Math Ed. 515: Foundation of Mathematics Education

Semester: First **Nature of the course: Theoretical**

Course no.: 515 **Credit hours: 3**

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

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1. Course Introduction

This course is designed to provide a broader and deeper understanding of the state of the art of mathematics education which draws upon four main foundations: mathematical foundation, psychological foundation, cultural foundation and technological foundation. This course has been updated and modified to meet the changing needs of mathematics education.

2. General Objectives

The general objectives of this course are as follows.

- To provide the students with broader and deeper understanding of the nature of mathematics and mathematical education in the changing philosophical contexts,
- To develop a deeper understanding of the theories of learning mathematics with their implications,
- To acquaint the students with the main features of instructional models/strategies in the context of specific topics,
- To make the students familiar with different resources and their use in teaching mathematics,
- To develop an understanding of cultural and social issues in mathematics education and their implication on curriculum and classroom teaching,
- To acquaint the students with the components and principles of professional development of mathematics teachers,
- To develop the ability and skills of report writing and presentation on different aspects of mathematics education, and
- To acquaint the knowledge and skills possess for the professional development of mathematics teachers

3. Specific Objectives and Contents

Specific Objectives	Contents
• Explain the meaning of mathematics from different points of view • Explain the nature of mathematical knowledge on the basis of its assertion • Discuss how mathematics can be considered as consisting of different branches/areas/structures	**Unit-I Nature of Mathematics (8)** 1.1 Meaning and definitions of mathematics 1.2 Nature of mathematical knowledge (a priori and a posteriori)

• Explain the structure of various branches of mathematics with its unifying concepts • Identify issues/questions in relation to philosophy of mathematics • Explain the major views on philosophy of mathematics (absolutist and fallibilist views) • Explain the causes of emergence of logicism, formalism and constructivism in the absolutist philosophy of mathematics • List and explain the major features characterizing each of the three schools of absolutists' views • Explain why the three schools under absolutists' views could not establish mathematical knowledge as absolute knowledge • Examine the importance of the fallibilist views in spite of the absolutist views • List the basic assumptions underpinning mathematical knowledge as social construction and discuss how social constructivism connects subjective and objective knowledge in cycle	1.3 Structure of mathematical knowledge 1.3.1 Structure of mathematical knowledge 1.3.2 Structure of various branches of mathematics 1.4 Philosophy of mathematics *1.4.1 Introduction* *1.4.2 Major views (Absolutist and Fallibilist)* *1.4.3Development and main features of absolutism of the three schools of thought (logicism, formalism and constructivism)* *1.4.4 Reasons for the failure of the absolutist view* *1.4.5 Importance of the fallibilist view* *1.4.6 The social constructivist philosophy of mathematics*
• Examine the difference between mathematics education and mathematics • Explain the bases of mathematics education in terms of its major foundations: mathematical, psychological, cultural and technological • Differentiate between different ideologies of mathematics education based on Perry theory	**Unit- II Nature of Mathematics Education (8)** 2.1 A comparative view of mathematics and mathematics education 2.2 Foundation of mathematics education 2.2.1 Mathematical foundation 2.2.2 Psychological foundation 2.2.3 Cultural foundation 2.2.4 Technological foundation 2.3 Ideologies in mathematics education 2.3.1 Dualistic absolutism 2.3.2 Multiplistic absolutism 2.3. (Separated/ connected), 2.4.4 Relativistic fallibilism

• Explain the theoretical paradigm shift in the theories of learning mathematics • Discuss with illustrations the features of Ausubel's theory in terms of preconditions for reception learning, strategies for reception learning and advance organizer • Define and illustrate three types of mathematical concepts as mentioned by Dienes • Explain with examples how mathematical concepts are learned through Diene's six progressive stages • Analyze the relationship between Diene's six stages and his four general principles for teaching concepts • Develop a teaching/ learning strategy as an application of the stages to classroom teaching • Compare Gagne's product-oriented approach and Bruner's process-oriented approach to the teaching and learning of mathematics • Examine the thought processes involved in Skemp's learning of mathematics • Explain the meaning of constructivism from different perspectives • Identify the premises of constructivism and discuss their importance • Examine the role of the constructivist views on the teaching and learning of mathematics • Examine socio-cultural theories as the extension of the constructivist approach • Summarise briefly the position of different learning theories on typical problems of learning • Examine with illustrations the implications of learning theories for the teaching and learning of mathematics.	**Unit -III Theories of Learning Mathematics (10)** 3.1 Shift in the theoretical paradigm of learning mathematics 3.2 Ausubel's theory of learning 3.2.1 Preconditions for reception learning 3.2.2 Strategies for reception learning 3.2.3Advance organizer 3.3 Diene's theory 3.3.1Mathematical concepts 3.3.2 Stages in learning mathematics 3.3.3 Relationship between stages and principles 3.3.4 Application of Diene's stages in teaching/learning mathematics 3.4 Comparison between Gagne and Bruner approaches to the teaching and learning of mathematics 3.5 Skemp's psychological processes in learning mathematics 3.6 Constructivism in the learning of mathematics 3.6.1 Meaning and premises of constructivism 3.6.2 Constructivist views on the teaching /learning of mathematics 3.7 Socio-cultural theories as the extension of the constructivist approach 3.8 Implication of learning theories for teaching and learning mathematics
• Explain the prescriptive and normative nature of instructional strategies	**Unit-IV Instructional Strategies**

• Explain seven to nine expository activities and use them in developing teaching/learning activities for teaching skill, concept or a principle • Define problem solving and examine different situations for a problem • List and describe five steps of problem solving teaching/learning strategies and use them in developing for teaching problem solving • Define discovery learning and discuss its purposes • Explain the role of inductive and deductive approaches to developing teaching/learning strategies for discovery learning • Develop discovery lessons to teach specific topics in mathematics • Examine teacher's and student's roles in the constructivist classroom and use them for developing teaching activities • Examine and analyze teacher's roles in handling mathematics classes for socially, culturally and linguistically diverse students and use them in developing teaching/learning activities	**(8)** 4.1 Introduction 4.2 Expository model 4.3 Problem solving model (five steps) 4.3.1 Definition of problem 4.3.2 Five steps of the problem solving model and its use in teaching. 4.4 Discovery strategy 4.4.1Definition and purpose 4.4.2Inductive and deductive approaches in discovery learning 4.4.3 Development of a discovery lesson in mathematics 4.5 Teaching approaches in constructivism 4.6Teaching approaches in socially/culturally diverse situations
• Identify different types of materials required for equipping the mathematics classroom and explain how to manage them • Discuss the use of software packages in math teaching • Differentiate between manipulative and virtual manipulative materials and discuss their use in mathematics teaching • Discuss the various ways of using computers in teaching and learning mathematics • Discuss the importance of multimedia packages in teaching and learning math • Explain the educational objectives of games and paradoxes. • Develop or select different games for	**Unit-V Instructional Media and Technology for Mathematics Teaching** **(5)** 5.1 Use of ICT in mathematics teaching 5.1.1.Materials for equipping the math classroom 5.1.2Multimedia package 5.1.3 Software package 5.1.4Manipulative and virtual

teaching different objects of mathematics and explain their uses in teaching	manipulative materials 5.2 Games and puzzles
• Examine the historical development of math with respect to social development • Discuss the cultural foundation of math education • Examine the role of math in preserving and developing different cultures • Identify and explain the factors involved in social diversity in math classes • Explain the cognitive model of difference and its implication to teaching • Explain how social and cultural models seek to understand students' learning problems due to diverse backgrounds • Analyze the role of social diversity in framing the curriculum and teaching practices	**Unit - VI: Society and Social Diversity in Math Education (5)** 6.1 Cultural foundation of mathematics education 6.2 A socio-cultural approach to studying the teaching and learning of mathematics 6.2.1 Dimension of multicultural mathematics education 6.3 Diversity in mathematics 6.3.1 Social diversity in mathematics classes 6.3.2 Cultural diversity in mathematics education 6.3.3 Cognitive model of difference 6.3.4 Social model of difference 6.3.5 Implication of social diversity for curriculum framing and teaching practice
• Explain the meaning and importance of teacher education • Explain the models of the development of teaching staffs and explain them. • State different components of a staff development program and explain them • List the principles of professional development of mathematics teacher and discuss their significance as principles • Identify the different areas needed for teacher education and examine their interrelationships • Explain the need for the job induction training for novice teachers	**Unit-VII Mathematics Teacher Education (4)** 7.1 Introduction 7.2 Models of development of teaching staffs 7.3 Components of staff development 7.4 Contents for a math education program 7.5 Knowledge and skills possess for the professional development of

	mathematics teachers 7.6 Need for job induction training for novice teachers

Note: The figures in the parentheses indicate the approximate periods for 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 methods 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

- Group work
- Demonstration
- Multimedia presentation
- Project work
- Discussion
- Lecture

4.2 Specific Instructional Techniques (Theoretical Part)

Unit	Activities and Instructional Techniques
I	• Debate/discussion on the ideologies of mathematics education • Project work • Multimedia presentation • Debate • Discussion • Less lecture
II	• Expository technique • Problem solving • Discussion and project work • Group and individual multimedia presentation
III	• Expository model • Problem solving model • Discovery model • Constructivist, socio-cultural and socially critical theories based techniques and methods of teaching the respective model
IV	• Less expository presentations and more focus on study tasks and then discussion and question answer sessions • Problem solving

	• Discovery • Project work • Power point presentation
V	• Debate on equality and equity in mathematics classes • Multimedia presentation • Project work • Group discussion
VI	• Dialogical • Dialectical • Debate • Multimedia presentation • Discussion class on different models of staff development
VII	• Multimedia presentation • Project work • Discussion • Group presentation

5 Evaluation

5.1 Internal Evaluation (40%)

The 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 (assignment) 10 marks
- Second assessment(written test) 10 marks
- Third assessment(written test) a 10 marks

Total 40 marks

5.2 External Examination (60%)

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

- Objective questions (multiple choice questions) (10×1) 10 marks
- Short answer questions (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

Aichel, D. B. & Reys, R. E. (1997). *Readings in secondary school mathematics*. Prindle, Weber and Schmidt Inc

Ambrosio, U. (1985). *Socio-cultural bases for mathematics education*. Campinas Brazil: UNICAMP

Bell, H. F. (1978). *Teaching and learning mathematics*. WMC. Brown Company Publisher

D'Ambrosio, U. (2006). *Ethnomathematics: Link between traditions and modernity, Rotterdam*.Taipei:Sense Publisher

David, K. *Games in teaching mathematics*. Cambridge University Press.

NCTM (1994). *Professional development of teachers of mathematics*. Yearbook, Reston VA: National Council of Teacher of Mathematics.

Pandit, R. P. (2007). *Foundation of mathematics education*. Kathmandu: Mrs Indira Pandit.

6.2 References

Acharya , B. R. (2017). *Foundation of mathematics education*. Kathmandu: Dikshant Prakashan.

(Units 1-VII)

Ernest, P. (1993). *The philosophy of mathematics education.* Basing Stoke, Britain: Taylor and Francis Inc.

(Units- I,VI).

Gates, P. (2003). *Issues in mathematics teaching*. London: Routledge Flader. (Unit III).

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

Skemp, R. (1982). *The psychology of learning mathematics.* Hormonds Worth, Enland: Penguin Books.(Unit-III)

Upadhyay, H.P. (2070). *Exploratory teaching mathematics*, Kathmandu : Sakunda Pustak Bhawan. (Unit –III).

Vygotsky, L. S. (1986). *Thought and language* (13^{th} edition). England: The MIIT Press.(Unit-III).

Zeven berger, R. Dole, S. and Robert, J.W. (2005). *Teaching mathematics in primary school*. Australia : Allen and Unwin.(Unit-VI).

Math Ed. 516: Abstract Algebra **Nature of the course: Theoretical**
Course no. : Math Ed. 516 **Credit hours: 3**
Level: M. Ed **Teaching hours: 48**
Semester: First

1. Course Introduction

This course deals with axiomatic algebraic structures such as group theory, ring theory and field theory including Galois Theory of fields and solvability of polynomials. The concept of nilpotent and solvable groups are also included in group theory. Ring theory includes more fundamental concepts together with the ring of formal power series and the factorization of polynomial ring over unique factorization domains whereas field theory discusses fundamental theorem of Galois Theory, fundamental theorem of algebra, Galois groups of polynomials and solvability of polynomial equations.

2. General objectives

The general objectives of this course are as follows.

- To explore the knowledge on groups, normal and subnormal series of groups and nilpotent group.
- To enhance the basic concepts of ring, the ring of formal power series and the factorization in polynomial rings.
- To familiarize the students with the fundamental concepts of field extension, Galois group and Galois extension of field.
- To acquaint them with the Galois group of polynomials and the solvability of polynomial equations.

3. Specific Objectives and Contents

Specific Objectives	Contents
• Review the concepts of permutation groups, symmetric groups and the properties of internal and external direct product (sums) of groups • State Sylow's theorems with illustrations • Define subnormal, normal, ascending central and derived series of the groups with suitable examples • State and prove Zassenhau's lemma, Jordan Holder theorem and Scheier's theorem • Prove the properties of solvable and nilpotent groups	**Unit I: Nilpotent and Solvable Groups (10)** 1.1 Review of permutation groups, symmetric group, internal and external Direct products, Sylow's theorems and its application (no need to prove theorems). 1.2 Normal and subnormal series of groups 1.3 Ascending central series and derived series of groups 1.4 Nilpotent and solvable groups

• Review the fundamental concepts of rings including ideals, quotient ring of different integral domains, quotient field of integral domain and ring of polynomials • Define the ring of formal power series and prove the basic properties of that ring. • State and prove the division algorithm of polynomials over UFD. • Define primitive, monic and cyclotomic polynomials with examples and prove the Gauss lemma for the polynomial over UFD • State and prove Eisenstein's criterion of testing irreducibility of polynomial over UFD and apply this criterion to test the irreducibility of polynomials	**Unit II: Ring Theory (10)** 2.1 Review of the fundamental concepts of ideals, quotient ring, ring homomorphisms, integral domain, principal ideal domain, Euclidean domain, unique factorization domain (UFD), the field of fraction, and the ring of polynomials2.2 Ring of formal power series 2.3 Factorization in polynomial ring 2.4 Eisenstein's criterion of testing irreducibility of polynomial
• Define field extensions with examples and prove the various properties of field extensions • Define splitting field with examples and find the splitting field of polynomials • State and prove the existence and uniqueness theorems of the splitting field of polynomials • Explain the algebraic closure and normality of field extension • Define minimal polynomial and explain the simple and multiple roots of polynomials over the field • Analyze the structure of field and field extensions • Discuss Galois group and Galois extensions of field • State and prove the fundamental theorem of Galois Theory • State and prove the fundamental theorem of algebra	**Unit III: Field Extensions and Fundamental Theorems (14)** 3.1 Review of field extensions (algebraic, transcendental, normal, separable and inseparable extensions), splitting fields, algebraic closure of fields and normality 3.2 Roots of polynomials, adjunction of roots and minimal polynomial 3.3 Galois group of fields and Galois extensions of fields 3.4 Fundamental theorem of Galois theory 3.5 Fundamental theorem of algebra
• Define and determine the Galois group of polynomials over the field • Determine the fixed field of Galois Group of polynomial	**Unit IV: Galois Group of Polynomial and Solvability of Polynomial Equations (14)**

• Find the discriminant of quadratic, cubic and quartic polynomial equations • Define and find the resolvent cubic of the quartic polynomial equation • Define cyclic and cyclotomic extensions of field and prove the properties of those extensions • Define the radical extension of field and prove the properties of radical extensions • State and prove the Galois criterion of solvability of the polynomial equation by the radical method	4.1 Galois group of polynomials 4.2 Cyclic extension 4.3 Cyclotomic extension 4.4 Radical extensions 4.5 Solvability of the general polynomial equation of degree *n*

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

4. Instructional Techniques

This course is theoretical in nature and thus the teacher-centered instructional techniques will be dominant in the teaching learning process. However, the instructional techniques for this course are divided into two groups. The first group consists of general instructional techniques applicable to most of the contents. The second group consists of the specific instructional techniques applicable to the specific contents of each unit. The general and specific techniques are described below.

4.1 General Techniques

The following instructional techniques will be adopted according to the need and nature of the lesson.

- Lecture with illustrations
- Discussion
- Question-answer
- Group work and individual work

4.2 Specific Instructional Techniques

Unit	Activities and Instructional Techniques
I	• Individual work and group work presentation to explain and find the relation between Sylow's theorems, Sylows *p* -subgroups and *p*-subgroups • Group work discussion and then presentation on classifying finite groups of small order • Individual work and group work to explore some solvable and nilpotent groups • Individual assignment to find the series stated in this unit and presentation • Group tasks to solve the problems of exercise and discussion of the related theorem to solve these problems

II	• Inquiry and question answer • Individual work and group work presentation • Paper presentation • Problem solving exercise
III	• Individual work and group work presentation • Discussion for the solution of the related problems • Connecting examples with theorems and finding related examples • Group presentation to focus on the fundamental theorems and their importance
IV	• Individual work and group work presentation • Individual work to demonstrate the radical extension and solvability of polynomial equations • Discussion for the solution of related problems • Discussion to connect examples with theorems

5. Evaluation

5.1 Internal Evaluation (40%)

The internal evaluation will be conducted by the course teacher based on the 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%)

The Examination Division of the Dean's Office, Faculty of Education will conduct the final examination at the end of the semester.

• Objective questions (multiple choice) (10×1)	10 marks
• Short answer questions 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

Bhattacharya, P. B, Jain, S.K and Nagpaul, S.R (2007*). Basic abstract algebra*. India : Cambridge University Press.(Units I-IV)

Dummit, D. S and Foote, R. M (2008). *Abstract algebra.* India: Wiley East House.(Units I-IV)

Hungerford, T.W (1974). *Algebra*. New York: New York Inc. Springer Verlag. Units I-IV)

6.2. References

Bhattarai, B. N (2011). *Introduction of group theory*. Kathmandu: Subhakamana Prakashan.

Bhattarai, B. N. (2011). *Introduction of rings and modules.* Kathmandu: Subhakamana Prakashan.

Cohn, P. M (1977). *Algebra Vol I and II*. New York: John Wiley.

Fraleigh, J. B (1984*). A first course in abstract algebra*. New Delhi: Narosa Publishing House.

Gopal, K.N.S (1986). *University algebra.* India: Wiley Eastern Limited.

Herstein, I.N (2006). *Topic in tlgebra*. India: John Wiley and Sons.

Maharjan ,H. B (2007*). Group theory*. Kathmandu: Bhunipuran Prakasan.

Maharjan, H. B (2008). *Rings and modules*. Kathmandu: Bhunipuran Prakasan.

Math Ed. 517: Mathematical Statistics Nature of the course: Theoretical

Course number: Math Ed. 517 **Credit hours:3**

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

Semester: First

1. Course Introduction

This course is about how statistics most accurately communicates/describes the nature of attitude, achievements and events and also explains how it condenses opinions, performances and comparisons through summary numbers that can be understood at a glance through charts and graphs. Through tests of significance using the theory of probability, it also explains how statistics draws inferences, makes decisions and forms opinions about the events in day-to-day life. It covers the major contents like sampling techniques, hypothesis testing and correlation and regression .

2.General Objectives

The general objectives of this course are as follows.

- To enable the students to explain multinomial, power series, and logistic distribution and find the mixture of distributions,
- To familiarize the students with multivariate, discrete and continuous probability distributions, their mean variances and moment generating functions,
- To deal with the moments of linear combination of random variables and the Central-Limit theorem,
- To familiarize the students with various methods of sampling,
- To familiarize with the meaning and types of sampling distributions with and without replacement from normal population, and apply them,
- To acquaint the students with the importance of point estimation and interval estimation,
- To deal with different types of parametric and non-parametric tests of hypothesis and carry out tests of hypotheses;
- To acquaint the students with the importance of ANOVA and its application, and
- To enable them to explain the concepts of partial and multiple correlation and regression.

3. Specific Objectives and Contents

Objectives	Contents
• Identify the basic concepts and principles of probability • Define multinomial, logistic and power series distributions • Calculate the mean and variance of the above distributions	**Unit I: Probability Distributions (3)** **1.1 Review of probability distribution** 1.1.1 Multinomial distribution

	1.1.2 Power series distribution 1.1.3 Logistic distribution
• Describe multivariate probability • Define and calculate the mean and variance of joint probability distributions ,conditional distributions and independent random variables • Calculate the mean and variance of above distributions using the moment generating function and product moments	**Unit II: Joint Probability Distributions (6)** 2.1. Multivariate probability 2.1.1 Joint probability distribution 2.1.2 Marginal probability distributions 2.1.3 Conditional probability distributions 2.1.4 Independent random variables 2.2. Mean and variance of joint probability function 2.2.1 Covariance 2.2.2. Mean and variance of the linear combinations of random variables, 2.3. Conditional expectation and variance 2.3.1Moments and Mgf and its properties 2.3.2Product moment
• Define, explain and apply binomial, hypergeometric and Poisson distributions • Prove the binomial distribution approaches of the Poisson distribution • Derive the recursion formula of binomial, hypergeometric and Poisson distribution • Define, explain and apply uniform density, gamma, beta and exponential and normal distribution • Find the moment generating function of each of the above distributions • Find the mean and variance of each distribution using the moment-generating function	**Unit III: Discrete and Continuous Probability Distributions (8)** 3.1 Discrete probability distribution 3.1.1 Uniform distribution 3.1.2 Binomial mean and variance, recursion 3.1.3 Hyper-geometric distribution: mean, variance, recursion 3.1.4 Poisson distribution: mean, variance, recursion 3.2 Continuous distribution through Mgf 3.2.1 Uniform density 3.2.2 Gamma, beta , exponential and chi-square distributions: Mean and variance 3.2.3 Normal distribution: mean and variance 3.2.4 Normal approximation of binomial and its derivation
• Describe the steps in a sample survey, and design of questionnaires • Explain the methods of probability and non-probability sampling and determine sample size	**Unit IV: Sampling and Sampling Distributions(7)** 4.1 Principles of the sampling theory 4.2 Census, sample survey and questionnaires 4.3 Errors in data collection

• Derive the sampling distribution of mean • Derive the central limit theorem and its variance • Derive the chi-square, t-distribution, and F-distribution and their properties	4.4 Basic methods of sampling 4.4.1 Probability sample 4.4.2 Non-probability sample 4.5 Estimation of sample size 4.6 Meaning of sampling distribution 4.7 Sampling distribution of mean 4.8 Central limit theorem and its derivation 4.9 Sampling distribution of the difference of means 4.10 Sampling distribution of proportion, difference of proportion, variance, ratio of variance 4.11 Student t- distribution and derivation 4.12 F – distributions and derivation 4.13 Chi-square distribution and derivation.
• Differentiate between point estimation and interval estimation • State the properties of point estimation • Formulate and test a statistical hypothesis • Perform the appropriate test and make decision • Explain and use the one-way and two- way analyses of variance to test relevant hypotheses • Perform ANCOVA and make decision • Use the SPSS Software for testing hypothesis	**Unit V: Estimation of Parameters and Hypothesis Testing (14)** 5.1 Definition of estimation 5.1.1Types and properties of estimators 5.1.2 Confidence interval 5.2 Estimation and hypothesis testing 5.2.1 Means, difference between means (and ?) 5.2.2 Proportion, difference between proportion (and?) 5.2.3 Variance, ratio of two variances 5.2.4 Correlation coefficient and regression coefficients 5.2.5 Chi-square test for the goodness of fit, test for independence 5.2.6 One-way and two way analyses of variance 5.3 Analysis of covariance 5.4 SPSS application for hypothesis testing.
• Differentiate between parametric and non-parametric test • Explain and use various types of non-parametric tests to test the relevant hypothesis	**Unit VI: Non- Parametric Tests (5)** 6.1 Introduction to non-parametric test 6.1.1 Difference between parametric and non-parametric tests 6.1.2Types of non-parametric test: Sign test, U-Test, H-test, Friedman test, and Run test.

• Explain the meaning of multiple linear regression and derive the equation to regression plane • Determine multiple correlation and partial correlation • Find the test of the significance of regression coefficients and apply it to multiple regressions	**Unit VII: Partial and Multiple Correlation and Regression (5)** 7.1 Regression 7.1.1Multiple linear regression 7.1.2 Equation to regression plane 7.2 Correlation 7.2.1 Multiple correlation and partial correlation 7.2.2 Test of the significance of regression coefficients, model appraisal, and applications to multiple regressions 7.2.3Interpretation of multiple Regression and correlation.

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

2. 4. Instructional Techniques

The instructor will select the method/ 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 needed. The general and specific instructional techniques are described below.

3.

4. 4.1 General Techniques

5. The following general instructional techniques will be adopted according to the need and nature of the lesson:
    - Lecture with illustrations
    - Discussion
    - Question-answer
    - Collaborative learning

6. 4.2 Specific Instructional Techniques

Units	Activities and Instructional Techniques
I	• Discussion about the situation where multinomial, power series and logistic distribution are applicable. • Exercise on the use probability techniques to solve related problems
II	• Discussion and students' participation • Exercise by using probability techniques to find multivariate distributions.

III	• Group discussion • Individual presentation to engage themselves in internet browsing for searching mean, variance and moment generating functions of different types of probability distributions
IV	• Student engagement in internet browsing for different types of sampling and techniques of sampling distributions
V	• Group and individual presentation applying SPSS • Student participation in discussion
VI	• Exercise on the fitting of data into the computer and determining the appropriate tests using the non-parametric approach
VII	• Generate regression and correlation coefficients from the previous data and use them to estimate and establish the test of significance of regression and correlation coefficients

7.

8. 5 Evaluation

9. 5.1 Internal Evaluation (40%)

10. The internal evaluation will be conducted by the course teacher based on the following activities.

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

11. Total 40 marks

12.

13. 5.2 External Examination (60%)

14. The Examination Division of the Dean's Office, Faculty of Education will conduct the final examination at the end of the semester. The number of questions and marks allocated to different types of questions will be as follows.

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

15. Total 60 points

16.

17. 6. Recommended Books and References

18. 6.1 Recommended Books

19. Freund, J. E. (2012).*Mathematical statistics*, New Delhi: Prentice Hall of India (Units II-VI).

20. Pandit, R. P.& Bhattarai, L. N. (2016). *Mathematical statistics:* Kathmandu: Indira Pandit (Units II-VII).

21. Upadhyay, H. P. &Dhakal, B. P.(2069).*Mathematical statistics.* Kathmandu: Sunlight Publication(Units II-VII).

22. Bhat, B. R. (1999): *Modern probability theory: An introductory textbook*, (3rd ed.),New Delhi: New Age International (P) Limited, Publishers (Unit I)

23. 6.2. References

24. Garret, H. E. and Woodworth, R. S. (2000).*Statistics in Psychology and Education*. New York: Longman, Green and Co. Inc.
25. Gupta, S. C. & Kapoor, V. K.(2015). *Fundamentals of Mathematical statistics*. New Delhi: Sultan Chand & Sons.
26. Haslett, H. T (1983). *Statistics made simple*, Heinemann: London
27. Mendenhall, W, Schaeffer, R. L. and Wackerly, D. D. (1987). Mathematical Statistics with Applications. Boston: PWS Publishers.
28. Wallpole, R. (1979): *Introduction to statistics*, Delhi: Macmillan India

Johnson, R. A. and Wichen, D. W. (2006): *Applied multivariate statistical analysis*, Prentice Hall of India Design of Experiment.

Math Ed. 518: History of Mathematics **Nature of the course: Theoretical**
Course no. : Math Ed. 518 **Credit hours: 3**
Level: M.Ed. **Teaching hours: 48**
Semester: First

1. Course Introduction

This course is designed for the comprehensive study of the development of mathematics which helps the students to understand and demonstrate their knowledge of the historical facts of the development of mathematics and mathematical thoughts. This course also focuses on the teaching-learning activities related to the developmental perspectives of mathematics and mathematical culture and explores the history of different papyrus, in different archives and in different monuments/artifacts found in the Hindu, Egyptian, Babylonian, Greek, Mayan, Roman, Chinese and other civilizations.

2. General Objectives

The general objectives of this course are as follows.

- To acquaint the students with the problems of mathematics of antiquity,
- To familiarize them with the early systems of development of numerals and number systems,
- To investigate how mathematics has developed over the centuries,
- To explain early mathematics as practiced by people in different civilizations,
- To address the contemporary issues in mathematics and the history of the philosophy of mathematics,
- To empower the students for addressing the development of modern mathematics from the middle ages to the calculus and other discoveries to recent numbers theory,
- To enable them to establish the relationship between modern mathematics and science
- To examine the contributions of mathematicians to the development of mathematics. and
- To familiarize the students with the practices and developments of South Asian mathematics (Nepal and India).

3. Specific Objectives and Contents

Specific Objectives	**Contents**
• List and describe the problems of mathematics of antiquity • List the characteristic components of number sense and illustrate the skills needed to count • Illustrate the symbolization of numbers and numerals with examples • Explain the systems of numbers and numerals (Kharosty, Brahmi, Lichhavi, Hindu-Arabic, Chinese and Greek).	**Unit-I: The Origin and Pre-history of Mathematics (7)** 1.1 Mathematics of antiquity (pre-historic): Classical problems of mathematics of antiquity 1.2 Primitive counting: Sense of number 1.3 Numbers, numerals and their symbols 1.4 Characteristic components of number sense (meaning, relationship, magnitude operations and referents) and skills need to count (rank, association, succession). 1.5 System of numbers and numerals (Kharosty, Brahmi, Lichhavi, Hindu Arabic, Chinese and Greek)

• Explain ancient Egyptian mathematics: Arithmetic, geometry, pure and practical • Describe Babylonian mathematics: Arithmetic, geometry, astronomy • Point out the situations of development of mathematics in the Dark age in Europe • Elucidate the development of Greek mathematics • Explain the Zeno's paradox and concept of infinitesimal • Explain the contribution of Greek mathematics philosophers: Thales and Pythagoras. • Describe the geometry developed by Hippocrates, Euclid and Tartaglia • Describe the contributions of Archimedes, Apollonius' Diophantus and Hypatiain to the development of mathematics	**Unit-II: Early Western Mathematics (8)** 2.1 Ancient Egyptian mathematics (arithmetic, geometry, pure and practical) 2.2 Babylonian mathematics (arithmetic, geometry, astronomy) 2.3 Mathematics in the Dark age (work of Boethius, Bede, Alcuin and Gerbert) 2.4 Greek mathematic philosophers: Zeno of Elea, Thales, Pythagoras, Hippocrates, Euclid, and Tartaglia 2.5 Mathematics developed by Archimedes, Apollonius, Diophantus and Hypatia
• Describe the history of mathematics developed by Aryabhata, Brahmagupta, Varahmihira, Śripati. • Explain briefly Sulbasutra (Baudhayana Sulba Sutra), Siddhanta, Samhita, Lagadha and Vedanga Jyoutisha • Delineate the concept of review and excavation of mathematics manuscript-Bakshali manuscripts. • Explain the early Chinese documents on arithmetical classic, nine chapters and Liu Hui • Describe the development of magic square and its uses	**Unit-III: Early Eastern Mathematics (8)** 3.1 Brief introduction to Hindu mathematicians and their contributions to'l[pk mathematics developments: Aryabhata I and Aryabhata II, Brahmagupta, Varahmihira and Śripati. 3.2 Development of Sulba sutra (Baudhayana Sulba sutras), Siddhanta, Samhita, Lagadha and Vedanga Jyoutisha 3.3 Concept of review of mathematics manuscript-Bakshali manuscripts 3.4 Chinese early documents (arithmetical classic, nine chapters and Liu Hui) and magic squares
• Describe early, high and later mediaeval age's mathematics in Europe. • Describe the development of mathematics due to Arabian mathematicians- Alberuni, Al-Khwarizmi, Abu Kamil, and Omar Khayyam • Examine the mathematics developed by Bhaskaracharya II. • Explain the mathematics developments in Renaissance: Algebra (second degree and cubic	**Unit-IV: Medieval Mathematics** **(Early, High and Later mediaeval)(6)** 4.1 Introduction to the three phases of medieval period's European mathematics 4.2 Mathematics developed by Alberuni, Al-Khwarizmi, Abu Kamil and Omar Khayyam 4.3 Mathematics developed by Bhaskaracharya II 4.4 Mathematics in renaissance: Algebra,

equation, indices), trigonometric identities, logarithm and Projective geometry • State and discuss the development and importance of Fibonacci sequence $F_n = F_{n-2} + F_{n-1}$ for n ≥3 with stating $F_1 = F_2 = 1$	trigonometry, logarithm (Napier)and projective geometry 4.5 Development of Fibonacci sequence and its importance
• Identify the concept of the development of groups, rings, fields, and vector space, algebraic geometry, differential geometry, non-Euclidean geometry and topology • Discuss the dawn of modern mathematics • Explain the historical development of calculus, mean value theorems of differential calculus and fundamental theorems of integral calculus • Discuss the development of differential equations • Describe the geometry developed by Format, Desargues and Pascal • Give introduction to modern mathematical sciences developed by Galileo, Kepler, and Rene Descartes • Explain the contemporary mathematics: Analysis, Algebra, Geometry and Probability • Argue the history of philosophy of mathematics (formalism, intuitionism, logicism) • Evaluate the latest mathematical developments of Karl Weierstrass, George Cantor, and Ramanujan	• **Unit-V: Modern Mathematics (12)** • Review of the concept of the development of groups, rings, fields, and vector space, algebraic geometry, differential geometry, Euclidean and non-Euclidean geometry and topology • Concept of the dawn of modern mathematics • Historical development of calculus: Concept of derivative (Newton/Leibnitz), concept of Mean Value Theorem for differential calculus, concept of the fundamental theorems of integral calculus and differential equation • Development of analytic geometry (developed by Fermat**)** • Geometry developed by Desargues and Pascal • Modern mathematical Sciences: Galileo, Kepler, René *Descartes* • Contemporary mathematics: analysis, algebra, geometry, probability • History of the philosophy of mathematics.(formalism, intuitionism, logicism) • Latest mathematicians' mathematics developments: Karl Weierstrass, Maria Agnesi, George Cantor, Ramanujan
• Acquire the knowledge of practices of mathematics in Nepal and India • Explore the ethno-mathematical and indigenous mathematical practices in Nepal • Explore the historical timeline of the practices of mathematics in Nepal • Evaluate the contribution of Nepali mathematicians to the development of mathematics (Halayudha Bhatt, Laxmipati Pande, Gopal Pande, Naya	**Unit-VI: Review of South Asian Mathematics (7)** 6.1 Brief review of south Asian sub continental mathematics (mathematics practices in Nepal and India) 6.2 Introduction and review of ethno mathematics based on Nepali culture 6.3 Review of historical timeline of mathematics practices in Nepal 6.4 Mathematics developed by Nepali

Raj Pant and Chandrakala Devi Dhananjaya.) • Discuss the development of mathematical institutions (NMS, MEC, NMC, WoNiMS, MST and their academic activities for the development of mathematics	mathematicians: Halayudha Bhatt, Laxmipati Pande, Gopal Pande, Naya Raj Pant, Chandrakala Devi Dhananjaya 6.5 Mathematical institutions of Nepal (NMS, MEC, NMC, WoNiMS and MST)

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

4. Instructional Techniques: The instructional techniques can vary as according to the nature of the contents. A few general techniques and specific instructional techniques are given below.

4.1 General Techniques

- Lecture with illustration
- Discussion/interaction
- Demonstration/presentation
- Field trip (If possible).
- Project work and home assignments.

4.2 Specific Instructional Techniques

Units	Activities and Instructional Techniques
I	• Individual and group discussion on the early development of numbers and numerals in different civilizations • Report writing on antiquity of mathematics • Consultation of library to prepare a report on classical mathematics developments in Nepal • Group and individual assignments • Presentation of the symbolization of numbers and numerals: Brahmi, Lichchhavi and Hindu Arabic.
II	• Group discussion on the development of Western mathematics around the Mediterranean sea and Roman empire • Report writing and presentation on Egyptian, Babylonian, Greek and Hindu mathematics and presentation • Group discussion on the development of mathematics by Zeno of Elea, Diophantus, Pappus, Hypatia, Archimedes, Apollonius, Thales, Pythagoras, Hippocrates, Euclid, etc.
III	• Group discussion for the information of the earliest concept of Baudhayana Sulba Sutra, mathematics manuscript like Bakshali manuscripts, Siddhanta and Samhita • Individual and group assignment for the collection of manuscripts and the documents of classical mathematics.
IV	• Group discussion on the development of mathematics at the early medieval ages, high mediaeval ages, and later medieval ages • Discussion on the meaning of renaissance with algebra, trigonometry,

	logarithm and projective geometry
V	• Group discussion on the development of mathematics from the 16^{th} to the 20^{th} • Preparation of a report on the development of mathematics from the 16^{th}-20^{th} centuries. • Discussion on the mean value theorems of differential calculus, differential equations, groups, rings, fields, algebra, analytic and differential geometry, Euclidean and non- Euclidean geometry, topology, etc. • Brows net to search recent development of mathematics
VI	• Individual and group reports of sources of historical development of mathematics in the south Asian sub-continent • Individual and group task for searching and investigating the Nepali mathematicians and indigenous mathematics, their mathematical creations, books, articles, reviews, etc. • Individual and group discussion on the activities of Nepali mathematicians/organizations from antiquity to the 21st century's first decades.

5. Evaluation

5.1 Internal Evaluation (40%)

The internal evaluation will be conducted by the course teacher based on the 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 Evaluation (60%)

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

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

Total **60 marks**

6. Recommended Books and References

6.1 Recommended books

Boyer, C.B. (1968). *A history of mathematics.* New York: John Willy and Sons Inc. (Units II and III)

Burton (2007). *The history of mathematics*: *An introduction*, (6th Edition), McGraw−Hill Company. (Units I and V)

Cooke, R. (1997). *The history of mathematics: A brief course.* New York: John Wiley and Sons, Inc. (Units IV and VI)