**Course Title:Teaching Undergraduate Mathematics**

**Subject Code: Math Ed. 535 Nature of the Course: Theoretical**

**Level: M.Ed. Credit hours: 3**

**Semester: Third Teaching hours: 48**

**1.Course Description**

This course is designed for Master’s level in mathematics education. It is expected that this course shall sharpen students in content knowledge for teaching at secondary and undergraduate level and provide knowledge in pedagogies. This course is focused especially on abstract algebra, analysis and geometry which are considered as the foundations for learning advance mathematics. This course provides meaningful content learning and pedagogical skills and competencies necessary to run the courses in higher secondary and undergraduate level. It also intends to impart the students of mathematics that is particularly necessary to the teachers who are teaching at undergraduate level as well as at secondary level. This course is an enrichment course to the teachers to make them fit into dealing contents of school mathematics and undergraduate mathematics meaningfully. The contents for this enrichment course are simplified and made meaningful for the purpose of teaching. Besides the content enrichment, it provides undergraduate mathematics teaching instructional models to the students – an appropriate pedagogy for actionable learning. This course makes students able to design lessons for undergraduate courses using different instructional strategies.

**2.General Objectives**

The general objectives of this course are as follows:

* To enhance the prospective teachers to fit and link appropriate philosophy and learning theory in teaching mathematics at secondary and undergraduate level.
* To enrich the prospective teachers on the fundamental mathematical contents for teaching at schools and undergraduate level.
* To introduce different instructional strategies used in teaching undergraduate mathematics.
* To enhance competencies in using problem base learning/ project base learning like relevant teaching models suitable for schools and undergraduate level mathematics teaching.
* To boost the capacity of designing lessons for undergraduate courses using instructional theories and ICTs.

**3.Specific Objectives and Contents**

|  |  |
| --- | --- |
|  **Specific Objectives** |  **Contents** |
| * Explain the nature of mathematical knowledge, its existence and justification with respect to different philosophical positions
* Explain how different philosophical positions influence/imply to the different nature of learning
* Examine the prevailing mathematics classroom practices in the light of philosophical positions
* Differentiate children learning and adult learning behaviours in mathematics learning
 | **Unit I: Philosophy of Mathematics and its Implication to Learning Theories (6)*** 1. The nature of mathematical knowledge, its existence and justification
	2. Influence/Implications of different philosophical positions on mathematics learning theories
	3. Philosophy/ideology and classroom practices
 |
| * Demarcate the differences between concepts in other field of knowledge and mathematics
* Expose the system of mathematical reasoning as mathematicians do for generating mathematics.
* Explain the ways of writing proofs of a theorem and solving mathematical problem
* Analyse the mathematical writing using language of logic, operators, signifiers, qualifiers etc.
* Teach writing language of mathematics – use of qualifier, quantifier and connecting ideas.
* Use different models of theorem proving for facilitating students in reading mathematics.
 | **Unit II. Mathematical Reasoning and Proof (**7**)*** 1. Mathematical Concepts and its development
	2. Mathematical reasoning and conceptualization
	3. Ways of mathematical reasoning and conceptualization
	4. Intuition and proof
	5. Structure of proof and techniques in mathematics for the undergraduate level.
 |
| * Review by contrasting different instructional strategies.
* Analyse the relevance of different instructional strategies for undergraduate mathematics teaching
* Use problem base learning in teaching mathematics at secondary and undergraduate level.
* Get experience on designing lessons based on PBL and use the designed lesson in classroom teaching as action research project and make reflection.
* Reflect on instructional practices at colleges based on research studies.
* Critically examine the relevance of different instructional strategies in undergraduate mathematics teaching. Use open courseware and ICTs in teaching undergraduate mathematics
 | **Unit III. Instructional Strategies (8)*** 1. Different instructional strategies for undergraduate mathematics
		1. Review of different instructional strategies
		2. Problem Solving
		3. Collaborative learning/cooperative learning
		4. Discovery/Inquiry based learning
		5. Project-Based learning
	2. .Problem-Based Learning (PBL)
		1. Historical Development of Problem-Based Learning (PBL) and its practices.
		2. Rationale of PBL introduction in undergraduate mathematics teaching
		3. Designing and use of problem base learning(PBL) in undergraduate mathematics teaching
		4. Models of PBL and some skeptics regarding PBL
		5. Design the problems of undergraduate mathematics content based on PBL.
 |
| * Present the mathematics into the form of reducing abstraction in course of teaching algebra.
* Utilize the fundamentals and basics of algebra for developing a theorem and solving a problem in teaching and guiding the students solving problem.
* Reconstruct the fundamentals of algebra through extensive journey over the contents of algebra that are usually taught in at secondary schools and undergraduate level.
* Examine the links between the different concepts of algebra.
* Examine and analyse the missing links in teaching algebra in the designated level.
* Present and fit the missing link between different mathematics in course of teaching some courses in the designated level.
* Prepare some lessons of algebra for teaching using different methods of proof techniques.
 | **Unit IV. Content Enrichment in Algebra(9)*** 1. Conceptual development of algebra:

Transition from arithmetic to algebra* 1. Number theory and theory of equation
		1. **Number Theory**:
* Divisibility,
* Prime numbers,
* Division Algorithm,
* GCD,
* Euclidean Algorithm,
* Fundamental theorem of Arithmetic,
* Different Base number system,
* Modular arithmetic,
* Diophantine analysis
	+ 1. **Theory of Equation**:
* Polynomials,
* Factor theorem,
* Fundamental theorem of Algebra,
* Quadratic formula,
* Rational roots theorem and some consequences,
* Solving higher order polynomials(cubic equation, Cardan’s contribution, fourth degree and higher order equation)

4.3.Structure and proof in Modern Algebraand techniques of proof for the undergraduate level.* 1. .Readings of selected contents of abstract and linear algebra to analyze the method of mathematical reasoning and proof and developing teaching/learning lessons –
		1. Fundamental concepts in modern algebra
* Groups: Group, Subgroup, Lagrange's theorem and its interpretation, homomorphism and isomorphism, fundamental theorem of homomorphism, Normal subgroups, Quotient group, Permutation group
* Rings: Ring, subring, Ring homomorphism, ideals, various integral domains, polynomial ring, gauss lemma, Einstein's criterion for testing irreducibility and its applicability, rational root theorem,
* Fields: Fields and its extension, algebraic and transcendental element, splitting field and algebraic field, fundamental theorem of algebra,
* Vector space:vector spaces, basis and dimension, linear transformations, eigenvalues and eigenvectors.

4.5 Difficulties and issues in learning algebra |
| * Present the mathematics into the form of reducing abstraction in course of teaching analysis, number theory, topology etc.
* Utilize the fundamentals and basics of analysis for developing a theorem and solving a problem in teaching and guiding the students solving problem.
* Reconstruct the fundamentals of analysis through extensive journey over the contents of analysis that are usually taught in at secondary schools and undergraduate level.
* Examine and analyse the missing links in teaching analysis in the designated level.
* Present and fit the missing link between different mathematics in course of teaching some courses in the designated level.
* Prepare some lessons for teaching analysis using different methods of proof techniques
 | **Unit V: Content Enrichment in Analysis(9)*** 1. Fundamentals of Real and Complex Analysis.
		1. Field axiom,
		2. Order axiom
		3. Completeness axiom)
	2. Historical approach of real analysis:Transition from calculus to analysis

5.3 Analysis from real to complex5.4Building real number and complex number5.5 Function and modeling5.6 Readings of selected contents of real analysis to analyze the method of mathematical reasoning and proof* + 1. $\in -δ$ definition of limit and continuity and its interpretation,
		2. Relation between the limit of the set, limit of function and limit of the sequence,
		3. Fundamental theorem of calculus its meaning,
		4. Relation between derivative and integration and its interpretation
		5. Topological properties on real line
* Interval,
* Interior of a set,
* Open and closed set,
* limit, closure, boundaries

5.7.Structure of proof in Analysis and proving techniques for the undergraduate level. |
| * Use ideas that are very relevant to reducing abstraction in course of teaching geometry at secondary schools and undergraduate level.
* Utilize the fundamentals and basics of different system of geometry for developing a theorem and solving a problem in teaching and guiding the students solving problem.
* Reconstruct the fundamentals of geometry through extensive journey over the contents of geometry that are usually taught in at secondary schools and undergraduate level.
* Examine and analyse the missing links in teaching geometry in the designated level.
* Present and fit the missing link between different mathematics in course of teaching some courses in the designated level.
* Prepare some lessons for teaching geometry using different methods of proof techniques
 | **Unit VI: Content Enrichment in Geometry (9)**6.1 Historical and conceptual development of geometry6.2.Different systems of geometry:* + 1. Euclidean Geometry
* Foundations
* Logical shortcomings
	+ 1. Non-Euclidean Geometry
* Emergence
* Axiomatic foundations
	+ 1. Analytic Geometry
* Analytic representation of plane,
* Solids and conic sections,
* Measurement and volume
	+ 1. Projective geometry
* Homogeneous coordinates,
* Perspectivity
* Projectivity
* Duality
* Cross ratio
	+ 1. Transformation geometry
* Isometric
* Non-isometric
* Inversion
	+ 1. Topological geometry
* Graph
* Network of plane
* Surface

6.3 Structure of proof in geometry and proving techniques 6.4 Four Pillars of Geometry |

 **4. Instructional Techniques**

The instructor will select the method or methods of instruction most suitable for a particular topic. It is quite acceptable to select more than one method and combine them into a single period of instruction whenever it is needed. The general and specific instructional techniques are described below.

 **4.1General Instructional Techniques**

 Following general instructional techniques will be adopted according to the need and nature of the lesson:

* Lecture
* Discussion
* Demonstration
* Presentation sessions
* Observation of class
* Critical overview
* Preparing reports and presentation
* Project work
* Problem solving
* Individual work
* Group work
	1. **Specific Instructional Techniques**

|  |  |
| --- | --- |
|  **Unit** |  **Activities and Instructional Techniques** |
|  **I** | * Philosophy/ideology and its implication in classroom practices (group discussions/term paper)
 |
|  **II** | * Writing mathematical proofs – challenges for the young learners.(Essay/term paper)
* Different methods of writing proofs and the language of mathematics for writing.( Essay)
 |
|  **III** | * Assignment of writing essays on different instructional strategies (individual contribution) and sharing with the friends using moodle platform for comments and suggestion and finalization of the paper.
* Online discussion with the students in different instructional strategies and PBL.
* Designing lessons on PBL and use them in classroom teaching and prepare a report reflecting the practice.(group work)
 |
| **IV, V and VI** | * Readings and reflecting are the major activities with assignments for each content (different group will do work on different topics and inter groups sharing in seminar).
* Learning difficulty of undergraduate students in modern algebra, analysis, geometry and possible pedagogical suggestion(Group project)
* Writing of papers in different mathematical problem solving and the methods of solving
* Sharing of the assignments to the community of learners (on line, seminar, and presentation).
* Some open-book type tests given to the students to complete in a restricted timeframe as designed by the tutor/Professor.
* Some open-book type tests given to the students to complete in a restricted timeframe as designed by the tutor.
* Preparation of teaching, learning and training modules under the guidance of instructor or main professor
	+ Note: Unit IV – VI are used for teaching preparation of the students. The students have to go through the text suggested for these units and prepare teaching, learning, and training modules in groups and use in peer teaching.
 |

**5. Evaluation**

 **5.1.Internal Evaluation (40%)**

Internal evaluation will be conducted by the course teacher based on the following activities:

* Attendance 5 marks
* Participation in learning activities 5 marks
* First assignment/mid-term exam 10 marks
* Second assignment/assessment 10 marks
* Third assignment/assessment 10marks

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**Total 40 marks**

 **5.2.External Examination (60%)**

Examination Division of the Dean office, Faculty of Education will conduct final examination at the end of the semester. The number of questions of different types and marks allocated to each type will be as follows:

* Objective questions (multiple choice) (10 x1 ) 10 marks
* Short answer question 6 with 2 OR questions (6 x 5) 30 marks
* Long answer questions 2 with 1 OR questions (2 x 10 ) 20 marks

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**Total**  **60 marks**

**6.Recommended Books and References**

**6.1 Recommended Books**

Alan, S.& Alice F. A. (2011).*The mathematics that every secondary school mathematics teacher needs to know*. Routledge (Units II, IV, V & VI)

Axler, S.,&Ribet,K.A.(2008). *Undergraduate texts in mathematics: Readings in mathematics.* Springer. (Unit VI)

Barbara J.D., Susan E.G., & Deborah, E. A. (eds)(2001). *The power of problem-based learning. Springer Verlag.*(Units I and III,)

Elena N. (2008).*Amongst mathematicians: Teaching and learning mathematics at university level*. Springer (Unit I and II full reading)

Erdman, J.M.(2011). *Companion to real analysis*. Portland State University.(Unit V)

Ernest, P. (1991). *The philosophy of mathematics education*.RoutledgeFalmer. (Unit I)\

Ernest, P. (2018). *Philosophy of mathematics education today*. Springer.(Unit I)

Finam, M. B. (2001). *Fundamentals of linear algebra*. Arkansas Tech University(Unit IV)

Gillies, R. M. & Ashman, A. F. (2003). Cooperative learning. London: RoutledgeFalmaer. (Unit III)

Haggarty, R. (1993). *Fundamentals of mathematical analysis* (2nded.). England: Addison-Wesley Publishers Ltd.(Unit V)

John S. W.(2010). *Four pillars of geometry*. Springer (Unit VI)

Judson, T. W. &Beezer, R. A. (2015). *Abstract algebra: Theory and applications*. (Unit V)

Sundstrom, T. (2014). *Mathematical reasoning: Writing and proof*. Pearson.(Unit II)

Ulrich D.& Pamela, G. (2011). *Reading, writing and proving: A closer look at mathematics*. Springer (Units II, IVand V))

* 1. **References**

….. (2010). *Complete mathematics, teach yourself*.

Ernest, P. (1998). *Social constructivist philosophy of mathematics education*.Newyork: State University of New York.

Sthal, S. (1999). *Real analysis: A historical approach*. Newyork:John Wiley & Sons, InC.

*The existence of Real Numbers*, *POME*, 2018; Vol: 30

**Course title: Differential Geometry Nature of the course: Theory**

**Course no.: Math Ed.537 Credit hours: 3**

**Level: M.Ed. Teaching hours: 48**

**Semester: Third**

# 1. Course Description

This course is designed to provide wider knowledge and skills on differential geometry for Math Educators. It comprises a range of skills varies from curves in space to intrinsic and extrinsic properties on surface. This course deals with curves and surfaces in 3-space using the tools of calculus and linear algebra. Topics covered in this course includes local and global properties of curves and surfaces. The course is divided in five major units. It starts with curves in space and then introduce some special curves. Then the course introduces surface and its fundamental form. Finally, the course deals with intrinsic and extrinsic properties on surface.

# 2. General Objectives

The general objectives of this course are as follows:

* To utilize the concept of a space curve and its types in problem solving
* To apply basic results of surface to solve related problems
* To interpret the fundamental forms of surface
* To explore and prove local properties on surface
* To calculate and apply fundamental coefficients of surface in problem solving

# 3. Specific Objectives and Contents

|  |  |
| --- | --- |
|  **Specific Objectives** |  **Contents** |
| * To understand curves in space, and to find its class
* To define, derive, and compute tangent line and its related theorems
* To compute order of contact between curve and surface and apply it in problem solving
* To explain osculating plane, derive its equation and apply it in problem solving and theorem proof
* To analyze fundamentals of space curve and derive its equations
* To define curvature and torsion and apply it in problem solving and theorem proof
* To state and prove fundamental theorem of space curve
 | **Unit I: Curves in Space (10)**1.1 Space curve and its class1.2 Tangent to the space curve 1.3 Order of contact 1.4 Osculating plane 1.5 Fundamentals on space curve 1.6 Curvature, torsion and screw curvature 1.7 Intrinsic equation |
| * To explain helix and prove its related theorems
* To define osculating circle and analyze its properties
* To analyze osculating sphere and prove its properties and related theorems
* To compare Evolute and involute and compute its curvature and torsion
* To state Bertrand curves and prove its properties
 | **Unit II: Special Curves (9)**2.1 Cylindrical helix 2.2 Osculating circle and osculating sphere 2.3. Evolute and involutes 2.4 Bertrand curves and its properties |
| * To define surface and find its class
* To analyze regular point, singular point
* To explain parameter transformation and prove its geometric significance
* To analyze tangent plane and normal line and use it in problem solving and theorem proof
* To explain family of surface, and evaluate characteristic line, envelope, characteristic point and edge of regression, and to prove related theorems
* To compare ruled surface and its kinds and use it in problem solving and theorem proof
* To explore developable surface associated with space curves and prove related theorems
 | **Unit III: Surface (10)**3.1 Surface and its Class3.2 Regular and Singular Point3.3 Transformation and its geometric significance3.4 Tangent plane and normal line3.5 Family of surface3.6 The ruled surface 3.7 Developable surface  |
| * To interpret first and second fundamental forms geometrically and apply them in proving theorems
* To calculate first and second fundamental coefficients of surface
* To prove Weingarten equations
* To explain direction component and direction coefficient
* To define family of curves and its differential equation
* To explore orthogonal trajectories and its differential equation
* To compare double family of curves and its orthogonality
 | **Unit IV: Fundamental Forms (9)**4.1 Fundamental forms of surface4.2 Fundamental coefficients of surface4.3 Weingarten equations 4.4 Direction coefficients and related results4.5 Family of curves4.6 Orthogonal trajectories4.7 Double family of curves |
| * To define intrinsic and non-intrinsic properties on surface
* To explain normal curvature, principal curvature, normal section, principal section, principal direction and derive its differential equation
* To prove Meusnier’s theorem
* To define developable surface and prove related theorems
* To understand line of curvatures and prove related theorems
* To state and prove Rodrigue’s formula, Monge’s theorem, Euler’s theorem, Joachimsthal’s theorem
* To compute conjugate direction and prove related theorems
* To define asymptotic lines and prove related theorems
* To explore fundamental equation and compute christoffel coefficients
* To state and derive Gauss characteristic equation
* To derive Mainardi-codazzi equation
 | **Unit V: Properties on Surface** (10)5.1 Local non-intrinsic property of surface5.2 Normal curvature and related theorems5.3 Meusnier’s theorem5.4 Developable surface5.5 Minimal surface5.6 Line of curvature and its properties5.7 Rodrigue’s formula, Monge’s theorem, Euler’s theorem, 5.8 Joachimsthal’s theorem5.9 Conjugate direction and its properties 5.10 Asymptotic lines and related theorems5.11 The fundamental equation of surface theorem5.12 Gauss characteristic equation5. 13 Mainardi-codazzi equation |

Note: *The figures in the parentheses indicate approximate teaching hours allocated for respective units.*

**4. Instructional Techniques**

The instructor will select the method or methods of instruction most suitable for a topic. It is quite acceptable to select more than one method and combine them into a single period of instruction whenever it is needed. The general and specific instructional techniques are described below.

**4.1 General Instructional Techniques**:

The following general method of instruction will be adopted according to the need and nature of the lesson:

* Lecture
* Demonstration
* Discussion
* Group work

 **4.2Specific Instructional Techniques**

|  |  |
| --- | --- |
| **Unit** | **Activities and Instructional Techniques** |
| I | * Multimedia presentation
* Project work
 |
| II | * Multimedia presentation
* Project work
 |
| III | * Project work and presentation
 |
| IV | * Multimedia presentation
* Project work
* Group Discussion
 |
| V | * Multimedia presentation
* Project work
* Group Discussion
 |

**5. Evaluation**

 **5.1 Internal Evaluation (40%)**

Internal evaluation will be conducted by course teacher based on following activities

* Attendance 5 marks
* Participation in learning activities 5 marks
* First assessment (assignment) 10 marks
* Second assessment (written test) 10 marks
* Third assessment (written test) 10 marks

**Total 40 marks**

 **5.2 External Examination (60%)**

Examination Division, Office of the Dean, Faculty of Education will conduct final examination at the end of the semester. The number of questions and their types along with their marks allocated to each type will be as follows:

* Objective questions (multiple choice) (10 x 1) 10 marks
* Short answer questions 6 with 2 OR questions (6 x 5) 30 marks
* Long answer questions 2 with 1 OR question (2 x10) 20 marks

**Total 60 marks**

# Recommended and References

# Recommended Books

Gupta, P. P., Mallik, G. S & Pundir, S. K., (2011). *Differential geometry*. Meerut: Meerut Pragati Prakashan. (Units I -V)

Koirala S. P, & Dhakal B. P. (2068). *Differential geometry*. Sunlight Publication, Kirtipur, Nepal. (Units I -V)

# Reference Books

Carmo, M. P. (1976) *Differential geometry of curves and surfaces*. Englewood Cliffs, NJ: Prentice-Hall (Units I & II)

Lal, B., (1969). *The three-dimensional differential geometry*. Delhi: Atma Ram and Sons. . (Units I-II)

Lipschutz, M. M., (2005). *Theory and problems of differential geometry- Schaum’s outline series*. Delhi: Tata McGraw-Hill Publishing Company Ltd. 6.

Wilmore, T. J., (2006). *An introduction to differential geometry*. Delhi: Oxford University Press.. (Units I -V)

**Course title:** Measure Theory and Topology

**Nature of course:** Theoretical

**Course number:** Math. Ed. 538

**Level:** M. Ed. **Credit hours:** 3

**Semester:** Third  **Teaching hours:** 48

1. **Course Description**

 This course is designed to provide students with the sound knowledge of measure theory and topology. The topics on measure theory deal with the theory of measure and integration in a simple setting of Euclidean and abstract space. The theory first uses the familiar facts from calculus. Later on, a more general treatment based on abstract notions characterized by axioms with less geometric content is given. As a preliminary step, students study outer measure and Lebesgue measure of a set, measurable functions, Lebesgue integral,  classes and integration in Euclidean and abstract spaces. The topics in topology deal with the definition of metric spaces as topological spaces, generalized topological spaces and their properties.

1. **General objectives**

Upon completion of this course, students will be able to

* grasp the basic concept of the Euclidean space 
* realize the knowledge of outer measure, Lebesgue measue and measurable functions with their properties
* develop the understanding of Lebesgue integrals
* deal with the properties of space
* comprehend the abstract treatments of Lebesgue measure and integration
* grasp the basic concept of metric space and topological space
* extend the metric space to more general concept of topological space
* deal with the properties of a distance function and explore the useful aspects of metrics
* deal with the properties of connectedness and compactness in topological spaces
1. **Specific Objectives and Contents**

|  |  |  |
| --- | --- | --- |
| **Unit** | **Specific Objectives** | **Contents Periods** |
| **I** | * To understand the points and sets in, $n$ - dimensional interval and its volume
* To realize the meaning of outer measure
* To understand the properties of outer measure: nonnegative extended real valued, monotonicity and countable subadditivity
* To understand measurable sets and their properties
* form a set called Cantor set: an uncountable set with zero outer measure
* To define measurability of a set $E$ in  and introduce the Lebesgue measure for a measurable set
* To define $σ$ - algebra, Borel $σ$ - algebra and prove some related theorems
* To prove the Caratheodory theorm
 | **Unit I: Lebesgue measure and outer measure (7)*** 1. Points and sets in
	2. Outer measure of a set in
	3. Cantor set
	4. Lebesgue measurable sets and Lebesgue measure
	5. $σ$ - algebra and Borel $σ$ - algebra
	6. Caratheodory theorem
 |
| **II** | * To prove the properties of the measurable functions
* To discuss Egorov’s theorem
* To prove the results related to convergence in measure
 | **Unit II: Lebesgue Measurable Functions (6)*** 1. Lebesgue measurable function and its properties
	2. Semi continuous function and its properties
	3. Egorov’s theorem
	4. Convergence in measure and its properties
 |
| **III** | * To explain and prove the properties of Lebesgue integral including Monotone convergence theorem, Tchebyshev’s inequality, Fatou’s lemma, Lebesgue dominate convergence theorem for both non-negative and arbitrary measurable functions
* To establish the relation between Riemann and Lebesgue integrals
 | **Unit III: Lebesgue Integrals (8)*** 1. Integral of non-negative functions
	2. Properties of the integral
	3. Integral of arbitrary measurable functions
	4. Relation between Riemann and Lebesgue integrals
 |
| **IV** | * To explain spaces
* To prove different inequalities in space
* To explain classes
* To prove the properties of classes
* To state the properties of additive set function and measure
* To prove the results related to measure space.
 | **Unit IV: Classes and Abstract Integration (8)** * 1. classes
	2. Young’s, Holder’s and Minkowski’s inequalities
	3. classes
	4. Banach and metric space properties
	5. space
	6. Additive set function, measures and their properties
	7. Measure space
	8. Measurable function on measure space and its properties
 |
| **V** | * To define metric in terms of distance function
* To define open and closed sets on a general metric space
* To define topological space and its interior, closure and boundary
* To define the basis and sub-basis and extension to topological space
* To determine topologically equivalence spaces with the help of continuous functions
* To discuss topological properties and construct subspaces
 | **Unit V: Topological Spaces (8)*** 1. Definition and examples of metric spaces
	2. Open sets and closed sets in metric spaces
	3. Definition and some examples of topological spaces
	4. Interior, closure and boundary
	5. Basis and sub-basis
	6. Continuity and topological equivalences
	7. Topological properties and Subspaces
 |
| **VI** | * To determine the properties of connected and disconnectedness
* To prove theorems on connectedness and draw their applications
* To establish the properties of path connected spaces
 | **Unit VI: Connectedness (6)** * 1. Connected and disconnected spaces
	2. Theorems on connectedness
	3. Connected subsets of the real line
	4. Applications of connectedness

**6.5** Path connected spaces |
| **VII** | * To define compactness and establish it as a topological property
* To use continuity in the compact spaces
* To derive the properties of compactness
 | **Unit VII: Compactness (5)*** 1. Compact spaces and subspaces
	2. Compactness and continuity

7.3 Properties related to compactness |

Note: *The figures in the parentheses indicate approximate teaching hours to respective units.*

1. **Instructional Techniques:**
	1. **General techniques:**
* Lecture
* Discussion
* Question-Answer
* Presentation
* Project work
	1. **Specific Instructional Techniques:**

|  |  |
| --- | --- |
| **Unit** | **Activities and Instructional Techniques** |
| **I** | * Individual and group discussions on outer measure and Lebesgue measure of a set
* Some problem sets to prove theorems related to outer measure
* Assignments on Lebesgue measure and measurable sets
 |
| **II** | * Individual and group discussions on measurable functions
* Group and individual assignments on problems related to measurable functions
 |
| **III** | * Individual and group discussions on Lebesgue integrals
* Group and individual assignments on problems related to integrals and their applications
 |
| **IV** | * Individual and group discussions on  and  classes
* Individual and group assignments on the related problems on these classes, Banach and Hilbert spaces
* Individual and group discussions on the set function, measure and measurable sets of the abstract space
* Assignments of the related problems
 |
| **V** | * Individual and group discussions on metrics, metric spaces, topologies, topological spaces and theorems on topological spaces
* Individual and group assignments on various problems on the spaces
 |
| **VI** | * Individual and group discussions on connectedness and disconnectedness of a set
* Group and individual assignments on related problems of connectedness and disconnectedness
 |
| **VII** | * Individual and group discussions on compactness and noncompactness of a set
* Group and individual assignments on related problems of compactness and noncompactness
 |

1. **Evaluation**
	1. **Internal evaluation 40%**

Internal evaluation will be conducted by course teacher based on following activities:

* Attendance 5 marks
* Participation in learning activities 5 marks
* First assignment / written test 10 marks
* Second assignment / project work 10 marks
* Third assignment / assessment 10 marks

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Total 40 marks

* 1. **External evaluation (Final Examination) 60%**

Faculty of Education, Examination division will conduct final examination of weight 60 marks at the end of semester. The number of questions and marks allocated to each type will be as follows:

* Objective questions (Multiple Choice of Items) (10 x 1) 10 marks
* Short answer questions 6 with 2 OR questions (6 x 5) 30 marks
* Long answer questions 2 with 1 OR question (2x 10) 20 marks

------------------------------------------------------------------------------------------Total 60 marks

1. **Recommended Books and References**
	1. **Recommended Books**
* Croom, F. H. (1998). *Principle of topology*. Orlando, Flogida (Units: **V**, **VI** and **VII**)
* Wheeden, R. I. & Zygmund, A. (1977). *Measure and integral*. New York (Units: **I**, **II**, **III** and **IV**)
	1. **Referances**
* Cohn, D. L. (1993). *Measure theory*. Barkhauser. Boston.
* Jain, P. K. & Gupta, V. P. (1986). *Lebesgue measure and integration*. New Delhi.
* Munkres, J. R. (1998). *Topology*. New Delhi: Prentice Hall of India.
* Pandey, U.N.(2016). *Real Analysis.* Kathmandu: Bidyarthy Publishers and Distributions, Bhotahiti.

**Course Title: Studies in Mathematics Education**

**Course Number: Math Ed. 539 Nature of the Course: Theoretical**

 **Level: M. Ed. Credit hours: 3**

**Semester: Third Teaching hours: 48**

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**1. Course Description**

This course aims at giving exposure to students about some of the books written in mathematics education that are used all over the world extensively. It also aims to let students pick up global issue which is locally important, write an essay and give seminar related to components of mathematics education, like nature of mathematics, pedagogies for mathematics, teacher development, assessment strategies and research agenda.

**2. General Objectives**

The general objectives of this course are as follows:

* To make the students knowledgeable about the strength of books written on mathematics education and enable to appraise them.
* To provide students with in-depth exposures to different curriculum and their materials around the globe.
* To make the students philosophically aware regarding mathematics education
* To describe qualitative research approach in mathematics education
* To make the students able to prepare contextual mathematics curriculum and able to analyze critically the existing mathematics curriculum
* To make the students able in preparing and presenting analytical write-ups and participate actively in the seminar of mathematics education.

**3. Specific Objectives and Contents**

|  |  |
| --- | --- |
| **Specific Objectives** | **Contents** |
| * Explain different views on nature of mathematics and math education
* Address different issues related to mathematical knowledge.
* Illustrate the philosophical roots of mathematical concept construction and nature of mathematical knowledge.
* Explain the dialogical and cultural nature of mathematics.
* Compare and contrast among different world views of mathematics.
 | **Unit I: Nature of Mathematics and Mathematics Education** **(10)** 1.1 Views on the nature of mathematics1.2 Views on the nature of math education1.3 Philosophical roots of mathematical concept construction1.5 Dialogical nature of mathematics1.6 Cultural nature of mathematics1.7 Different world views: Newtonian, Einsteinium, and Chaotic |
| * Explain the concept with its role and effects of fundamental human interest in curriculum formation.
* Develop the concept of comprehensive/ contextualized/Inclusive mathematics curriculum.
* Explain the parameter of analyzing the curriculum
* Explain the different approaches to math curricula of Nepal.
* Give critical appraisal of math curriculum of Grade IX to Bachelor level.
* Describe the statues of material used in mathematics teaching.
 | **Unit II: Curriculum Studies (9)** * 1. Fundamental human interest in curriculum formation (Technical, Practical and Emancipatory)

 * 1. Ideas of constructing comprehensive (Inclusive) mathematics curriculum ( local needs base ,students ability and interest, needs and orientation of country, diversity friendly and global practices)
	2. Parameter for analyzing the curriculum:

 2.3.1 Emerging knowledge and skill, philosophies, discourse, ideas2.3.2 Situation analysis ( market, state need, learners need , commity need)2.3.3 Policy analysis2.3.4 Educational forces(Internal practices /power, civil society* 1. Studies of IX to Bachelor’s math curricula of Nepal
	2. Status of materials used in mathematics teaching
 |
| * Explain different research paradigms from positivism to Criticalism, and Connect the idea of research paradigm with various research areas in mathematics education.
* Explain the major shift in mathematics education research focusing on issues of cultural diversity mathematics education.
* Justify why social turn gained more attention in research work mathematics education research.
* Make critical appraisal how individual experience, reflection can become a knowledge focusing on ethnography, auto-ethnography, phenomenology, case study, action research
* State mathematics literacy as a research issue.
 | **Unit III: Research in Mathematics Education**  **(13)** 3.1 Simple introduction of different research paradigms such as * + 1. Positivism
		2. Post-positivism

 3.1.3 Interpretivism 3.1.4 Criticalism3. 2 Issues of cultural diversity in mathematics education research3.3 Strong social turn in mathematics education research3.4 Ethnography, Auto-ethnography, phenomenology, Narrative Inquiry, Case study, Action research3.5 Mathematics literacy as a research issue |
| * Present the review of the assigned books/ Chapters.
* Give critical appraisal of the assigned books/ chapters.
 | **Unit IV: Review and Appraisal of Selected Books** **(8)**  4.1 Critical issues in mathematics education* Social Justice and Mathematics education: Issues, Dilemmas, Excellence and Equity (Chapter 23, pp. 319-336)

 4.2 Issues in mathematics teaching* What values do you teach when you teach mathematics? (Chapter 7, pp. 93-104)

 4.3 What is mathematics really? 4.4 18 unconventional essays on the nature of mathematics* Socratic dialogue on mathematics (pp. 1-16)
	1. New mathematics education research

4.Mathematics Knowledge and political power (pp. 11-22)* Challenges for mathematics education research (pp. 33-50)
* Mathematics learning as a social practice (pp. 147-152)
* Materialization and organization: Towards a cultural anthropology of mathematics (pp. 23-32)
 |
| * Prepare and present analytical write-up related to the different aspects of mathematics education.
* Conduct a seminar on the assigned issue of mathematics Education.
 | **Unit V: Analytical Write-up and Organization Seminar (8)**  5.1 Book Review/ Chapter Review  5.2 Long Essays* 1. Seminar
 |

 *Note: The figures in the parentheses indicate the approximate teaching hours allocated to the respective units.*

 **4.Instructional Techniques**

The instructor will select the method or methods of instruction most suitable for a particular topic. It is quite acceptable to select more than one method and combine them into a single period of instruction whenever it is needed. The general and specific instructional techniques are described below.

 **4.1.General Instructional Techniques**

 Following general instructional techniques will be adopted according to the need and nature of the lesson:

* Group work
* Demonstration
* PowerPoint presentation
* Project work
* Lecture

**4.2 Specific Instructional Techniques**

|  |  |
| --- | --- |
| **Unit** |  **Activities and Instructional Techniques** |
| I | * Internet browsing followed by discus
* Multimedia presentation
 |
| II | * Bringing curriculum of different countries and compare and contrast among their key ingredients.
* Multimedia presentation
* Project work
 |
| III | * Internet browsing for the sample of different researches on social and cultural aspects of mathematics
* Discussion
* Project work
 |
| IV | * Intensive and extensive reading of different seminal textbook written on the issues of mathematics education
* Project work
* Multimedia presentation
* Group discussion
 |
| V | * Book Review (1000 words approx 4 pages): The following key features must be included:
* General information (Author, date, title, publisher, place of publication)
* Summary of key sections of the book
* Summary of key issues presented in each sections/chapter of the book
* Information about the Potential reader of the book
* Long Essays (4000 words approx 16 pages): Students are expected to select an issue of global/local in nature in mathematics education and address it with sufficient facts figures and arguments in their own style. Conventional as well as unconventional way of writing is desired.
* Seminar: (1500 words approx 6 pages): Brainstorming session is required in order to students’ exposure to select a good and burning issue in mathematics education. For example: Should we prepare world citizen through our mathematics education course?
* Presentation
* Project work
* Multimedia presentation
 |

**5 Evaluation**

**5.1 Internal Evaluation (40%)**

Internal evaluation will be conducted by course teacher based on following activities

* Attendance 5 marks
* Participation in learning activities 5 marks
* First assessment(assignment) 10 marks
* Second assessment(written test) 10 marks
* Third assessment(written test) 10marks

**Total 40 marks**

 **5.2 External Examination(60%)**

 Examination Division of the Dean’s office will conduct final examination at the end of the semester. The number of questions and its type with marks allocated will be as follows:

* Objective questions (multiple choice) ( 10 × 1) 10 marks
* Short answer question 6 with 2 OR questions (6 × 5) 30 marks
* Long answer questions 2 with 1 OR question ( 2 × 10 ) 20 marks

**Total** **60 marks**

**6. Recommended Books and References**

 **6.1 Recommended Books**

Doll, W. E. (1993). *A post-modern perspective on curriculum.* New York: Teachers College Press. (Unit II)

Ernest, P., Greer, B. & Shreeraman, B. (Ed). (2009). *Critical issues in mathematics education*. Charlottte, NC: Information age publishing. (Unit V)

Gates, P. (2001). *Issues in mathematics teaching.* London and NY: Routledge and Falmer (Unit I, IV)

Hersh, R. (Ed) (1997) *What is mathematics really?* NY: Oxford University Press. (Unit I, IV)

Hersh, R. (Ed.) (2006). *18 unconventional essays on the nature of mathematics.* NY: Springer. (Unit I)

Maaz, J. & Schloeglmann, W. (Ed) (2006). *New mathematics education research and practice*. Rotterdam, The Netherlands: Sense (Unit III)

**6.2 References**

Acharya B.R. (2017). *Studies in mathematics education*. Dikshant Publication: Kathmandu. (Unit I to V)

Acharya , B. R. ( 2017). *Diversity in mathematics education*. Dikshant Publication: Kathmandu. (Unit II & III).

Bachman, D. (2007). *Advance calculus demystified: A self-teaching guide.* New York: Mcgrow Hill. (Unit II)

*Baumslag*, B. (2000). *Fundamentals of teaching mathematics at University level*: Imperial College press. (Unit II)

Handa, Y. ( ). *What does understanding mathematics mean for teachers? Relationship as a metaphor for knowing.* Routledge (Unit I)

Nardi, E. & Iannone, P. ( ). : *How to prove it: A brief guide for teaching proof to year 1* mathematics graduates*.* Norwich, UK: (Unit II).

Pandit R. P. et al ( 2018*). Studies in mathematics education*. Kathmandu: Indira Pandit.

PISA (2010). *Mathematics teaching and learning strategies in PISA*: OECD (Unit II).

Robert, A. W. (1996). *Calculus: The dynamics of change.* Mathematical Association of America (Unit II).

Shresha, M. B. ( 2014). *Philosophy of mathematics*. Kathmandu: Nepal Pragya Pratisthan. ( Unit-I).

Upadhyay, H. P. (2013). *A dialogue: mathematics as an umbrella concept unifying all disciplines. Kathmandu*: Council of mathematics Education. (Unit V).