	he module/subject			ode
Nume	rical Analysis		10	010115131010111980
Field of stu		tramural Second-cycle	Profile of study (general academic, practical) (brak)	Year /Semester
Elective path/specialty			Subject offered in:	Course (compulsory, elective)
	Struc	tural Engineering	Polish	obligatory
Cycle of st	study:		Form of study (full-time,part-time)	
	Second-c	ycle studies	part-time	
No. of hou	urs			No. of credits
Lecture:	: 16 Classes	s: 10 Laboratory: 10	Project/seminars:	3
Status of t	the course in the study	program (Basic, major, other)	(university-wide, from another field	1)
		(brak)	(b)	rak)
Education	areas and fields of sci	ence and art		ECTS distribution (number and %)
10ch'				
lechnic	cal sciences	3 100%		
	Technical scie	ences		3 100%
dr inż. email: tel. +4 Facult	nsible for subje . Tomasz Jankowiak : tomasz.jankowiak 48616652814 ty of Civil and Enviro otrowo 5 60-965 Poz	© ⊉put.poznan.pl onmental Engineering		
Droroe	illisites in term			
Freied		is of knowledge, skills an	d social competencies:	
	Knowledge	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline l implicit solution of the equations	earity, buckling, linear of motion
1		Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline	earity, buckling, linear of motion
1 2 3	Knowledge	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline l implicit solution of the equations	earity, buckling, linear of motion
1 2 : 3	Knowledge Skills Social competencies	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linea	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline l implicit solution of the equations	earity, buckling, linear of motion
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1 I 2 1 3 1 A goal is	Knowledge Skills Social competencies nptions and obj to learn and practic ring	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the fi	earity, buckling, linear of motion nite element method
1 I 2 3 3 3 A goal is engineerid	Knowledge Skills Social competencies nptions and obj to learn and practic ring Study outco	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline d implicit solution of the equations ar and nonlinear problems by the fi	earity, buckling, linear of motion nite element method
1 I 2 1 3 1 A goal is engineeri Knowle 1. The fir	Knowledge Skills Social competencies nptions and obj e to learn and practic ring Study outco edge: nite difference method	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline d implicit solution of the equations ar and nonlinear problems by the fi in solving complex nonlinear struct educational results for a	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03]
1 I 2 2 3 2 A goal is engineering Knowle 1. The fir 2. The fir	Knowledge Skills Social competencies nptions and obj e to learn and practic ring Study outco edge: nite difference method	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the fi in solving complex nonlinear struct educational results for a	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03]
1 I 2 2 3 3 A goal is engineering Knowle 1. The fir 2. The fir [K_W03,	Knowledge Skills Social competencies nptions and obj to learn and practic ring Study outco edge: nite difference method nite element method , K_W01]	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part i, its implicit and explicit approache	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline d implicit solution of the equations ar and nonlinear problems by the fi in solving complex nonlinear struct educational results for a	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems -
1 I 2 2 3 3 A goal is engineeri Market A goal is engineeri 1. The fir 2. The fir [K_W03, 3. Advan buckling]	Knowledge Skills Social competencies nptions and obj to learn and practic ring Study outco edge: nite difference method nite element method , K_W01] need numerical meth stability analysis, bas	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part i, its implicit and explicit approache	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline d implicit solution of the equations ar and nonlinear problems by the fi in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structure d dynamic problems, contact prob	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems -
1 I 2 2 3 3 A goal is engineeri Market A goal is engineeri 1. The fir 2. The fir [K_W03, 3. Advan buckling]	Knowledge Skills Social competencies nptions and obj to learn and practic ring Study outco edge: nite difference method nite element method , K_W01] need numerical meth stability analysis, bas	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ods applied to nonlinear static and	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline d implicit solution of the equations ar and nonlinear problems by the fi in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structure d dynamic problems, contact prob	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems -
1 I 2 3 3 I 3 I 4 goal is engineeri 5 I. The fir 1. The fir I. The fir 2. The fir IK-W03, 3. Advan buckling 5 Skills: 1. Solving	Knowledge Skills Social competencies options and obj to learn and practic ring Study outco edge: nite difference method , K_W01] need numerical meth stability analysis, ba	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ad problems by numerical methods	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structure d dynamic problems, contact prob hics [K_W04]	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post-
1 I 2 2 3 I A goal is engineeri Knowle 1. The fir 2. The fir [K_W03, 3. Advan buckling] Skills: 1. Solving 2. Modeli	Knowledge Skills Social competencies options and obj to learn and practic ring Study outco edge: nite difference method , K_W01] need numerical meth stability analysis, ba	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies iectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ad splied to nonlinear static and asics of computational fluid dynamic al problems by numerical methods ment method advanced boundary in	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structures d dynamic problems, contact prob hics [K_W04] - [K_U04, K_U06] and initial-boundary problems - [I	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post- k_U06, K_U04]
1 I 2 2 3 3 A goal is engineeri A goal is engineeri I. The fir 2. The fir [K_W03, 3. Advan buckling] Skills: 1. Solving 2. Modeli 3. Usage	Knowledge Skills Social competencies nptions and obj e to learn and practic ring Study outco edge: nite difference method nite element method , K_W01] need numerical meth stability analysis, base of a commercial fin	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies iectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher adds applied to nonlinear static and asics of computational fluid dynamic al problems by numerical methods ment method advanced boundary ite element program to practical co	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structure d dynamic problems, contact prob hics [K_W04]	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post- k_U06, K_U04]
1 I 2 3 3 Assum A goal is engineering Knowle 1. The fir 2. The fir [K_W03, 3. Advan buckling : Skills: 1. Solving : Skills: 1. Solving : Scial	Knowledge Skills Social competencies ptions and obj to learn and practic ring Study outco edge: nite difference method ite element method K_W01] need numerical meth stability analysis, bas g advanced practica ling by the finite elem e of a commercial fin competencies:	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ods applied to nonlinear static and asics of computational fluid dynamic al problems by numerical methods nent method advanced boundary ite element program to practical c	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structures d dynamic problems, contact prob itcs [K_W04] - [K_U04, K_U06] and initial-boundary problems - [k	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post- K_U06, K_U04] K_U18]
1 I 2 3 3 3 A goal is engineering Knowled 1. The fir 2. The fir [K_W03, 3. Advan buckling Skills: 1. Solving 3. Usage Social 1. Studer	Knowledge Skills Social competencies ptions and obj to learn and practic ring Study outco edge: nite difference method , K_W01] need numerical meth stability analysis, base of a commercial fin competencies: nt understands need	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ods applied to nonlinear static and asics of computational fluid dynamic al problems by numerical methods nent method advanced boundary is ite element program to practical constructions solving the oreal solving theore	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structures, applied to solving nonlinear struc	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post- k_U06, K_U04] k_U18] blems - [K_K03]
1 I 2 3 3 3 A goal is engineering Knowld 1. The fir 2. The fir [K_W03, 3. Advan buckling] Skills: 1. Solving 2. Modeli 3. Usage Social 1. Studer 2. Studer	Knowledge Skills Social competencies options and obj to learn and practic ring Study outco edge: nite difference method , K_W01] need numerical meth stability analysis, ba og advanced practical ling by the finite elem to f a commercial fin competencies: nt understands need nt is aware of needs	Basics of partial differential equa method ? Plain stress, plane str dynamic, nonlinear :explicit and Solving static and dynamic linear Social competencies ectives of the course: e using the finite element method mes and reference to the od applied to solving nonlinear part , its implicit and explicit approacher ods applied to nonlinear static and asics of computational fluid dynamic al problems by numerical methods nent method advanced boundary is ite element program to practical constructions solving the oreal of the courses and the solving theore	ations, basics of nonlinear structu ain, 3d, shells, geometrical nonline implicit solution of the equations ar and nonlinear problems by the find in solving complex nonlinear struct educational results for a rtial differential equations - [K_W0 es, applied to solving nonlinear structures, applied to solving nonlinear struc	earity, buckling, linear of motion nite element method ctural problems in civil field of study 1, K_W03] uctural problems - lems, buckling and post- k_U06, K_U04] k_U18] blems - [K_K03]

Course grading: Lectures - end-term exam, Laboratory - evaluation	of the exercises and the final te	st
Course desc	ription	
Physical nonlinearity. Constitutive modelling in civil engineering (for of the experiments and computer simulations in description of the d strain rates condition. Using of the computer simulation to describe impacts, explosions and floods. The coupling problems (thermo-me temperatures (fire). The contact conditions. The basics of the fluid	ynamic behaviour of the materia the behaviour of the structure for chanical) ? the behaviour of the	al and structure in high or unique loadings as structure at elevated
Basic bibliography:		
Additional bibliography:		
Result of average stud	lent's workload	
Activity	Time (working hours)	
1. Lectures		16
2. Labs	10	
3. Final exam		24
Student's wo	rkload	
Source of workload	hours	ECTS
Total workload	50	3
Contact hours	26	2
Practical activities	24	1