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TOPIC PLAN		
Partner organization	Faculty of Sciences, University of Novi Sad, Serbia	
Topic	Complex Numbers and Complex Functions	
Lesson title	Complex Numbers and SageMath	
Learning objectives	• Students will refresh their understanding of complex numbers • Students will refresh their understanding of Python • Students will understand how to use JupyterNotebooks • Students are encouraged to use technology and different software in their work, while considering problem-based situations	**Methodology** ☐Modeling ☒Collaborative learning ☐Project based learning ☒Problem based learning **Strategies/Activities** ☐Graphic Organizer ☒Think/Pair/Share ☒Discussion questions **Assessment for learning** ☒Observations ☒Conversations ☐Work sample ☐Conference ☐Check list
Aim of the lecture / Description of the practical problem	The aim of the lecture is to make students able to use SageMath to calculate with complex numbers and to use simple Python programs in SageMath As a practical problem lecturer poses several equations to solve using SageMath functions solve (to solve an equation) and plot (to plot a function to see whether it has real roots). It is important for teacher to present several equations that do not have real roots and to compare the outcome of plot and solve functions.	

Previous knowledge assumed:	• Arithmetic with complex numbers • Elements of Python programming	☐Diagnostics **Assessment as learning** ☒Self-assessment ☐Peer-assessment ☐Presentation ☐Graphic Organizer ☒Homework
Introduction / Theoretical basics	These lecture plans are designed to implement the lectures that are given in detail in the accompanying material “Complex numbers” by Dragan Mašulović. As the theoretical basis for the lecture the lecturer is expected to cover the material in Section 1 “A refresher on complex numbers” (pages 1—4) of the manuscript and to work several examples by hand on the blackboard.	**Assessment of learning** ☐Test ☒Quiz ☐Presentation ☐Project ☐Published work
Action	As the main part of the lecture the lecturer is expected to cover the material in Section 2 “At the computer keyboard” (pages 5—7) and Section 3 “Where did complex numbers come from” (pages 8 and 9) of the manuscript (see also the Addendum) and to work several examples using SageMath.	
Materials / equipment / digital tools / software	The accompanying lecture notes are given the references at the end of this topic plan; Equipment: classroom, green board, chalk in different colors; Digital tools: laptop, projector; Software: SageMath	
Consolidation	The students through the above examples should understand the nature of complex numbers and phenomena that lead to complex numbers. The students will also understand the power of computer algebra systems when it comes to visualizing functions and solving polynomial equations.	

Reflections and next steps	
Activities that worked	**Parts to be revisited**
After the class, the teacher according to his personal perceptions regarding the success of the class fills in this part	Through the success of the homework done by the students, questions and discussion at the beginning of the next class, the teacher comes to the conclusion which parts of this class should be revised

References

1. D. Mašulović. Complex numbers. Manuscript prepared under the auspices of this project proposal
2. J. P. D'Angelo. An Introduction to Complex Analysis and Geometry. American Mathematical Society, 2010
3. V. J. Katz. A History of Mathematics: An Introduction. 3rd Ed, Addison-Wesley, 2009
4. A. Speight. Byte-Size Python. John Wiley & Sons, 2020
5. P. Zimmermann et al. Computational Mathematics with SageMath. Volume 160 of Other Titles in Applied Mathematics, SIAM 2018