

YEAR 1

SEMESTER 1

Four-Year B.Ed. Course Manual

LEARNING, TEACHING AND APPLYING NUMBER
AND ALGEBRA





The Government of Ghana



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FOREWORD

These Initial Teacher Education course manuals were developed by a team consisting of members from Colleges of Education and four universities namely the University of Ghana, Kwame Nkrumah University of Science and Technology, University of Education, Winneba, and University for Development Studies. This team was originally constituted by the National Council for Tertiary Education (now the Ghana Tertiary Education Commission) in 2019 to support the delivery of the new B.Ed. curriculum with assistance from T-TEL and UK Aid. The revision, finalization and printing of these manuals took place in 2021 with support from T-TEL and Mastercard Foundation.

The course manuals have been produced for use as general guides for the delivery of the new four-year B.Ed. curriculum in Colleges of Education in collaboration with their affiliated universities. They are designed to support student teachers, tutors, and lecturers in delivering a complete B.Ed. course for training student teachers which meets the requirements of the National Teachers' Standards, enabling them to teach effectively in basic schools.

The first section of the manuals is focused on the course information and vision for the B.Ed. curriculum. The second section presents the course details, goal for the subject or learning area, course description, key contextual factors as well as core and transferable skills and cross-cutting issues, including equity and inclusion. The third section is a list of course learning outcomes and their related learning indicators. The fourth section presents the course content which is broken down into units for each week, the topic and sub-strands and their related teaching and learning activities to achieve the learning outcomes and the teaching and learning strategies. This is followed by course assessment components in section five. Each manual contains a list of required reading and references as well as teaching and learning resources. The final section presents course related professional development for tutors and lecturers to be able to use each section of the manual.

Field instructions to guide Supported Teaching in School are integrated into the course manuals to provide the student teacher with guidance in developing teaching throughout the entire period of study to be able to meet the requirements of the National Teachers' Standards (NTS) and the National Teacher Education Curriculum Framework (NTECF). To ensure maximum benefit the course manuals should be used in addition to other resources such as the NTS, NTECF, National Teacher Education & Assessment Policy and the National Teacher Education Gender Equality and Social Inclusion (GESI) Strategy and Action Plan.. This will help to ensure that student teachers' learning is integrated within the wider teacher education policy framework.

Professor Mohammed Salifu
Director General,
Ghana Tertiary Education Commission

ACKNOWLEDGEMENTS

The course manuals were developed through the collaborative efforts of a team of individuals from Colleges of Education, University of Ghana, Kwame Nkrumah University of Science and Technology, University of Education, Winneba, and University for Development Studies. They were produced in association with the Ghana Tertiary Education Commission of the Ministry of Education, Ghana.

A participatory team approach was used to produce this set of resources for tutors/lecturers, mentors, and student teachers. We are grateful to the specialists who contributed their knowledge and expertise.

Special thanks to Professor Jophus Anamuah-Mensah- T-TEL Key Advisor, Dr. Eric Daniel Ananga-T-TEL Key Advisor for Curriculum reform and Beatrice Noble-Rogers who provided key editorial, review and content input and facilitated the process of drafting and finalising the course manual.

Patricia Appiah-Boateng and Gameli Samuel Hahomene, served as typesetting and formatting coordinators and designed and produced the illustrations, tables, and other graphics which appear in the pages. They spent time and effort designing and redesigning the graphic layout and producing the camera-ready copy resulting in a set of materials that are easy to use, read, and reference.

Thanks also goes to all T-Tel staff members who worked to support production of these course manuals, particularly Beryl Opong-Agyei and Gideon Okai. Their frankness and co-operative attitude complimented the team approach used to produce this manual.

We are indebted to the Ministry of Education and the Ghana Tertiary Education Commission (GTEC) for the general support and specific helpful advice provided during production of the course manuals. Recognition and thanks must go to Chief Technical Advisor for T-TEL and Policy Advisor to the National Education Reform Secretariat, Akwasi Addae-Boahene, Prof. Mohammed Salifu, the Director General of GTEC and Mr. Jerry Sarfo the coordinator for the colleges of education, who in diverse ways supported during the course manual writing workshops.

In addition to all the staff who participated visibly in the development of these materials we would like to acknowledge all those people from the many colleges of education and universities in which we have worked who have, directly or indirectly, shared their views on the curriculum with us.

Core Writing Team

Prof. Ruby Hanson	Science	Dr. Winston Abroampa	Pedagogy
Dr. Vincent Anum Ankamah-Lomotey		Prof. Samuel Kweku Hayford	
Mr. Jonathan Ayelsoma Samari		Prof. Imoro Braimah	
Prof. Victor Antwi		Prof. Anthony Donkor	
Prof Reuben Tamakloe		Dr. Maxwell Kwesi Nyatsikor	
Dr. Ernest I.D. Ngman-Wara		Mr. Kweku Esia-Donkoh	
Prof. Darmian K. Mereku	Mathematics	Dr. Paul Kwadwo Addo	Literacy and Language and Communication Studies
Prof. Christopher A. Okpoti		Dr. Yaw Nyadu Offei	
Mr. Ahmed K. Amihere		Prof. Charles Owu-Ewie	
Mr. Zakaria A. Sadiq		Mr. Robert Quansah	
Prof. Reginald Ocansey	Physical Education and Music and Dance	Mr. Kwasi Adomako	
Prof. Cosmas W.K. Mereku		Dr. Yvonne A.A. Ollennu	
Dr. Mawuyram Quessie Adjahoe		Mr. Richard Bampoh Addo	
Dr. Harriet Naki Amui		Dr. Salome Praise Otami	
Dr. Emmanuel Osei Sarpong	ITC	Dr. Jemima Anderson	
Dr. Ephrem K. Kwaa-Aidoo		Dr. Sarah Emma Eshun	
Mr. Victor King Anyanful		Dr. Mrs. Cecilia Esinam E. Agbeh	
		Mr. Ibrahim Osmanu	
		Mr. Felix A. Odonkor	French

INTRODUCTION TO COURSE MANUALS

Welcome to this B.Ed. Course manual.

Following the accreditation of the B.Ed. by the National Accreditation Board with its recognition as a world class teacher education curriculum, the decision was taken to support effective implementation through the development of course manuals. The course manuals provide tutors and lecturers with the materials necessary to support teaching each of the B.Ed. Courses. The manuals adhere directly to, and emphasise, the principles and standards set out in the NTS, NTECF and in the B.Ed. and will help ensure operationalising the Government's Teacher Education Reform Policy.

The manuals serve the following purposes:

- They are the key educational agreements between the training institution and the student teachers. In this way student teachers know what the expectations are for them and for the training they will receive.
- They lay out the course outcomes, content, strategies and assessment, thereby providing direction to and consistency in training and B.Ed. implementation among tutors across the country.
- They are explicit documents that provide other institutions with information on which to base transfer/ articulation decisions.

Specifically, they also:

- Support coherent lesson planning and teaching which will enable student teachers to achieve the NTS and become good teachers who ensure all pupils' learning whilst offering tutors the flexibility for adaptation for local needs and contexts.
- Provide a lesson by lesson overview of the course, building on and developing the material in the course specifications.
- Inform tutors, student teachers and others working with student teachers about:
 1. What is to be taught and why.
 2. How it can be taught.
 3. How it should be assessed.
- Provide opportunities for student teachers to develop and apply knowledge during supported teaching in school, creating a strong bond between learning in school and in the training institution.
- Reflect the stage of student teacher development, set out in the model for progress across the four years of the B.Ed.
- Can be used as self-study tools by student teachers.
- Ensure that all information necessary to inform teacher training is in one place (serves as reference document).
- The manuals are the basis of the CoEs and university professional development sessions to ensure Principals, Tutors, lecturers and Heads of Department are fully familiar with the details of: courses, outcomes, content, approaches, assessments and lessons.

Who are course manuals for:

- College of Education Tutors
- Teacher Education University Lecturers
- Student Teachers
- Mentors and Lead Mentors
- All those with an interest in teacher education.

USING THIS MANUAL

Writers of the manuals engaged widely with colleagues in each subject area at each stage of development. Besides, writers envisaged themselves in varied contexts as they wrote, to suggest methodologies and strategies for teaching the topics which would ensure student teachers are enabled to achieve the learning outcomes. In view of our commitment to creativity, problem solving, collaboration and to lifelong learning, we expect that individual tutors will “own” their manuals and become user-developers. Lessons in the manuals will be topics for weekly PD meetings where tutors/lecturers will situate the lessons in the contexts of their colleges and their student teachers, in order to maximize the benefits.

It is also expected that tutors will model the best pedagogic practices for student teachers. Key among such practices is the communication of the importance of having a personal teaching philosophy. We expect that tutors and lecturers will explicitly communicate their personal teaching philosophies to their student teachers during the first meeting of every course. In preparation for this, we suggest you set out your personal teaching philosophy and how it will be demonstrated in your teaching using, or adapting, the sample sentence introductions below.

My teaching philosophy is

In view of this philosophy, I will facilitate this course by/through

LEARNING, TEACHING AND APPLYING NUMBER AND ALGEBRA

COURSE DETAILS							
Course name	LEARNING, TEACHING AND APPLYING NUMBER AND ALGEBRA						
Pre-requisite	Senior High School Mathematics						
Course Level	100	Semester	1	Course Code		Credit Value	3 Hours

THE VISION FOR THE NEW FOUR-YEAR B.Ed. CURRICULUM

To transform initial teacher education and train highly qualified, motivated new teachers who are effective, engaging and fully prepared to teach the basic school curriculum and so improve the learning outcomes and life chances of all learners they teach as set out in the National Teachers' Standards. In doing this to instil in new teachers the Nation's core values of honesty, integrity, creativity and responsible citizenship and to achieve inclusive, equitable, high quality education for all learners.

GOAL FOR THE SUBJECT OR LEARNING AREA

The programme intends to prepare student teachers to develop competence and acquire requisite knowledge, skills and attitudes that will enable them to facilitate teaching and learning of mathematics as well as demonstrate commitment to equity and inclusivity in their work to apply these in real life.

COURSE DESCRIPTION

The course will commence with an audit of subject knowledge to establish support for addressing student teachers' learning needs, perceptions and misconceptions in Number and Algebra. This will be done through practical interactive approaches to review student teachers' previous knowledge and experiences within the scope of Number and Algebra. The development of knowledge, skills and generalization of fundamental concepts of Number and Algebra can lead to a student teacher's ability to apply these areas of mathematics. Algebra is about generalized mathematical thinking arising from observing and applying patterns in creating relationships. Such patterning, generalisation and algebraic reasoning will serve as a means to develop deductive and inductive reasoning in student teachers.

Topics in Number and Algebra include; recognizing and developing patterns, using numbers and number operations, properties of numbers, concept of sets, number bases and modulo arithmetic, and algebraic expressions. In addition, student teachers will explore operations on algebraic expressions, and to apply mathematical properties to algebraic equations and functions as found in the basic school mathematics curriculum (See B4. 2.1.2. Translate among different representations of a pattern, such as a table, a chart or concrete material).

KEY CONTEXTUAL FACTORS

1. Teachers often tend to present mathematical concepts, work several examples on the board, and then assign exercises in which learners practise whatever has just been presented, that is an approach that has been widely criticised.
2. The current educational system pays much more attention to preparing students for examinations, at the expense of helping them to develop core skills such as critical thinking, creativity, digital literacy, reflection and evaluation they will need to participate fully in their professional lives. In mathematics, the rote learning for examinations can act as a barrier to students' developing the skills and understanding required to apply mathematics in every-day life.

3. Previous experiences of learners indicate lack of connection between Number and Algebra.
4. Some teachers may have inadequate pedagogical knowledge in teaching Number and Algebra, integration of subject specific pedagogy for mathematics can address this in Initial Teacher Education (ITE).
5. The mode of assessment and assessment items in examination do not promote the use of sound methodology of teaching and learning Number and Algebra.
6. Lack of and / or effective use of relevant and appropriate teaching and learning resources in the teaching and learning of Number and Algebra.
7. There are sometimes gender bias issues associated with girls and mathematics ability.

CORE AND TRANSFERABLE SKILLS AND CROSS CUTTING ISSUES, INCLUDING EQUITY AND INCLUSION

- **Core and transferable skills include:** Critical thinking, problem solving, social skills, creative thinking and communication skills, use of ICT.
- **Problem solving, critical and creative thinking:** Mathematical critical thinking is based on objective analysis of facts which will lead creative thinking and problem-solving. Problem-solving is the central focus of mathematics instructions as well as an integral component of assessment. Problem-solving techniques should therefore be consciously employed in the teaching and learning of mathematics. (CLO 1, 2).
- **Social and communication skills:** Communication is an important skill in the teaching and learning of mathematics. Presentation of classroom instructions should support student teachers to develop mathematical language, including symbols and vocabulary. There is the need to promote interaction in the mathematics classroom to enhance critical thinking and interpersonal relationship for effective learning. (CLO 1).
- **Use of ICT:** The 21st century has come with a revolution regarding the use technology tools. This has influence what and how mathematics is to be taught. There is therefore, the need to Integrate ICT in developing number and algebraic concepts in the mathematics classroom. (CLO 2).
- **Cross cutting issues include:** Assessment literacy and assessing students' progress and professional values and attitudes, reflection and classroom enquiry.
- **Cultural issues:** The multicultural nature of the Ghanaian child calls for classroom instructional and assessment strategies (including examples) that have the potential to address socio-cultural issues emerging from the teaching and learning of mathematics (CLO 4).
- **Gender issues in Mathematics:** Discuss to demystify the notion that Mathematics is male dominated subject (gender issues). (CLO 3)
- **Background of student teachers:** Since student teachers come from different backgrounds with possible different entry behaviours, abilities, conscious efforts should be made to include them in the teaching and learning situation. Engage in reflective thinking about how mathematics was taught in student-teacher's basic and high school days (CLO 4).
- **Needs of the student teachers:** Student teachers may have different needs (such as hunger, stress, sickness, financial, etc.) that are likely to affect their participation and learning in the mathematics classroom. Conscious efforts should be made to identify and address these needs and to inspire student teachers for effective transfer of knowledge.
- **Inclusivity:** Since student teachers may have different levels of physical and cognitive challenges, classroom instructional and assessment practices should consciously be designed to include all. Provide support for all learners in the mathematics classroom, irrespective of their challenges. (CLO 3).

Course Learning Outcomes	Learning Indicators
On successful completion of the course, student teachers will be able to:	
<p>1. Demonstrate deep understanding of working with key mathematical concepts in the Number and Algebra content domains in the basic school mathematics curriculum (professional values, knowledge & practice) (NTS 2b).</p>	<p>1.1 Outline and address their perception and misconceptions about concepts in Number and Algebra. 1.2 Select and use the most appropriate mathematical method(s) or heuristics (techniques) in carrying out tasks/exercises/problems in number and algebra. 1.3 Make connections between mathematical concepts in the Number and Algebra content domains and apply them in solving real-life problems. 1.4 Produce a brief report on their understanding of Number and Algebra.</p>
<p>2. Use manipulatives and other TLMs including ICT in a variety of ways in learning mathematics concepts (practical skills, digital literacy, problem solving) (NTS 3j).</p>	<p>2.1 Integrate ICT in developing number and algebraic concepts in the basic school classroom. 2.2 Use drawing tools to conduct number and algebraic investigations emphasising visualization, pattern recognitions, conjecturing, etc. 2.3 Solve mathematics problems using manipulatives and/or technology related strategies in a variety of ways. 2.4 Use adaptive TLMs to support pupils with SEN.</p>
<p>3. Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge) (NTS 2f).</p>	<p>3.1 Discuss personal perception about individuals with special needs in learning number and algebra. 3.2 Examine student teachers own misconceptions about number and algebra. 3.3 Provide support for colleagues in the mathematics classroom. 3.4 Cooperate with colleagues in carrying out mathematics tasks. 3.4 Engage in reflective thinking about how mathematics was taught in student-teacher's basic and high school days. 3.5 Discuss to demystify the notion that Mathematics is male dominated subject (gender issues).</p>
<p>4. Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains (knowledge) (NTS 2f).</p>	<p>4.1 Address Socio-cultural issues emerging from the teaching and learning of mathematics. 4.2 Reflect and show how student teachers' mathematics history influences their views of mathematics and its learning.</p>

1. Course Content

Unit	Topics	Sub-topic (if any)	Teaching and learning activity to achieve the learning outcomes
1	<p>Numbers and Numeration systems: <i>Learning, teaching and applying</i></p> <p>1 WEEKS</p>	<ol style="list-style-type: none"> Misconceptions and barriers in teaching and learning number. Development of Real number, up to Irrational. 	<ul style="list-style-type: none"> Discussion of student teachers' perception and misconceptions about concepts in Number and Algebra; student teachers to reflect on what a good teacher of mathematics is. Using various collaborative activities to address misconception and barriers in teaching and learning number and algebra. Example, using number arrays to develop algebraic concepts. Investigations and Mathematical problem-solving strategies involving numbers will be used. Using various collaborative activities including think pair, share, group work and role play that will lead to the development of the numeration system.
2	<p>Operations and Properties on Integers (number sense): <i>Learning, teaching and applying.</i></p> <p>1 WEEK</p>	<ul style="list-style-type: none"> Operations of Integers. Properties: Closure, commutative, associative, distributive, identity, inverse properties. 	<ul style="list-style-type: none"> Use of manipulative as well as the number line for the operations. Using Investigations to explore properties. Use of Mathematical problem-solving strategies. E.g. Word problems, study and discuss concepts in a given task.
3	<p>Operations and properties of rational and irrational numbers: <i>Learning, teaching and applying.</i></p> <p>1 WEEK</p>	<ul style="list-style-type: none"> Naming of fractions. Operations on common fractions, decimals number, percentages and irrational numbers. Properties of rational (including density property) and irrational numbers. Place values decimal places, approximations; significant figures including rounding off numbers and standard form. 	<ul style="list-style-type: none"> Explore misconceptions of fractions, through discussions. Use fractional models and visual aids (TLMs) and developing multiple representations for a single mathematical concept. Use the concept of square roots to establish the notion of irrational numbers. Explore number of fractions between any two given fractions through activity method. Make connections among common fractions, decimals and percentages, with degree of accuracy, using manipulatives and visual aids (TLMs). Approximate given numbers to a specified value using number lines and other TLMs.

Unit	Topics	Sub-topic (if any)	Teaching and learning activity to achieve the learning outcomes
4	Concept of Sets: <i>Learning, teaching and applying.</i> 2 WEEKS	Sets of numbers, e.g., even and odd numbers, multiples, factors, prime numbers, squares, cubes, perfect numbers. Venn diagrams (two and three set problems), word problem.	<ul style="list-style-type: none"> • Transition from set of numbers to real life groupings. • Use real life situations involving groupings with certain characteristics.
5	Algebraic expressions, equations and inequalities: <i>Learning, teaching and applying</i> 2 WEEKS	<ul style="list-style-type: none"> • Simplification, expansion and factorization. • Solving linear equations and inequalities. 	<ul style="list-style-type: none"> • Explore the meaning of variables using drill and practice. Transitioning from number to algebra. • Use models and appropriate diction to deal with misconceptions of algebraic expressions (e.g. using algebra tiles to demonstrate identities). • Apply the distributive property to expansion. • Use inverse of numbers and operation principles. • Use methods of elimination, substitution and graphical approach.
6	Everyday and commercial arithmetic: <i>Learning, teaching and applying</i> 2 WEEKS	<ul style="list-style-type: none"> • Ratio, rates, proportion, scales, percentages (taxation, discount, commissions, VAT, etc.) 	<ul style="list-style-type: none"> • Investigations and Mathematical problem-solving strategies. • Using applications to real life situation. • Mathematical discourse: Learning by talking.
7	Number bases and Modular arithmetic: <i>Learning, teaching and applying .</i> 1 WEEK	<p>Expressing numbers of different bases; binary (base two), base five, base eight, and base ten.</p> <p>Cyclic variable, concept of modular arithmetic, addition and subtraction of modular arithmetic, multiplication in modular arithmetic.</p>	<ul style="list-style-type: none"> • Use of polygonal shapes to explore number bases and modular arithmetic. • Application to real life situations through presentations. • Using models to represent place value concept with respect to different bases. • Using place value model and chart to explore different number bases.
8	Relations and Functions and algebraic graphs: <i>Learning, teaching and applying</i> 2 WEEKS	Types of Mapping/Relation, functions; domain, co-domain, range, inverse, composition and graphs.	<ul style="list-style-type: none"> • Using mathematical explorations, transitioning from number patterns to algebraic ideas.

2. Suggested Teaching and Learning Strategies

- Discussions of concepts and misconceptions,
- Investigations to arrive at generalizations,
- Problem-solving strategies,
- Collaborative activities (think-pair-share),
- Multiple representations (principle of multiple embodiment),
- Establishing connections between and among related concepts,
- Using mathematical explorations, transitioning from number patterns to algebraic ideas.

3. Course Assessment Components

Component 1: Formative assessment

Summary Assessment Method: written assignment, (Not more than 1500 words)

Student teachers write a reflective paper on how number and algebra were taught in their basic school days, compare with current practice in basic schools and with what they are learning on the B.Ed. This should include consideration of how counting in their local languages is done and how it can influence young children's learning of early number concepts. They should identify what approaches to teaching number and algebra are most effective and why they think so.

Weighting: 30%

Related CLOs: 1, 2.

NTS:

- 1a) Critically and collectively reflects to improve teaching and learning.
- 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.
- 2c) Has secure content knowledge, pedagogical knowledge and pedagogical content knowledge for the school and grade they teach in.
- 2e) Understands how children develop and learn in diverse contexts and applies this in his or her teaching.
- 2f) Takes accounts of and respects learners' cultural, linguistic, socio-economic and educational backgrounds in planning and teaching.

Component 2: Formative assessment

Summary of assessment Method: (Group and individual presentation)

Student teachers to present class assignment on using manipulatives and other TLMs, including ICT, in a variety of ways to establish Number and Algebraic concepts in the classroom, identify a range of mathematical methods or heuristics (i.e. using mental strategies, models, paper and pencil, etc.) in carrying out tasks / exercises / problems in number and algebra in the school mathematics curriculum.

Weighting: 30%

Related CLOs: 2, 3

NTS:

- 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.
- 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning
- 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)
- 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning.

Component 3: Summative assessment

Summary of assessment Method: (End of Semester Examination and/or Project)

Student teachers to solve examination questions based on Number and Algebra, problems that integrate content with using both content and pedagogical knowledge including questions demanding “how”, “discuss”, “explain”, “illustrate”, etc.

Weighing: 40%

Related CLOs:1, 2, 3

NTS:

2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.

2c) Has secure content knowledge, pedagogical knowledge and pedagogical content knowledge for the school and grade they teach in.

2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.

3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning

2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)

Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.

4. Required Reading and Reference List

Main

Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.

Additional

Backhouse, J. K., Houldsworth, S. P. T. & Horril, P. J. F. (2005). Pure mathematics 1. (Seventh edition). London Longman.

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Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers.

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Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education.

Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.

5. Teaching and Learning resources

Maths posters; Manipulatives and visual aids; Computers; Graph sheets; Set of Mathematical instruments; Paper grids; etc.

6. Course related professional development for tutors/ lecturers

See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.

LESSON 1

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Numbers and Numeration systems: Learning, teaching and applying				Lesson Duration	3 hours
Lesson description	<p>The first part of this lesson will focus on the introduction to the course manual and, perceptions of student teachers about a good mathematics teacher.</p> <p>This is an introductory lesson that seeks to audit content knowledge and experiences of student teachers to establish and address their learning needs, perceptions and misconceptions in Number and numeration system. The areas to be covered include using numbers and number operations, and properties of numbers leading to development of Real number, up to Irrational numbers.</p> <p>The lesson begins with starters or mental maths games and reinforcement games and activities. The main lesson focuses on reviewing the student teachers' conceptual understanding, computational skills and heuristics in recognising number facts and relationships quickly and accurately. Areas of number to be covered are:</p> <ul style="list-style-type: none"> • Numeration systems – hindu-arabic, roman and traditional Ghanaian counting systems. • Skip count forwards and backwards in 2s, 5s and 100s up to 1000; and skip count forwards and backwards by 5000s, 10,000 and 100,000 up to 1,000,000; write numbers in words and numerals up to 1,000,000,000 and even above. • Solve examination questions based on number and algebra. Student teachers will be expected to solve problems that integrate content with pedagogy. This includes questions demanding "how", "discuss", "explain", "illustrate", etc. (Nts 2b, 2f; ntecf, 38). 					
Previous student teacher knowledge, prior learning (assumed)	Student-teachers have learnt numeration system at the JHS and SHS levels and can outline the various number systems.					
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, misconceptions about number and numeration system.					
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study	E-learning opportunities √
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	<p>Face-to-face and e-learning opportunities:</p> <ul style="list-style-type: none"> • The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. • The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. 					

<p>Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.</p>	<p>The purpose of the lesson is to:</p> <ul style="list-style-type: none"> • Audit content knowledge and experiences of student teachers to establish and address their learning needs, perceptions and misconceptions in number and numeration system. • Develop student teachers' understanding of properties of numbers leading to development of real number, up to irrational numbers.
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<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	<p>Learning Outcomes: The student teacher will be able to:</p>	<p>Learning Indicators</p>	<p>Developing and addressing Cross cutting issues – core and transferable skills, inclusivity, equity and diversity.</p>
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate knowledge and skills of observation and reporting on class teaching and wider school activities (in School) • (NTS 3k). • Use manipulatives and other TLMs and models in a variety of ways in developing and learning number concepts. • Demonstrate knowledge and understanding of the key features of the basic school curriculum (BSC); and specifically focusing on core subjects and their associated expected learning outcomes (NTS, 2a). 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties of sets of numbers during the development of the various sets within the real number system through investigations. • Illustrate the various sets of numbers on Venn diagrams and to share their results with colleagues. • Identify, select (or design) and use manipulatives and other TLMs to develop number concepts, as well as, suggest appropriate materials that can be used to teach similar concepts of numeration system in the basic school curriculum. 	<ul style="list-style-type: none"> • Gender issues in Mathematics: Conscious effort in composition groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline. • Background of student teachers: Instructional practices and policies will be designed to take care of student teachers' backgrounds. • Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations. • Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to activities to achieve learning outcomes depending on delivery mode selected. Teacher-lead collaborative group work or independent.				
WEEK 1 Numbers and Numeration systems: <i>Learning, teaching and applying.</i>	Introduction to Course Manual	1 Hour	Introduce student teachers to the Course Manual and discuss the various components (PD Theme 1).	Participate in the discussion of various components of the course manual; take opportunity to ask questions about the Course Manual. Outline expectations and views about the mathematics course.
	Misconceptions and barriers in teaching and learning of numbers,	2 Hours	Initiate discussion on how the numeration systems developed over time, as well as how, different civilizations and cultures used numbers to help unearth student teachers' misconceptions (PD Theme 3).	Participate in a discussion using number games, puzzles and the "Read my mind" number and word games to identify and discuss their misconceptions about concepts in Number and Algebra. Reflect on the historical development of the numeration system and the contributions of different civilizations and cultures have made until the emergence of the Hindu-Arabic base ten system.

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
	Development of Real number system (Natural, Whole, Integers, Rational and Irrational) and complex numbers (ie. $a + bi$, where a and b are real and $i = \sqrt{-1}$).	2 Hours	<p>Assign student teachers to discuss the topic “What would happen in a world without numbers”?</p> <p>Put student teachers in groups for collaborative activities to come out with justifications for the various number systems. (PD Theme 3).</p>	<p>Engage in a think-pair-share activity to discuss the role played by number in our everyday activities.</p> <p>Use various collaborative activities to address their misconceptions and barriers in teaching and learning number.</p> <p>Use the closure property to justify the development of the various number systems.</p>
			Model investigations and problem-solving activities on numbers. (PD Theme 1).	Engage in investigations and Mathematical problem-solving strategies involving numbers using manipulatives such as grids, spreadsheets, game cards, calendars in e-learning and face-to-face modes.
			Lead discussion on the development of numeration system, skip counting and base 10 place value.	Engage in collaborative activities including think pair, share, group work and role play that will lead to the development of the numeration system.
			Monitor group presentations and refines student teachers results on Real number system. (PD Theme 3 & 4).	Present their results/ observations in small groups based on the discussions in a face-to-face mode.

<p>Lesson assessments - evaluation of learning: of, for and as learning within the lesson (linked to course lesson learning outcome)</p>	<p>Summary Assessment Method: think-pair-share Student teachers are assigned to illustrate the various sets of numbers on Venn diagrams and share their results with colleagues in-class. (Assessment for learning). Related CLOs: 1, 2. NTS: 1a) Critically and collectively reflects to improve teaching and learning. 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.</p> <p>Summary of assessment Method: (Group and individual presentation) Student teachers to identify and design manipulatives and other TLMs that can be used to teach number concepts, to be included in their portfolios. (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teachers to identify the characteristics and properties of sets of numbers within the real number system through investigations. (NTS: 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching and learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

LESSON 2

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Operations and Properties of Integers (number sense): Learning, teaching and applying				Lesson Duration	3 hours	
Lesson description	This is the second lesson and it seeks to build on student teachers' knowledge and experiences on the real number system. The areas to be covered include operations of integers (developing and using number sense), it is intended to expose student teachers to use variety of manipulatives including the number line.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers can demonstrate sound knowledge of Number and numeration system.						
Possible barriers to learning in the lesson	<p>Different entry behaviours: Student teachers' prior knowledge of integers and operations on integers may differ and can result in different learning needs. Tutor should employ differentiated instruction and assessment to address it.</p> <p>Student teachers' learning styles not matching lecturer/tutor's teaching style.</p> <p>Socio-cultural issues: Individuals have different social and cultural backgrounds and are not likely to respond to the period of transitioning from pre-tertiary to tertiary environment (this may affect learning).</p>						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	<p>Face-to-face, Independent study and e-learning opportunities:</p> <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						

<p>Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.</p>	<p>The purpose of the lesson is to:</p> <ul style="list-style-type: none"> • Build on student teachers' knowledge and experiences on the real number system and to expose student teachers to use variety of manipulatives including the number line.
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<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	<p>Learning Outcomes: The student teachers will be able to:</p>	<p>Learning Indicators</p>	<p>Identify Which cross-cutting issues- core and transferable skills, inclusivity, equity and addressing diversity. How will these be addressed or developed?</p>
<ul style="list-style-type: none"> • Learning indicators for each learning outcome . 	<ul style="list-style-type: none"> • Use manipulatives and other TLMs in a variety of ways in learning Operations and Properties of Integers. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains. 	<ul style="list-style-type: none"> • Outline the various operations and properties of Integers and to share their results with colleagues. • Highlight the potential socio-cultural issues (ie. counting in their local language, eg 19 is read as 20-1 in Dagbani) and misconceptions they hold about the number systems through think-pair-share. 	<ul style="list-style-type: none"> • Background of student teachers: Instructional practices and policies will be designed to take care of student teachers' background. • Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations, • Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to activities to achieve learning outcomes depending on delivery mode selected. Teacher-lead collaborative group work or independent.				
<p><i>WEEK 2</i></p> <p>Operations and Properties on Integers (number sense):</p> <p><i>Learning, teaching and applying</i></p>	<p>Operations of Integers</p> <p>Properties: Closure, commutative, associative, distributive, identity, inverse properties.</p>	<p>3 Hours</p>	<p>Engage student teachers in a number game as a starter for learning Integers. (PD Theme 1).</p>	<p>Participate in mental activities to prepare them for smooth start of learning integers to promote critical thinking.</p>
			<p>Supply manipulatives for the operations on Integers. (eg. Multi-purpose grid game for operation of integers) (PD Theme 1).</p>	<p>Use manipulatives such as multi-purpose grid to explore operations on Integers and their properties in a collaborative group work.</p>
			<p>Initiate Mathematical problem-solving strategies based on the properties and operation of Integers. (PD Theme 1).</p>	<p>Use Mathematical problem-solving strategies. E.g. Word problems, to study and discuss concepts in a given task in a face-to-face mode.</p>

<p>Lesson assessments - evaluation of learning: of, for and as learning within the lesson.</p>	<p>Summary Assessment Method: group work Student teachers to outline the operations and properties of Integers and to share their results with colleagues. (Assessment for Learning) Related CLOs: 1, 2. NTS: 1a) Critically and collectively reflects to improve teaching and learning. 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes.</p> <p>Summary of assessment Method: (Group and individual presentation) Student teachers are assigned to develop manipulatives for investigating operations on Integers. (Assessment as Learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teachers to outline the operations and properties of Integers and to share their results with colleagues. (Assessment for Learning) NTS: 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, multi-purpose grid game, spreadsheets, game cards, calendars, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Lt.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<ul style="list-style-type: none"> • See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.

LESSON 3

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Operations and properties of rational and irrational numbers: Learning, teaching and applying 1				Lesson Duration	3 hours	
Lesson description	This is the third lesson and it seeks to introduce fractions and its operations to student teachers. The areas to be covered include: Operations on common fractions, decimals number, percentages and irrational numbers. Others are Properties of rational (including density property) and irrational numbers, Place value, decimal places, approximations; significant figures including rounding off numbers and standard form.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers have successfully studied Number and Algebra at their Basic and SHS levels and can demonstrate their ability on Operations and properties of rational and irrational numbers.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in- class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of number. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc., 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Build on student teachers’ knowledge and experiences on operations and properties of rational and irrational numbers: Expose student teachers to the development and use of manipulatives to establish the concepts of common fractions, decimals number, percentages and their relationships and to apply such concepts to real life situation. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of the operations and properties of rational and irrational numbers. • Use manipulatives in a variety of ways in learning number concepts. 	<ul style="list-style-type: none"> • Identify and analyse the operations and properties of rational and irrational numbers through investigations. • Select appropriate materials and other TLMs to model and solve problems based on rational and irrational numbers. (e.g., geodot papers and designs, as well as tiles). • Illustrate the various sets of numbers on Venn diagrams and to share their results with colleagues. 	<ul style="list-style-type: none"> • Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline. • Background of student teachers: Instructional practices and policies will be designed to include to take care of student teachers' backgrounds. • Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations. • Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to activities to achieve learning outcomes depending on delivery mode selected. Teacher-lead collaborative group work or independent.				
Operations and properties of rational and irrational numbers: <i>Learning, teaching and applying</i>	Naming of fractions. Operations on common fractions, decimal numbers, percentages and irrational numbers. Properties of rational (including density property) and irrational numbers.	3 Hours	Engage student teachers in a number game as a starter. (PD Theme 1).	Actively participate in mental activities to prepare them for the learning of the concept of fraction.
			Initiate discussion to explore misconceptions of fractions. (PD Theme 3).	Brainstorm to explore their misconceptions about fractions, in groups.
			Present various fractional models and visual aids (TLMs) for multiple representations of the concept of fraction. (PD Theme 5).	Use fractional models and visual aids (TLMs) and developing multiple representations for a single mathematical concept.
			Lead student teachers to use a multiplication chart (see CPD Needs) to develop the concepts of equivalent fractions. (PD Theme 1 & 5).	Participate in a discussion to design a multi-purpose multiplication chart and use it to develop the concept of equivalent fractions and other related concepts.
			Engage student teachers to explore other fraction related concepts. (PD Theme 1 & 3).	Explore various forms of fraction concepts, for example, operations on fractions.
			Model the development of the concept of square roots using square tiles and geodot patterns to establish the notion of irrational numbers. (PD Theme 1 & 5).	Participate in the investigative activities for the development of the concept of square roots to establish the notion of irrational numbers using square tiles and geodot patterns. Use e-learning opportunities and other models to explore the nature and properties of irrational numbers.

<p>Lesson assessments – evaluation of learning: of, for and as learning within the lesson</p>	<p>Summary Assessment Method: group work Student teachers to analyse strategies used by their peers in solving problems involving operations on fractions. (Assessment for learning) Related CLOs: 1, 2. NTS: 1a) Critically and collectively reflects to improve teaching and learning. 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) Student teachers in small groups, illustrate the various sets of numbers on Venn diagrams to present their results in-class (in their meeting). (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teachers are assigned to solve problems based on rational and irrational numbers to be discussed in-class (Assessment of learning) NTS: 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

LESSON 4

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Operations and properties of rational and irrational numbers: Learning, teaching and applying 2				Lesson Duration	3 hours	
Lesson description	This is the fourth lesson and it seeks to extend fractions and its operations to student teachers. The areas to be covered include: Operations on common fractions, decimal numbers, percentages and irrational numbers. Others are properties of rational (including density property) and irrational numbers, place value, decimal places, approximations; significant figures including rounding off numbers and standard form.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers can outline Operations and properties of rational and irrational numbers: Learning, teaching and applying 1.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities: <ul style="list-style-type: none"> The face-to-face mode will include lecturer / tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of number. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						

<p>Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.</p>	<p>The purpose of the lesson is to:</p> <ul style="list-style-type: none"> • Build on student teachers' knowledge and experiences on operations and properties of rational and irrational numbers: • Expose student teachers to the development and use of manipulatives to establish the concepts of common fractions, decimal numbers, percentages and their relationships and to apply such concepts to real life situations.
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<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification • Learning indicators for each learning outcome 	<p>Learning Outcomes: The student teachers will be able to:</p>	<p>Learning Indicators</p>	<p>Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.</p>
	<ul style="list-style-type: none"> • Demonstrate the development and understanding of operations and properties of rational and irrational numbers in the basic school mathematics curriculum. • Demonstrate value as well as respect for equity and inclusion in the mathematics classroom. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties of sets of numbers during the development of the various sets within the real number system through investigations. • Model the connection among common fractions, decimal fractions, and percentages using the draught board and other local materials. • Write a reflective paper about the need to respect equity and inclusivity in the mathematics classroom as an assignment to be presented the following week. • Outline and discuss the educational implications of knowing and taking care of the different socio-cultural issues in the teaching and learning of mathematics. • Identify and demonstrate the need for diversity in planning and performing collaborative group work on number systems. • Model the connection among common fractions, decimal fractions, and percent using the draught board or any similar material (e.g., any structured 10 × 10 area model. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is a male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' background.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations,</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study.				
Operations and properties of rational and irrational numbers: Learning, teaching and applying	Place values, approximations; significant figures including rounding off numbers and standard form.	3 Hours	Engage student teachers in a fraction game as a starter. Eg. Converting common fractions to decimals and vice versa. (PD Theme 1).	Actively participate in mental activities for learning of decimal (fractions) numbers.
			Demonstrate how to establish the fact that there are a number of decimal fractions between any two given fractions through activity method. (PD Theme 1 & 3).	Explore number of decimal fractions between any given two fractions through activity method.
			Initiate a process to explore the connections among common fractions, decimals and percentages, with degree of accuracy, using manipulatives and visual aids (TLMs). (PD Theme 1, 4, & 5).	Use variety of manipulatives and visual aids (TLMs) to explore connections among common fractions, decimals and percentages, with degree of accuracy. Use the draught board (or a model of it) and other 10 by 10 grids to model the connection among common fractions, decimal fractions, and percentages.
			Engage student teachers in a discussion based on the need for diversity in planning and performing collaborative group work on number systems. Introduce student teachers to the concept of approximation of given numbers to specific values using number lines and other TLMs. (PD Theme 1, 3, & 4).	Participate in the discussion based on the need for diversity in planning and performing collaborative group work on number systems. Outline and use appropriate techniques to approximate given numbers to a specific value using diversity in planning and performing collaborative group work on number systems.

<p>Lesson assessments - evaluation of learning: of, for and as learning within the lesson</p>	<p>Summary Assessment Method: presentation of group assignment Student teachers to design and produce manipulatives for teaching fractions. Related CLOs: 2, 3. NTS: 1a) Critically and collectively reflects to improve teaching and learning. 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (individual presentation) Student teachers engage in an independent study based on gender, equity, inclusivity, and diversity and to write a reflective paper to be presented in-class; (Assessment for learning) Discuss the educational implications of knowing and taking care of the different socio-cultural issues in the teaching and learning of mathematics. (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teachers to produce a poster based on the core skills and socio-cultural issues that have impact on learning mathematics for teaching as an assignment to be presents in the next lesson (Assessment of learning) NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, draught board, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra</p>

LESSON 5

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Concept of Sets: Learning, teaching and applying				Lesson Duration	3 hours	
Lesson description	This is the fifth lesson and it seeks to introduce student teachers to the concept of sets. The areas to be covered include Sets of numbers such as: even and odd numbers, prime and composite numbers, multiples and factors, squares, cubes, perfect numbers, Venn diagrams (two and three set problems) and word problems.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers can form sets of number based on real life happenings as well as rational and irrational numbers.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	<p>Face-to-face, independent study and e-learning opportunities:</p> <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of number. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	<p>The purpose of the lesson is to:</p> <ul style="list-style-type: none"> Build on student teachers' knowledge and experiences on the concept of sets. Develop and use appropriate manipulatives and ICT tools to investigate the relationships among the various sets of number and how to apply these to the basic school curriculum. Consciously encourage student teachers to develop problem solving strategies. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. • Learning indicators for each learning outcome. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
	<ul style="list-style-type: none"> • Demonstrate the development and understanding of the concept of sets in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways in learning concept of sets. • Demonstrate value as well as respect for equity and inclusion in the mathematics classroom. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning of concept of sets. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties of sets of number during the development of the various sets within the real number system through investigations. • Select and use appropriate manipulatives to solve problems based on sets. • Identify and demonstrate the need for diversity in their collaborative group work on the concept of Sets. 	<p>Gender issues in Mathematics: Conscious effort in composition groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is a male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' background.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study				
Concept of Sets: <i>Learning, teaching and applying</i>	Sets of numbers, eg., even and odd numbers, multiples, factors, prime numbers, squares, cubes, perfect numbers. Venn diagrams (two and three set problems), word problem.	3 Hours	Model suitable game(s) to introduce the concept of sets. Engage student teachers in a game based on sets. (PD Theme 1).	Participate in the activity by suggesting appropriate games for teaching sets of numbers.
			Initiate discussions on strategies that leads to transitioning from set of numbers to real life groupings. (PD Theme 3)	Brainstorm to identify strategies that can lead to the transitioning from sets of number to real life groupings. Outline the importance of using real life phenomena in the teaching and learning of sets.

Concept of Sets: <i>Learning, teaching and applying</i>	Sets of numbers, eg., even and odd numbers, multiples, factors, prime numbers, squares, cubes, perfect numbers. Venn diagrams (two and three set problems), word problem.	3 Hours	Assign student teachers to small group to explore models and strategies to illustrate set problems such as Venn diagrams. (PD Theme 4).	Explore models and strategies to represent sets of numbers in their small groups to be presented later.
			Assign student teachers to pose and solve word problems based on sets. (PD Theme 4).	Pose and solve word problems based on sets using appropriate strategies and tools.
Lesson assessments - evaluation of learning: of, for and as learning within the lesson	<p>Summary Assessment Method: group work Student teachers to select and use appropriate manipulatives to solve problems based on concept of sets. (Assessment for learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) student teachers to outline and discuss the educational implications of knowing and taking care of the different socio-cultural issues in the teaching and learning of mathematics. (Assessment for learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Identify and analyse the characteristics and the properties of sets of numbers during the development of the various sets within the real number system through investigations. (Assessment of learning) Related CLOs: 1, 3 NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge) Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>			
Teaching Learning Resources	Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.			
Required Text (core)	Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.			
Additional Reading List	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers.</p> <p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers.</p> <p>Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education.</p> <p>Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>			
Required CPD	See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.			

LESSON 6

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Algebraic expressions, equations and inequalities: Learning, teaching and applying				Lesson Duration	3 hours	
Lesson description	This is the sixth lesson which exposes student teachers to the concept of algebraic expressions, equations and inequalities.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers can recall basic facts in formulating algebraic expressions, equations and inequalities.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Expose student teachers to the concept of algebraic expressions, equations and inequalities. Develop appropriate strategies (and TLMS and ICT tools) that can help them to undertake projects in algebraic expressions, equations and inequalities. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of algebraic expressions, equations and inequalities in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways to learn algebraic expressions, equations and inequalities. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties to be considered for algebraic expressions, equations and inequalities within the real number system through investigations. • Select and use TLMs appropriately for developing concepts based on algebraic expressions, equations and inequalities. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is a male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' background.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study				
Algebraic expressions, equations and inequalities: Learning, teaching and applying	Simplification, expansion and factorization. Solving linear equations and inequalities.	3 Hours	Start lesson with a game that serves the purpose of transitioning from a number to algebra. (PD Theme 1)	Involve in mental drills for the learning of algebraic expressions, equations and inequalities.
			Initiate a discussion to explore the meaning of variables, using drill and practice to transition from number to algebra. (Eg. $2 + 3 ; 2 + x$) (PD Theme 3)	Explore the meaning of variables using discussion, drill and practice to transition from number to algebra. (Eg. $2 + 3 ; 2 + x$) Use the calendar and other number grids to design fun games to transition from number to algebra (formulating algebraic expressions and equations from number games).
			Provide models and appropriate diction to deal with misconceptions of algebraic expressions (e.g. using algebra tiles to demonstrate identities). (PD Theme 1 & 5).	Deal with misconceptions of algebraic expressions (e.g. using algebra tiles to demonstrate identities).
			Lead discussion on the use of the distributive property to expansion. (PD Theme 3).	Apply the distributive property to expansion.
			Use inverse of numbers and operation principles. (PD Theme 1).	Explore how the inverse of numbers can be used as the main principle in solving equations algebraically. For example, if the operation involved in solving for an unknown is addition, we undo it with subtraction and vice versa. Similarly, we undo multiplication with division and vice versa.

			Use methods of elimination, substitution and graphical approach. (PD Theme 1).	Use methods of elimination, substitution and graphical approach.
Lesson assessments – evaluation of learning: of, for and as learning within the lesson	<p>Summary Assessment Method: group work Student teachers to select and use appropriate manipulatives to solve problems based on concept of sets. (Assessment for learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) student teachers to outline and discuss the educational implications of knowing and taking care of the different socio-cultural issues in the teaching and learning of mathematics. (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (short mid semester test) To write a short test on lessons covered in lessons 1-5. (Assessment of learning) Related CLOs: 1, 3 NTS: 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>			
Teaching Learning Resources	Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.			
Required Text (core)	Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd			
Additional Reading List	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers.</p> <p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers.</p> <p>Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education.</p> <p>Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>			
Required CPD	See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.			

LESSON 7

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1	2	3	4	5	6	7	8	9	10	11	12
Title of Lesson	Everyday and commercial arithmetic: Learning, teaching and applying 1							Lesson Duration	3 hours							
Lesson description	This is the seventh lesson which exposes student teachers to everyday and commercial arithmetic. Areas to cover include ratio, rates, proportion, scales and percentages (taxation, discount, commissions, VAT, etc.)															
Previous student teacher knowledge, prior learning (assumed)	Student teachers can differentiate between two concepts in business mathematics that will be a necessary ground for learning everyday and commercial arithmetic.															
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.															
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum									
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 															
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Expose student teachers to the concept of ratios, rates, proportion, scales and percentages (taxation, discount, commissions, vat, etc.). Develop appropriate learning strategies where percentages (taxation, discount, commissions, vat, etc.) Can be applied. 															

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding everyday and commercial arithmetic in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways in learning number concepts. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties of everyday and commercial arithmetic through investigations. • Illustrate the various sets of numbers to analyse everyday and commercial arithmetic and to share their results with colleagues. • Highlight the potential socio-cultural issues and misconceptions they hold about everyday and commercial arithmetic systems through think-pair-share. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is a male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' background.</p> <p>Problem solving, critical and creative thinking: this can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study				
Everyday and commercial arithmetic: Learning, teaching and applying	Ratio, rates, proportion, scales.	3 Hours	Start lesson with mental drills using related games. (PD Theme 1).	Participate in mental drills for the learning ratio, rates, proportion, scales, etc.
			Introduce the concepts of ratio and proportion using multi-purpose multiplication chart (See CPD Needs). (PD Theme 1).	Explore the concept of ratio and proportion by applying knowledge and understanding gained from finding equivalent fractions using the multi-purpose multiplication chart or by any appropriate strategy.
			Engage student teachers to explore other ratio related concepts using materials in our environment, e.g. tiles, linoleum, designs in fabrics. (PD Theme 1).	Explore various forms of ratio concepts using materials in our environment, e.g. tiles, linoleum, designs in fabrics.
			Initiate Investigations and Mathematical problem-solving strategies for Ratio, rates, proportion, scales. (PD Theme 1).	Investigations and Mathematical problem-solving strategies.
			Assign student teachers in groups to conduct an investigation on Ghanaian socio-cultural practices that involve the application of ratio, rates, proportions, and scales. (PD Theme 4).	Conduct the investigation on Ghanaian socio-cultural practices that involve the application of ratio, rates, proportions and scales, and write reports to be submitted later for peer review.

<p>Lesson assessments - evaluation of learning: of, for and as learning within the lesson</p>	<p>Summary Assessment Method: group work group presentations on various sets of numbers to analyse everyday and commercial arithmetic and to share their results with colleagues. (Assessment for learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) student teachers to present individual assignment on potential socio-cultural issues and misconceptions they hold about everyday and commercial arithmetic systems through think-pair-share. (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) student teachers to write a short teacher-made test on characteristics and the properties of everyday and commercial arithmetic. (Assessment of learning) Related CLOs: 1, 3 NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, draught boards, multiplication charts, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

LESSON 8

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Everyday and commercial arithmetic: Learning, teaching and applying 2				Lesson Duration	3 hours	
Lesson description	This is the eighth lesson which exposes student teachers to everyday and commercial arithmetic. Areas to cover include applications of percentages, such as profit and loss, taxation, discount, commissions, VAT, tariffs, etc.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers can initiate investigations and Mathematical problem-solving strategies for ratio, rates, proportion, scales and relate them to everyday and commercial arithmetic.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Expose student teachers to everyday and commercial arithmetic. Develop appropriate strategies for teaching application of percentages such as taxation, vat, discount, commission. Develop student teachers’ ability to consciously connect common fraction concepts to decimal fractions and to percentage. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. • Learning indicators for each learning outcome . 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
	<ul style="list-style-type: none"> • Demonstrate the development and understanding of everyday and commercial arithmetic in the basic school mathematics curriculum. • Use manipulatives and other (see previous comment) in a variety of ways in teaching and learning everyday and commercial arithmetic. • Demonstrate value as well as respect for equity and inclusion in the mathematics classroom. 	<ul style="list-style-type: none"> • Identify and analyse strategies for solving real life problems that involve the application of percentages through collaborative small group investigations. • Give examples of some types of everyday and commercial arithmetic and to devise different strategies for solving related problems and sharing their results with colleagues. • Identify and demonstrate the need for diversity in their collaborative group work on everyday and commercial arithmetic, write and present a reflective paper based on this. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is a male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to take care of student teachers' background.</p> <p>Problem solving, critical and creative thinking: this can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study				
Everyday and commercial arithmetic: Learning, teaching and applying	Percentage and its applications (profit and loss, taxation, discount, commissions, VAT, tariffs, etc.)	3 Hours	Start lesson with mental drills using related games. (PD Theme 1).	Participate in mental drills for the learning of percentages and its applications.
			Task student teachers to convert common fractions to decimals to percentages and vice versa. (PD Theme 1).	Use a draught board (or a model of it), multi-purpose chart and other area models to convert common fractions to decimals to percentages and vice versa.

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Everyday and commercial arithmetic: Learning, teaching and applying	Percentage and its applications (profit and loss, taxation, discount, commissions, VAT, tariffs, etc.)	3 Hours	Encourage extended learning and applications of percentages to real life situation. (PD Theme 1).	Use instructions given to engage in extended learning and applications of percentages to real life situation.
			Initiate and directs Mathematical discourse among student teachers on application of percentages in daily life. (PD Theme 3).	Engage in Mathematical discourse on percentages and its applications with peers to enhance communication, critical and creative thinking.
			Engage student teachers to solve problems on applications of percentages and to justify the appropriateness of their strategies. (PD Theme 1).	Participate in solving problems on applications of percentages and to justify the appropriateness of their strategies.
Lesson assessments - evaluation of learning: of, for and as learning within the lesson	<p>Summary Assessment Method: small group project Presentation of individual project to outline and analyse how percentages are applied to taxation, discount, commissions, VAT. (Assessment of learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning.</p> <p>Summary of assessment Method: (Group and individual presentation) Presentation of individual reflective paper on the need for addressing diversity in the teaching of everyday and commercial arithmetic. (Assessment for learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) student teachers to outline strategies for solving real life problems that involve the application of percentage to be submitted later. (Assessment of learning) Related CLOs: 1, 3 NTS: 2 b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>			
Teaching Learning Resources	Manipulatives such as number grids, spreadsheets, game cards, calendars, draught board, graph sheets, multi-purpose chart etc.			
Required Text (core)	Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.			
Additional Reading List	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers.</p> <p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers.</p> <p>Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education.</p> <p>Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>			
Required CPD	See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.			

LESSON 9

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12		
Title of Lesson	Number bases and Modular arithmetic: Learning, teaching and applying 1			Lesson Duration	3 hours		
Lesson description	This is the ninth lesson and is meant to expose student teachers to the concepts of number bases and modular arithmetic. The aspects to be considered include: expressing numbers of different bases; binary (base two), base five, base eight, and base ten.						
Previous student teacher knowledge, prior learning (assumed)	Student teachers have studied number and numeration system as well as, operations on numbers using base ten.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities as modes of delivery used include the following examples: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Expose student teachers to different bases such as binary (base two), base five, base eight, and base ten, etc. Model the teaching of number bases and modular arithmetic using appropriate strategies. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of number bases and modular arithmetic in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways in learning concepts based on number bases and modular arithmetic. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains. • Demonstrate awareness of the existence of different number bases in various local languages and dialects. 	<ul style="list-style-type: none"> • Identify and analyse when number bases and modular arithmetic concepts are introduced in the basic school mathematics curriculum and the suggested strategies and manipulatives for teaching these concepts. • Design and use appropriate manipulatives and outline how such manipulatives can be used in teaching number bases and modular arithmetic concepts. • Outline the historical development and use of various aspects of number bases and modular arithmetic in various cultures and present findings in small groups. • Highlight the potential socio-cultural issues involved in number bases and modular arithmetic by counting in local languages and dialects and to Identify and to explore the number bases which these languages and dialects can be associated with. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include to take care student teachers' background.</p> <p>Problem solving, critical and creative thinking: this can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study.				
Number bases and Modular arithmetic: Learning, teaching and applying	Expressing numbers of different bases; binary (base two), base five, base eight, and base ten.	3 Hours	Start lesson with drills on counting in local languages (L1). (PD Theme 1).	Student teachers count in their local languages taking note of possible bases.
			Introduce student teachers to other bases, besides base ten, and lead a discussion on the inter-conversion of bases (including converting numbers from one to another without going through base ten). (PD Theme 1 & 3).	Discuss the need for knowing other bases and provide examples of how certain bases are used in real life and to participate in small group discussion leading the inter-conversion of bases (including converting numbers from one to another without going through base ten).
			Initiate investigations that will lead to the development of the concept of modular arithmetic using number grids and divisibility rules. (PD Theme 1).	Participate in the investigative activities to develop the concept of modular arithmetic.
			Encourage application of modular arithmetic to real life situations through presentations. (PD Theme 1).	Present findings of projects on application to real life situations through presentations.
			Task student teachers to find remainders of numbers in given modulus using the divisibility rule. (PD Theme 1).	Find remainders of numbers in given modulus using the divisibility rule.

<p>Lesson assessments – evaluation of learning: of, for and as learning within the lesson</p>	<p>Summary Assessment Method: small group project Student teachers are tasked to outline the historical development and use of various aspects of number bases and modular arithmetic in various cultures to be submitted later. (Assessment as learning) Related CLOs: 1, 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) Presentation of individual/group project to outline and analyse how numbers can be converted from one base to another (including not transitioning through base ten) to be presented later. (Assessment for learning) Related CLOs: 1, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge) 3m) Identifies and remediates learners’ difficulties or misconceptions, referring learners whose needs lie outside the competency of the teacher.</p> <p>Summary of assessment Method: (class exercise) Student teachers are tasked to answer questions on worksheets based on number bases and binary operations. (Assessment of learning) Related CLOs: 1, 2 NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

LESSON 10

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12		
Title of Lesson	Number bases and Modular arithmetic: Learning, teaching and applying 2			Lesson Duration	3 hours		
Lesson description	<ul style="list-style-type: none"> This is the tenth lesson and is meant for exposing student teachers to the concept of cyclic variable, concept of modular arithmetic, addition and subtraction of modular arithmetic, multiplications in modular arithmetic as well as solving linear equations in modular arithmetic. 						
Previous student teacher knowledge, prior learning (assumed)	JHS and SHS Core Mathematics curricula, number and numeration system, number bases and modular arithmetic.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	<p>Face-to-face, Independent study and e-learning opportunities as modes of delivery used include the following examples:</p> <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	<p>The purpose of the lesson is to:</p> <ul style="list-style-type: none"> Introduce student teachers to cyclic variable, concept of modular arithmetic, addition and subtraction of modular arithmetic and multiplication of modular arithmetic. Model the teaching of number bases and modular arithmetic using interactive strategies. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of number bases and modular arithmetic in the basic school mathematics curriculum. • Use manipulatives and other TLMs and models in a variety of ways in learning number base and modular arithmetic concepts. • Demonstrate value as well as respect for equity and inclusion in the mathematics classroom. 	<ul style="list-style-type: none"> • Identify and analyse models, such as clocks/polygons and number grids, to represent place value concepts, with respect to different modular characteristics, through investigations. • Illustrate the various number bases and modular arithmetic and to share their results with colleagues. • Identify and demonstrate the need for diversity in planning and executing collaborative group work on number base and modular systems. 	<p>Gender issues in Mathematics: conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline.</p> <p>Background of student teachers: instructional practices and policies will be designed to include to take care student teachers' background.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study.				
Number bases and Modular arithmetic: Learning, teaching and applying	Cyclic variable, concept of modular arithmetic, addition and subtraction of modular arithmetic, multiplication in modular arithmetic.	3 Hours	Start lesson with drills on counting in local languages (L1). (PD Theme 1).	Student teachers count in their local languages, taking note of possible bases.
			Introduce cyclic models such as clocks to represent place value concept with respect to different modular. (PD Theme 1).	Use cyclic models to represent place value concepts with respect to different bases (e.g. clock arithmetic in modulo 8 will have a cycle of 8).
			Initiate how the clock model can be applied to addition and subtraction of modular arithmetic. (PD Theme 1 & 5)	Use the concept learnt on the clock model to do addition and subtraction of modular.
			Introduce place value model and chart to explore different number bases. (PD Theme 1 & 5)	Use place value models and number grids (chart) to explore different number bases in class.
			Provide and/or model polygonal shapes to explore number bases and modular arithmetic. (PD Theme 1, 4, & 5)	Undertake small group projects to prepare and use polygonal shapes to explore number bases and modular arithmetic.
Lesson assessments – evaluation of learning: of, for and as learning within the lesson	<p>Component 1: Formative assessment</p> <p>Summary Assessment Method: small group project</p> <p>Identify and analyse models such as clocks/polygons and number grids to represent place value concept with respect to different modular characteristics through investigations. (Assessment for learning)</p> <p>Related CLOs: 1, 2.</p> <p>NTS:</p> <p>1a) Critically and collectively reflects to improve teaching and learning.</p> <p>3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning.</p>			

	<p>Summary of assessment Method: (Group and individual presentation) Student teachers to undertake small projects to explore properties of operations on modular arithmetic (using cyclic/polygonal shapes) (Assessment of learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teachers to complete worksheets on various number bases and modular arithmetic and to share their results with colleagues. (Assessment as learning) Related CLOs: 1,3 NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
Teaching Learning Resources	Manipulatives such as number grids, spreadsheets, game cards, calendars, cyclic and polygonal models, etc.
Required Text (core)	Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.
Additional Reading List	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers.</p> <p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers.</p> <p>Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education.</p> <p>Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
Required CPD	<ul style="list-style-type: none"> • See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.

LESSON 11

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	LEVEL 100	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Relations and Functions and their graphs: Learning, teaching and applying 1				Lesson Duration	3 hours	
Lesson description	This is the eleventh lesson which exposes student teachers to the concept of relations, functions and their graphs: The aspect to be considered include: Types of mapping/relation, functions; domain, co-domain, range, inverse, composition and their graphs.						
Previous student teacher knowledge, prior learning (assumed)	Student teaches have studied basic theories of relations and mapping and can relate them to real life situation.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities as modes of delivery used include the following examples: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: <ul style="list-style-type: none"> Introduce student teachers to relations and functions and their graphs which will prepare student teachers adequately to handle the basic school mathematics curriculum. 						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of relations and functions and their graphs in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways in teaching and learning relations and functions and their graphs. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning mathematics in the content domains. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and the properties of relations and functions and their graphs within the real number system through investigations. • Illustrate the various types of relations and functions and their graphs and to share their results with colleagues. • Highlight the potential socio-cultural issues and misconceptions they hold about relations and functions and their graphs through think-pair-share. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' backgrounds.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study				
Relations and Functions and algebraic graphs: Learning, teaching and applying 1	Types of mapping/ relation, functions; domain, co-domain, range, inverse.	3 Hours	Start lesson with drills on relations and functions. (PD Theme 1).	Student teachers engage in drills on relations and functions.
			Initiate discussion on mathematical explorations, transitioning from number patterns to algebraic ideas. (PD Theme 1 & 3).	Engage in discussions leading to mathematical explorations, transitioning from number patterns to algebraic ideas.
			Introduces the concept of relation as set of ordered pairs.	Engage in the concept of relation as set of ordered pairs.
			Initiate discussion on types of relations using diagrams and other manipulatives. (PD Theme 1, 3, & 5)	Engage in discussion on types of relations using diagrams and other manipulatives.
			Outlines the difference between functions and relations.	Use group activities to establish the difference between functions and relations.
			Introduce concepts of domain, co-domain, range, inverse and composite functions.	Explore concepts of domain, co-domain, range, inverse and composite functions.

<p>Lesson assessments – evaluation of learning: of, for and as learning within the lesson.</p>	<p>Summary Assessment Method: small group project Student teachers to illustrate the various types of relations, mapping and functions and their graphs and to share their results with colleagues, through collaborative group work. (Assessment for learning) Related CLOs: 1, 2. NTS: 1a) Critically and collectively reflects to improve teaching and learning. 3h) Sets meaningful tasks that encourages learner collaboration and leads to purposeful learning</p> <p>Summary of assessment Method: (Group and individual presentation) Highlight the potential socio-cultural issues and misconceptions they hold about relations and functions and their graphs through think-pair-share. (Assessment as learning) Related CLOs: 2, 3 NTS: 3j) Produces and uses a variety of teaching and learning resources including ICT, to enhance learning 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Summary of assessment Method: (class exercise) Student teacher to complete worksheets on domain, range and inverse of functions. (Assessment of learning) Related CLOs: 1,3 NTS: 2b) Has comprehensive knowledge of the official school curriculum, including learning outcomes. 2f) Demonstrate value as well as respect for equity and inclusion in the mathematics classroom (knowledge)</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
<p>Teaching Learning Resources</p>	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.</p>
<p>Required Text (core)</p>	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
<p>Additional Reading List</p>	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
<p>Required CPD</p>	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

LESSON 12

DUPLICATE THE PLANNER FOR EACH LESSON

Plans for each lesson in the semester.

The following format should be completed for each lesson in the semester.

Year of B.Ed.	1	Semester	1	Place of lesson in semester	1 2 3 4 5 6 7 8 9 10 11 12
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Title of Lesson	Relations and Functions and their graphs: Learning, teaching and applying 2*				Lesson Duration	3 hours	
Lesson description	<ul style="list-style-type: none"> This is the twelfth lesson which exposes student teachers to the concept of relations, mapping and functions and their graphs: special attention will be paid to properties and operations on functions, composition and their graphs. 						
Previous student teacher knowledge, prior learning (assumed)	Student teachers have studied types of relations and mapping and can relate them to real life situations.						
Possible barriers to learning in the lesson	Different entry behaviours, Socio-cultural issues, different learning needs, diversity, misconceptions about fractions, etc.						
Lesson Delivery - chosen to support student teachers in achieving the outcomes	Face-to-face √	Practical Activity	Work-Based Learning	Seminars	Independent Study √	E-learning opportunities √	Practicum
Lesson Delivery – main mode of delivery chosen to support student teachers in achieving the learning outcomes.	Face-to-face, Independent study and e-learning opportunities as modes of delivery used include the following examples: <ul style="list-style-type: none"> The face-to-face mode will include lecturer/tutor-initiated class discussions, small group in-class exploration, group presentations, think-pair-share moments, lecture, etc. The e-learning opportunities will include exploring number games and activities to develop properties of numbers and relationships between and among sets of numbers. The independent study mode includes student teachers producing individual reflective journal entries, engaging in independent inquiry, etc. 						
Purpose for the lesson, what you want the students to achieve, serves as basis for the learning outcomes. An expanded version of the description.	The purpose of the lesson is to: Introduce student teachers to properties and operations on functions, composition and graphs to build on their initial understanding of these concepts and how to apply them to real life situations.						

<ul style="list-style-type: none"> • Learning Outcome for the lesson, picked and developed from the course specification. 	Learning Outcomes: The student teachers will be able to:	Learning Indicators	Developing and addressing Cross cutting issues - core and transferable skills, inclusivity, equity and diversity.
<ul style="list-style-type: none"> • Learning indicators for each learning outcome. 	<ul style="list-style-type: none"> • Demonstrate the development and understanding of relations and functions and their graphs in the basic school mathematics curriculum. • Use manipulatives and other TLMs in a variety of ways in teaching and learning of relations and functions and their graphs. • Demonstrate value as well as respect for equity and inclusion in the mathematics classroom. • Demonstrate awareness of core skills, individual characteristics and socio-cultural issues in teaching and learning relations and functions and their graphs. 	<ul style="list-style-type: none"> • Identify and analyse the characteristics and properties of relations and functions and their graphs through investigations. • Illustrate the various aspects of relations and functions and their graphs and to share their results with colleagues. • Identify and demonstrate the need for diversity in planning and executing collaborative group work on relations and functions and their graphs. • Highlight the potential socio-cultural issues relating to relations and functions and their graphs and misconceptions they hold about these concepts through think-pair-share. 	<p>Gender issues in Mathematics: Conscious effort in composition of groups based on gender and mixed abilities will go a long way to demystify the notion that Mathematics is male dominated discipline.</p> <p>Background of student teachers: Instructional practices and policies will be designed to include student teachers' backgrounds.</p> <p>Problem solving, critical and creative thinking: This can be achieved through mathematical investigations and explorations.</p> <p>Social and communication skills: Presentation of group activities and participation in mathematical discourse promote the development of mathematical language, including symbols and vocabulary.</p>

Topic Title	Sub-Topic:	Stage/ time	Teacher Activity	Student Activity
Teaching and learning to achieve learning outcomes: depending on delivery mode selected. Teacher led, collaborative group work or independent study.				
Relations and Functions and algebraic graphs: Learning, teaching and applying 2	Properties and operations on functions, composition and graphs.	3 Hours	Start lesson with drills on relations and functions. (PD Theme 1)	Student teachers engage in drills on relations and functions.
			Initiate discussions based on properties of functions using graphs, diagrams, ICT, etc. (PD Theme 1, 3, & 5)	Engage in discussions based on properties of functions. e.g. $((f(x)^{-1}))^{-1} = f(x)$ $\frac{1}{f(x)} \neq f(x)^{-1}$
			Introduces discussion on the operations on functions. (PD Theme 3)	Engage in the discussions based on operations on functions.
			Introduce the concept of composition of functions.	Investigate some properties and applications of functions. e.g. $(f \circ g)^{-1} = g^{-1} \circ f^{-1}$ $fg \neq f \circ g$

Lesson assessments - evaluation of learning: of, for and as learning within the lesson	<p>Summary Assessment Method: Review of semester one course Student teachers to review the semester one course with tutor.</p> <p>Summary of assessment Method: (whole class activity) Student teachers discuss and submit their learning journals for considerations Summary of assessment Method: (whole class activity) Student teachers to discuss end of semester examination issues with tutor</p> <p>Note: The assessment procedures should make room for differentiation - gender, equity, SEN, and inclusivity.</p>
Teaching Learning Resources	<p>Manipulatives such as number grids, spreadsheets, game cards, calendars, etc.</p>
Required Text (core)	<p>Gordor, B. K., Naandam, S. M., & Nkansah, B. K. (2012). Core mathematics for senior high schools. Accra: Sam-Woode Ltd.</p>
Additional Reading List	<p>Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Tutor notes. Accra: Unimax Publishers. Martin, J. et. al. (1994). Mathematics for teacher training in Ghana: Students activities. Accra: Unimax Publishers. Ministry of Education (2015). Core mathematics modules for SEIP. Accra: Ministry of Education. Ministry of Education. (2010). Teaching syllabus for core mathematics (Senior High School). Accra: Ministry of Education, Science and Sports.</p>
Required CPD	<p>See PD Material on Teaching Year 1 Semester 1 Mathematics Course on Learning, Teaching and Applying Number and Algebra.</p>

