

MASTER OF EDUCATION(MATHEMATICS EDUCATION)

Abbreviated as M Ed (Mathematics Education)

CURRICULUM

Revised Version of Master of Education (Mathematics Education)- 2006



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Course revision proposal for Academic Council

Master of Education(Mathematics Education)

Rationale

There has been an immense growth in the field of education in Nepal in the last six decades. However, the quantitative growth, realized in the form of number of the institutions and the areas of disciplines, has not been able to bring about qualitative development. This is a major case in the field of teacher development and school education. In the quest of education, the public as well as the private sector have made substantial investments in school education in general and Mathematics Education in particular, with not much satisfying result. One of the major causes of low mathematics attainment of school students is the lack of quality mathematics teacher development programmes and appropriate mathematics teaching materials due to the lack of skilled, informed, creative and motivated teacher educators and material developers. The traditional approach to teaching mathematics has not helped to make a better image of mathematics; rather it has contributed to depict mathematics as a dry, non-creative and difficult subject. Besides, without the skills and knowledge of research, teachers rarely focus on the evidence-based approach to pedagogical change.

Considering these things in to account, Kathmandu University, School of education started M. Ed. in mathematics from 2006, February to produce quality teachers, teacher educators, material developers and researchers in the field of mathematics education. The program has been running smoothly and our graduates have exposed in reputed position in their field inside the nation, and in abroad too. The illumination of knowledge in school education in general and in mathematics education in particular has been mounting day by day. Now, it is essential to revisit our curriculum to meet the demand of today. From the experiences of last many years, we have proposed some of the new courses in mathematics education.

Key features of the program

The proposed program will have the following Key features.

- **Need based**: One of the major features of the program is to address the need of the secondary, higher secondary schools and other education related institutes. Formal and informal interaction with teachers, teacher educators, school principals, teacher education experts, teacher development organizers and materials developers have demonstrated a need of mathematics education development programme to produce quality human resources.
- **Pedagogical Content Knowledge (PCK)**: The common belief in society is a person who knows mathematics very well is the best person to teach mathematics. The principle of "Knowing to teach mathematics" is neglected. For this, this program

aims to develop mathematics teachers who know mathematics and its pedagogy in an integrated way, not in fragmented way.

- Applied Mathematics: There is always debate in academia regarding the contents of mathematics that should be taught. The main purpose of this program is to develop teachers, teacher educators and research practitioner. Besides some foundation courses (such as Algebra, Topology, Analysis, etc.) we emphasized on applied mathematics courses (such as; Mathematical Modeling, Statistics for Teachers, Fractal Geometry, Number theory and Teaching Arithmetic, Probability and Operation Research, etc.) so that our graduate will be able to envision the uses of mathematics in the field and make further career in their areas of interest.
- Modeling of pedagogy: Pedagogy of each course will be based on the latest principles of teaching and learning of mathematics. Specifically, students will be benefited through their instructors' facilitation, assessment and overall teaching techniques. Specific facilitation techniques such as instructor-learner conferences, presentations, investigative tasks, and collaborative projects, problem solving and group learning methods will be employed.
- Practice-based and skills oriented: The students will undergo practical experience by literally undertaking tasks of teaching mathematics, facilitating teacher development workshops, undertaking small scale research projects and developing materials. The use of ICT in teaching and learning mathematics is highly valued. When they come out from the University, they will be expected to be independent practitioners in the field.

Structure of the program

The program is of four semesters. There are courses for 60 credit hours comprising core courses (6 credit hours), specialization courses (42 credit hours) and practical courses (??)

Entry Requirements

For enrolment to two-year M Ed programme, those having a B. Ed in Mathematics or PGDE in mathematics or BA in mathematics or B. Sc in Physical and mathematical sciences or any equivalent degree* with minimum of 50% or 2.5/4 in aggregate will be eligible candidates. However, those having a BA or B. Sc will have to take two extra 3-credit mathematics education courses as specified by School of Education.

*Internationally, graduates of the following areas are eligible to study mathematics education.

- Computer Science
- Computing with mathematics minor
- Computer and Electronics engineering programs

Evaluation and Graduation

The course facilitator assigned with the course paper is entirely responsible for the evaluation. The in semester; CAS comprises 50% weightage and end semester Paper Based Test (PBT) carries the rest 50%. Students will be graded as the letter grade system in practice at KU. The grades and their corresponding impression have been presented below.

Grade	A	A-	B+	B	B-	C+	C	F
Grade Point	4.0	3.7	3.3	3.0	2.7	2.3	2.0	Below 2.0
Performance	Outstanding	Excellent	Very Good	Good	Satisfactory	Fair	poor	Fail

In order to pass, the scholar has to maintain at least C in individual course and a Cumulative Grade Point Average (CGPA) 3.0. The calculation of CGPA and their impression is as follow.

CGPA is calculated at the end of the program using the given relation.

$$\text{CGPA} = (c_1 g_1 + c_2 g_2 + c_3 g_3 \dots) / (c_1 + c_2 + c_3 \dots)$$

Where c_1, c_2, \dots denote credits associated with the courses taken by the student and g_1, g_2 denote grade values of the letter grades earned in the respective courses.

CGPA at the end of the degree defines the division as follows:

CGPA	Impression/Division
3.7 to 4	Distinction
3.25 to less than 3.7	First
3 to less than 3.25	Second
Less than 3	Fail

The entire requirement must be completed within the four year time frame irrespective of the credits completed in different semesters.

Courses

The taught courses have been divided mainly into three categories: Core, Foundation and Specialization Professional. Core courses are common to all M. Ed. students. Foundation courses have been designed to develop conceptual understanding of key mathematical ideas while the professional courses are to increase the professionalism among the graduates in the areas of teaching, educating and researching. The courses are given below in the table.

Core Courses (6 Cr. Hrs)

1. EDUC 508 Theory and Practice in Education (3)
2. EDUC 509 Research Methodology (3)

Concentration Courses

a) Foundation Courses (27 Cr. Hrs.)

1. EDMT 501 Analysis (3)
2. EDMT 505 Algebra (3)
3. EDMT 509 Topology (3)
4. EDMT 511 Mathematical Modeling (3)
5. EDMT 512 Statistics for Teachers (3)
6. EDMT 513 Number Theory and Teaching Arithmetic (3)
7. EDMT 514 Theory and Application of Differential Equations (3)
8. EDMT 515 Discrete Mathematics and Problem Solving (3)
9. EDMT 516 Probability and Operations Research (3)

b) Professional Courses (24 Cr. Hrs.)

1. EDMT 540 ICT in Mathematics Education (3)
2. EDMT 541 Teaching and Learning in Mathematics (3)
3. EDMT 542 Curricula in Mathematics Education (3)
4. EDMT 543 Assessment in Mathematics Education (3)
5. EDMT 544 Teacher Development in Mathematics Education (3)

c) Electives Courses (3 cr. Hrs.) (Any One)

1. EDMT 517 Multivariable Calculus (3)
2. EDMT 518 Functional Analysis (3)
3. EDMT 519 Fractal Geometry (3)
4. EDMT 548 Recent Paradigms of Mathematics Learning (3)
5. EDMT 549 Historical Development of Mathematical ideas (3)
6. EDMT 550 Ethnomathematics (3)

d) Practical courses

6. EDMT 545 Internship (3)
7. EDMT 546 Research Project-1 (3)
8. EDMT 547 Research Project-2 (3)

Or EDMT 599 Dissertation (6)

Course Descriptions

Core Courses (6 Cr. Hrs.)

1. EDUC 508 Theory and Practice in Education (3)

This course is about linking educational theories into practices. Educational theories seek to know, understand, prescribe and apply into educational practices. This course includes many topics such as ethics of belief, politics, social values, pedagogy, andragogy, curriculum, learning, teaching, policy, plan, leadership, culture, etc link with education. The course also includes different premise for twenty first century education. Selected theories of education will be discussed to capture the different dimensions of educational thoughts. During the course of the study, students are expected to relate these perspectives, principles and thought in the development of Nepalese Education. The main aim of the course is to widen the horizon of the knowledge and ideas of students so that they could be able to identify day to day educational problems and issues associated with certain theories, principles and philosophies of broad spectrum of educational landscape.

2. EDUC 509 Research Methodology (3)

This Masters level course aims to address some key concepts of positivistic, interpretive and critical research paradigms. More specifically, the course incorporates different research designs including survey, case study, comparative and experimental research designs; ethnography, phenomenology, narrative research and critical research. The course aims at developing competence among the students to plan, and conduct educational research utilizing quantitative and qualitative research approaches.

Concentration Courses

Foundation Courses (27)

1. EDMT 501 Analysis (3)

The main aim of this course is to provide to the students not only the theoretical understanding but also to develop in them the capacity to solve problems. The focus will be on the proper understanding of the subject rather than proving abstract theorems. The main objectives of this course are to understand the fundamentals of the set of real numbers, to identify basic concepts and properties of Analysis and to apply the concepts on problem-solving.

2. EDMT 505 Algebra (3)

This course deals with abstract algebra course with associated concepts, theorems and problems with a focus on conceptual knowledge of algebra. This course covers various structure theories of groups, rings, fields and modules in a view to demonstrate how different structures have their commonalities and differences

between them. The objectives of the course are to develop conceptual understanding of structure theories of different algebraic systems with their applications, to make students to get insight into the conceptual ideas of mathematical structures and to make students to solve problems related to the algebraic systems. It is envisaged that this course enables students to experience the practical and aesthetic dimensions of recent field of study in mathematics.

3. EDMT 509 Topology (3)

In the course, students have to study basic topological properties in such a way that exhibits thorough understanding and applications in different settings. Foundations of topology prepare students to enter into topological spaces. The main discussion may start from naive notion of set theory and different operations; relation and function and Euclidean Space, introduction of topology and exploring its application areas with historical review. Topological spaces is about to construct topological space with the notion of open/closed set. It is better to review the notion of point set topology of Real analysis before coming to the class. This section deals with the construction of topology with basis and sub-basis. Interior, closure and boundary points and sets of will be applied in study different examples including the case of GIS. Creating different topological spaces like subspace topology, product topology and quotient topology is dealt with to extend the topological properties in different forms. Different spaces are constructed with the help of topology and sub/basis. Next, the continuous function and homoemorphism is used to study of properties of a space with the help of other topological spaces. Connectedness and compactness are further properties to be dealt in the course. Finally metric space topology is explored with a view to relate with already learnt topology.

4. EDMT511 Mathematical Modeling (3)

The course will explore mathematical ideas and tools for exploring natural world. Particular emphasis will be placed on the process of creating a mathematical model starting from a physical scenario using graphical, numerical, symbolic, and verbal techniques to describe and study real-world data and phenomena. Emphasis is on the use of elementary functions to investigate and analyze applied problems and questions. Course is emphasizing model construction, analysis and application. It uses variety of fields such as physics, biology, chemistry and economics as examples where students will learn how to develop and use mathematical models of real-world systems. It aims learner to able to analyze and evaluate the mathematical information, concepts and thoughts in verbal, numeric, graphical and symbolic forms while solving a variety of problems and solve multiple-step problems through different (inductive, deductive, and symbolic) modes of reasoning. Modeling change by difference equations, Decay model, Non/linear DE, discrete optimization modeling, modeling by graph theory, and continuous optimization modeling are focus areas of exploration.

5. EDMT 512 Statistics for Teachers (3)

This course mainly focuses on probabilistic and inferential statistical ideas in the field of teaching, applied mathematics, and educational research through problem solving approach. All areas of science, including educational research, involved with the quantitative study of real phenomena involve the application of statistics, with the intent of enabling the student to perform fundamental data displays, analyses,

and interpretations of univariate and bivariate statistics. Coincident with the acquisition of the ability to perform these tasks is the acquisition of the ability to interpret and critique the application of statistical techniques by other researchers in scientific publications. The laboratory portion of this course is meant to provide the student with a working knowledge of the desktop computer program, Statistical Package for the Social Sciences (SPSS).

6. EDMT 513 Number Theory and Teaching Arithmetic (3)

This course deals with the basic concepts of number theory such as concept of divisibility, divisibility test, the concept of GCD and LCM and prime numbers for teachers. Different concepts and theory with applications are dealt. Different concepts and theory includes Diophantine Equation, Primes and Their Distribution, The Theory of Congruence, Special Divisibility Test, Linear Congruence, Chinese Remainder Theorem, Wilson Theorem, Fermat's Little Theorem, Euler's Theorem, Order, Primitive Root and Index, Quadratic Congruence, The Legendre Symbol, Quadratic Reciprocity Law, Quadratic Congruence with Composite Moduli, etc are dealt. The course integrates teaching strategies, planning, developing instructional materials, assessment for/of learning in teaching arithmetic in high school.

7. EDMT 514 Theory and Application of Differential Equation (3)

This course is about differential equations: ordinary and partial. Differential equations are the tools for providing mathematical meaning of the nature. This course gives an idea about the use of the differential equation apart from how to solve these equations. The main objective of the course is to impart an increased understanding of differential equations and foundation knowledge. The course consists of first order differential equations, linear second order and higher order differential equations, power series solution, system of linear first order differential equations and stability theory. The course will also cover a brief introduction of partial differential equation. Theory will be demonstrated with some real situational applicable problems.

8. EDMT 515 Discrete Mathematics and Problem Solving (3)

Discrete mathematics is such mathematics which deals with discrete objects. Discrete objects are those which are separated from (not connected to/distinct from) each other. Integers (aka whole numbers), rational numbers (ones that can be expressed as the quotient of two integers), automobiles, houses, people etc. are all discrete objects. This course offers the students techniques in how to think logically and mathematically and apply these techniques in solving problems. To achieve this goal, students will learn logic and proof, sets, functions, as well as algorithms and mathematical reasoning. Key topics involving relations, graphs, trees, and formal languages and computability are mainly covered in this course.

Specialization Professional Courses (24 Cr. Hrs)

1. EDMT 540 ICT in Mathematics Education (3)

The significance of mathematics in other branches of science and its value in developing interdisciplinary individual capabilities needs no description. Connecting such valuable subject with computer technology can create a separate area of knowledge/study. Management of computer added mathematics teaching learning environment in today's modern classroom is the demand of the time and change in technology. So, this course reflects the changes in information, exchange of technology and will be able to provide the students with the required level of skill to use computer in teaching-learning Mathematics. Students will acquire skills to use computer for processing documents, developing teaching learning materials (audio/visual) and organizing collaborative learning of Mathematics subject. Students will also undertake projects based on application of computer in Mathematics Teaching throughout the course. The course focuses to develop the ability of designing audio/visual teaching aids and effective presentation with the help of some basic software and to develop skill of using some software which is especially designed to help Mathematics teaching and learning.

2. EDMT 541 Teaching and Learning Mathematics (3)

The approaches to teaching and learning of mathematics have been changed significantly in the last few years. Challenges posed by declining interests of students in mathematics are multifaceted and indeed, are of the domain of pedagogical discussion. Researches in mathematics learning have shown that the creative teaching/learning strategies are the sources of intrinsic motivation towards learning of mathematics. Considering these as major part, the proposed course aims at enhancing skills and practice of novice teachers through series of planning sessions, materials construction, workshops, modern approaches of teaching, micro-teaching activities, various modes of evaluation etc. The course also deals with the recent learning approaches in mathematics giving much emphasis on cognitive, constructivist cultural management-related theories of mathematics learning. Rather than focusing on only theoretical issues, the course emphasizes on current practices in a view to improve mathematics teaching and learning practices in schools.

3. EDMT 542 Curricula in Mathematics Education (3)

This course aims at helping postgraduate students to conceptualise, develop and design curriculum for school (primary, secondary and higher secondary). The course aims for awaken about various images of curriculum and the "human interest" that orients the particular type of curriculum. Focusing more on the blend of theory and practice of curriculum development, the course addresses various models of

curriculum development process, implementation and evaluation. The main objectives of the course is to develop an acquaintance with the concept of curriculum, nature of different mathematics curricula, to analyze mathematics curricula in accordance with different models and types and to be able to develop mathematics curricula using different methods of curriculum development.

4. EDMT 543 Assessment in Mathematics Education (3)

Assessment is viewed as the process of gathering and discussing information from multiple and diverse sources in order to develop a deep understanding of what students know, understand, create and can do with their knowledge as a result of their educational experiences. The process culminates when assessment results are used to improve subsequent learning. The course aims the ways of evaluating the students' performances and exploring the issues while developing multiple assessment tools in mathematics with the notion that effective assessment is ongoing and embedded in instructional activities. This course focuses on the recent perspectives and issues in students' assessment in mathematics and their individual assessment. The main objectives of this course are to make students able to understand the nature and uses of different types of tools and techniques of assessment in education, to acquire the skill to construct and use the multiple assessment tools, to administer the tests and interpret the scores and its implications to students and parents and to undertake action research and interpret the results.

5. EDMT 544 Teacher Development in Mathematics Education (3)

This course is designed for graduate level students as a practical course in teacher development. With this course students will play a different role from a teacher i.e. of a teacher developer. Teacher development in itself is a wide area and training students to be teacher developers will certainly be an ambitious task. So this course will be an introductory one and will develop in students general philosophy of teacher development and skills required to help teacher development. The areas addressed by the course will be teacher training, observation and feedback, continuing professional development and mentoring

6. EDMT 545 Internship (3)

The internship is designed to help the students to integrate classroom theory with practical work to experience in the public sector or in a private setting. It is based on the premise that learning in the work world can enhance the learning in the classroom. Therefore, the venue should provide opportunity for students to expand their knowledge as well as for them to contribute to the activities being undertaken by the organization. In the internship, students will use academic knowledge and apply professional skills, work with professionals who will be mentors for them, discover strengths which can be further developed, discover weaknesses which can be corrected and evaluate and further define career goals. There will be internship

guide developed by the university. The students will follow the guidelines and act accordingly to complete their internship.

7. EDMT546 Mathematics Education Research Project-1 (3)

The research project-1 is offered in the third semester. The main purpose of this research project-1 is to develop research proposal by the students in their areas of interest. The students will develop this proposal under three modules. Module-1 is Introduction Unit followed by Issue statement, Purpose of the Study, Research Questions, Research Hypothesis if exists, significance of the study, de/limitation, etc. or any other accepted format provided by the facilitators. Module-2 is about literature Review Unit. It consists thematic review, theoretical review, policies reviews, reviews of past researches, research gaps, conceptual framework, theoretical framework, etc. or any other accepted format provided by the facilitators. Module-3 is about research methodology section.

8. EDMT 547 Mathematics Education Research Project-2 (3)

The research project-2 is offered in the fourth semester. The main purpose of this Research Project-2 is to produce the data from the field, analyze and interpret the data, draw findings and conclusions. This research project has two sections. The first section involves preparing an account of the analysis and/or interpretation of the data (terminology depends on research methods). Likewise, the second section involves drawing from, integrating and extending work in all previous sections to prepare the final project report.

9. EDMT 599 Dissertation (6)

Electives Courses (6 Cr. Hrs.) (Any Two)

1. EDMT 516 Probability and Operations Research (3)

Probability and Operational research has a relation with different areas of study and it has several applications. This course aims at revisiting the conceptual understanding of probability and probability distribution (such as; Binomial, Poisson, Normal, Hypergeometric, etc) and focusing on operations research, which includes solving operational questions, solving questions related to resources' operations, and solving decisionmaking questions. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and persons can implement their decisions based on quantitative analyses. Operation research will be a good assistance for teachers in different areas. The main purpose of this course is to solve operational questions, solve questions related to resources' operations such as: human, machine, materials, energy, information and funds, and to solve decision making questions.

2. EDMT 517 Multivariable Calculus (3)

The course deals with the advanced calculus concepts covering wide ranges of topics such as space coordinates, multiple integrals, and functions of complex variables. The objective of this course is to make students able to extend the plane coordinates to space coordinates, to develop the concepts of the functions with several variables with its multiple integrals and then extended to vector valued functions with its some properties and to develop understanding of the complex analytic functions and Fourier series and its transform which further on extended to the Laplace transform.

3. EDMT 518 Functional Analysis (3)

The main aim of the course is to develop foundation in functional analysis and encourage solving some problems based on theorem and seeking practical implications. The project based method will be followed. It will cover normed spaces, completeness, functionals, Hahn-Banach theorem, duality, operators; Lebesgue measure, measurable functions, integrability, completeness of L^p spaces; Hilbert space; compact, Hilbert-Schmidt and trace class operators; as well as spectral theorem.

4. EDMT 519 Fractal Geometry (3)

Fractal geometry is one of the most emerging fields of mathematics in wider range of field which is also called describe as mathematical set that typically displays self-similar patterns. The class will give an introduction to the geometry of fractals and to their occurrence in the context of dynamical systems and in relation to chaos theory. This course aims to discover the theory of fractals and their geometry,

Hausdorff measure and dimensions and some alternative way of measuring dimension which is one of them most important part of fractal and their methods of calculation, local structures of fractals and their projections and intersections. The examples of fractals drawn from a wide variety of areas of mathematics and nature, including self-similar and self-affine sets, graphs of functions, examples from number theory and pure mathematics, Julia sets, random fractals and some applications. Some of the natural projects will be carryout during the semester course based on the discovered ideas.

5. EDMT 548 Recent Paradigms of Mathematics Learning (3)

The course deals with the recent learning approaches in mathematics giving much emphasis on the theoretical views of cognitive, constructivist cultural management learning. The course emphasis is on current practices in a view to improve mathematics teaching and learning practices in schools. The course has the following objectives; to identify and develop understanding of different learning paradigms in mathematics, to explore shortcomings in current pedagogical practices and identify ways to improve them, to be able to write and implement modules/units for different mathematics lessons using latest teaching/ learning approaches to mathematics, to explore research issues related to mathematics learning, etc

6. EDMT 549 Historical Development of Mathematical Ideas (3)

People have developed extreme attitudes towards mathematics such as, a) mathematics is a dreadfully complex language and has to be avoided as far as possible, b) mathematics has the ultimate beauty and goodness, and is the essence of all truths, and c) mathematics is magical, mystical and not real. Neither of these attitudes does represent the nature of mathematics nor help to develop the concept of mathematics as a product of human civilizations. Given this, the course has been designed to explore and promote the idea that mathematics has been developed by various civilizations, and is indispensable for the humanity. The main objectives of the course are to conceptualize mathematics as a result of human activity, to uncover the developmental aspects of various mathematical concepts and to realize the importance of mathematics for the humanity.

7. EDMT 550 Ethnomathematics (3)

Mathematics has been developed by every culture in the world. Ethnomathematics is the study of mathematical thinking such as the ideas of local mathematics involving number, logic, spatial configuration, and more significant, the combination or organization of these into systems and structures found outside what we traditionally consider mathematics. This course aims to strengthen and expand the understanding of several fundamental mathematical practices and mathematical reasoning of different people of various communities through investigation of the mathematics of non-Western cultures and the mathematical structures inherent in

activities such as games, music and day-to-day practice. The students are expected to not only master the mathematics, but to make sophisticated comparisons between cultures, to understand the differences between Ethnomathematics and academic mathematics, to investigate the historical and cultural role of mathematics in non-Western societies, and to appreciate the challenges faced by non-Western mathematicians.

The End