Far Western University
Faculty of Education
Professional Bachelor of Education (P.B.Ed.) Program

Course Title: **Curriculum, Assessment and Planning of Mathematics Education**

Course No: Math.Ed. 424	Nature of course: Theoretical
Level: P.B.Ed.	Credit hours: 3
Semester: second	Teaching hours: 48

1. Course Introduction

This course is designed for students of the Professional B.Ed. Program. program who have already completed the undergraduate level majoring in mathematics. The main purpose of the course is to familiarise students with the concepts associated with the mathematics curriculum, planning mathematics curriculum, and different techniques of assessing students' performance in mathematics. The course consists of three related areas: Curriculum, Planning, and Assessment. The concept of curriculum from the development perspectives has been discussed. The process of planning mathematics curriculum at different levels and the criteria for assessment of students' cognitive and affective domains are covered in the course.

2. Course Objectives

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

- To demonstrate understanding of the nature of mathematics, mathematics education and their relationship.
- To demonstrate understanding of curriculum and its components.
- To discuss the process of mathematics curriculum development in different levels of school education.
- To reflect critically on the mathematics curriculums of school level (1-10).
- To evaluate the school level curriculum analytically based on appropriate criteria.
- To demonstrate understanding of different assessment techniques that can be suitable for assessing students' learning in mathematics.
- To design assessment tools, conduct assessments, ensure the validity and reliability of assessment items, record the students' performance, analyze and interpret the students' learning.

3. Course Contents and Specific Objectives

Specific Objectives	Content
• To analyze critically the definitions of mathematics given by mathematicians. • To differentiate absolutists' view and fallibilists' view on nature of mathematics. • To differentiate subjective and objective	**Unit I: Nature of Mathematics and Mathematics Education [10]** 1.1 Nature of Mathematics 1.1.1 Definitions of mathematics 1.1.2 Absolutists' view and fallibilists' view

knowledge of mathematics. • To explain the concept of mathematics education. • To describe four foundations of mathematics education (psychological, mathematical, philosophical and cultural). • To explain the relationship between mathematics and mathematics education.	1.1.3 Subjective and objective mathematical knowledge 1.2 Nature of Mathematics Education 1.2.1 Concept of mathematics education 1.2.2 Foundations of mathematics education 1.2.3 Relationship between mathematics and mathematics education 1.2.4 Philosophy of mathematics education
• To describe a concept of curriculum. • To explain the components of the curriculum. • To reflect on Tyler's model of curriculum development. • To explain the concept of integrated curriculum. • To describe different types of integrated curriculums: transdisciplinary, interdisciplinary, and multidisciplinary.	**Unit II: Introduction of Curriculum [7]** 2.1 Concept of curriculum 2.2 Components of curriculum (objectives, content, learning experiences, and evaluation) 2.3 Tyler's model of Curriculum development models 2.3 Concept of Integrated curriculum
• To explain the concept and importance of curriculum planning. • To describe process of school level curriculum development and revision at basic level (1-3; 4-5; 6-8) and secondary level (9-10) in Nepal. • To explain theoretical foundations of curriculum development. • To discuss the structure of school level curriculum. • To explain the national objectives of school education. • To give critical comment 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). • To discuss the responsible bodies of curriculum development. • To explain challenges in the curriculum development planning of mathematics	**Unit III: Curriculum Planning Process of School Level in Nepal [8]** 3.1 Concept and importance of curriculum planning. 3.2 Curriculum development and revision process at basic level and secondary level 3.2 Theoretical foundations of curriculum development 3.3 Structure of school level curriculum 3.4 Level wise competences of school education 3.5 Students' evaluation system 3.6 Responsible bodies of curriculum development 3.7 Challenges in the curriculum development planning of mathematics
• To reflect on mathematics curriculum of basic level (1-3) based on introduction,	**Unit IV: Study of School Level Mathematics Curriculum [12]**

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, 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 mathematics curriculum of basic level (4-5 and 6-8) and secondary level (9-10) • To evaluate critically the mathematics curriculum of basic level (1-3; 4-5; 6-8) and secondary level (9-10).	4.1. Study of curriculum of basic level 4.1.1 Study of integrated curriculum (Mathematics curriculum) of basic level (1-3). 4.1.2 Study of mathematics curriculum of basic level (4-6) 4.1.3. Study of mathematics curriculum of basic level (6-8) 4.2 Study of mathematics curriculum of secondary level (9-10) 4.3 Appraisal of mathematics curriculums of school level (1-10)
• To share the ideas of assessment; assessment of/for/as learning. • To explain the process of assessing the knowledge and skills of cognitive, affective, and psychomotor domains. • To explain the process of formative assessment in mathematics. • To differentiate between objective and subjective tests. • To explain characteristics and guidelines for developing objective and subjective test items. • To develop different types of objective and subjective test items their development. • To form specification grid for different grades of school level mathematics. • To create and apply project(s) to assess students' learning outcomes in mathematics. • To develop and implement rubrics and portfolios for CAS in mathematics. • To share the importance of journal writing, peer assessment, and self-assessment as formative assessment tools for mathematics.	**Unit V: Assessment tools and techniques for Mathematics [11]** 5.1 Assessment as learning, Assessment of learning, and assessment for learning 5.2 Assessment of cognitive domain and affective domain 5.3 formative assessment in mathematics. 5.4 Assessing through objectives and subjective test items 5.5 Content Validity and reliability of test items 5.6 Formation of specification grid 5.7 Assessing through projects and practical 5.8 Continuous assessment system (CAS); Portfolio-based assessment 5.9 Journal writing, Peer-assessment, and Self-assessment

4. Methodology and Techniques

- For unit I, engage students in classroom discussion. Divide students in groups and ask to prepare a reflection note and present in the classroom.
- For unit II, discuss on the theoretical aspects concerning curriculum, integrated curriculum, and the Tyler's model of curriculum development.
- For unit III, let the students to study the national curriculum framework, divide the students in groups, let them to prepare reports and ask them to present in class.
- For unit IV, engage students in a group work of studying the mathematics curricula of different grades (1-10). Further, ask them to prepare an evaluation report of the curriculum and present in a class.
- For unit V, ask students to prepare test items from different grades. Further, ask students to demonstrate the way of assessing students using those assessment items.
- Keep a record of all the tasks conducted by students and provide feedback when necessary.
- As far as possible, encourage group work and ensure collaboration.

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 marks**

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

(Reflective notes on two questions given by the teacher and presentation)

c) **Assignment II**: **one Term paper/ Essay/Project and Interview:** **20 marks**

(Development of one set of test items of mathematics of any grade, one set of projects, and one practical, and implementing them in the school setting, writing the report based on the implementation experiences, followed by individual viva-voce)

i) test items development and implementation (5 marks)
ii) project development and implementation (5 marks)
iii) practical work design and implementation (5 marks)
iv) report and viva (5 marks)

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

5.2 End Semester Examination Model

Nature of question	Total questions to be asked	Total questions to be answered	Total marks
Group A: Multiple choice	10	10	10×1 = 10
Group B: Short answer type question	8	6	6×5 = 30
Group C: Long answer type question/case studies	3	2	2×10 =20
Total			**60**

Recommended Textbooks/Reference Materials

Brookhart, S. M. (2013). *How to create and use rubrics for formative assessment and grading*. ASCD. [Unit V]

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

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

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

Frey, N., & Fisher, D. (2011). *The formative assessment action plan: Practical steps to more successful teaching and learning*. ASCD [Unit V]

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

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

Marzano, R. J. (2006). *Classroom assessment and grading that work*. ASCD. [Unit V]

Tyler, R. W. (1949). Basic principles of curriculum and instruction. University of Chicago Press. [Unit II]

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

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

(Note: The above list of resources is for sample. The course facilitators should choose the appropriate materials to meet the learning outcomes mentioned in the plan.)

Far Western University
Faculty of Education
Professional Bachelor of Education (P.B.Ed.) Program
(Pedagogy and Material Development in Schools: Teaching of Mathematics)

Course Title: **Teaching of Mathematics**

Course No: Math.Ed. 425	Nature of course: Theoretical
Level: P.B.Ed.	Credit hours: 3
Semester: second	Teaching hours: 48

1. Course Introduction

This course is designed for the students of Professional B.Ed. Programs who have already completed the undergraduate level majoring in mathematics. The course has two-fold objectives: to make students in designing and implementing appropriate pedagogy in teaching school level mathematics and to develop skills in developing and using instructional materials in teaching school-level mathematics. The first part of the course is designed to engage students with the learning perspectives and several innovative pedagogical approaches to teaching mathematics. The second part of the course starts with the introduction of teaching materials, and progresses through content-wise teaching materials. The course focuses on developing understanding and skills in learning theories and pedagogical approaches and 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.

2. Course Objectives

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

- To demonstrate understanding of learning theories appropriate for learning mathematics.
- To show understanding and skills in using innovative pedagogical approaches in teaching school-level mathematics.
- To demonstrate skills of developing lesson plan, unit plan, annual plan, and teaching module.
- To realize the importance of the 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 appreciate the value of instructional resources in mathematics teaching.

3. Course Contents and Specific Objectives

Specific Objectives	Content
• To explain Piaget's theory, Brunner's theory, Gagne's theory of learning, and Glaserfeld's radical constructivism, and Vygotksy's social constructivism.	**Unit I: Learning Perspectives for Mathematics Teaching[10 hours]** 1.1 Piaget's theory of learning 1.2 Brunner's theory of learning

• To explain Gagne's theory of learning and Van Hiele model of geometric thinking • To explore the implications of above mentioned learning theories in mathematics teaching.	**1.3** Constructivists' theory of learning: Radical constructivism and social constructivism **1.4** Gagne's theory of learning **1.5** Van Hiele model of geometric thinking
• To explain the concept, steps (if any), role of teacher, role of students, and conditions to apply of different pedagogical approaches. • To compare and contrast different methods of teaching concerning nature, role of the teacher, role of students, and conditions of applying them. • To select an appropriate method of teaching for a particular topic at the school level of mathematics.	**Unit II: Instructional Methods [12 hours]** 2.1 Inductive and deductive method 2.2 George Polya's problem solving method 2.3 Problem based learning 2.4 Project based learning 2.5 Inquiry-based learning 2.6 Art-based teaching 2.7 STEAM pedagogy 2.8 Flipped learning pedagogy 2.9 Culturally Responsive Pedagogy and Ethnomathematics
• To describe the meaning and importance of instructional planning. • To develop an annual plan, unit plan, lesson plan, and teaching module for specific school-level mathematics topics. • To design lesson plans under different learning perspectives (e.g., 5E lesson plan, constructivist lesson plan, expository lesson plan)	**Unit III: Planning Instruction [9]** 3.1 Introduction to instructional planning 3.2 Annual plan, unit plan, and lesson plan 3.3 Teaching module
• To explain the construction process of models (*made by card sheet, plywood, glaze paper, transparent sheet, cardboard, thermocol sheet, or similar objects*) for deriving/demonstrating the formula for the area of plane figures. • To design above mentioned models and explain their application in mathematics teaching. • To explain the meaning of nets and solid structure of 3D figures. • To construct nets, solid structure, and a skeleton model of specified solids. • To derive and demonstrate the formula	**Unit IV: Materials for Teaching Mensuration [9 hours]** 4.1 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] 4.2 Three-dimensional objects, their surface area and volume 4.2.1 Meaning of Nets and solid structure of3D objects 4.2.2 Nets and solid structure of five regular polyhedron, prism (triangular and rectangular), pyramid (triangular and square based), circular cylinder, and circular cone

for surface area and volume of 3D figures using models. • To develop models representing volume relationship between specified solids.	4.2.3 Models to derive/demonstrate surface area and volume of cylinder, cone, frustum of a cone, prisms, pyramids, sphere, hemisphere, hollow sphere, hollow cylinder 4.2.4 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 board and their applications in mathematics teaching. • To develop models used to verify various specified results (mentioned in content column) and demonstrate the application models in teaching those results. • To explain the construction process of clinometers, hypsometer, • To design these materials and explain their application in math teaching.	**Unit V: Materials for Teaching Geometry and Trigonometry [4 hours]** 5.1 Geometry 5.1.1 Mecano strips, Tangram, Geoboard (square and circular), Circle board, coordinate board, 5.1.2 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*] 5.2 Trigonometry 5.2.1 Clinometer (30^o, 45^o, 60^o, and general) 5.2.2 Hypsometer
• To introduce algebraic tiles. • To demonstrate process of adding and subtracting algebraic terms using tiles. • 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. • To verify the algebraic identities geometrically.	**Unit VI: Materials for Teaching Algebra [4 hours]** 6.1 Introduction of algebraic tiles 6.2 Addition and subtraction of like terms using tiles 6.3 Factorizing using algebraic tiles 6.4 Verification of algebraic identities geometrically *[$(a+b)^2= a^2+2ab+b^2$, $(a-b)^2= a^2-2ab+b^2$, $(a+b)^3 =a^3+3a^2b+3ab^2+b^3$, $(a-b)^3 =a^3-3a^2b+3ab^2-b^3$, $a^3-b^3=(a-b)(a^2+ab+b^2)$, $a^3+b^3 =(a+b)(a^2-ab+b^2)$]*

4. Methodology and Techniques

- To facilitate learning theories and pedagogical approaches, engage students in discussion, assign group work regarding understanding of theories and methods, and let them prepare and present the group work reports in a whole class.
- Engage students in preparing different plans. After the development of instructional plans and assessment items, let them to implement in natural settings (schools).
- 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 the materials they developed.
- 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.

5. Evaluation Scheme

5.1 **Internal Evaluation (40%)**

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

d) **Attendance and Participation in class activities**: **5 marks**

e) **Assignment I: Reflective Notes and Class presentation:** **5*2=10 marks**
(Reflective notes on 2 questions given by the teacher at the end of the unit and presentation on those 2 questions)

f) **Assignment II**: **Materials Development:** **5*3=15 marks**
(Development of at least three resource materials for teaching school-level mathematics. The resource materials should be locally made and in the form of objects.)

d) **Mid-term exam:** **10 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	10	10×1 = 10
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Group C: Long answer type question	3	2	2×10 =20
Total			**60**

Recommended Resource Materials

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

Maharjan, H. B., & Upadhyay, H. N. (2009). *Mathematics instructional materials*. Paluwa Prakashan

Rosa, M. & Orey, D. C. (2011). *Ethnomathematics: the cultural aspects of mathematics. Revista Latinoamericana de Etnomatemática*, 4(2). 32-54

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 III-VI]

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

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