Z1-PU7	WYDANIE N1	Strona 1 z 3

(*faculty stamp*)

COURSE DESCRIPTION

1.Course title :VECTORS, TENSORS AND FIELDS	**2. Course code**
3. Validity of course description: 2018/2019	
4. Level of studies: 1st cycle of higher education	
5. Mode of studies: intramural studying	
6. Field of study: MATHEMATICS	(FACULTY SYMBOL) RMS
7. Profile of studies: pan-academic	
8. Programme: all	
9. Semester:IV, 1st cycle of higher education	
10. Faculty teaching the course: Institute of Mathematics	
11. Course instructor: **dr hab. Edward Kwaśniewicz**	
12. Course classification: a limited selection of items (monographic lecture)	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Knowledge of the basics of differential and integral calculus	
16. Course objectives: Learning the basic computational methods of vector and tensor calculus. Learning the basics of the theory of scalar and vector fields	

17. Description of learning outcomes:

Student who has completed the subject:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knows and understands the definition of vector spaces, knows definition of the dot and cross products and multiple vector products.	Test	lecture class	K1A_W02 K1A_U01
2.	Knows what are the equivalent bases, knows how to express vector in different bases, can apply Levi-Civita symbol and Einstein summation convention in some vector operations	Test	lecture class	K1A_W01 K1A_W02 K1A_W09 K1A_U01
3.	Knows the definition of tensors, can give some examples of tensors and can determine a rank of tensors, knows transformation rules of tensors when changing the coordinate system, can define a concept of tensor invariants, knows theorem on eigenvalues of tensors.	Test	lecture class	K1A_W01 K1A_W02 K1A_W09 K1A_W10 K1A_U01
4.	Can give examples of scalar and vector fields, understands physical meaning of the gradient, divergence and curl operators, can calculate line, surface and volume integrals of the scalar and vector fields, can apply Gauss' and Stokes' integral theorems. .	Test	lecture class	K1A_W02 K1A_W09 K1A_U01
5.	Knows examples of curvilinear systems, knows bases in these systems, knows how to present gradient, divergence and curl operators and in orthogonal curvilinear coordinate systems.	Test	lecture class	K1A_W09 K1A_W10 K1A_U01

18. Teaching modes and hours

Lecture	**Class**
Sem 5 - 30 h.	Sem 5 - 30 h

19. Syllabus description:

Semester IV :

Vector calculus: geometrical view, basis vectors, index notation, free and dummy indices, dot product, cross product, multiple scalar and vector products, Kronecker delta symbol ,Levi-Civita symbol, Einstein summation convention, linear transformation of basis, inverse transformation, examples of orthogonal transformations, product of transformations, transformation of the scalar and vector products, parity violation.

Primer on the tensor calculus: physical relations between vectors, definition of tensors, rank of tensor, examples of tensors – stress tensor, the inertia tensor, electrical conductivity tensor, transformation properties of tensors, invariants of tensors, theorem on the eigenvalues of tensors, diagonalization of a real, symmetric tensors..

Basics of field theory:. scalar field and gradient of scalar field, directional derivative, maxima and minima, Laplacian operator, divergence and curl, physical interpretation of "div" and "curl", vector operator identities, curvilinear coordinate systems, line integrals, surface integrals, volume integrals, integral definition of divergence, divergence theorem (Gauss theorem), continuity equation, sources and sinks, line integral definition of curl, Stokes' theorem, example of joint use of divergence and Stokes' theorems.

Classes. Subject of exercises coincides with the content of lectures. For exercises are solved tasks related to the theme last lectures preceding exercise

20. Examination: no

21. Primary sources:

21. Primary sources:

1. J. Peacock. Foundadions of Mathematical Physics. Vectors, Tensors and Fields (free access from Google)

2. K.F.Riley, H.P. Hobson, S.J. Bence. Mathematical Methods for Physics and Enginering, Cambridge University Press, 2006. Chapters to study: 7, 8,10, 11,26 (free access from Google)

22. Secondary sources:

1. E. Karaśkiewicz, *Zarys teorii wektorów i tensorów*, PWN, Warszawa 1976

2. **D. A. Clarke. A Primer on Tensor Calculus, Saint's Mary University, Halifax NS, Canada 2011 (free access from Google)**

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/45
2	Classes	30/45
3	Laboratory	/
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	60/90

24. Total hours: 150

25. Number of ECTS credits: 5

26. Number of ECTS credits allocated for contact hours: ?

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):0
26. Comments: **Principles of evaluation:** Test – 80 points, Overall assessment of the lessons (activity and the presence on the exercises) – 20 points. To pass, it is necessary to obtain a total of 41 points, including at least 30% of the points of each learning outcome component **.**

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*