Revised/Effective 2079/80

Far Western University
Faculty of Education

Course Title: **Integral Calculus**
Course No. : Math.Ed.121
Level: B.Ed.
Semester: 2nd

Nature of course: Theoretical
Credit Hour: 3
Teaching Hrs: 45

1. Course Description

This course is designed for undergraduate level students to develop understanding and skills of integral calculus and differential equations. It consist integration techniques, applications of integral in quadrature, rectification, surface area and volume of solid of revolution, and differential equations. Concept and skills of Limit of a function, Simple techniques of differentiation and integration of different types of functions are prerequisite for this course. This course can help students to build foundation for higher studies in mathematics.

2. General Objectives

General objectives of this course are as follows:

- To demonstrate understanding and skills of different techniques and principles associated with antiderivative.
- To demonstrate understanding and skills of different techniques and principles associated with definite integral.
- To demonstrate understanding and skills of different techniques, principles and application of integral calculus in determining arc length, area, volume, and surface area.
- To solve different type of differential equations and apply them in real world problems.
- To be confident on the learning of skills, concepts, and theorems of Integral Calculus and differential equations.
- To be engaged in constructing meanings of concepts, skills and theorems of integral calculus and differential equations.

3. Specific objectives and contents

Specific objectives	Contents
• To illustrate the concept of antiderivative, definite integral, and improper integral. • To find antiderivative of some functions using one or more of the methods of integration (transformation, substitution, integration by parts, partial fractions) • To introduce the concept of definite integral. • To interpret definite integral as a limit of a sum. • To interpret geometrically the meaning of definite integral.	**Unit I: Antiderivative, Definite Integral and Improper Integrals (7 hrs)** **1.1 Antiderivative** 1.1.1 Concept of antiderivative 1.1.2 Methods of integration 1.1.3 Integration of rational functions **1.2 Definite Integral** 1.2.1 Concept of definite integral 1.2.2 Integration as the limit of a sum

• To explain the fundamental theorems of integral calculus and apply it to evaluate definite integrals. • To establish general properties of definite integral and use them in solving problems. To define improper integral with example. • To evaluate improper integral of first kind and second kind • To derive formula for some standard infinite integral and apply them in evaluating integrals. • To complete the project work assigned by teacher on application of integral on real life context.	1.2.3 Geometrical interpretation of definite integral 1.2.4 Fundamental Theorem of integral calculus (without proof) 1.2.5 General properties of definite integral **1.3 Improper integrals** 1.3.1 Introduction of infinite integral 1.3.2 Types of infinite integral (Integral with infinite limits and Integrals in which integrand is not bounded) 1.3.3 Some standard infinite integrals 1.4 *Project work:* Applications of integral in real life
• To find the reduction formula for some special integrals. • To define beta and gamma function. • To prove the properties of beta and gamma functions. • To apply the properties of Beta & Gamma functions to evaluate some integrals.	**Unit II: Reduction Formulae, Beta Functions, and Gamma Functions (4 hrs)** 2.1 Reduction formulae for some special functions 2.2 Concept of Beta and Gamma functions 2.3 Properties of Beta and Gamma functions
• To explain methods of tracing curves in Cartesian form or Polar form. • To derive formula for area under a curve, area between two curves, and area bounded by closed curves. • To apply above formulas in solving area related problems. • To find Arc length of a curve in different forms (Cartesian, Polar, Parametric). • To find intrinsic equations from Cartesian equation, polar equation, parametric equations, and pedal equations. • To solve problems related with arc length. • To determine intrinsic equation of a curve from Cartesian equation and Polar equations. • To complete the project work assigned by teacher on application of quadrature and rectification on real life context.	**Unit III: Quadrature and Rectification (8 hrs)** 3.1 Review of tracing curves in Cartesian form and polar form 3.2 Quadrature 3.2.1 Concept of quadrature 3.2.2 Area in Cartesian co-ordinates 3.2.3 Area in polar co-ordinates 3.2.4 Area between two curves 3.2.5 Area bounded by a closed curve. 3.3 Rectification 3.3.1 Concept of rectification 3.3.2 Arc Length of curves in Cartesian, Parametric , pedal, and Polar form 3.6 Intrinsic equations from Cartesian equation and Polar equations 3.7 *Project Work:* Application in real life context
• To explain meaning of solid of revolution. • To derive expression for volume of solid of revolution (about axes or parallel to axes) and apply them to solve problems.	**Unit IV: Volume and Surface Area of Solid of Revolution (4 hrs)** 4.1 Solids of revolution

• To derive formulas for surface area of a solid of revolution and apply them in solving related problems. • To complete the project work assigned by teacher on application of volume and surface area on real life context.	4.2 Volume of a solid of revolution (in Cartesian form and Polar Form) 4.3 Volume when axis of revolution is parallel to the x-axis or y-axis 4.4 Volume from polar equations 4.5 Surface area of a solid of revolution 4.6 *Project Work:* Application in real life context
• To explain the concept of differential equation with example. • To explain meaning of order & degree of differential equation, and determine them. • To explain meaning of solution of differential equation with example. • To form the differential equation for a given family of curves.	**Unit V: Differential Equations (2 hrs)** 5.1 Elementary concept of differential equation 5.2 Definition of differential equation 5.3 Order and degree of differential equation 5.4 Solution of differential equation
• To explain meaning of first order and first degree differential equation with example. • To describe technique of solving differential equation in different standard forms and apply them in solving such type of equations (variable separable, homogeneous differential equations, linear differential equation ,Bernoulli differential equation, exact differential equation & equations reducible to above forms) • To explain concept of Integrating factor and use it to solve differential equation.	**Unit VI: Differential Equations of First Order and First Degree (7 hrs)** 6.1 Introduction 6.2 Variable Separable Form 6.2.1 Change of variables to reduce in variable separable form 6.3 Homogeneous differential equation 6.3.1 Equations reducible to homogeneous form 6.4 Exact differential equations 6.4.1 Integrating factors and solution by inspections 6.5 Linear differential equations 6.5.1 Equations reducible to linear form 6.5.2 Bernoulli's equation
• To formulate and solve first order and first degree differential equations of contextual problems. • To formulate and solve first order and first degree differential equations of problems in geometry.	**Unit VII: Application of First Order and First Degree Differential Equations (3 hrs)** 7.1 Modeling problems in Geometry 7.2 Modeling problems in Real world
• To explain technique of solving differential equations which are solvable for p, solvable for y or solvable for x, and solve such equations. • To solve differential equations in Clairaut's form.	**Unit VIII: Differential Equations of First Order but not of First Degree (4 hrs)** 8.1 Introduction 8.2 Equations solvable for p, for y, and for x 8.3 Clairaut's equation
• To solve second order linear differential with constant coefficients. • To solve second degree linear differential with	**Unit IX: Linear Differential Equations of Second Order (6 hrs)**

constant coefficients using the concept of particular integral. • To solve homogeneous linear differential equations of order two and more.	9.1 Second order linear differential equations with constant coefficients 9.2 Particular Integral 9.3 Homogeneous linear differential equations of second order

4. Methodology and Techniques

- Inquiry Based Learning to derive formulae and to develop conceptual understanding.
- Project-Based Learning to facilitate application aspect.
- Problem Based Learning to help students in solving comparatively difficult problems in the exercises.
- Support students in their ZPD using constructivist perspective.
- **Exploration:** Help students to explore the essence of the contents, prove the necessary theorems, and solve problems.
- Use **collaborative learning strategies** together with expository-based demonstration methods as per the nature of the content.
- **Discussion:** discuss the application of the theorems and ask students to solve the problems.
- As far as possible teacher need to focus on **authentic and meaningful learning** by taking help of reference books.
- Teachers may use mathematical software (e.g. MATLAB, Geogebra)
- It is suggested to help students in developing conceptual understanding of the content, help them in deriving formulae, and support them in solving only few problems given in the exercises. But, let the students solve problems in the exercises themselves.

5. Evaluation Scheme

5.1 **Internal Evaluation (40%)**

Internal Evaluation will be conducted by course teacher based on following activities.

a) **Attendance and Participation in class activities**: **5+5= 10 marks**

b) **Assignment I: Reflective Notes and Class presentation:** **5+5= 10 marks**
(Reflective notes on 2 to 4 questions given by teacher at the end of the every unit and presentation on any two questions among them)

c) **Assignment II**: **one Term paper/ Essay/Project and Interview:** **5+5=10 marks**
(Logical essay/term paper/project on the topics chosen by students and approved by the teacher and interview)

d) **Mid-term exam:** **10 marks**

Description of the Internal Evaluation

Mid-term exam: ***Engagement in a Class:*** Marks will be assigned based on the attendance and engagement in the classroom activities. At least 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.

Reflective Journal: It is individual work. Each student must submit their reflective journal of each chapter or teacher will give some questions that need reflective activities. The reflective journal will be returned to the students after its evaluation. Each student need to make presentation on their reflective journal.

Term paper*:* It is individual work. It must be prepared by the use of computer in a standard format of academic writing and must contain at least 5 pages. Quality, format, and time of submission will be the major criteria of the evaluation. Teacher will take interview of students based on their term paper.

Project Work: Students will be divided into groups. Each group will be assigned the project concerning application of theorems and content in different chapters. Each group will present their findings in a whole class.

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.

5.2 External Evaluation (60%)

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.

End Semester Examination Model

Nature of question	Total questions to be asked	Total questions to be answered	Total marks
Group A: Multiple choice	10 questions	10	10×1 = 10
Group B: Short answer type question	6 with 2 'or' questions	6	6×5 = 30
Group C: Long answer type question/case studies	2 with 1 'or' question	2	2×10 =20
Total			**60**

Recommended Books

Koirala, S. P, Pandey, U. N, & Pahari, N. (2017). *A textbook on integral calculus*. Vidyarthi Prakashan.

Pant, G. D. & Shrestha, G. S. (2071). *Integral calculus and differential equations*. ABC Prakashan.

References

Das, B. C. & Mukherjee, B. N. (1994). *Differential Calculus* (40th ed.). Narosa Publishing House.

K. C. D. J. & Budhathoki, T. B. (2019). *Differential equations.* Heritage Publications and Distrubutors.

Larson, R., & Edwards, B. H. (2009). *Calculus* (9th ed.). Brooks/Cole.

Spivak, M. (2008). *Calculus*.: Cambridge University Press.

Thomas, G.B. & Finney, R.L. (2001). *Calculus* (9th ed.). Pearson Education.

Revised/Effective 2079/80

Course Title: Geometry
Course No. : Math.Ed.122
Level: B.Ed.
Semester: 2nd

Nature of course: Theoretical
Credit Hour: 3
Teaching Hrs: 45

1. Course Introduction

The concepts in geometry are fundamental to study higher level mathematics. This course is designed to provide a geometric experience through axiomatic approach and to provide a better understanding of Elementary plane geometry. Prerequisites of this course are fundamental ideas of concepts in school geometry and skills of proof techniques. This course deal with axiomatic systems, different axiomatic systems for Euclidean geometry, geometry without parallel postulate, Euclidean geometry, analytic geometry, and Non-Euclidean geometries.

2. Course Objectives

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

- To demonstrate understanding of axiomatic system and its properties.
- To realize that there can be more axiomatic systems for the Euclidean geometry.
- To derive theorems of neutral geometry by using SMSG postulates 1 through 15.
- To demonstrate understanding and skills of Euclidean geometry of the plane through axiomatic approach.
- To apply idea of analytic and transformational geometry to deal with Euclidean geometry.
- To accept the existence of non-Euclidean geometries (Hyperbolic and Elliptic).
- To derive some fundamental theorems of hyperbolic and elliptic geometry.
- To be confident on the learning of skills, concepts, and theorems of different axiomatic geometries.
- To be engaged in constructing meanings of concepts and principles of different axiomatic geometries.

3. Course Contents and Specific Objectives

Specific Objectives	Content
• To describe axiomatic system & its properties. • To interpret axioms and model of four point geometry. • To interpret axioms and model of incidence geometry.	**Unit I: The Axiomatic System** [3 hrs] 1.1 Introduction of an axiomatic system 1.2 Properties of axiomatic system 1.3 Four-point geometry 1.4 Incidence geometry
• To explain briefly the Euclid's geometry and flaws in his presentations • Discuss and compare Hilberti model, Birkhaf's model, and SMSG postulates for Euclidean geometry	**Unit II: Models for Euclidean Geometry** [5 hrs] 2.1 Euclid's Geometry and flaws 2.1 Hilbert's Model for Euclidean Geometry 2.2 Birkhoff's Model for Euclidean Geometry 2.3 SMSG Postulates for Euclidean Geometry

• To prove theorems on preliminary notions of neutral geometry. • To state congruence axiom and prove congruence conditions. • To determine different equivalent forms of Euclid's fifth postulate. • To state and prove Saccheri –Legendre theorem • To derive different theorems associated with Saccheri quadrilateral and Lambert quadrilateral • To illustrate the concept of angle of parallelism and prove associated theorems	**Unit III: Neutral Geometry** [7hrs] 3.1 Preliminary Notions 3.2 Congruence Conditions 3.3 The Place of Parallels 3.4 The Saccheri-Legendre Theorem 3.5 Saccheri quadrilateral and Lambert quadrilateral 3.6 Angle of parallelism
• To state Euclidean parallel postulate and prove some of its implications related to triangle & parallelogram • To prove theorems on area of polygon • To define similar polygons and state and prove similarly conditions • To establish theorem concerning circles & triangles • To describe nine point circle • To perform Euclidean construction	**Unit IV: Euclidean Geometry of the Plane** [10hrs] 4.1 The Parallel Postulate and Some Implications 4.2 Congruence and Area 4.3 Similarity 4.4 Euclidean Results Concerning Circles 4.5 Some Euclidean Results Concerning Triangles 4.6 More Euclidean Results Concerning Triangles 4.7 The Nine-Point Circle 4.8 Euclidean Constructions
• To introduce coordinate system of the plane • To derive analytic equations of straight lines and circles • To define different isometric transformations (translation, reflection, rotation, and glide reflection) and illustrate their properties • To prove translation, rotation and reflection are isometrics • To define homothety and prove related theorems. • To derive analytic equations of isometrics and similarities. • To find image of a point under different isometries and homothety using analytic equations • Define inversion in a circle and prove associated theorems.	**Unit V: Analytic and Transformational Geometry** [10hrs] 5.1 Analytic Geometry 5.2 Transformational Geometry 5.3 Analytic Transformations 5.4 Inversion

• To describe different geometries and their invariants under transformations. • To give brief introduction of non-Euclidean geometry • To state hyperbolic parallel postulate and prove theorems related to Saccheri quadrilateral & Lambert quadrilateral. • To prove hyperbolic results concerning defect of polygons and equivalent polygons. • To establish theorem for area in hyperbolic geometry. • To introduce elliptic geometry & illustrate its models • To prove theorems concerning elliptic geometry, • To compare Euclidean hyperbolic and Elliptic geometry in terms of their properties.	**Unit Six: Non-Euclidean Geometries** [10hrs] 6.1 Erlanger program for unifying geometry 6.2 Introduction of Non-Euclidean Geometries 6.3 The Hyperbolic Parallel Postulate 6.4 Defect of a polygon in Hyperbolic geometry 6.5 Area in Hyperbolic geometry 6.6 Elliptic Geometry

4. Methodology and Techniques

- Teachers are suggested to facilitate in a sequence of **evidence to reasoning**.
- Teachers are suggested to consider **models, evidence, visualization, and ICT** while facilitating any of the topics.
- Engage students in drawing activities and establishing link between diagrams and verbal explanations.
- Inquiry Based Learning to develop proof of the theorems.
- Constructivist approach to develop conceptual understanding of concepts.
- Project-Based Learning to facilitate application aspect of theorems.
- Problem Based Learning to help students in solving problems in the exercises.
- Support students in their ZPD using constructivist perspective.
- **Exploration**: Help students to explore the essence of the concepts and theorems.
- Use collaborative learning methods together with expository-based demonstration methods as per the nature of the content.
- **Discussion:** discuss the application of the theorems/formulas and ask students to solve the problems applying theorems.
- Teachers may use mathematical software **Geogebra**.

5. Evaluation Scheme

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Wallace, E. C. &West, S.F.(1998). *Roads to geometry*.(2nd edition).Prentice Hall.

Reference Books

Pandey, U. N. (2016). *Modern geometry*. Vidyarthi Prakashan.

Maskey, S. M. (2002). *Introduction to modern mathematics(volume 1)*. Ratna Pustak Bhandar