Far Western University
Faculty of Education
Bachelor of Mathematics Education Program

Course Title: Mathematical Analysis
Course No. : 367
Level: B.Ed.
Semester: 6th

Nature of course: Theoretical
Credit Hours: 3
Total periods: 48

1. Course Description

This course is designed for Undergraduate students to develop an understanding and skills in some aspects of Mathematical Analysis. It bridges the gap between elementary real analysis and an advanced course in mathematical analysis. To understand the materials included in this course, the reader must be familiar with the content of calculus of a single variable and elementary real analysis, such as sequences of real numbers, series of real numbers, limits, continuity, derivatives, and integrals of a function, etc. This course starts with the Riemann-Stieltjes integral, which is similar to the Riemann integral. Then, a sequence and series of functions is included. Then, the metric space is introduced. Finally, compact metric and connected metric spaces are introduced.

2. General Objectives

At the end of the course, the students will be expected

- To demonstrate understanding and skills of various concepts, principles, and approaches of the Riemann-Stieltjes integral.
- To apply different tests for examining the uniform convergence of a sequence and series of functions.
- To analyze critically the concepts associated with metric space and apply the idea to solving related problems.
- To demonstrate understanding of concepts and theorems concerning compact spaces and connected spaces.
- To appreciate the beauty of the connection between the content of this course with calculus and real analysis.
- To become confident in their learning of various concepts, principles, and approaches of mathematical analysis.

3. Specific objectives and contents

Specific Objectives	Contents
• To explain the concept of the Riemann integral. • To explain the concept of Riemann-Stieltjes integral. • To prove theorems on refinement of partitions. • To prove a necessary and sufficient condition for integrability. • To prove some sufficient conditions for the existence of the Riemann-Stieltjes integral • To prove properties of integrable functions. • To explain the Riemann-Stieltjes integral as a limit of a sum.	**Unit I: Riemann Stieltjes Integral (9)** 1.1 Definition of Riemann Integral 1.2 Definition of Riemann-Stieltjes integral 1.3 Refinement of partitions 1.4 Necessary and sufficient condition for integrability 1.5 Properties of integrable functions 1.6 Definition of Riemann-Stieltjes integral as a limit of a sum
• To define point-wise convergence of a sequence of functions with examples. • To define uniform convergence of a sequence of functions with examples. • To state, prove, and apply Cauchy's criterion for	**Unit II: Sequence and Series of Functions [10 Hrs.]** 2.1 Point-wise convergence of a sequence of functions 2.2 Uniform convergence of a sequence of functions 2.3 Cauchy's criterion for uniform convergence 2.4 Test for uniform convergence of a sequence

uniform convergence. • To test the uniform convergence of a sequence of functions. • To state, prove, and apply different tests for the convergence of series (M_n-test and Weierstrass's M-test). • To state and apply Abel's test and Dirichlet's test in determining convergence. • To prove properties of uniform convergence of a sequence and series. • To prove theorems concerning the relation between uniform convergence and continuity.	2.5 Test for uniform convergence of series (Weierstrass's M-test, Abel's test, Dirichlet's test) 2.6 Properties of uniform convergence of a sequence and series 2.7 Uniform convergence and continuity
• To introduce power series with examples. • To define and find the radius of convergence and interval of convergence of some specific power series. • To state and prove the Cauchy-Hadamard theorem.	**Unit III: Power Series [4 Hrs.]** 3.1 Introduction of power series 3.2 Radius of convergence and interval of convergence 3.3 Cauchy-Hadamard theorem
• To define metric space with examples • To verify that some specific functions are metric on the given sets. • To define various concepts (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) and prove theorems concerning open and closed sets. • To define a subspace of a metric space and prove theorems of subspace. • To explain the meaning of Cauchy sequence, complete metric space, continuous function, uniformly continuous function, and associated concepts with examples. • To prove theorems on convergence of sequences, Cauchy sequence, and complete metric space, and continuity and uniform continuity.	**Unit IV: Metric space [15 Hrs.]** 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
• To define compact metric spaces and connected metric spaces with examples. • To prove theorems concerning compact metric spaces and connected metric spaces.	**Unit V: Compact Spaces and Connected Spaces [10 Hrs.]** 5.1 Definition of compact metric space 5.2 Properties of compact metric spaces 5.3 Definition of connected metric space 5.4 Properties of connected metric spaces

4. Methodology and Techniques

- Emphasize developing conceptual understanding of concepts and discuss on examples and non-examples of the concepts in detail. Try to engage students in constructing multiple representations and establishing the relationship among the multiple representations.
- While teaching concepts, support students in their zone of proximal development (ZPD) using a constructivist perspective.
- To teach theorems, discuss in detail the statement of theorems, discuss on the sketch of proof, and let the students engage in writing proof. As far as possible verify the theorems with the help of examples.

- 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, teachers need to focus on **authentic and meaningful learning** by taking the help of reference books.

5. Evaluation Scheme

5.1 **Internal Evaluation (40%)**

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

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

(Attendance 5 marks and engagement on learning 5 marks)

b) **Assignment I: Reflective Notes and Class presentation:** **5+5= 10 marks**

(Let the students prepare a reflective note of every chapter. Ask students to prepare a short note on some assigned topic; ask them to present it in the classroom, and ask some questions based on the document and the presentation: ***Document 5 marks; presentation and dealing with questions 5 marks****)*

c) **Assignment II: Project Work** **5+5=10 marks**

(Let the students to construct proof of some theorems that are not proved in the book and solve at least one new problem by using that theorem: ***Written document 5 marks and viva 5 marks****)*

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

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-of-Semester Examination Model

Nature of the 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	2 with 1 ‘or’ question	2	2×10 =20
Total			**60**

Recommended book

Malik, S.C. and Arora, S. (2010). *Mathematical analysis* (4th ed.). New Age International (for all units)

Rudin, W. (1976). *Principles of Mathematical Analysis* (3th ed.). McGraw-Hill (for unit I)

Bartle, R. G. & Sherbert, D. R. (2005).*Introduction to real analysis* (3rd ed.). Wiley (for power series)

References

David. V. W. (1996). *Advance calculus*. Prentice Hall of India

Narayan, S. & Raisinghania, M. D. (2009).*Elements of real analysis* (10th ed.*).* S. Chand and Company.

Apostol, T. M. (1974). *Mathematical analysis* (2nd ed.). Addison-Wesley.

Far-western University
Faculty of Education
Mathematics Education Programs

Course Title: Vector Geometry
Course No. : Math. Ed. 368 | Nature of course: Theoretical
Level: B.Ed. (Mathematics) | Credit: 3
Semester: Sixth | Total periods: 48

1. Course Description:

This Course is designed for students who take mathematics education as a specialisation area at the bachelor's Level. It covers topics such as scalar and vector functions, their derivatives and integrals, the gradient, divergence, curl, line/surface/volume integrals, as well as key integral theorems. The prerequisites for this course include elementary concepts of vectors, their products, and simple differentiation and integration of single-variable functions.

2. General Objectives

The following are the general objectives of this course:

- To develop an understanding of vectors and their products
- To enhance skills in differentiating and integrating vector-valued functions
- To develop mastering skill in gradient, divergence, and curl operations
- To build concepts and skills for line, surface, and volume integrals
- To enable application of integral transformation theorems

3. Specific objectives and contents.

Specific objectives	Contents
• To define vector, collinear vectors, and coplanar vectors with examples. • To define scalar product and vector product of two vectors with examples and interpret them geometrically. • To derive some properties of scalar and vector products. • visualisations to demonstrate geometric interpretations of vector operations using (e.g., GeoGebra)	**Unit I: Scalar and vector quantities (3 Hrs)** 1.1 Scalar vs. vector quantities 1.2 Types of vectors (collinear, coplanar) 1.3 Vector addition laws 1.4 Rectangular resolution of vectors 1.5 Scalar (dot) product and vector (cross) product with geometric interpretations 1.6 Properties of vector products 1.7 Determinant form of vector product
• To define scalar triple product and vector triple product of three vectors with examples, and interpret them geometrically. • To establish properties of the scalar triple product and	**Unit II: Product of Three or Four Vectors (9 Hrs)** 2.1 Scalar triple product and geometric meaning

vector triple product. • To define the scalar and vector product of four vectors with examples • To define a reciprocal system of vectors and establish their properties, and real-world applications	2.2 Vector triple product 2.3 Products of four vectors 2.4 Reciprocal system of vectors and properties

• To define the limit and derivative of a vector function and interpret them geometrically. • To apply techniques of differentiation to find the derivative of a vector function • To find the partial derivative of a vector function • To find the derivative of the scalar and vector triple product • To define vector integration and use standard results in finding the integral of a vector function	**Unit III: Differentiation & Integration of Vectors (9 Hrs)** 3.1 Limits and derivatives of vector functions 3.2 Geometric interpretation of derivatives 3.3 Partial derivatives of vector functions 3.4 Differentiation of scalar/vector triple products 3.5 Vector integration techniques
• To define point function, level surface and vector differential operator. • To define the gradient of a scalar function, the divergence of a vector function and the curl of a vector function with examples • to find the gradient, divergence and curl of given functions • To give a geometrical interpretation of the gradient of a scalar function • To give a physical concept of the divergence of a vector function	**Unit IV: Gradient, Divergence and Curl (10** Hrs) 4.1 Point functions and level surfaces. 4.2 Vector differential operators (∇) 4.3 Gradient, divergence, curl with interpretations 4.4 Laplacian operator 4.5 Physical concepts of divergence
• To define line, surface and volume integrals with examples. • To derive formulae related to line, surface and volume integrals. • To solve problems associated with line, surface and volume integrals.	**Unit V: Line, Surface & Volume Integrals (8 Hrs)** 5.1 Definitions and examples 5.2 Path independence of line integrals 5.3 Irrotational vector fields 5.4 Evaluation techniques for surface integrals 5.5 Volume Integral
• To state without proof Green's theorem, Stokes' theorem, and Gauss's theorem. • To apply Green's theorem, Stokes' theorem and Gauss's theorem in solving problems of integration	**Unit VI**: **Integral Transformation Theorem (9 Hrs)** 6.1 Green's theorem (statement, application 6.2 Stokes' theorem 6.3 Gauss' divergence theorem 6.4 Area calculation using Green's theorem

4. Methodology and Techniques

Units I, II, III: Lectures with geometric examples

- Problem-solving: Numerical exercises. Physics applications (torque).
- Tech Tools: GeoGebra for visualisations.

Units IV, V: Lectures with geometric examples

- Collaborative: Discuss EM/physical meanings.
- Tech: MATLAB simulations. Wolfram Alpha for path visualisation

Unit VI: Lectures: Diagram-based proofs (Green's/Stokes').

- Problems: Area/volume applications.
- Collaborative: Case studies

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.

2. Evaluation Scheme

5.1 Internal Evaluation **40%**

Internal Evaluation will be conducted by the course teacher based on the 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 the teacher at the end of every unit and presentation on any two questions among them)

c) Assignment II: one Term paper/ Practicum/Project and Interview: **5+5=10 marks**

(Logical essay/term paper/project on the topics chosen by the student and approved by the teacher and an interview)

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

For External evaluation (60%)

At the end of the semester, an external examination will be held by the Office of the Controller of Examinations for 60% weightage. The types, number of questions and their mark distributions in the question paper are presented in the following table. The external exam will be taken for 3 credits, and then the marks obtained will be converted to 60%.

The Office of the Controller of Examinations will conduct the final examination at the end of the semester.

Types of questions	**Total questions to be asked**	**Number of questions to be answered and marks allocated**	**Total marks**
Group A: Multiple choice items	10 questions	10 × 1	10
Group B: Short answer questions	6 with 2 'or' questions	6 ×5	30
Group C: Long answer questions	2 with 1 'or' question	2 ×10	20

Text and References

1- Sing, M. B. and Bajracharya, B. C. (2069). *A textbook of vector analysis*. Kathmandu: Sukunda Pustak Bhawan (Textbook covers all six chapters)

2- Prasad Lalji (2019) . *Vector Analysis*. Paramount Publications (India)

3- Vector Calculus" by Michael Corral : Link: https://www.mecmath.net/

Far Western University
Faculty of Education
Bachelor of Mathematics Education Program

Course Title: Curricula in Mathematics Education
Course No. : 369
Level: B.Ed.
Semester: 6th

Nature of course: Theoretical
Credit Hour: 3
Total periods: 48

1. Course Introduction

The course is designed for the undergraduate students of the mathematics education program. It is all about the curriculum, curriculum materials, and critical appraisal of curricula. The course starts with the concept and images of the curriculum. The focus of the course is on the study and appraisal of school-level mathematics curricula. The prerequisites of the course are knowledge of the curriculum and models of curriculum development. The course requires the deep engagement of students in the study and analysis of the curriculum, textbook, and teachers' guide.

2. Course Objectives

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

- To reflect on the different progressive curriculum images of the curriculum.
- To discuss the process of mathematics curriculum development at different levels of school education.
- To demonstrate understanding of the existing school-level mathematics curriculum.
- To analyze the existing school-level mathematics curriculum, textbooks, and teachers' guides.
- To envision the ideal mathematics curriculum for different grades of school level.
- To appreciate the role of curriculum in any educational program.
- To engage oneself in the analysis of existing curricula.

3. Course Contents and Specific Objectives

Specific Objectives	Content
• To explain the concept of curriculum. • To discuss elements of the curriculum. • To explain the elements of a curriculum. • To explain the concept of integrated curriculum. • To describe different ways of integration: transdisciplinary, interdisciplinary, and multidisciplinary. • To explain different images of curriculum and give critical comments on them. • To develop own concept image for a curriculum.	**Unit I: Concept and Images of Curriculum [10]** 1.1 Meaning of curriculum 1.2 Elements of curriculum (objectives, content, teaching-learning experiences, and evaluation) 1.3 Concept of integrated curriculum 1.4 Progressive Images of Curriculum 1.4.1 Curriculum as a program of planned activities 1.4.2 Curriculum as intended learning outcomes 1.4.3 Curriculum as experience

• To describe the process of school-level mathematics curriculum development and revision at basic level (1-3) ; basic level (4-5), basic level (6-8), and secondary level (9-10) in Nepal. • To explain the theoretical foundations of curriculum development. • To discuss the structure of the school-level curriculum. • To explain the national objectives of school education. • To give critical comments on the level-wise competences. • To describe the students' evaluation systems at basic level (1-3), basic level (4-5), basic level (6-8), and secondary level (9-10).	**Unit II: Mathematics Curriculum Development Process in Nepal [5]** 2.1 Curriculum development and revision process at the basic level and secondary level 2.2 Theoretical foundations of curriculum development 2.3 Structure of school-level curriculum 2.4 National objectives of school education 2.5 Level-wise competences of school education 2.6 Students' evaluation system
• To reflect on the mathematics curriculum of basic level (1-3) based on introduction, development of integrated curriculum framework, level-wise competencies, grade-wise learning outcomes, scope and sequence of content, skills of integrated curriculum, integrated form of curriculum, learning facilitation process, and student evaluation process. • To reflect on level-wise competences, grade-wise competences, scope-wise learning outcomes, scope, sequence, and description of content, learning facilitation methods and process, and students' evaluation process in the mathematics curriculum of basic level (4-5), basic level (6-8), and secondary level (9-10) in Nepal.	**Unit III: Study of Mathematics Curricula [10 Hrs.]** 3. 1 Study of the integrated curriculum of basic level (grades 1-3) 3.2 Study of the curriculum of the basic level (grades 4-5) 3.2 Study of the curriculum of the basic level (grades 6-8) 3.2 Study of the curriculum of the secondary level (grades 9-10)
• To discuss the criteria of critical appraisal of the mathematics curriculum (in terms of curriculum elements). • To analyze critically the curriculum of basic level (1-3) from an integrated perspective. • To analyze critically the curriculum of the basic level (4-5). • To analyze critically the curriculum of the basic level (6-8). • To analyze critically the curriculum of secondary level (9-10).	**Unit IV: Evaluation of Mathematics Curricula [8 Hrs.]** 4.1 Criteria of critical appraisal of mathematics curricula 4.2 Critical appraisal of the mathematics curriculum of grades 1-3 from an integrated perspective. 4.3 Critical appraisal of the mathematics curricula of basic level (4-5) 4.4 Critical appraisal of the mathematics curricula of basic level (6-8) 4.5 Critical appraisal of the mathematics curricula of secondary level (9-10)
• To prepare summary reports of any one of the Textbooks of Mathematics.	**Unit V: Study of Mathematics Textbook and Teacher's Guide [9]**

• To prepare review reports (concerning curriculum) of any one of the Textbooks of Mathematics. • To prepare summary reports of any one of the Teachers' Guides of mathematics. • To prepare review reports on any one of the Teachers' Guide (concerning curriculum) of mathematics.	5.1 Mathematics Textbooks 5.1.1 Study of the textbook of mathematics from grade 1 to grade 10 5.1.2 Critical analysis of the textbook of mathematics from grade 1 to grade 10 5.2 Teachers' Guide 5.2.1 Study of the teachers' guide of mathematics from grade 1 to grade 10 5.2.2 Critical analysis of the teachers' guide of mathematics from grade 1 to grade 10
• To envision a theoretical model of curriculum for any one of the grades of school education (What components should be included in the curriculum, what characteristics it must possess) • To envision an ideal mathematics curriculum for any one of the grades of school education.	**Unit VI: Envisioning a Mathematics Curriculum [4]** 6.1 Envisioning a theoretical model of mathematics curriculum 6.2 Envisioning a mathematics curriculum for school-level mathematics

4. Methods and Techniques

- **Unit I:** Let the students share their understanding of the curriculum and its elements, and then discuss these topics. Let the students share their understanding of the curriculum and discuss different progressive images of the curriculum.
- **Unit II:** Let the students study the national curriculum framework, divide the students into groups, let them prepare reports, and ask them to present in a class.
- **Unit III:** Engage students in the study of school-level curriculum. For this, group work might be more fruitful. Let the students prepare reports and present them to the whole class.
- **Unit IV:** First, discuss the criteria for evaluating curriculum. Then, engage students in the evaluation of school school-level curriculum. For this, group work might be more fruitful. Let the students prepare reports and present them in a whole class.
- **Unit V: L**et the students engage in evaluating textbooks and teachers' guides in relation to the corresponding curricula. In this unit, group work might be more fruitful.
- **Unit VI:** Give students a group work (Project Work) to envision the mathematics curriculum of any one of the grades 1-10.
- Overall, use principles of constructivism to facilitate the course.

5. Evaluation Scheme

5.1 **Internal Evaluation (40%)**

Internal Evaluation will be conducted by the course teacher based on the 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 the teacher at the end of every unit and presentation on any two questions among them)

c) **Assignment II**: **one Term paper/ Essay/Project and Interview:** **5+5=10 marks**

(Project Work: Let the students prepare a report on the existing curriculum and its evaluation for any one of the grades of school education. Let them present in a class.)

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

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 Resources

Bhuttah, T. M., Xiaoduan, C., Ullah, H., & Javed, S. (2019). Analysis of Curriculum Development Stages from the Perspective of Tyler, Taba and Wheeler. *European Journal of Social Sciences*, *58*(1), 14-22. [Unit IV]

CDC (2022). *National Curriculum Framework (NCF 2076)*. Author. [Unit II]

Center for Curriculum Development (2078). *Letter Grading Directory, 2078.* Center for Curriculum Development. [Unit II]

Fogarty, R. (1991). Ten ways to integrate curriculum. *Educational leadership*, *49*(2), 61-65. [for unit I] http://webmedia.jcu.edu/cas/files/2014/09/Fogarty-Ten-Ways-to-Integrate-Curriculum.pdf

Hunkins, F. P., & Ornstein, A. C. (2016). Curriculum: Foundations, principles, and issues. Pearson Education [for unit I]

Maharjan, H. B. ,Paudel, L., & Upadhyay, H. N. (2068). *Teaching mathematics in secondary schools*. Buddha Publications,

Schubert, W. H. (1986). *Curriculum: Perspective, paradigm and possibility*. Macmillan [for unit I]

Upadhyay, H. P., Uadhyay, M. P., & Luitel, S. (2070).*Exploratory teaching mathematics.* Sukunda Pustak Bhawan

https://moecdc.gov.np/en/curriculum (for all curriculums)

https://moecdc.gov.np/en/text-books (for all text books of mathematics)

https://moecdc.gov.np/en/teacher-guides (for all teachers' guides)