hours]** 4.1 Visualization of parabola 4.2 Canonical equation of a parabola 4.3 The eccentricity of a parabola 4.4 The equation of a tangent line to a parabola 4.5 Focal property of a parabola

	4.6 The scale of eccentricities 4.7 Applications of parabola
• To transform coordinates of a point under a change of coordinate system. • To rotate rectangular coordinate system on a plane • To derive and use rotation matrix.	**Unit 5 Changing a coordinate system [3 hours]** 5.1 Transformation of the coordinates of a point under a change of a coordinate system 5.2 Rotation of a rectangular coordinate system on a plane 5.3 The rotation matrix
• To establish the relations of the curves of the second order and classify them. • To determine the surface of second order and classify them. • *To visualize Quadric surfaces*, or *quadrics* for short, consisting of different types: ellipsoids, hyperboloids of one sheet, hyperboloids of two sheets, elliptic paraboloids, and hyperboloid paraboloids.	**Unit 6 Curve and Surface of Second Order [3 hours]** 6.1 Curves of the second order 6.2 Classification of curves of the second order 6.3 Surfaces of the second order 6.4 Classification of surfaces of the second order 6.5 Visualization of curves with classification
• To extend understanding of distance formula, section formula, direction of lines, etc from two to three dimensions. • To derive equation of plane and find angle between planes.	**Unit 7 The Plane [6 hours]** 7.1 Review of three dimensional geometry 7.2 General Equation of First Degree and in different form 7.3 Angle between two planes

• To solve systems of planes and find the volume of the tetrahedron. • To find the length of perpendicular from a given point to a plane. • To find the orthogonal projection of the plane and volume of tetrahedron	7.4 Equation of plane through given point and parallel/perpendicular to a given plane. 7.5 Plane through three points 7.6 Two sides of a plane 7.7 Perpendicular distance and bisector of angles between the planes 7.8 Pair of planes 7.9 Visualization and applications of the plane
• To derive the equation of straight lines in space. • To demonstrate the condition of lines to be in plane and coplanar lines. • To interpret the equation of curve, surface, locus of intersecting lines, skew lines in a simplified form.	**Unit 8 Straight line [6 hours]** 8.1 Visualization of line with respect to three dimension 8.2 Equation of a straight line in different forms 8.3 Angle between a line and a plane 8.4 Condition of parallism and perpendicularity 8.5 Co-planar lines 8.6 The shortest distance between two lines 8.7 Applications of straight lines
• To derive equation of sphere and solve related problems.	**Unit 9 Sphere [6 hours]** 9.1 Visualization of sphere in coordinate system 9.2 Equation of sphere in different forms 9.3 Plane section of sphere 9.4 Tangent plane to sphere 9.5 Applications of sphere

• To find the equations of cones and cylinders and solve related problems.	**Unit 10 Cone and Cylinder [6 hours]** 10.1 Visualization of cone and cylinder with coordinate system 10.2 Relation of General equation of second degree in x, y and z and the equation of cone 10.3 Cone and generator, mutually perpendicular generators 10.4 Right circular cone 10.5 Tangent line and tangent plane at a point 10.6 Reciprocal cone and enveloping cone 10.7 Equation of cylinder 10.8 Enveloping cylinder 10.9 Right circular cylinder 10.10 Applications of cone and cylinder
• To derive equation of central conicoid and derive different conditions of it. • To illustrate different properties of central conicoid.	**Unit 11 Central Conicoid [6 hours]** 11.1 Visualization of central conicoid 11.2 Equation of central conicoid 11.3 Point of intersection of lines with central conicoid 11.4 Tangent plane at a point to the central conicoid 11.5 Normal at a point to the central conicoid 11.6 Director sphere 11.7 Polar planes and polar lines

	11.8 Conjugate diameters and semi-diameters

4. References

1. Joshi, M. R. (1990). *Analytical Geometry*. Kathmandu: Sukunda Books Publications. (Unit 1-6).
2. Staphit, Y. R and Bajracharya, B. C. (2011). *Three dimensional geometry*. Kathmandu: Sukunda Pustak Bhawan. (Unit 7-11)
3. Narayan S. (2012). *Analytical solid geometry*. New Delhi: S. Chanda and Company Pvt LTD. (unit 7-11)

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Course Title: Discrete Mathematics
Semester: Third **Course No. : Math.Ed.232**
Credit Hour: 3 (45 hours) **Full marks: 100**
Pass marks: 45

1. Course Introduction

In the age science and technology, recent years, the discrete mathematics, and finite structures, have
gained great importance. This course covers a selection of topics from discrete mathematics. Fundamentals of mathematics of finite structures like counting principles, Set theory and logic, properties of integer, group, Markov chain, generating function etc are dealt in this course.

2. General Objectives

On completion of the course the students will be able to:
a) prove and apply fundamental principles of counting in different area of mathematics like permutation, combination.
b) use mathematical induction in further problems and proving related theorems.
c) apply the recursive process in solving related problems.
d) use the notion of relation and function in carrying algorithmic problems.
e) establish first and second order recursive relations of linear and non-linear types.
f) apply principles of inclusion and exclusion in developing rook polynomials.
g) realize the use of generating function in developing partition.
h) apply Euclidean algorithm to solve related arithmetic problems.
i) prove theorem related to prime number
j) test the group property of given binary operation
k) verify the Homomorphism property

3. Specific objectives with contents

Specific objectives	Contents
Use principal of fundamental counting Solve the problems using permutation, combination and binomial theorem	Unit One: Fundamental Principles of Counting(2) 1.1 The rule of sum and product 1.2 Permutation, combination and binomial theorem 1.3 Combinations with repetition
Solve the problem of set theory by using various laws and Venn diagram Construct truth table of given premises Test the validity of the argument by truth table, Venn diagram,laws of inferences	Unit Two: Review on Set Theory and Logic(3) 2.1 Set and subsets 2.2 Set operations and laws of set theory 2.3 Counting and venn diagram 2.4 Basic connectives and truth table 2.5 Logical equivalence and logical implications

	2.6 The use of quantifiers
Verify Euclidean algorithm Establish the relation between GCD and LCM Prove the theorems of prime number	Unit Three: Properties of Integer(6) 3.1 Divisibility theory in Integer 3.1.1 The division Algorithm 3.1.2 The greatest common divisor 3.1.3 The Euclidean algorithm 3.1.4The Diophantine equation 3.2 Primes and their distributions 3.2.1 The fundamental theorem of arithmetic 3.2.2 The sieve Erasthenes 3.2.3 The gold batch conjecture
Find the Cartesian products of given sets Solve the problem of relation and function Analyze the algorithms	Unit Four: Relations and Functions (4) 4.1 Cartesian Products and relations 4.2 Functions: Plain and one-to-one 4.3 Onto functions: stirling numbers of the second kind 4.4 Special functions 4.5 The Pigeonhole principle 4.6 Function composition and inverse function 4.7 Computational complexity 4.8 Analysis of algorithms
Examine the algebraic structure evaluate semigroups, monoids, homomorphism, sub semigroup & submonoid find cosets, normal subgroup examine the homomorphism of agiven function	Unit: Five: Group (8) 5.1 Definition of algebraic structure, examples, properties 5.2 Semigroups, Monoids, Homomorphism, Subsemigroup & submonoid 5.3 Sosets & Lagrange's Theorem, Norman group, Normal subgroup and their properties
Solve the problem using the principle of inclusion and exclusion	Unit Six: The Principle of Inclusion and Exclusion (5) 6.1 The principle of inclusion and exclusion 6.2 Generalizations of the principle 6.3 Derangements: nothing is in its right place 6.4 Rook polynomials 6.5 Arrangements with forbidden positions
Solve the related problems by using different generating functions Solve the first/second ordernon /homogeneous problems by using generating function or others methods	Unit Seven: Generating Functions & Recurrence Relations(5) 7.1 Introductory Examples 7.2 Definition and Examples: Calculation techniques 7.3 Partitions of Integers 7.4 The exponential generating functions: The first-order linear recurrence relation

	7.5 The second-order linear homogeneous: recurrence relation with constant coefficients 7.6 The non homogeneous recurrence relation 7.7 The method of generating functions 7.8 A special kind of Nonlinear recurrence relation
Verify Markov property Prove theorem of Markov chain Perform branching process Solve the problem by applying Ergodic concept	Unit Eight: Introduction to Markov Chain (12) 8.1 Specifying and simulating a Markov chain 8.2The Markov property 8.3 “It’s all just matrix theory 8.4 The basic limit theorem of Markov chains 8.5 Stationary 8.6 Irreducibility, periodicity, and recurrence 8.7 An aside on coupling 8.8 Proof of the Basic Limit Theorem 8.9 A SLLN for Markov 8.10 Branching Processes 8.11 Ergodicity Concepts 8.12 Threshold Phenomenon 8.13 A random time to exact stationarity 8.14Proof of threshold phenomenon in shuffling.

4. References

a) Grimaldi, R. P. (2003). *Discrete and combinatorial mathematics*. Pearson Education.

b) Rosen,K. H. (2012). *Discrete mathematics and its applications* (7th ed). The McGraw-Hill Companies.

c) Burton, D. M. (2012). *Elementary Number Theory*: McGraw Hill Indai

Far Western University
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Course Title: **Teaching Algebra**

Course No. : Math.Ed.241	Nature of course: Theory
Level: B. Ed.	Semester: Fourth
Total periods: 45	Time per period: 1 Hour

1. Course Introduction

This course deals about different techniques of teaching algebra. Algebra is considered as the foundation for higher mathematics and an important tool for mathematical modeling. It is seen that almost all the students find algebra as an interesting subject to solve the mathematical problems, but they lack to understand the application part of the school algebra. In this context, this course develops teachers, who will be able to make conceptual clarity in algebra, able to develop various teaching materials, able to assess the students' learning outcomes and provide some remedial measures.

2. General Objectives

The general objectives of this course are as follows:

1. To develop algebraic thinking with various modes of representation and logic
2. To develop and use the various manipulative in teaching algebra
3. To be aware on different teaching methodologies in algebra teaching
4. To be awake in various ways of problem solving strategies
5. To be able to develop modules in algebra teaching and use them in peer teaching
6. To use various strategies of assessment in algebra teaching

3. Contents in Detail with Specific Objectives.

Specific Objectives	Contents
• To be aware and use multiple representation and multiple ways of thinking • To use set theoretical ways of Algebra	**Unit I: (Algebraic Thinking: 6 hours)** 1.1 Different modes of Representation 1.2 Different Modes of thinking (Logic) 1.3 Modes of Abstraction 1.4 Set theoretical approach to Algebra
• To develop manipulative materials and use them.	**Unit II: (Manipulative in Teaching Algebra: 12 hours)** 2.1. Manipulative and their important in teaching 2.2. Formation of manipulative and their uses: blocks,

	real objects, balance, factorization block etc.
• To use inductive and deductive approach in algebra teaching • To use Analytic and Synthesis approach in algebra teaching • To use Discovery Approach in algebra teaching	**Unit III: (Teaching Approaches in Algebra: 6 hours)** 3.1 Inductive and Deductive approach 3.2 Analytic and Synthesis approach 3.3 Discovery Approach
• To know the roles of problem solving in Algebra • To use the various steps of problem solving approach in Algebra teaching • To be able to use ten ways of Problem solving strategies	**Unit IV: (Problem Solving in Algebra: 7 hrs)** 4.1 The nature of Problem Solving 4.2 A psychological view of Problem Solving 4.2.1 Five Steps of Problem Solving (John Dewey, "How we think") 4. 2. 2 Four steps of Problem solving (George Polya, How to Solve it?) 4. 3 The ten problem solving Strategies
• To develop modules in teaching algebra • To apply modules inside the classroom	**Unit V: (Developing Modules in teaching Algebra (Practical) (9 hrs)** (This should be designed for practical session. The teachers will provide various models of "Development of modules in teaching Algebra" with some examples. The students (in a group and later individually) develop the modules and conduct micro-teaching in the class. The peer feedback will be taken before finalizing the modules.)
• To develop various tools (Objective questions, short questions, projects etc.) for assessment and apply them in algebraic class.	**Unit VI: (Assessment: 5 hrs)** 6.1 Developing items for objective question 6. 2 Developing Short Questions 6.3 Developing for problem solving 6.4 Project based assessment in algebra

4. References

(There is no any single book in the reference. The teacher should make learning materials from the various textbooks, net and other resources and provide students.)

Approaches to Algebra. Perspectives for research and teaching. Kluwer Academic Publishers, Netherlands. Janvier, C.: 1996. Modeling and the Initiation into ... www.allacademic.com/meta/p117670_index.html?PHPSESSID=62a2d42485087937533383a59b0b314b0

Fostering algebraic thinking: a guide for teachers, grades 6-10, Mark J. Driscoll Edition illustrated Publisher Heinemann, 1999ISBN0325001545, 9780325001548

French, D. (2002), Teaching and Learning Algebra. London: Continuum. Galpin, B., Graham, A. (eds.) (2001), 30 Calculator Lessons for Key Stage 3. A+B Books ... eprints.soton.ac.uk/41376

The Future of the Teaching and Learning of Algebra (2004) : The 12th ICMI Study edited by Kaye Stacey, Helen Chick, Margaret Kenda

Making Algebra Come Alive; Student Activities and teachers note (2004): Posamentire, A., Sage Publication, India, New Delhi

The Algebra Teacher's Activity-a-Day, Grades 6-12: Over 180 Quick Challenges, Frances, Johh, W. (2010): Jossey Bass Publication

Far Western University
Faculty of Education

Course Title: Real Analysis I

Course No. Math.Ed.242 **Nature of course: Theory**

Level: B.Ed. **Semester: 3rd**

Total periods: 45 **Time per period: 1 Hour**

COURSE INTRODUCTION

This course consists of basic idea of Real Analysis. It explores important properties of Real Analysis by simple methods and is also fundamental for further study in mathematics/education. In this course, you will study basic properties of real number to Riemann integral.

Real Analysis is the theoretical version of single-variable calculus and a particular case of mathematical analysis. It is being noticed that Calculus courses develop progressively into more complicated forms of calculation using mostly elementary functions. However, Analysis deals with abstract functions, and uses precise definitions of fundamental notions ("real number", "function", "limit", "continuity", and so on.) to prove key theorems about derivatives, integrals and series, and establish the precise extent to which they apply. The rigorous approach to analysis allows students to develop logical and analytical foundations of mathematics.

General Objectives

The expected learning outcomes are divided into three groups as given below.

1. To develop fundamental understanding of different proof techniques of Analysis.
2. To develop critical thinking among learners.
3. To use analytical ability in other context.

4. Learn the content of real analysis.

5. Learn good mathematical writing skills and style.

Contents in Detail with Specific Objectives

Specific objectives	Contents
Learner as expected to • Choose statements • Construct equivalence statements. • Construct real number • Assess axioms of Peano.	**Unit-I (5 Hr) Preliminaries and Real Numbers** 1.1. Statements, production of new statements and equivalence of two statements $p \leftrightarrow q$ 1.2. Axioms and theorems, Method of proof, Sets, Set operations, lows.

• Express the real number in terms of union of rational and irrational number. • Reconstruct axiom of Order in **R** • Proof Archimedean, Dedekind and denseness properties of **R**	1.3.Real numbers, Peano's axioms for natural numbers, Rational, Irrational numbers 1.4.Axioms of real numbers: extend, field, addition, multiplication and subtraction and division of **R.** 1.5.Axiom of order in **R** 1.6.Absolute value of a real number 1.7.Boundedness and completeness in of subsets of **R** 1.8.Some of the consequences of completeness axiom: Archimedean, Dedekind, Denseness properties of **R**
• discriminate open and closed interval • Find the length of intervals • Construct and show neighborhood of points • Define interior and exterior points of set. • Proof Bolzano-Weierass's theorem • Write adherent or closure point of a set • Differentiate beterrn closure, dense and perfect sets.	**Unit-II (5 days) Open and Closed sets** 2.1.Intervals, Open intervals, Closed intervals and infinite intervals, and length of an interval. 2.2.Neighborhoods, neighborhood of point and set. 2.3.Interior and exterior points of set. 2.4.Limit points of a sets: Bolzano-Weierass's theorem 2.5.Adherent or closure point of a set, Derived, Closure, Dense and perfect set.
• Construct sequence from real number • Write the definition of Boundedness of Sequence • Define limit point of a sequences • Evaluate sufficient condition to have a limit point of sequence. • Give example of upper and lower limits of bounded sequence • Compose a convergent sequence • Provide proof for general principle of convergence for sequence and Cauchy's theorem. • Compare convergent and non-convergent sequence • Assess divergent and oscillatory sequence • Interpret Sandwich theorem for sequences of real number • Establish monotonic sequence for cantor's and uniform convergence	**Unit-III (5) Real sequences** 3.1. Sequences, Constant sequence, Boundedness of Sequence 3.2.Limit Points of a sequences 3.3.Sufficient conditions of number *l* to be or not to a limit point of a sequence u. 3.4.Upper and lower limits of a bounded sequence 3.5.Convergent sequence [general principle of convergence for sequence, Cauchy's theorem and Non-convergent sequences] 3.6.Divergent and Oscillatory sequence 3.7.Sandwich theorem for sequences of real numbers 3.8.Monastic sequences[cantor's intersection and nested interval theorem and Uniform Convergence]

• Construct different infinite series • Find partial sums of infinite series • Solve convergence of an infinite series examples • Proof necessary and sufficient condition for convergent series • Examine the series by using a. Cauchy test b. Maclaurin Integral test c. D' Alembret's ratio test d. Logarithmic ratio test	**Unit-IV (7) Infinite Series** 4.1. Definition of infinite series 4.2. sequence of partial sums of an infinite series 4.3. convergence of an infinite series 4.4. Cauchy's general principle of convergence for series 4.5. A necessary and sufficient condition for convergent series. 4.6 some test of series of positive terms [Cauchy-Maclaurin integral test, couchy condensation test, comparison test, D'Alembret's ratio test and Logarithmic ratio test]
• Compare function and relation • Contrast domain and range of function • Distinguish function and inverse function • Develop tracendental function • Illustrate monotonic real valued function at a point. • Identify limit of a function. • Proof sandwich theorem for a function • Investigate one side limits in different cases • Point out continuous function for both cases. • Subdivide types of discontinuous function • Proof Borel's and Boundeness Theorem	**Unit-V (9) Functions, Limit and Continuity** 5.1. Functions as a relation, domain and range of a function, inverse and tracendental functions and Boundedness of function. 5.2. Monotonic real valued function at a point. 5.3. Limit of a function as $x \rightarrow a$ and sandwich theorem for function. 5.4. One side limits [Limit from above or right and below or left] 5.5. Continuous functions [Continuous function, Continuity at a point, continuity from left or right of a function] 5.6 Discontinuous function and types. 5.7. Borel's and Boundedness Theorem
• Establish derivative of a function. • Find condition for derivability at a point • Show the condition for continuity and derivability. • Proof darbox theorem • Proof mean value theorem.	**Unit-VI (3) Derivability** 6.1. Derivative of a function, Derivability at a point 6.2. continuity and Derivability 6.3. Darbox Theorem 6.4 Some mean value theorem [Roll's, Legranges and Cauchy's Mean value theorem]

• Develop partition of a closed interval. • Find darbox sum • Proof four properties of darbox sum. • Examine upper and lower darbox sum. • Proof necessary and sufficient condition for integrability. • Proof theorems related to sum, product and distributive properties of integration • Find the class of function integrable over [a, b] • Examine Riemann integral when b≤ a. • Proof generalized mean value theorem of integration • Proof integration by parts • Examine and proof Bonnet's and Weiertress's mean value theorem and Weierstras's theorem.	**Unit-VII (11) Riemann Integration** 7.1 Partition of a closed interval, Darbox sums and four properties 7.2. Upper and Lower Darbox sums 7.3. Upper and Lower integrals and limiting case 7.4. Riemann integral[A necessary and sufficient condition for integrability and theorems related to sum, product and distributive properties] 7.5. Some classes of functions integrable over [a, b]. 7.6. Riemann Integral when b≤ a. 7.7. Generalized mean value theorem of integration. 7.8. Integration by Parts 7.9. Bonnet's and Weiertrass's mean value theorem and Weierstras's(Second mean Value theorem.

Reading Materials

1. Gupta SL & Rani N. (2010).*Real Analysis*. New Delhi: Vikas Publication House PVT. LTD
2. Maskey, S.M. (2005). *Real Analysis*. Kathmandu:
3. Lebl, J. (2011). *Introduction to Real Analysis*. California: Frank Beatrous and Yibiao Pan
4. Trench, W. (2010). *Introduction to real analysis*: San Antonio, Pearson Education

Far Western University
Faculty of Education

Course Title: **Probability and Statistics**
Course No. : Math. Ed. 243 | Nature of course: Theory
Level: B. Ed. | Semester: Fourth
Total periods: 45 | Time per period: 1 Hour

1. Course Introduction

The main aim of this course is to make students familiar with probability theory and the use of statistics in various areas. The two areas of study are closely related, since probability theory relies upon statistics in order to analyze random events. The contents in this course include various probability distribution, estimations, correlation and regression. The second part of this course includes hypothesis testing and the introduction and basic use of Statistical Package for Social Sciences (SPSS).

2. General Objectives

The general objectives of this course are as follows:

1. To develop a conceptual understanding of probability and probability distribution.
2. To be familiar with sampling distribution and estimation.
3. To apply the concept of correlation and regression to solve the problems.
4. To use the test of hypothesis
5. Perform statistical analysis using data sets and SPSS software including:
6. Measures of central tendency and variability
7. Graphic displays (e.g., histograms, scatter plots etc.)

3. Contents in Detail with Specific Objectives.

Specific Objectives	Contents
• To be able to prove some theorems on probability including Baye's theorem • To solve some problems with the help of Baye's theorem	**Unit I: Basic theorems on Probability (3 hrs)** 1.1 Various forms of Probability, Some theorems on probability including Baye's theorem (it's proof and related problem)
• To describe probability of discrete random variable. • To define binomial distribution	**Unit II Binomial Distribution (5 hrs)** 2.1 Discrete Random Variable: Probability distribution, cumulative distribution,

• To describe the properties of binomial distribution • To derive mean and variance of binomial distribution • To solve some related problems.	mathematical expectation, mean and variance. **2.2** Binomial distribution: its probability distribution, properties, mean and variance, related problems.
• To describe probability of continuous random variable. • To prove Chebyshev's theorem • To define normal distribution • To describe the properties of normal distribution • To derive mean and variance of normal distribution and to solve some related problems using normal distribution table. • To identify and use the relation between Binomial and Normal distribution	**Unit III: Normal Distribution, relation between Binomial and Normal (7 Hrs)** 3.1 Continuous Random Variable: Probability density, cumulative distribution, mean and variance, Chebyshev's theorem and its use. 3.2 Normal Distribution: its probability density, properties, mean and variance, areas under standard normal curve, related problems 3.3 Normal Approximation to the Binomial
• To conceptualize the central limit theorem. • To Use the ideas of standard errors of the mean and central limit theorem. • To estimate the population mean for both large and small samples.	**Unit IV Sampling Distribution and Estimation (5 hrs)** 4.1 Population and Sample, Techniques of sampling, distribution of sample mean, Central Limit Theorem, use of central limit theorem, Standard Error of statistics 4.2 Estimation-point and interval, properties of good estimator, unbiased estimates of the population mean and variance from a sample, confidence interval for mean and variance.
• To be familiar with the concept of correlation and regression. • To describe the properties of correlation and regression. • To apply correlation and regression to solve problems.	**Unit V Correlation and Regression (4 hrs)** 5.1 Properties of correlation, probable error, 5.2 Pearson's Correlation 5.3 Rank Co-relation 5.4 Equation of Regression, properties of regression 5. 5 Angle between Regression lines

• To understand the basic concept of Hypothesis	**Unit VI Test of Hypothesis: Basic Concept (3 hrs)** 6.1 Meaning and Characteristics of Hypothesis 6.2 Null and Alternate hypothesis 6.3 One-tailed and two-tailed test 6.4 Type I and Type II error 6.5 Level of significance and critical region
• To describe the conditions for Z test • To test significance of difference of two means of large samples when the population variance is unknown	**Unit VII: Test of Hypothesis: Z-test (4 hrs)** 7.1 Conditions for Z test 7.2 Difference between two means of large samples when the population variance is unknown.
• To describe the conditions for t-test • To test significance of difference of two means of simple samples	**Unit VIII: Test of Hypothesis: t-test (4 hrs)** 8.1 Conditions for t- test 8.2 Difference between two means of small samples
• To describe the conditions for chi-square test. • To test significance difference of independent.	**Unit IX: Test of Hypothesis: Chi-Square test (4 hrs)** 9.1 Conditions for Chi-square test 9.2 Significance test of independent
• To entry data in SPSS • To calculate the central tendencies and variability • To display data in the form of histograms, pie chart, bar graph, scatter plots.	**Unit X: Introduction to SPSS (6 hrs)** 10. 1 Data Entry in SPSS 10.2 Calculation of Measures of central tendency and variability, graphic displays (e.g., histograms, pie chart, bar graph, scatter plots) using SPSS software.

4. References

Gupta S. C. *Fundamental of Statistics;* New Delhi: Himalaya Publishing House, India, 2006.

Gupta S. P. *Statistical Method;* New Delhi: S. Chand and Sons Publishers, India 2007.

David Stirzakar. *Probability and Random Variables, A Beginner's Guide;* Cambridge University Press, 1999.

Sheldon M. Ross. *Introduction to Probability Model*; Academic Press, 1997.

Levin R. I. and Rubin D. S.; *Statistics for Management* [7th Ed.] Prentice Hall. New Delhi, India.

Ajai S. Gaur, Sanjay S. Gaur; *Statistical Methods for Practice and Research: A Guide to Data Analysis Using SPSS,* 2nd ed, 2011. SAGE Publication Inc (Response Books), New Delhi, India.

John E. Freund's. *Mathematical Statistics with Application* [2009, 7th Ed, Pearson Education]

Far Western University
Faculty of Education

Course Title: Real Analysis II **Full Marks: 100**
Course No: Math.Ed.351 **Pass Marks: 45**
Nature of Course: Theoretical **Teaching**
Hours: 45
Level: Undergraduate
Semester: 5th

1. Course Description

This course is designed for Undergraduate students to provide fundamental concept of real analysis. Real analysis is fundamental for study of higher mathematics. It attempts to fill the gap and to make transfer from elementary calculus to advance course in analysis. This course deals with limit and continuity, derivability and Riemann integral of real valued function. The course also includes Riemann Stiltjes integral.

2. General Objectives

Broadly, the course has following objectives

- To develop in students an understanding of limit and continuity of a function and their properties.
- To make students able in understanding concept of derivative and proving theorems on derivability.
- To make students able in understanding concept of Riemann integral and proving theorems on Riemann integral.
- To make students able in understanding concept of Riemann-Stiltjes integral and to explain relationship between Riemann integral and Riemann-Stiltjes integral.

3. Specific objectives and contents

Specific Objectives	Contents
• To define function as a relation. • To explain concept of composite and inverse function. • To illustrate monotonic real valued functions with example.	**Unit I: Functions(2)** 1.1 Function as a relation 1.2 Some particular functions 1.3 Composite functions and inverse functions 1.4 Functions with range in $\mathbb{R}$
• To explain $\mathscr{E}-\delta$ definition of a limit of a function. • To explain limit of a function graphically. • To prove properties of limit of a function. • To illustrate concepts of one sided limits and their graphical representation. • To explain technique of evaluation of	**Unit II: Limit of a functions(6)** 2.1Definition of a limit of a function 2.2 Properties of limit of a function 2.3 One sided limits 2.4 Infinite limits and limits at infinity

one sided limits. • To discuss with examples concept of infinite limits and limits at infinity.	
• To explain concept of continuity of a function at a point on its domain. • To classify discontinuities of functions at a point. • To prove some important theorems on continuity. • To prove properties of uniformly continuous functions.	**Unit III: Continuity of a functions (10)** 3.1 Definition of continuity of a function at a point 3.2 Discontinuity of a function and its types 3.3 Theorems on continuity of functions(Borel's Theorem, Boundedness Theorem, Intermediate value theorem and Fixed point theorem) 3.4 Uniform continuity of functions
• To explain concept of derivative of a function at a point. • To explain relation between continuity and derivability. • To prove properties of derivative. • to state and prove mean value theorems and interpret them graphically. • To discuss maxima and minima of a function at point. • To state and prove Taylor's and Maclaurin's theorem. • To discuss different indeterminate forms with examples. • To prove theorems on indeterminate forms including L' Hospital's rule.	**Unit IV: Derivability (12)** 4.1 Definition of a derivative of a function 4.2 Derivability and continuity 4.3 Properties of derivatives 4.4 Mean value theorems (Rolle's theorem, Lagrange's Mean value theorem, Cauchy's mean value theorem) 4.5 Taylor's theorem and Maclaurin's theorem 4.6 Maxima and Minima 4.7 Indeterminate forms ($\frac{0}{0}, \frac{\infty}{\infty}, \infty - \infty, 0 \times \infty, 0^0, \infty^0, 1^\infty$) and L' Hospital's rule.
• To define Upper and Lower Darboux sums and Prove four properties. • To define upper and lower Riemann integral of a function on closed interval and prove Darboux theorems • To explain concept of Riemann integral of a function. • To state and prove Necessary and sufficient condition for integrability. • To prove properties of Riemann integral and integrable functions. • To state and prove mean value theorems • To state and second fundamental theorem of integral calculus. • To explain the technique of evaluating the definite integral using integration by parts and change of variable in the	**Unit V: Riemann Integration (12)** 5.1 Darboux sums and four properties 5.2 Definition of Riemann integral 5.3 Necessary and sufficient condition for integrability. 5.4 Properties of Riemann integral 5.5 Properties of integrable functions 5.6 Mean value theorems for integral (Bonet's and Weierstrass's) 5.7 Second fundamental theorem of integral calculus 5.8 Integration by parts 5.9 Change of variable

integral.	
• To explain concept of Riemann Stiltjes integral. • To prove theorems on refinement of partitions. • To state and prove necessary and sufficient condition for integrability. • To prove theorems of integrable functions. • To explain Riemann Stiltjes integral as a limit of a sum.	**Unit VI: Riemann Stiltjes Integral (6)** 6.1 Definition of Riemann Stiltjes integral 6.2 Refinement of partitions 6.3 Necessary and sufficient condition for integrability 6.4 Properties of integrable functions 6.5 Definition of Riemann Stiltjes integral as a limit of a sum

4. References

Gupta, S. L. and Rani, N. (2003).*Fundamental real analysis (4th)*. New Delhi: Bikash Publishing House

Malik, S.C. and Arora, S. (2010). *Mathematical analysis (4th)*. New Delhi: New Age International Pvt. Ltd.

Maskey, S.M. (2007). *Principles of real analysis*. (2nd). Kathmandu: Ratna Pustak Bhandar

Far Western University
Faculty of Education

Course Title: Calculus II
Course No: Math.Ed.352
Nature of Course: Theoretical
Level: Undergraduate
Semester: 5th

Full Marks: 100
Pass Marks: 45
Teaching Hours: 45

A. Differential calculus

Unit 1: Curvature

i. Introduction, Definition of curvature and radius of curvature

ii. Formula for radius of curvature in

a) Intrinsic form b) Cartesion form c) Parametric form d) Polar form e) Pedal form f) Tangential polar form

iii. Curvature at origin, chord of curvature

a) Through origin b) Parallel to coordinate axes c) Centre of curvature, problems related to above topics

Unit 2 : Jacobians

i. Definition of Jacobians
ii. Case of function of function
iii. Reciprocal relation in Jacobians $(\frac{\partial(z_1,z_2,\ldots,z_n)}{\partial(x_1,x_2,\ldots,x_n)} \times \frac{\partial(x_1,x_2,\ldots,x_n)}{\partial(z_1,z_2,\ldots,z_n)} = 1)$
iv. Jacobians of implicit functions, problems related to above topics

B. Integral calculus

3. Infinite integral

i. Introduction

ii. Types of infinite integral

a) Integral with infinite limits b) Integrals in which integrand is infinity

c) Some standard infinite integrals

4. Quadrature

i. Area in Cartesian co-ordinates

ii. Area in polar co-ordinates

iii. Area between two curves

iv. Area of closed curves

5. Rectification

i. Length of curves

ii. Lengths of curves from

a) Cartesian equation b) Parametric equation c) Polar equations

iii. Intrinsic equation

iv. Intrinsic equation from

a) Cartesian equation b) Polar equations

6. Volume and surface:

i. Solids of revolution

ii. Volume of a solid of revolution

iii. Volume when axis of revolution is parallel to the x or y axis

iv. Volume from polar equations

v. Surface of a solid of revolution

C. Differential Equations

Unit 7: Elementary concepts of Differential equations (for review only)

i. Definition of differential equation

ii. Order and degree of differential equation

iii. Formulation of differential equation

iv. Solution of differential equation

Unit 8 : Differential equation of first order and first degree

i. First order and first degree differential equation

ii. Equations in which variables are separable

iii. Change of variables to reduce in variable separable form

iv. Homogeneous differential equation

v. Linear differential equations

vi. Equations reducible to homogeneous form

vii. Bernoulli's differential equation

viii. Other equations reducible to linear form

ix. Exact differential equations

x. Integrating factors and solution by inspections

Unit 9 : Differential equations of first order but not of first degree

i. Equations solvable for p

ii. Equations solvable for y

iii. Equations solvable for x

iv. Clairaut's equations

Unit 10 : Linear differential equations with constant coefficients

i. Introduction

ii. Solution of the equations f(D)y = Q

iii. Solution of $(D^2+PD+Q)y = 0$

iv. Solution of $(D^2+PD+Q)y = R$

v. Particular integral in various cases

vi. Solution of n^{th} order linear differential equations with constant coefficient

Unit 11: Homogeneous linear differential equations

i. Introduction

ii. Solving a homogeneous linear differential equations of second order

iii. Equations reducible in homogeneous linear form

iv. Homogeneous linear differential equations of order more than two

Far Western University
Faculty of Education

Course Title: History of Mathematics — **Full Marks: 100**
Course No: Math.Ed.353 — **Pass Marks: 45**
Nature of Course: Theoretical — **Teaching Hours: 45**
Level: Undergraduate
Semester: 5th

1. Course Description

This course is designed for Undergraduate students to make students familiar with basic knowledge of historical development of Mathematics. It deals with the development of mathematics in early, medieval and modern era.

2. General Objectives

Broadly, the course has following objectives

- To make students able to explain early mathematics practiced by peoples in different civilization.
- To make students able to trace development of mathematics in ancient, medieval and modern period.
- To make students able to describe development of different branch of mathematics like analytic geometry, projective geometry, calculus etc.

3. Specific objectives and contents

Specific Objectives	Contents
• To explain ancient Babylonian mathematics, specifically, Arithmetic, Algebra and Geometry.	**Unit I:Babylonian Mathematics(3)** 1.1 Sources 1.2 Arithmetic 1.3 Algebra 1.4 Geometry
• To explain ancient Egyptian mathematics, specifically, Arithmetic, Algebra and Geometry.	**Unit II: Egyptian Mathematics(3)** 2.1 Sources 2.2 Arithmetic 2.3 Algebra 2.4 Geometry
• To describe contributions of mathematicians of Greek in the development of mathematics.	**Unit III: Greek Mathematics(10)** 3.1 sources 3.2 Mathematicians before Euclid(Thales, Pythagoras and Pythagoreans, Zeno of Ela, Eudoxus) 3.3 Euclid and his Element

	3.4 Mathematicians after Euclid (Archimedes, Apollonius, Eratosthenes, Heron, Diophantus, Pappus, Ptolemy, Hyptia)
• To explain briefly contributions of hindu mathematicians(Aryabhata, Brahmgupta, Bhaskara, Ramanajun) • To describe mathematics included in Sulv Sutra and Siddhanta	**Unit IV: The mathematics of Hindus(4)** 4.1 The earliest period (Sulvsutra, Jaina Mathematics and Siddhantha) 4.2 The Middle Period (Aryabhata, Brahmgupta, Bhaskara) 4.3 Modern Period (ShrinivasaRamanajun)
• To describe how mathematics was developed in dark age and in the period of transmission. • To explain briefly mathematics of thirteenth, fourteenth and fifteenth century in Europe. • To describe contributions of Francois Viete in mathematics.	**Unit V: Medieval European Mathematics(5)** 5.1 The dark age 5.2 The period of transmission 5.3 mathematics in thirteenth, fourteenth and fifteenth century 5.4 Francois Viete 5.5 Solutions of Cubic and quadratic equations
• To describe contribution of Napier in development of logarithm • To describe contributions of Descartes and Fermat in development of Analytic geometry • To explain contribution of Newton and Leibniz in development of calculus. • To describe how non- Euclidean geometry, projective geometry, projective geometry and topology were developed. • to describe contributions of well-known other mathematicians of modern era.	**Unit VI: Mathematics of Seventeenth Century and After(20)** 6.1 Napier and his logarithms; Harroit and Oughtred; Galileo; Keepler; Desargues and Pascal. 6.2 Descartes and Fermat : Analytic Geometry 6.3 Cavalieri's method of indivisibles 6.4 Beginning of differentiation and integration. 6.5 Wallis; Barrow; Newton; Leibniz; Jakob Bernoulli & Johann Bernoulli; Taylor; Maclaurin; Lagrange; Laplace and Legendre 6.6 Gauss, Cauchy, Abel, Galois, Weirstrass and Riemann. 6.7 Erlanger program of Felix Klein 6.8 Cantor, Kronecker and Poincare. 6.9 Development of n- dimensional geometry, non Euclidean geometry, Projective geometry and Topology.

4. References

Eves, H. W. (1976). An introduction to history of mathematics (5th ed.). USA: CBS college publishing

Cooke, R. B. (1997). *The history of mathematics: a brief course.* New York: John Willy and Sons Inc.

Far Western University
Faculty of Education

Course Title: Teaching Arithmetic — **Full Marks: 100**
Course No: Math.Ed.354 — **Pass Marks: 45**
Nature of Course: Theoretical — **Teaching Hours: 45**
Level: Undergraduate
Semester: 5th

1. Course Description

This course is designed to make the students familiar with modern strategies of teaching arithmetic. Arithmetic is the key element of human civilization. Men have been using counting process since or even earlier than they have invented written language for their mass communication. They have developed many algorithms to make rapid calculation. But reason behind each algorithm is hidden. It is hoped that that students will understand the justification of each step of every algorithm after the completion of this course.

2. General Objectives

- To make students realize that arithmetic is necessary for their daily life.
- To make students realize that arithmetic is base for higher mathematics as well as for scientific study.
- To make the students able in selecting best strategies to teach each topic of arithmetic.
- To make students able in giving the justification of each steps involved in algorithms.

3. Specific objectives

After the completion of the study students will be able to:

1) State the objective of teaching arithmetic.
2) Prepare Scope and sequence chart.
3) Keep in mind problems and issues of teaching arithmetic while preparing teaching strategies.
4) Differentiate between numbers and numerals and state the characteristics of Egyptian, Roman and Hindu- Arabic Numerals and number systems.
5) Represent each number in the power of bases other than ten.
6) Prepare plans and modules to teach different topics from Arithmetic.
7) Choose appropriate methods to teach different topics from arithmetic.
8) Prepare and administer achievement test and interpret the result.
9) Prepare and collect appropriate low cost materials needed to arithmetic.

4. Contents

Unit I: Study of Curriculum

1.1 Objectives (General and specific)

1.2 Scope and sequence chart

Unit II: Teaching Strategies (some problems and issues)

2.1 Four Problems regarding teaching and learning

- Teaching for understanding
- Teaching for assimilation
- Teaching for transfer
- Teaching for permanence

2.2 Issues regarding methods of teaching

- Lecturer versus discovery method
- Inductive versus deductive method
- Problem solving strategy

Unit III: Number and Numerals

3.1 Egyptian Numerals

3.2 Roman Numerals

3.3 Hindu-Arabic Numerals

3.4 Bases other than ten

3.5 Expended notation in power of bases

Unit IV: Teaching Different Topics of Arithmetic

4.1 Teaching four simple rules (Use of Abacus, Base ten blocks and bundle of sticks)

4.2 Teaching fraction, decimal, percentage, ratio and proportion.

4.3 Teaching square root algorithm

4.4 Teaching Unitary method

4.5 Teaching profit and loss

4.6 Teaching simple and compound interest

Unit V: Planning and evaluation

5.1 Preparation of annual plan, unit plan and lesson plan.

5.2 Preparation of teaching modules

5.3 Collection and preparation of low cost materials

5.4 Preparation and administration of achievement test

5.5 Preparation and administration of Objective test items.

5.6 Item Analysis (calculation of difficulty level, discrimination index and power of distractor).

5. References

Pandit, R. P. (2009).*Teaching mathematics*. Kathmandu: Indira Pandit

Upadhyay, H. P., Upadhyay, M. P. and Luitel, S. (2070). *Exploratory Teaching Mathematics*. Kathmandu: SukundaPustakBhawan

Far Western University
Faculty of Education

Course Title: **Abstract Algebra**
Course No: Math. Ed 361
Nature of Course: Theoretical
Level: Undergraduate
Semester: 6^{th}

Full Marks: 100
Pass Marks: 45
Teaching Hours: 45

1. Course Description

This course is designed to develop the conceptual understanding and problem-solving ability of undergraduate-level students on algebraic structures. The course deals with algebraic structures such as group, ring, and field. The axiomatic approach of defining structures, isomorphism, and developing proofs of theorems are the beauty of the course. Simple ideas of the number system, knowledge of logic and proof techniques, and the idea of function are prerequisites for the course.

2. General Objectives

The aim of the course is to develop conceptual understanding and proof construction skills on fundamental algebraic structures. The general objectives of this course are as follows:

- To develop conceptual understating of a group, ring, field, and associated concepts.
- To develop theorem proving and problem-solving ability associated with an algebraic structure.
- To develop higher-order thinking, critical thinking, and imaginative thinking of the learners in the area of algebraic structures.
- To make students able to compare different algebraic structures through isomorphism and apply them appropriately in problem-solving.

3. Specific Objectives and Contents

Specific Objectives	Contents
• To define binary operation with examples • To test whether a particular operation on a given set is a binary operation or not • To define algebraic structure with examples • To define group, subgroup, normal subgroup and prove related theorems • To define cosets with examples and prove the Lagrange theorem • To illustrate normalize, centralizer, and center with examples and prove related theorems	**Unit I: Group Theory (13)** 1.1 Binary Operation 1.2 Algebraic Structures 1.3 Group (Definition, permutation group, cyclic group) and related theorems 1.4 Subgroup (definition, example, and related theorems) 1.5 Normal subgroup (definition, example, and related theorems) 1.6 Cosets (definition, example, and related theorems, Lagrange theorem) 1.7 Normalizer, centralizer, and center (definition, example, and related theorems)
• To describe quotient group with examples	**Unit II: Group homomorphism and isomorphism (8)**

• To describe group homomorphism, image, and kernel of homomorphism with examples and prove related theorems • To explain the concept of isomorphism with examples • To state and prove first, second, and third isomorphism theorems use them in solving problems related to isomorphism • To state and prove correspondence theorem	2.1 Quotient group 2.2 Homomorphism and related theorems 2.3 Isomorphism (first, second, and third isomorphism theorem and correspondence theorem)
• To define ring and its types with examples and prove related theorems • Explain the concept of zero divisors with examples • To describe the integral domain, division ring, and prove related theorems • To define a field with example and explain the relationship between field and integral domain • To discuss Boolean ring with examples • To define subring and determine whether a subset of a ring is subring or not, and prove related theorems • To discuss ideals and quotient ring with examples and prove related theorems • To explain the concept of ring homomorphism, ring isomorphism, and prove related theorems including three fundamental theorems	**Unit III: Ring theory (9)** 3.1 Ring, a ring with unity, a ring with zero divisors, ring without zero divisors, integral domain, division ring, field, Boolean ring, and related theorems 3.2 Subring (Definition, example, and related theorems) 3.3 Ideals and quotient ring 3.4 Ring homomorphism, ring isomorphism, three isomorphism theorems of rings, and other related theorems
• To define unit, associates, prime element, an irreducible element of a ring and prove related theorems • To explain prime ideal, maximal ideal, and principal ideal with an example, and prove related theorems • To define Euclidean ring, ED, UFD, and PID with examples and prove related theorems • Explain the ascending chain of ideals	**Unit IV: ED, UFD, and PID (9)** 4.1 Unit, associates, prime element, an irreducible element of a ring 4.2 Prime ideal, maximal ideal, and principal ideal 4.3 Euclidean ring, Euclidean domain, and ascending chain of ideals 4.4 Unique factorization domain and principal ideal domain 4.5 Relationship between ED, UFD, and PID

with examples	
• To define subfield with examples and prove related theorems • To explain filed extension and its degree with example and prove related theorems • To describe field adjunctions, finitely generated field, simple field extension, and algebraic extensions with examples • To define minimal, irreducible, and reducible polynomial with example • To explain the characteristic of a field	**Unit V: Field Theory (6)** 5.1 Field and subfield 5.2 Field extension and its degree 5.3 Field adjunction, finitely generated field, and simple field extension 5.4 Algebraic extension 5.5 Polynomial and characteristic field

4. Methodology and Techniques

Instructional techniques applicable to most of the units are lecturer with illustration, expository-based demonstration, group discussion, Problem Solving Approach, project-based learning, presentation, and collaborative learning methods. Collaborative activities and construction of subjective mathematical knowledge should be emphasized.

5. Evaluation Scheme

The assessment of students' performance is made through formative and summative evaluation. Classroom activities, report writing, presentation, individual work, and group work can be used as formative evaluation. For summative evaluation, an internal assessment of 40% and an external evaluation of 60% will be conducted. Internal assessment should be used as a formative evaluation also.

Internal Evaluation (40%)

For internal evaluation following points will be considered

Topic	Marks
Class Attendance	5
Class Presentation	5
Group Work	5
Quiz	5
Mid-Term Exam	10
Investigative Projective Work	5
Term Paper	5
Total	40

For External evaluation (60%)

At the end of the semester, an external examination will be held by the Office of the Controller of Examination for 60% weight.

Reference

Bhattarcharya. P. B., Jain, S. R., & Nagpaul, S. R. (1995). *Basic abstract algebra*. Cambridge University Press.
Dumit, D. S. & Foote, R. M. (2004). *Abstract algebra*. Wiley
Fraleigh, J. B. (2003). *A first course in abstract algebra*. Pearson Education
Hungerford, T. W. (1974). *Algebra*. Spronger

Far Western University
Faculty of Education

Course title: Professional Development of Mathematics Teacher
Course No: Math.Ed.362 **Credit hour: 3**
Level: B.Ed. **Teaching Hour: 45**
Semester: Sixth

1. **Course Description:**

This Course is designed for those students who take mathematics education as specialization area in Bachelor Level. The main aim of this course is development of mathematics teacher in their profession. It provides knowledge and skills of perspective mathematics teacher in the different areas of mathematics education. It deals with concept of mathematics & mathematics education, learning theories, curriculum, techniques of developing effective learning environment and supervision in mathematics instruction.

2. **General Objectives**

Following are general objective of this course:

- To develop an understanding on nature and structure of mathematics and mathematics education.
- To impart Knowledge of learning theories and enable the students in using them in designing instruction in order to teach secondary level mathematics.
- To develop skills of evaluating curriculum, textbook and teachers guide of school mathematics.
- To enable students in conducting an action research in mathematics education.
- To enable students in maintaining effective learning environments.
- To develop supervision skills to improve teachers competency of classroom instruction and learning facilitation in students.

3. **Specific objectives and contents.**

Specific objectives	Contents
• Differentiate mathematics and mathematics education with respect to their nature and structure. • State goals of mathematics education. • Describe need and importance of mathematics teaching in school level • Describe problems and issues inherent	**Unit I: Concept of mathematics and mathematics education (7)** 1.1 Origin and development of mathematics. 1.2 Definitions of mathematics 1.3 Nature and structure of mathematics. 1.4 Development of mathematics education. 1.5 Nature and structure of mathematics

in mathematics education.	education. 1.6 Goals of mathematics education. 1.7 Need and importance of mathematics teaching in school level. 1.8 Problems and issues inherent in mathematics education.
• Compare and contrast behaviorist cognitivist and constructivist theory of learning. • Describe learning theories given bypiaget, Brunner, Gagne, Diene, Ausubel, Van Hiele and explain their implication in mathematics education. • Explain constructivist learning theory and its implication in teaching mathematics in secondary level.	**Unit II Learning theories and their implication (15)** 2.1 Overview of Behaviorists, Cognitivist and constructivist theory of learning. 2.2 Piaget's theory of intellectual development 2.3 Brunner's theory of instruction 2.4 Gagne's theory of learning 2.5 Diene's theory of learning 2.6 Ausubel's theory of meaningful verbal learning. 2.7 Constructivist learning theory. 2.8 Van Hiele model of geometric thinking.
• Describe meaning of curriculum, textbook and teacher guide • Explain steps of curriculum development according to Hilda Taba model • Describe qualities of good textbook and teacher's guide • Analyze critically the curriculum, textbook and teachers guide of secondary level mathematics in Nepal.	**Unit III: Curriculum, Text book and Teacher guide(6)** 3.1 Meaning and definition of curriculum. 3.2 Elements of curriculum 3.3 Steps of curriculum development (Hilda Taba model) 3.4 Critical appraisal of curriculum. 3.5 Textbook and Teacher guide 3.6 Qualities of good textbook and teachers guide 3.7 Critical appraisal of textbook and teachers guide 3.8 Overview of mathematics curriculum, textbook and teachers guide of secondary level in Nepal.
• Describe techniques of using mathematics textbook effectively • Describe techniques of using learning resources effectively • Explain how to assign and evaluate homework • List out classroom questioning strategies. • Describe how to diagnose and resolve learning difficulties • Explain technique of maintaining discipline in classroom.	**Unit IV: Developing and maintaining Effective learning Environment (6)** 4.1. Using mathematics textbook effectively 4.2. Using teaching learning resources 4.3. Assigning and evaluating homework 4.4. Classroom questioning strategies 4.5. Diagnosing and resolving learning difficulties 4.6. Maintaining discipline in the classroom.
• Describe action research and its	**Unit V:Action Research in Mathematics**

characteristics • Write procedure for conducting action research • Develop proposal for action research and reporting results of action research	**education (5)** 5.1 Introduction of action research 5.2. Characteristics of an action research 5.3. Procedure for action research 5.4. Writing Proposal for action research and reporting its results.
• Describe Need and techniques of supervision. • Evaluate the status of teaching using different scales	**Unit VI: Supervision in mathematics instruction(6)** 6.1. Concept of Supervision 6.2. Need of supervision 6.3. Techniques of Supervision 6.4. Use of supervision technique to improve classroom teaching 6.5. Rating of teacher's teaching using different scales

4. References

Bell, F. H. (1978). *Teaching and learning mathematics*. WMC: Brown Company Publisher

Cohen, L., Manion, L. and Morison, K. (2007): *Research methods in education* (6thed.). London: Rutledge

Maharjan, H. B. et. al. (2068).*Teaching mathematics in secondary schools*. Kathmandu: Buddha Academic Publisher's and Distributers

NCTM (1994).*Professional development of teachers of mathematics*. Yearbook, Reston VA: National council of teachers of mathematics

Pandit, R. P. (2009).*Teaching mathematics*. Kathmandu: Indira Pandit

Upadhyay, H. P. et. al. (2070).*Exploratory teaching mathematics.* Kathmandu: Sukunda Pustak Bhawan

Far Western University
Faculty of Education

Course Title: Teaching Mathematics in Secondary Level
Course No.: Math.Ed.363 **Credit hours: 3**
Semester: Sixth **Teaching hour: 45**
Level: Bachelor

1. **Course Description**

This course is designed for students studying in Bachelor level with mathematics education as specialization area. The main aim of this course is to enable students in planning for instruction, conducting teaching learning activities and evaluating student's performance. It deals with taxonomy of instructional objectives, instructional strategies, instructional materials, evaluation and teaching different topics from secondary level mathematics. This course provides road map from planning to evaluation.

2. **General Objectives**

Following are general objectives of this course:

- To enable students in preparing objectives of different levels of cognitive, affective and psychomotor domain.
- To enable students in selecting and using different instructional strategies to teach different topics from secondary level mathematics.
- To enable students in developing different types of instructional materials and using them in teaching mathematics.
- To make students able in developing lesson plan, unit plan, annual plan and teaching module and using them in instruction.
- To enable students in constructing reliable and valid test and using non testing devices to access students' performance.
- To enable students in teaching different topics of secondary level mathematics.

3. **Specific objectives and contents**

Specific Objectives	**Content**
• Write objectives of different levels of cognitive domain from mathematics of secondary level. • Describe different levels under affective domain and psychomotor domain.	**Unit I: Taxonomy of instructional Objectives(4)** 1.1 Objectives of cognitive domain (Bloom) 1.2 Objectives of affective domain (Krathwohl) 1.3 Objectives of psychomotor domain (Simpson)
• Describe four problems of mathematics instruction and explain how these problems can bead	**Unit II : Instructional strategies(12)** 2.1 Problems of instruction in mathematics (understanding, assimilation, permanence and transfer)

dressed. • Describe techniques of managing classroom diversity. • Describe how mathematical anxiety can be addressed in students. • Compare and contrast different methods of teaching with respect to nature, advantages, disadvantages and application. • Select appropriate method of teaching for particular mathematics topic.	2.2 Managing classroom diversity 2.3 Mathematical anxiety in students 2.4 Teaching Methods 2.4.1 Inductive and Deductive method 2.4.2 Analysis and synthesis method 2.4.3 Problem solving method 2.4.4 Guided discovery method 2.4.5 Expository method 2.4.6 Collaborative learning method 2.4.7 Constructivist teaching method 2.4.8 Demonstration method 2.4.9 Discussion method 2.4.10 Question –Answer method 2.4.11 Experimental method 2.4.12 Laboratory method 2.5 Selecting teaching methods for mathematics teaching
• Classify teaching materials and explain their importance in teaching math. • Construct different teaching materials and write their application in teaching math in secondary level. • Select appropriate materials to the given classroom situation.	**Unit III : Instructional Materials(9)** 3.1 Introduction of Instructional materials 3.2 Types of instructional materials (Audio, Visual, Audio-Visual, Manipulate, Computer, Multimedia) 3.3 Importance of teaching materials in teaching mathematics 3.4 Construction and use of teaching materials [Tan Gram; Geo Board; Graph Board, Circle Board; Clinometer; Trundle wheel; Factorization Blocks; Different Models, Models of prism, pyramid, cone, cylinder, sphere, hemisphere, combined solids; Materials representing area of circle, volume of cylinder, volume of pyramid; Models representing different theorems on geometry]
• Discuss instructional planning and its importance in teaching. • Describe Annual plan, unit plan, lesson plan, teaching module and developing them for topics on mathematics.	**Unit IV : Planning Instruction(6)** 4.1 Instructional planning 4.2 Annual plan 4.3 Unit plan 4.4 Lesson plan 4.5 Teaching module
• Define test, measurement and evaluation. • Explain different types of measurement and evaluation. • Prepare specification chart for	**Unit V : Evaluation in Mathematics Instruction(7)** 5.1 Evaluation and measurement 5.2 Formative and summative evaluation 5.3 Norm referenced and criterion Referenced measurement

secondary school mathematics test. • Discuss how to establish reliability and validity of test. • Construct multiple choice items and subject test items from secondary level mathematics. • Explain item analysis and use it in preparation of test. • Use different scoring techniques in checking answer copies • Explain use of test result. • Describe various types of alternative.	5.4 Techniques of evaluation(test and non-testing devices) 5.5 Specification chart 5.6 Test: Reliability and validity 5.7 Construction of test item • .objective(multiple choice) • . subjective 5.8 Item analysis 5.9 Scoring of test items 5.10 Use of test result 5.11 Alternative assessment [CAS, portfolio, project work, class work, homework, class test , quizzes]
• Explain techniques of teaching facts, skills, concepts, principle, problem solving and theorem proving. • Teach each of the topic from secondary level mathematics (compulsory and optional mathematics)	**Unit VI : Teaching Secondary school mathematics(7)** 6.1 Teaching facts, concepts, skill and principle 6.2 Teaching problem solving 6.3 Teaching theorem proving 6.4 Teaching different topics from secondary level mathematics

4. References

Bell, F. H. (1978). *Teaching and learning mathematics*. WMC: Brown Company Publisher

Maharjan, H. B. & Upadhyay H. N. (2009).I*nstructive mathematics materials.*Kathmandu: Paluwa Prakashan

Maharjan, H. B. et. al. (2068).*Teaching mathematics in secondary schools*. Kathmandu: Buddha Academic Publisher's and Distributers

Pandit, R. P. (2009).*Teaching mathematics*. Kathmandu: Indira Pandit

Upadhyay, H. P. et. al. (2070).*Exploratory teaching mathematics.* Kathmandu: Sukunda Pustak Bhawan

Far Western University
Faculty of Education

Course title: Vector Analysis
Course No: Math.Ed.364 **Credit hour: 3**
Level: B.Ed. **Teaching Hour: 45**
Semester: Sixth

1. Course Description:

This Course is designed for those students who take mathematics education as specialization area in Bachelor Level. It deals with scalar and vector valued functions; differentiation and integration of vector functions; gradient of scalar functions, divergence of vector functions and curl of vector functions; line, surface and volume integral and integral transformation theorems. Prerequisites of this course are elementary ideas of vectors and their products and ordinary differential and integral calculus of scalar functions.

2. General Objectives

Following are general objective of this course:

- To develop an understanding vector and product of vectors.
- To develop on students skills of differentiation and integration of vector valued functions.
- To develop on students understanding and skills of finding gradient of scalar function, divergence of vector functions and curl of vector function.
- To develop concept and skills on students of line, surface and volume integral
- To enable students in understanding and applying different theorems on integral transformation.

3. Specific objectives and contents.

Specific objectives	Contents
• To define vector, collinear vectors, coplanar vectors with example. • To define scalar product and vector product of two vectors with examples and interpret them geometrically.	**Unit I: Scalar and vector quantities** 1.1 Scalar & Vector Quantities 1.2 Different Types of Vector 1.3 Laws of Vector Addition 1.4 Collinear Vectors 1.5 Coplanar & Non-coplanar Vectors 1.6 Rectangular Resolution of Vectors

• To derive some properties of scalar and vector product.	1.7Geometrical Interpretation of Scalar Product of Two Vectors 1.8 Vector Product of Two Vectors & Its Geometrical Interpretation 1.10 Properties of Vector Product 1.11 Vector Product of Two Vectors in the Determinant Form
• To define scalar triple product and vector triple product of three vectors with examples and interpret them geometrically • To establish properties of scalar triple product and vector triple product. • To define scalar and vector product of four vectors with examples • To define reciprocal system of vectors and establish their properties	**Unit II :Product of Three Vector** 2.1 Introduction 2.2 Product of Three Vectors 2.3 Scalar Triple Product & Its Geometrical Interpretation 2.4 Properties of Scalar Triple Product 2.5 Vector Triple Product 2.6 Geometrical Meaning of Vector Triple Product 2.7 Product of Four Vectors 2.8 Scalar & Vector Product of For Vectors 2.9 Reciprocal System of Vectors 2.10 Properties of Reciprocal System
• To define limit and derivative of a vector function and interpret them geometrically. • To apply techniques of differentiation to find derivative of vector function • To find partial derivative of vector function • To find derivative of scalar and vector triple product • To define vector integration and use standard results in finding integral of vector function	**Unit III: Differentiation & Integration of Vectors** 3.1 Introduction 3.2 Vector Function 3.3 Limit of Vector Function 3.4 Derivative of Vector Function 3.5 Geometric Interpretation of Derivative of Vector Function 3.6 Techniques of Differentiation of Vector Function 3.7 Partial Derivative of Vector Function 3.8 Derivatives of Scalar & Vector Triple Product 3.9 Integration 3.10 Standard Results
• To define point function, level surface and vector differential operator. • To define gradient of scalar	**Unit IV: Gradient, Divergence & Curl** 4.1 Point Function 4.2 Level Surfaces 4.3 Directional Derivative of Scalar Point

function, divergence of vector function and curl of vector function with examples • to find gradient, divergence and curl of given functions • To give geometrical interpretation of gradient of scalar function • To give physical concept of divergence of vector function	Function 4.4 Vector Differential Operators 4.5 Gradient of a Scalar point Function 4.6 Divergence & Curl of Vector Point Function 4.7 Laplacian Differential Operators 4.8 Summation Notation of Divergence &Curl 4.9 Divergence & Curl of a Curl 4.10 Physical Concept of Divergence of Vector Function 4.11 Geometrical Interpretation of a gradient of Scalar Function
• To define line, surface and volume integral with example. • To derive formulae related to line, surface and volume integral • To solve problems associated with line, surface and volume integral	**Unit V:Line, Surface & Volume Integrals** 5.1 Line Integral 5.2 The Line Integral Independent of Path 5.3 Irrotaional Vector Field 5.4 Surface Integral 5.5 Evaluation of Normal Surface Integral 5.6 Volume Integral
• To state and prove Green's theorem, Stock's theorem and Gauss's theorem • To apply Green's theorem, Stock's theorem and Gauss's theorem in solving problems of integration	**Unit VI**: **Integral Transformation Theorem** **6.1 Introduction** 6.2 Green's Theorem in Plane 6.3 Area Using Green's Theorem 6.4 Stokes Theorem 6.5 Gauss's Theorem (Divergence Theorem)

4. References

Sing, M. B. and Bajracharya, B. C. (2069). *A textbook of vector analysis*. Kathmandu: Sukunda Pustak Bhawan

Far Western University
Faculty of Education

Course Title: Number Theory
Course No: Math.Ed.471
Nature of Course: Theoretical
Level: Undergraduate
Semester: 7^{th}

Full Marks: 100
Pass Marks: 45
Teaching Hours: 45

Unit 1: Divisibility Theory in the Integers;

The division algorithm, the greatest common divisor, the Euclid algorithm the linear Diphontine equation

Unit 2: Primes and their distribution prime numbers and their properties, Fundamental theorem of Arithmetic, the sieved of Eratosthenes, To prove that there are an infinite numbers of prime, The Goldbach Conjucture

Unit 3: The theory of Congruences Definition and basic properties of Congruences

Unit4: Fermat's theorem

Fermat's Faclorisation method

Fermat's little theorem

Wilson's theorem

Unit5: Numbers Theoretic functions

The functions T and 6, their basic properties, their multiplicative nature, the mobius function mobius inversion formula, the greatest integer function

Unit 6: Eulers phi function multiplicative nature of phi function, basic properties of phi function generalized form of Fermat's theorem

Unit 7: Quadratic Reciprocity law:

Quadratic residues and non residues, Euler's criterion, the Legend symbol and its properties Gaurs lemma and related theorems, Gaurs Quadratic reciprocity law,

Unit 8: Perfect numbers and Fermat's number perfect numbers, their basic properties, mersenne primes and their properties, Fermat's numbers and their properties

Unit 9: The Fermat Conjecture

The Pythagorean Triples and their properties, the famous 'last' theorem and results based on it

Unit 10: Fibonacci numbers

Introduction of Fibonacci numbers, their sequence Properties of Fibonacci numbers, certain identifies involving Fibonacci numbers

Far Western University
Faculty of Education

Course Title: **Graph Theory**

Course Number: Math.Ed.472 Nature of Course: Theoretical

Semester: VII Credit hour: 3

Introduction:- Graph Theory is one of the branches of Modern Mathematics. It deals in solving not working problems of modern scientific world. It is frequently applied in physics Mathematics, Engineering< Biology, chemistry, geography and many other subjects. An engineer uses a planar graph tay out the plan of utility services(such as supply of water, electricity, gas etc) to different houses of urban area. A tourist wishing to visit famous cities of the world may use the shortest path problems to make his tour the most economical. Many topics of graph theory are being used by experts in their concerned areas.

General objectives:

1. To make the students familiar with the net working problems of the scientific world.
2. To make them `able to apply the knowledge of graph theory of different scientific subjects.
3. To make them able to use graph theory to solve the net working problems that arises in their daily life.

Specific objectives:

After the completion of this course, the students will be able to

1. Define the basic concepts such as graph, multigraph, complete graph, bipartite graph, platonic graph, edges, verticies, sub graph etc.
2. Recognize the network, walk, trail, path circuit and cycle (give example by drawing figure)
3. Prove some theorems telated to edges and vertices.
4. Define isomorphic graph and prove the theorems related to it.
5. Compute incidence and adjacency matrices of a graph and a multigraph.
6. Define Eulerian and Hamiltonian graph and prove the theorems related to it.
7. Solve the shortest path problem of a weighted graph.
8. Represent data on various topics in a tree diagram.
9. Illustrate the spanning trees of a given graph.
10. Prove some theorems on trees.
11. Prove Euler's theorem: v-c+h=g
12. Define chromatic number and prove that a planar graph has chromatic number$\leq$5.
13. Apply diagraphs to solve the problem of tournament and traffic flow.

Unit 1: Introduction to graph

1. Edges and verticies. Empty graph (null graph), Trivial graph multigraph parallel edges, complete graph, bipartite graph, platonic graph, degrees of a vertex, even or odd vertices.
2. Some theorems relating to edges and vertices.
   (i) Sum of the degrees of all vertices of a graph in equal to twice the number of edges.
   (ii) The number of odd vertices in a graph is always even.
   (iii) Total number of edges in a complete graph with 'n' vertices is equal to ½ n(n-1).
   (iv) The complete bipartite graphkm, n consists ofm+n vertices and mn edges.

Unit 2: Connectivity

1. Walk , trail, path, circuit and cycle.
2. Connected and disconnected graph.
3. Isographism of graphs.
4. Subgraphs, spanning subgraphs, induced subgraphs, bridge and cut vertex.
5. Matrix representation of graphs.
   (computation of incidence and adjacency matrices)

Unit 3: Eulerian and Hamiltonian graphs.

1. Konigsberg Bridge problem, Eulerian circuit with even vertices, Eulerian circuit with two odd vertices.
2. Hamiltonian path, Hamiltonian cycle.
3. Weighted graph, shortest path problem, chinese postman problem.

Unit 4: Trees

1. Representation of tree diagrams with some given data. eg. classification of quadrilaterals, Administrative chart of an office.
2. Properties of trees.
3. Spanning of trees.
4. Minimal spanning trees of a weighted graph.
5. Khuskal's Algorithm.

Unit 5: Planar graphs

1. Euler's theorem : v-e+r=2
2. Colouring of graphs, chromatic number and five colour problem.

Unit 6: Diagraphs

1. Directed walk, directed cycle, reachable vertex.

2. Weakly connected and strongly connected diagraphs.
3. Relations and matrices of diagraphs.
4. Tournament and Traffic flow.

Reference

S.M.Maskey – First course in graph theory.

Far Western University
Faculty of Education

Course Title: Enrichment of Mathematics Teachers

Course Number: Math.Ed.473 **Nature of Course: Theory + Practical**

Semester: VII **Credit hour: 3**

1. Course Description

This course has many components that will let student-teachers (ultimately pupil) develop positive attitudes for appreciation of mathematics as a discipline through practical hands-on experience and through logical reasoning.

2. Course General Objectives

The aim of enrichment curriculum is to support student-teachers in the development of following aspects:

I. To enable students to get insight into historical methods of doing mathematics.
II. To provide different learning experiences to different learning ability groups.
III. To provide practical experiences of extracurricular activites to become a professional mathematics teachers.
IV. To develop practical skills to make mathematics understandable through hands-on-experience while preparing 3-D objects and through logical amusements through measuring, drawing, sketching, modeling, interpreting, curve fitting, etc.

3. Specific Objectives and Contents Specific

Specific Objectives	Specific Contents
i. To describe challenges in teaching mathematics with respect to students, mathematics and society ii. To describe ten techniques of motivating students and apply them in mathematics class iii. To describe classroom questioning techniques and apply them in teaching iv. To describe nature of problem and ten strategies of problem solving v. To describe and use different strategies for teaching lessons	**Unit 1: Basics for Mathematics Teachers (7)** 1.1.The challenges of teaching • Today's students, mathematics and society's needs 1.2. Motivating students (Ten Techniques) 1.3. Classroom discourse (Classroom questioning technique) 1.4. The nature of problem (Ten problem solving strategies) 1.5. Strategies for teaching lessons more effectively • Using tree diagram or branching; paper folding and cutting; mathematical models and manipulative; pictures

more effectively.	
i. To select proper enrichment strategies of teaching suitable for different ability groups. ii. To prepare an outline for an enrichment unit for each of the following curriculum topics. iii. To present additional sites for enrichment contents in maths.	**Unit 2 : Enriching Mathematics Instruction(7)** 2.1 Enriching mathematics instruction with an historic approach 2.2 Enrichment techniques for all ability levels 2.3 The slow learner 2.4The average-ability students 2.5The gifted students
iv. To conduct and organize many extracurricular activities such as mathematical contests, assembly program, Fair, trips v. To organize training/talk program or peer teaching program.	**Unit 3: Extracurricular Activities in Mathematics(5)** 3.1 The mathematical club, mathematics team, mathematics magazine 3.2 Mathematics contests, Projects 3.3 Mathematics Fair/trips, Mathematics assembly 3.4 Peer teaching, Guest Speaker

i. To construct magic square of any order and discover the properties of magic squares. ii. To solve different problems related to four basic operation and alphametics. iii. To state and analyze properties of palindromic numbers. iv. To use the properties of usual and unusual numbers in calculation. v. To demonstrate the skill of using ancient Egyption method of calculation. vi. To compute present worth of many paid in later years. vii. To sketch different patterns in algebra and geometry. viii. To create different 3-D models and 2-D maps and use in teaching mathematical concepts. ix. To identify and explain where mathematics is found in nature. x. To depict the meaning of different terms used in statistics, probability through graphs, dominoes etc.	**Unit 4:Enrichment Units for the Secondary Mathematics Teachers (26)** 4.1 Arithmetic: Magic square, Alphametics, Number theory: Prime numbers, Divisibility test, Palindrome number, Number nine, symmetric, Ancient Egyptian arithmetic, continued fraction, Diophantine equation, Fermat's, Wilson's and Euler's theorem, tangram, … 4.2 Algebra: Arithmetic, geometric and Harmonic mean and relations, Algebraic identities, Euclidean Algorithm, Algebraic Fallacies, Complex number, Reflexive, symmetric, and transitive relations,… 4.3 Geometry: Nine point circle, Euler lines, Simson line, Golden rectangle and triangle, Geometric fallacies, Regular polyhedra, 4/5 color problem, Angle in a clock, Parabolic envelop, Angle trisection, Construction of ellipse, Parabola and hyperbola, Schematic chart of different geometries: Klein bottle, Koenisberg bridge problem, mathematics found in nature, Mathematical modelling,…. 4.4 Trigonometry: Basic formula in trigonometry, Multiple angles, Unit circles,… 4.5 Statistics: position of mean, median, and Mode, Dispersions and their relations, z-score, graphical representation of correlation, and regression, Mathematics of life insurance 4.6 Probability: Dominos, Birthday problem, Probability for baseball, 4.7 Test of hypothesis: α, β error

4. Reference

Posamentier, A. S. and Smith, B. S. (2015).*Teaching secondary mathematics: Techniques and enrichment.* New York: Pearson.

Posamentier, A. S. and Stepelman, J. (1990).*Teaching secondary school mathematics*. New York: Macmillan Publishing Company.

Upadhyay, H. P.; Upadhyay, M. P &Luintel, S. (2070). *Exploratory teaching mathematics. K*athmandu: Sukunda Pustak Bhawan.

Far Western University
Faculty of Education

Course Title: Mathematical Analysis **Full Marks: 100**
Course No: Math.Ed.481 **Credit Hour: 3**
Nature of Course: Theoretical **Teaching Hours: 45**
Level: Undergraduate
Semester: 8th

1. Course Description

This course is designed for Undergraduate students to develop understanding and skills of some aspect of mathematical analysis. It bridges the gap between elementary real analysis and advance course in mathematical analysis. To understand materials included in this course the reader must be familiar with content of calculus of single variable and elementary real analysis, such as, sequence and series of real numbers; limits, continuity, derivative and integral of a function etc. This course consists of improper integral, sequence and series of functions, power series and metric space.

2. General Objectives

Broadly, the course has following general objectives:

- To make students familiar with concept and skills of convergence of improper integrals.
- To make students able to test uniform convergence of sequence and series of functions by using different tests.
- To make students familiar with properties of power series.
- To familiarize students with the basic features of metric spaces.

3. Specific objectives and contents

Specific Objectives	Contents
• To define improper integrals of unbound function having finite limits of integration with examples • To define improper integrals of functions having infinite range of integration with examples • To prove theorems on test of convergence(comparison test, general test for convergence, absolute convergence) of integrals of unbounded function with finite limits of integration and apply them in solving related problems • To prove theorems on test of convergence (comparison test, general test for convergence, absolute convergence, Abel's test, Dirichlit's test) of integrals of functions with infinite range of integration and apply	**Unit I:Improper Integrals (9)** 1.1Introduction of improper integrals 1.2 Integration of unbounded functions with finite limits of integration 1.2.1 Definitions 1.2.2 Test for convergence (comparison test, general test for convergence, absolute convergence) 1.3 Integration of functions with infinite range of integration 1.3.1 Definition 1.3.2 Test for convergence (comparison tests, absolute convergence, general test for convergence, Abel's test, Dirichlet's test)

them in solving related problems	
• To define point wise convergence of sequence of functions with examples • To define uniform convergence of sequence of functions with examples • To state, prove and apply Cauchy's criterion for uniform convergence • To test uniform convergence of sequence of functions • To state, prove and apply different test for convergence of series (Weierstrass's M-test, Abel's test, Dirichlet's test) • To prove properties of uniform convergence of sequence and series • To prove theorems concerning relationship between uniform convergence and continuity; uniform convergence and integration and uniform convergence and differentiation	**Unit II: Sequence and Series of Functions (11)** 2.1Point wise convergence of sequence of functions 2.2 Uniform convergence of sequence of functions 2.3 Cauchy's criterion for uniform convergence 2.4 Test for uniform convergence of sequence 2.5 Test for uniform convergence of series (Weierstrass's M- test, Abel's test, Dirichlet'stest) 2.6 Properties of uniform convergence of sequence and series 2.7 Uniform convergence and continuity 2.8 Uniform continuity and integration 2.9 Uniform continuity and differentiation
• To define power series with examples • To prove basic theorems of power series • To define radius of convergence • To state and prove different theorems (differentiation, uniqueness, Abel's, Taylor's)	**Unit III: Power Series (4)** 3.1 Introduction of a power series 3.2 Basic theorems on power series 3.3 Radius of convergence and Cauchy-Hadamard theorem 3.4 Differentiation theorem and uniqueness theorem 3.5 Abel's theorem 3.6 Taylor's theorem
• To define metric space with examples • To prove theorems of open and closed sets • To define subspace of a metric space and prove theorems of subspace • To prove theorems on convergence of sequences • To prove theorems on Cauchy sequence and complete metric space • TO prove theorems on continuity and uniform continuity • To prove theorems on compact metric space • To prove theorems on connected metric space	**Unit IV: Metric space (21)** 4.1 Definition and examples of metric space 4.2 Open and closed sets (Open and closed spheres; Neighbourhood of a point; Open set; Limit points; Closed set; Closure of a set; interior, exterior and boundary points; Dense sets) 4.3 Subspace of a metric space 4.4 Convergence of a sequence in a metric space 4.5 Cauchy sequence and complete metric space 4.6 Continuity and uniform continuity 4.7 Compact metric space 4.8 Connected metric space

4. Recommended book

Malik, S.C. and Arora, S. (2010). *Mathematical analysis (4th)*. New Delhi: New Age International Pvt. Ltd.

5. References

Bartle, R. G. &Sherbert, D. R. (2005).*Introduction to real analysis (3rd)*. New Delhi: Willy Indies (P) Ltd.

David. V. W. (1996). Advance calculus. New Delhi: Prentice Hall of India

Narayan, S. &Raisinghania, M. D. (2009).*Elements of real analysis (10th).* New Delhi: S. Chand and company

Methodology and Techniques

Modes of instruction:

- Lecture
- Seminar
- Exercises
- Guided study
- Tutorial
- Independent study
- Project work
- Practical work

Modes of learning:

- Attending lectures,
- Doing assignments,
- Writing papers,
- Independent and private study,
- Reading books, reviewing journals and papers,
- Critiquing
- Group study
- Peer discussion
- Field visit

Evaluation Scheme

- Internal 40%
- External 60%

The internal evaluation will be conducted as follow:

	Activities	Marks
a)	Regularity and class participation(Attendance)	5
b)	Class room presentation	5
c)	Term paper	5
d)	Investigative project work	5
e)	Group work/discussion	5
f)	Reflection notes	5
g)	Mid-term exams	10

Attendance in Class: Students should regularly attend and participate in discussion in the class. 80% percent class attendance is mandatory for the students to enable them to appear in the End-Term examination. Below 80% in attendances that signify is NOT QUALIFIED (NQ) in subject to attend the end term examination.

Term paper: Term paper must be prepared by the use of computer in a standard format of technical writing and must contain at least 5 pages. It should be prepared and submitted individually. The stipulated time for submission of the paper will be seriously taken one of the major criteria of the evaluation.

Presentation: Student will be divided into groups and each group will be provided topic for presentation and it will be evaluated individually as well as GroupWise.

Assignment: Each student must submit the assignment individually. The stipulated time for submission of the assignment will be seriously taken one of the major criteria of the evaluation.

Mid-Term Examinations: It is a written examination and the questions will be set covering the topics as taught in the sessions. Mid-term examination will be based on the model prescribed for End-term examination and will contain 50% questions and full marks of it.

End-Term/External Examinations: It is also a written examination and the questions will be asked covering all the topics in the session of the course. It carries 60 marks. For simplicity, full marks will be assumed 100, and 60% of marks obtained will be taken for evaluation.