**Far Western University**
**Faculty of Education**
**Bachelor of Mathematics Education Program**

Course Title**: Real Analysis II**
Course No: Math.Ed.356
Level: Undergraduate
Semester: 5th

Nature: Theoretical
Credits: 3
Teaching Hours: 48

## 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

1. To develop the fundamental concept of limits and continuity their role in Real analysis.
2. To develop the concept of differentiability and interpret slope of the tangent line in different form.
3. To solve optimization problems and apply differentiability in real-world contexts.
4. To develop the fundamental concept of Riemann integrable functions and their applications in mathematics.
5. To build a strong foundation in real analysis to prepare for advanced mathematical concepts.

## 3. Specific objectives and contents

| Specific Objectives | Contents |
|---|---|
| • To define function as a relation.<br>• To explain concept of composite and inverse function.<br>• To illustrate monotonic real valued functions with example.<br>• To illustrate Monotonic real valued function at a point | **Unit I: Functions(4)**<br>1.1 Function as a relation<br>1.2 Some Specified functions<br>1.3 Composite functions and inverse functions<br>1.4 Functions with range in $\mathbb{R}$ |
| • To explain $\mathcal{E}-\delta$ definition of a limit of a function.<br>• To explain limit of a function graphically.<br>• To prove Algebraic properties of limit of a function.<br>• To illustrate concepts of one sided limits and their graphical representation.<br>• To explain technique of evaluation of one sided limits.<br>• To discuss with examples concept of infinite limits and limits at infinity.<br>• To discuss with examples concept of Upper and lower limits of indetermination | **Unit II: Limit of a functions (6)**<br>2.1Definition of a limit of a function<br>2.2 Algebra of limits of a function<br>2.3 One sided limits<br>2.4 Infinite limits and limits at infinity<br>2.5 Upper and lower limits of indetermination |

| | |
|---|---|
| • To explain concept of continuity of a function at a point on its domain.<br>• To illustrate concepts of composition of Continuous function<br>• To classify discontinuities of functions at a point.<br>• To prove some important theorems on continuity.<br>• To discuss with examples concept of Uniform continuity of functions graphically and prove their theorems | **Unit III: Continuity of a functions (11)**<br>3.1 Definition of continuity of a function at a point<br>3.2 Continuity of a function of a function<br>3.3 Discontinuity of a function and its types<br>3.4 Theorems on continuity of functions(Borel's Theorem, Boundedness Theorem, Intermediate value theorem and Fixed point theorem)<br>3.5 Uniform continuity of functions |
| • To explain concept of derivative of a function at a point.<br>• One sided derivability of a function at a point<br>• To explain relation between continuity and derivability.<br>• To prove Algebraic properties of derivative.<br>• To state and prove Mean value theorems and interpret them graphically.<br>• To state and prove Taylor's and Maclaurin's theorem.<br>• To discuss different indeterminate forms with examples.<br>• To prove theorems on indeterminate forms including L' Hospital's rule. | **Unit IV: Derivability (13)**<br>4.1 Definition of a derivative of a function<br>4.2 Derivability and continuity<br>4.3 Algebraic Properties of derivatives<br>4.4 Mean value theorems (Rolle's theorem, Lagrange's Mean value theorem, Cauchy's mean value theorem)<br>4.5 Taylor's theorem and Maclaurin's theorem<br>4.6 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.<br>• To define upper and lower Riemann integral of a function on closed interval and prove Darboux theorems<br>• To explain concept of Riemann integral of a function.<br>• To state and prove Necessary and sufficient condition for integrability.<br>• To prove properties of Riemann integral and integrable functions.<br>• To state and prove generalized mean value theorems<br>• To state and second fundamental theorem of integral calculus.<br>• To explain the technique of evaluating the definite integral using integration by parts. | **Unit V: Riemann Integration (14)**<br>5.1 Darboux sums and Four properties<br>5.2 Upper and Lower Riemann integral<br>5.3 Definition of Riemann integral<br>5.4 Necessary and sufficient condition for integrability.<br>5.5 Properties of Riemann integral<br>5.6 Properties of integrable functions<br>5.7 Generalized Mean value theorems for integral<br>5.8 Continuity and Derivability of Function defined by means of Integral<br>5.9 Integration by parts |

**4. Methodology and Techniques**

Teaching methods include both teacher-centered and student-centered approaches, carefully chosen based on the nature of the content. These methods emphasize delivering detailed explanations supported by examples and visual aids to enhance concept clarity. Additionally, they promote group discussions, teamwork, problem-solving approaches, presentations, and collaborative learning techniques.

## 5. Evaluation Scheme

The assessment of student's 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 internal assessment of 40% and external evaluation of 60% will be conducted. Internal assessment should be used as formative evaluation also.

## 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**

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

*(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**: **an Term paper/ Essay/Project and Interview:** **5+5=10**

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

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

### 5.2 External Evaluation (Final Examination) 60%

Office of the Controller of Examination will conduct final examination at the end of 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 |

**References**

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

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

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

**Far Western University**
**Faculty of Education**
**Bachelor of Education Program**

Course Title**: Topology and Graph Theory**
Course code: Math.Ed.357
Level: Undergraduate
Semester: 5th

Nature: Theoretical
Credits: 3
Teaching Hours: 48

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## 1. Introduction:

Graph Theory is one of the branches of Modern Mathematics. It deals in solving net-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 theory 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. Euler's theorem of graph theory is used in surface of polydedra.

## 2. General objectives:

a. To make the students familiar with the net-working problems of the scientific world.
b. To make them `able to apply the knowledge of graph theory of different scientific subjects.
c. To make them able to use graph theory to solve the net-working problems that arises in their daily life.
d. To apply the graph theory on surface of convex polyhedral.
e. To identify the topologically equivalent surfaces such as one-sided surface and two- sided surfaces.

## 3. Specific objectives and Contents

| **Unit 1: Introduction and basic concepts of graph. (10)** | |
|---|---|
| Specific Objectives | Contents |
| • To explain meaning of graph and its importance in many fields.<br>• To define different parts such as vertices, edges, multi-graph, complete graph, bipartite graph and sub-graph.<br>• To prove theorems relating to edges and vertices.<br>• To define and identify Walk, trail, path, circuit, cycle and their examples.<br>• To define Connected and disconnected graph.<br>• To define Isomorphism of graphs,<br>• To find out/ draw picture of Sub-graphs, spanning sub-graphs, induced sub-graphs, bridge and cut vertex with their | 1.1 Definitions and examples of: edges and vertices, empty graph (null graph), trivial graph, multi-graph parallel edges, complete graph, bipartite graph, degrees of a vertex, even or odd vertices.<br>1.2 Theorems on: sum of degree of vertices, number of odd vertices, number of edges in complete graph and number of vertices and edges of complete bipartite graph<br>1.3 Connectivity :( definitions and example) Walk, trail, path, circuit and cycle, connected and disconnected graph, bridge and cut vertex.<br>1.4 Isomorphism of graphs.<br>1.5 Sub-graphs, spanning sub-graphs, induced sub-graphs.<br>1.6 Matrix representation of graphs |

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|---|---|
| examples.<br>• To represent given graph in matrix form (incidence, adjacency) and vice-versa. | |
| **Unit 2: Traversability (9)** | |
| Specific Objectives | Contents |
| • To define Eulerian and Hamiltonian graph and prove the theorems related to it.<br>• To solve Konigbeg Bridge problem.<br>• To prove the Euler's theorems<br>• To utilize the Chinese postman problem and find its solution.<br>• To explain Hamiltonian path and cycle with example<br>• To solve the shortest path problem of a weighted graph. | 2.1.Eulerian and Hamiltonian graphs.<br>2.2.Konigsberg Bridge problem, Eulerian circuit with even vertices, Eulerian circuit with two odd vertices.<br>2.3.Theorems on existence of Eulerian graphs. (only two theorems)<br>2.4.Hamiltonian path, Hamiltonian cycle.<br>2.5.Weighted graph, shortest path problem, chinese postman problem |
| **Unit 3: Trees (6)** | |
| Specific Objectives | Contents |
| • To apply tree diagram on data of various topics<br>• To illustrate the spanning trees of a given graph.<br>• To prove some theorems on trees.<br>• To find minimal spanning tree by diagram<br>• To apply Kruskal's algorithm. | 3.1. Definition and examples of tree<br>3.2. Properties of trees<br>3.3. Spanning trees<br>3.4. Minimal spanning trees.<br>3.5. Kruskal's algorithm |
| **Unit 4: Planar Graphs (10)** | |
| Specific Objectives | Contents |
| • To identify planar and non-planar graphs.<br>• Prove Euler's theorem: v - e + r = 2<br>• To prove relations between number of edges and regions and relation of number of edges and vertices.<br>• To find number of colours for colouring vertices of graphs and maps.<br>• Define chromatic number and prove that a planar graph has chromatic number $\leq 5$.<br>• To verify Weich -Powell algorithm for colouring.<br>• To verify five colourable theorems. | 4.1. Planar graph definition and examples.<br>4.2. Regions of planar graphs.<br>4.3. Euler's theorem v –e +r =2<br>4.4.Theorem on Relation of number of edges and regions of planar graphs.<br>4.5.Theorem on number of edges and vertices.<br>4.6. Colouring of planar graph<br>4.7. Colouring of maps<br>4.8. Chromatic number<br>4.9. Weich-Powell algorithm for colouring of graphs.<br>4.10. Five colourable theorems. |
| **Unit 5: Topology of surfaces and Euler's theorem (13)** | |
| Specific objectives | Contents |

| | |
|---|---|
| • To define topologically equivalence the surfaces<br>• To define convex polyhedron<br>• To prove Euler's theorem on polyhedron.<br>• To prove the theorem on number of polyhedral.<br>• To identify two sided and one-sided surfaces.<br>• To define dual of a polyhedron.<br>• To define Torus and two-fold Torus.<br>• To construct model of torus and Klein bottle. | 5.1. Topological equivalence<br>5.2. Polyhedra<br>5.2.1. Convex polyhedron<br>5.2.2. Regular polyhedron<br>5.2.3. Euler's theorem on convex polyhedron<br>5.2.4. Theorem on number of regular polyhedra<br>5.3. Dual of a polyhedron<br>5.4. Semi regular polyhedron<br>5.5. Topology of surfaces<br>5.5.1. Two sided surfaces without boundary<br>5.5.2. Torus<br>5.5.3. Two-fold Torus<br>5.5.4. Genus of a surface<br>5.6. Euler's characteristics of a surface.<br>5.7. Theorem on V-E+F = 2-2p<br>5.8. One sided surface |

## 1 Methodology and Techniques

a. Teachers are suggested to facilitate students by visualizing every concept of graph.
b. Teachers are suggested to clarify the application part in each topic.
c. Engage students in drawing activities and establishing link between diagrams and definitions or verbal explanations.
d. Promotes students for inquiry-based learning to develop proof of the theorems.
e. Constructivist approach to develop conceptual understanding of concepts.
f. Problem Based Learning to help students in solving problems in the exercises.
g. Exploration: Help students to explore the essence of the concepts and theorems.
h. Use collaborative learning methods together with expository-based demonstration methods as per the nature of the content.
i. Discussion: discuss the application of the theorems/formulas and ask students to solve the problems applying theorems.
j. Teachers may use mathematical software Geogebra.

## 2 Evaluation Scheme

2.2 **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 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

2.3 **External Evaluation** (60%)

| Nature of questions | Total questions to be asked | Total marks |
|---|---|---|
| Group A: Multiple choice | 10 | 10x1=10 |
| Group B: Short questions | 6 questions with 2 or questions | 6x5=30 |
| Group C: Long questions | 2 questions with one or question | 2x10=20 |
| Total | | 60 |

## 3 Prescribed Books and References

Chartrand, G & Zhang, P. (2012). First course in graph theory. Dover Publications, Inc. (unit 1-5) http://lib.ysu.am/disciplines_bk/ or https://store.doverpublications.com

Maskey, S.M. (1995). Introduction to modern mathematics. Volume 2. Ratan Pustaka prakasan.

Maskey, S.M. (1998). First course in graph theory. Ratan Pustaka prakasan.

**Far Western University**
**Faculty of Education**
**Bachelor of Mathematics Education Program**

Course Title: **Designing Instructional Materials for Teaching Mathematics**
Course No. : Math.Ed.358 Nature of course: Theory
Level: Undergraduate Credit Hour: 3
Semester: 5th Total periods: 48 Hrs

## 1. Course Introduction

This course is designed for undergraduate students to develop skills in developing and using instructional materials in teaching school-level mathematics. The course starts with the introduction of teaching materials, progresses through content-wise teaching materials, and ends with digital resources. The course focuses on developing a deeper understanding of several mathematical concepts, deriving some formulae, and verifying some mathematical principles through teaching materials. The course is designed in such a way that it helps teachers to facilitate mathematical content in a meaningful way. Meaningful learning and conceptual understanding of school-level mathematics are taken into consideration. The major focus of the course is on practical work and skill development.

## 2. Course Objectives

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

- To realize the importance of mathematics laboratory and instructional materials in mathematics teaching.
- To demonstrate skills in designing models of teaching concepts, relations, and formulae of different domains of mathematics.
- To demonstrate understanding and skills in using instructional materials in mathematics teaching.
- To show understanding and skills in applying digital resources in mathematics teaching.
- To give value to meaningful learning, conceptual understanding, and practical knowledge of mathematical contents.
- To appreciate the value of instructional resources in mathematics teaching.

## 3. Course Contents and Specific Objectives

| Specific Objectives | Content |
|---|---|
| • To explain the concept, types, and rationale of instructional materials used in mathematics teaching.<br>• To explain the concept and purpose of mathematics laboratory. | **Unit I: Instructional Materials and Mathematics Laboratory [3]**<br>1.1 Introduction of Instructional materials<br>1.2 Types of instructional materials<br>1.3 Concept of Mathematics Laboratory<br>1.4 Purpose of mathematics laboratory |
| • To explain the construction process of models (*made by card sheet, plywood, glaze paper, transparent sheet, cardboard,* | **Unit II: Materials for Teaching Mensuration[13]**<br>2.1 Models to teach area of plane figures |

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|---|---|
| *thermocol sheet, or similar objects*) for deriving/demonstrating formula for area of plane figures.<br>• To design above mentioned models and explain their application in mathematics teaching.<br>• To demonstrate formula for area of plane figures by paper folding and cutting.<br>• To explain the meaning of nets, solid structure, and skeleton model of 3D figures.<br>• To construct nets, solid structure, and skeleton model of specified solids.<br>• To derive and demonstrate the formula for surface area and volume of 3D figures using models.<br>• To develop models representing volume relationship between specified solids. | 2.1.1 Models to derive/demonstrate formula for area of plane figures [triangle, parallelogram, rhombus (in terms of diagonal), square (in terms of diagonal), trapezium, kite, quadrilateral, aero head, circle]<br>2.1.2 Demonstration of formula for area of plane figures (mentioned in 2.1.1) by paper folding and cutting.<br>2.2 Three dimensional objects, their surface area and volume<br>2.2.1 Meaning of Nets, solid structure, and skeleton of 3D objects.<br>2.2.2 Nets and solid structure of five regular polyhedron, prism (triangular, rectangular, pentagonal, L shaped, stepped, plus shaped, E shaped), pyramid (triangular, square based, pentagonal), circular cylinder, and circular cone<br>2.2.2 Skeleton model of five regular polyhedron, cuboid, prism and pyramid<br>2.2.3 Models to derive/demonstrate surface area and volume of cylinder, cone, frustum of a cone, prisms, pyramids, sphere, hemisphere, hollow sphere, hollow cylinder<br>2.2.4 Models to represent volume relationship between cone and cylinder; between right circular cone, hemisphere, and right circular cylinder of same height and radii; between prism and pyramid |
| • To describe the construction process of Mecano strips, Tangram, Geoboard, Circle board, coordinate wheel, and coordinate board and their application in mathematics teaching.<br>• To develop models used to verify various specified results (mentioned in content column) and demonstrate the application models in teaching those results.<br>• To identify incentre, circumcenter, centroid, orthocenter and demonstrate their relation by paper folding. | **Unit III: Materials for Teaching Geometry [8]**<br>3.1 Mecano strips, Tangram, Geoboard (square and circular), Circle board, coordinate wheel, coordinate board,<br>3.2 Models used to verify various theorems [*concerning parallel lines intersected by a transversal; sum of the angles of a triangle; sum of the angles of a quadrilateral; exterior angle of a triangle, sum of exterior angles of polygon; congruence theorems (SSS, SAS, ASA, RHS); opposite angles of cyclic quadrilateral; Pythagoras theorem*]<br>3.3 Paper folding and cutting: Incentre, circumcenter, centroid, orthocenter and their relation |
| • To develop base 10 blocks, Cuisanaires Rod/Number strips, | **Unit IV: Materials for Teaching Arithmetic [5]**<br>4.1 Base-10 Blocks |

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|---|---|
| Number lines, number plates and Balance Beam, Material for teaching base 2 numeration system, Magic squares of type 3*3 and 4*4, Models for finding HCF and LCM, and Fractional Kit.<br>• To explain the construction process of each of these materials.<br>• To describe the application of these materials in math teaching. | 4.2 Cuisanaires Rod/Number strips<br>4.3 Number lines, number plates and Balance Beam<br>4.4 Material for teaching base 2 numeration system<br>4.5 Magic squares of type 3*3 and 4*4<br>4.6 Models for finding HCF and LCM<br>4.7 Fractional Kit |
| • To introduce algebraic tiles.<br>• To demonstrate process of adding and subtracting, algebraic terms using tiles.<br>• To develop geometric models to factorize expressions of the form $a^2-b^2$, $ax^2+bx+c$, $a^3-b^3$, and $a^3+b^3$ and explain the process of model development.<br>• To verify the algebraic identities geometrically. | **Unit V: Materials for Teaching Algebra [6]**<br>5.1 Introduction of algebraic tiles<br>5.2 Addition and subtraction of like terms using tiles<br>5.4 Factorizing using algebraic tiles<br>5.5 Verification of algebraic identities geometrically<br>*$[(a+b)^2= a^2+2ab+b^2$, $(a-b)^2= a^2-2ab+b^2$ , $(a+b)^3 =a^3+3a^2b+3ab^2+b^3$, $(a-b)^3 =a^3-3a^2b+3ab^2-b^3$, $(a+b+c)^2= a^2+b^2+c^2+2ab+2bc+2ca$, $a^3-b^3=(a-b)(a^2+ab+b^2)$ , $a^3+b^3 =(a+b)(a^2-ab+b^2)]$* |
| • To explain the construction process of clinometers, hypsometer, trundle wheel, trigonometric ratio explorer, and scientific model of sine, cosine, and tangent model.<br>• To design these materials and explain their application in math teaching. | **Unit VI: Materials for Teaching Trigonometry[3]**<br>6.1 Clinometer ($30^o$, $45^o$, $60^o$, and general)<br>6.2 Hypsometer<br>6.3 Trundle wheel<br>6.4 Trigonometric ratio explorer using circle board<br>6.5 Scientific model of sine, cosine, and tangent ratio. |
| • To explain the use of digital resources like LaTex, Geogebra, Mathigon, Mathematica, Maple, Matlab, and Demos in mathematics teaching.<br>• To explore digital resources from various software<br>• To search and use Geogebra resources in teaching mathematics.<br>• To design digital resources using Geogebra. | **Unit VII: Digital Resources for Teaching Mathematics [10]**<br>7.1 LaTeX<br>7.2 GeoGebra<br>7.3Mathigon<br>7.4Mathematica<br>7.5 Maple<br>7.6MatLab<br>7.7 Desmos |

**4. Methodology and Techniques**

- To facilitate model/materials construction, start the class with a discussion on the theoretical part, required raw materials, and the construction process of the material.

- After sufficient discussion let the students work in groups or individually according to the nature of the model.
- Support students during the material construction.
- After the construction of materials let them explore the use of the materials in mathematics teaching.
- Ask students to demonstrate the construction process and application of materials they developed.
- Let students keep a record of all the practical works (including the name of the material, required raw materials, construction process, and use in math teaching) completed during the class discussion, individual homework, and group homework assignments.
- As far as possible, manage one room for the math laboratory, and keep all the materials in that lab after designing the materials.
- As far as possible encourage group work and ensure collaboration.
- Project-based learning methods might work on several topics.
- To facilitate unit VII, discuss the introduction and application of specified digital resources. Discuss the way of searching readymade materials in different software. Give more emphasis on the Geogebra learning resources. Engage students in developing digital resources using GeoGebra.

**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** **4+4= 8 marks**

b) **Assignment I: Designing Material and its presentation** **3+3= 6 marks**
*(Student will design assigned teaching material and demonstrate construction process and application)*

c) **Assignment II**: **Group Project work** **4+4=8 marks**
*(Students will be provided a project work group wise; they have to prepare project report, and present in the classroom)*

d) **Mid-term exam:** **8 marks**

**5.2 External Evaluation (60%)**

External evaluation will consist of two categories: written examination covering 40 marks and practical covering 20 marks.

**(1) Written Examination:** It is also a written examination, and the questions will be asked covering all the topics in the session of the course. It carries 40 marks.

**End Semester Examination Model**

| Nature of question | Total questions to be asked | Total questions to be answered | Total marks |
|---|---|---|---|
| **Group A**: Multiple choice | 8 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 | 1 with 'or' question | 1 | 1×10 =10 |
| **Total** | | | **50** |

**(2) Practical (20%):** Office of the controller of examination will conduct final practical examination after the end of the final written examination. External examiner will conduct practical examination and the internal examiner will assist the external examiner. The evaluation will be based on the following criteria.

| **Category** | **Internal** | **External** | **Total** |
|---|---|---|---|
| Copy of all the works done during semester with sample materials (3-5 materials) | 3 | 2 | 5 |
| Viva based on the in-semester works | 2 | 3 | 5 |
| Practical Examination in Math Lab of concerned campus (designing any one materials asked by external examiner) | 3 | 7 | 10 |
| Total | 8 | 12 | 20 |

## Recommended Textbooks


Gratzer, G. (2024). *Text and math into latex*. Springer [for unit VII]

Hall, J., & Lingefjärd, T. (2016). *Mathematical Modeling: applications with Geogebra*. John Wiley & Sons. [for unit VII]

Khanal, B., Roka, J., Khatri, T. (2020). *Teaching material development*. Cambrize Publication [Optional; Teacher may use for some topics]

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

Maharjan, H. B., & Upadhyay, H. N. (2009). *Mathematics instructional materials*. Paluwa Prakashan [for units I-VI]

Singh, H., Avtar, R., & Singh, V. P. (2011). *A handbook for designing mathematics laboratory in schools*. National Council of Education Research and Training. [for units I-VI]

Torrence, B. F., & Torrence, E. A. (2019). *The student's introduction to mathematica and the wolfram language*. Cambridge University Press. [for unit VII]

Upadhyay, H. N. (2002). *Folding and cutting of papers in the teaching of mathematics*. Ekta Books Distributor Pvt. Ltd. [for the content related to paper folding and cutting]

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