<table>
<tr><td>COURSE NAME</td><td colspan="7">Introduction to Lie groups and Lie Algebras</td></tr>
<tr><td>Code</td><td>PMM919</td><td>Year of study</td><td colspan="5">2nd year of graduate study</td></tr>
<tr><td>Course teacher</td><td>Saša Krešić Jurić</td><td>Credits (ECTS)</td><td colspan="5">5,0</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td></td><td></td></tr>
<tr><td>45</td><td>15</td><td></td><td></td><td></td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of application of e-learning</td><td colspan="5"></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">The course objective is to introduce students to the fundamentals of Lie groups, Lie algebras and their representations. The emphasis is on understanding the theory and concrete examples illustrating the general theoretical results.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">Prerequisities: completed courses Linear Algebra (or Linear Algebra and Matrix Calculus) and Algebraic Structures.

Required competencies: knowledge of the fundamentals of linear algebra, matrix calculus and group theory.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">It is expected that the student will be able to:

1. formulate definitions and explain different concepts related to Lie groups, Lie algebras and representations,
2. explain the connection between Lie groups and Lie algebras,
3. exaplain the connection between Lie group and Lie algebra homomorphisms,
4. determine the exponenetial coordinates of a Lie group,
5. apply the Campbell-Baker-Hausdorff formula,
6. find irreducible representations of some classical Lie groups and Lie algebras,
7. apply the theory to problems in mathematics and physics.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="7">1. Matrix Lie grups: definition and examples (2 hours)
2. Isometry groups of bilinear forms, the Heisenberg group (2 hours)
3. Lie algebras: definition and examples (2 hours)
4. Lie algebra of a matrix Lie group (2 hours)
5. The exponential map (3 hours)
6. The Campbell-Baker-Hausdorff formula (3 hours)
7. The exponential coordinates of a Lie group (2 hours)
8. Homomorphisms of Lie groups and coverings (2 hours)
9. Homomorsphism of Lie algebras, the adjoint representation (2 hours)
10. Differentials of homomorphisms (2 hours)
11. Connection between homomorphisms Lie groups and Lie algebras (2 hours)
12. Real and comples forms of Lie algebras (2 hours)
13. Representations: definitions and examples (2 hours)
14. Connection between representations of Lie groups and Lie algebras (2 hours)
15. Equivalent representations, representations of complexified Lie algebras (2 hours)</td></tr>
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	16. Shur's lemma, the intertwining map (2 hours) 17. Irreducible representatins of SU(2) (3 hours) 18. Unitary representations of the Heisenberg group (1 hour) 19. Irredubile representations of su(2) and sl(2,C) (3 hours) 20. Representations of SO(3) (2 hours) 21. Applications to physics (2 hours) The following topics are elaborated throught the seminar (student chooses one topic): 1. Applications to physics: Poisson brackets and quantisation, boson and fermion operators, harmonic oscillator and angular momentum in quantum mechanics. 2. Semisimple Lie algebras, Cartan's criterion
Format of instruction	Lectures and seminar.
Student responsibilities	Class attendance, presentation of written or oral seminar.
Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance: 2 ECTS Seminar: 1 ECTS Final exam: 2 ECTS
Grading and evaluating student work in class and at the final exam	Seminar and final exam.
Required literature (available in the library and via other media)	B.C. Hall, Lie Groups, Lie Algebras, and Reprezentations, Springer-Verlag, 2003.
Optional literature (at the time of submission of study programme proposal)	1. W. Rossman, Lie Groups: An Introduction Through Linear Groups, Oxford University Press, 2002. 2. R. Gilmore, Lie Groups, Physics, and Geometry, Cambridge University Press, 2008. 3. R. Goodman, N.R. Wallach, Symmetry, Representations, and Invariants, Springer-Verlag, 2009.

Quality assurance methods that ensure the acquisition of exit competences	Anonymous student evaluations at the end of semester according to the regulations of the University of Split.
Other (as the proposer wishes to add)	