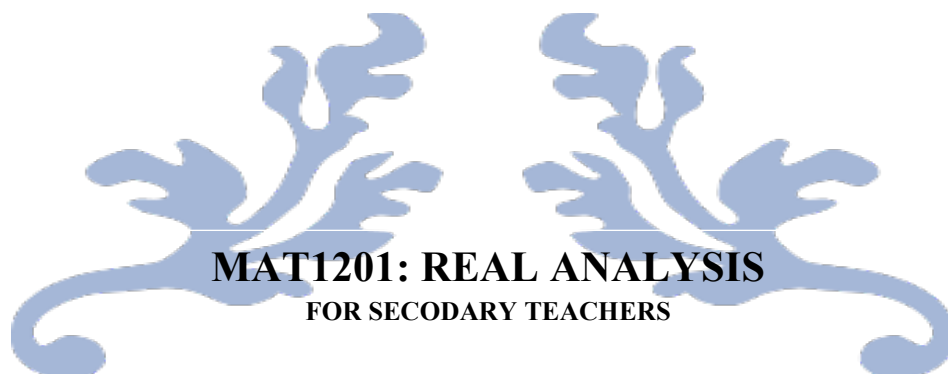


# MOUNTAINS OF THE MOON UNIVERSITY



$$\forall \tau \in \mathbb{R} \exists \delta: \delta = \mu \tau$$



**MAT1201: REAL ANALYSIS**  
FOR SECODARY TEACHERS

**ABOUT THE AUTHOR**

The Author is Issa Ndungo, currently teaching at Mountains of the Moon University, Uganda. The author passed through Musasa Primary School for Primary Education, Mutanywana Secondary School for Ordinary Level, Bwera Secondary School for Advanced Level, Mountains of the Moon University for Bachelor of Science with Education Degree (Mathematics/Economics) and Mbarara University of Science and Technology for Master of Science Degree (Pure Mathematics). The Author also holds a Certificate in Monitoring and evaluation and a Certificate in Financial Management.



The Author has taught in Secondary Schools such as Kamengo SS-Fort portal, Mutanywana SS-Kasese, Munkunyu SS-Kasese and Kyarumba Islamic SS-Kasese. In addition to this work, the Author has written Lecture Notes in Linear Algebra and Calculus. He has also written Mathematics related peer reviewed journal articles.

**Published Research Work by the Author**

1. Babirye Grace Nabulime, Byabasaija Deusdedit, Issa Ndungo (2021). A Reflection on the Role of Communal Resource Mobilization on Project Performance for Rural Development, Evidence from Kalungu District. Sch J Arts Humanit Soc Sci, 9(5): 138-143. [DOI: 10.36347/sjahss.2021.v09i05.001](https://doi.org/10.36347/sjahss.2021.v09i05.001).
2. Ndungo. I (2021): Exploring an Effective Approach of Teaching Mathematics During Covid-19 Pandemic. Merit Res. J. Edu. Rev. 2021 9(3): 048-052. [DOI: 10.5281/zenodo.4634557](https://doi.org/10.5281/zenodo.4634557)
3. Ndungo I, Asiimwe L, Biira M (2020). The relationship between school-based practices and students' discipline evidence from secondary schools in Kabarole District. Acad. J. Educ. Res. 8(3): 084-091. [DOI: 10.15413/ajer.2020.0104](https://doi.org/10.15413/ajer.2020.0104)
4. Ndungo. I, Biira. M. (2019): A concept map for teaching-learning logic and methods of proof: Enhancing students' abilities in constructing mathematical proofs. Merit Res. J. Edu. Rev. 2019 7(9): 101-108. [DOI: 10.5281/zenodo.3468495](https://doi.org/10.5281/zenodo.3468495)
5. Ndungo. I, Mugizi. M. (2019). The Teaching of Basic Mathematical Concepts to the Pre-service Teachers in Universities. A case of Mountains of the Moon University. Acad. J. Sci. Res. 7(5): 282-287. [DOI: 10.15413/ajsr.2019.0109](https://doi.org/10.15413/ajsr.2019.0109)
6. Ndungo. I, Mbabazi. A (2018). Institutional and communication factors affecting students' decisions to choose a university: The case of Mountains of the Moon University, Uganda. Acad. J. Educ. Res. 6(10): 257-262. ([DOI: 10.15413/ajer.2018.0128](https://doi.org/10.15413/ajer.2018.0128))

7. Ndungo. I, Biira. M (2018), Teacher quality factors and pupils' achievement in mathematics in primary schools of Kyondo, sub-county, Kasese District, Uganda. Acad. J. Educ. Res. 6(7): 191-195. ([DOI: 10.15413/ajer.2018.0117](https://doi.org/10.15413/ajer.2018.0117))
8. Ndungo. I, Sarvate. D (2016), GDD  $(n, 2, 4; \lambda_1, \lambda_2)$  with equal number of even and odd blocks. Discrete Mathematics. 339:1344-1354. [DOI: 10.1016/j.disc.2015.11.004](https://doi.org/10.1016/j.disc.2015.11.004)

These lecture notes were prepared to serve and facilitate the teaching of Bachelor Science with Education at Mountains of the Moon University. The notes are also relevant to students offering Computer Science.

The Author welcomes the readers to the content of the course unit that introduces the mathematical logical thinking and proving for the existence of certain mathematical concepts. The contribution of different Authors whose work was used in compiling this hand book is appreciated. Students are encouraged to read these notes carefully and internalize the necessary concepts for use in the subsequent course units. (For any error please notify the Author at [ndungoissa@mmu.ac.ug](mailto:ndungoissa@mmu.ac.ug)).

*Wishing you all the best, enjoy Real Analysis.*

## PREFACE

This course unit introduces students to the concepts of mathematics that are the building blocks of mathematical reasoning and mathematical proofs. The course unit handles concepts such as logic, methods of proof, sets, functions, real number properties, sequences and series, limits and continuity and differentiation. Real analysis provides students with the basic concepts and approaches for internalising and formulation of mathematical arguments. The course unit is aimed at:

- Providing learners with the knowledge of building mathematical statements and constructing mathematical proofs.
- Giving learners an insight on the concepts of sets and the relevant set theories that are vital in the development of mathematical principles.
- Demonstrating to learners the concepts of sequences and series with much emphasis on the bound and convergence of sequences and series.
- Providing students with the knowledge of limits, continuity and differentiation of functions that will serve as an introduction to calculus.

By the end of the course unit, students should be able to:

- Construct truth tables to prove mathematical statements or propositions
  - Use relevant methods of proof in constructing proofs of simple mathematical principles
  - Operate sets, prove basic set principles and have ability to explain the set concepts such as closure of a set, boundary point, open set and neighborhood of a point.
  - State and prove the axioms of real numbers and use the axioms in explaining mathematical principles and definitions.
  - Construct proofs of theories involved in sequences such as convergent, boundedness, and Cauchy properties as well as showing understanding of the connection between boundedness and convergent.
  - Obtain the limit of a function, construct relevant proofs for the existence of limits and perform algebra on limits.
  - State and prove the rules of differentiations and show understanding of the application of the concept of differentiation and the connection between limits, continuity and differentiation.
- The course will be delivered through: (1) three hours of lecture per session (2) a combination of lectures, discussions and presentations. Students will be given lecture notes on each unit but students will be required to make use of the university E-library for personal reading when answering the assignments.

The course is will be assessed through: (1) Course Work Assessment (class exercises, assignments & tests) (2) End of semester examination. The pass mark for this course unit is **50%**.