Opasraportti

Computer Science and Engineering (2016 - 2017)

Degree Programme in Computer Science and Engineering

Programme Structure Diagram of Degree Programme in Computer Science and Engineering is here: Bachelor of Science (Technology) and Master of Science (Technology). Programme Director of Degree Programme is Janne Heikkilä.

Programme Structure Diagram of Master's Programme in Computer Science and Engineering (2 year) is here.

International Master's Programme in Computer Science and Engineering, Programme Structure Diagram is here.

International Master's Programme in Biomedical Engineering: Signal and Image Processing Programme Structure Diagram is here.

Study Advising

In the Degree Programme in Computer Science and Engineering, your student counsellor is Varpu Pitkänen: study.itee(at)oulu.fi

Tutor Teachers and Student Tutors

Everyone new student is appointed tutor teacher and student tutor in Univeristy of Oulu. Tutor Teachers of Degree Programme in Computer Science and Engineering and student tutors is here.

University of Oulu

Engineering

Degree Programme in Computer Science and Engineering 2016-2017

Computer Science and Engineering, Bachelor of Science (Technology), 180 ECTS Credits

Course Structure Diagram 2016-2017

Compulsory Basic Studies, 59 ECTS cr

521002P	Orientation to Computer Science and Engineering	5.0	2.5	2.5										
031010P	Calculus I	5.0	5.0											
031078P	Matrix Algebra	5.0		5.0										
521141P	Elementary Programming	5.0	5.0											
901048Y	Second Official Language (Swedish), Written Skills	1.0			1.0									
901049Y	Second Official Language (Swedish), Oral Skills	1.0			1.0									
900081Y	Second Official Language (Finnish), Written Skills	2.0												
900082Y	Second Official Language (Finnish), Oral Skills	3.0												
031075P	Calculus II	5.0			5.0									
031021P	Probability and Mathematical Statistics	5.0			5.0									
902011P	Technical English 3	6.0					1.0	1.0	1.0	1.0	1.0	1.0		
031023P	Mathematical Structures for Computer Science	5.0					5.0							
031077P	Complex analysis	5.0					5.0							
030005P	Information Skills	1.0								1.0				
031076P	Differential Equations	5.0				5.0								
761113P	Electricity and magnetism	5.0							5.0					
Compulsory Intermediate Studies, 71 ECTS cr														
521109A	Electrical Measurement Principles	5.0	5.0											
521301A	Digital Techniques 1	8.0			4.0	4.0								
521150A	Introduction to Internet	5.0				5.0								
521286A	Computer Systems	8.0					4.0	4.0						
521457A	Software Engineering	5.0							5.0					
521145A	Human-Computer Interaction	5.0		5.0										
811312A	Data Structures and Algorithms	5.0						5.0						
031080A	Signal Alalysis	5.0						5.0						
521453A	Operating Systems	5.0								5.0				
521495A	Artificial Intelligence	5.0											5.0	
521337A	Digital Filters	5.0							5.0					
521467A	Digital Image Processing	5.0									5.0			
521330A	Telecommunication Engineering	5.0								5.0				
Bachelorâ€™s Thesis, 10 ECTS cr														
523991A	Bachelor's Thesis / Information Engineering	8.0											4.0	4.0

900060A	Technical Communication	2.0	1.0	1.0				
Preparatory Module for the Orientation 10 ECTS cr (only one module is selected)								
1. Information Processing Engineering:								
521484A	Statistical Signal Processing	5.0						5.0
031022P	Numerical Analysis	5.0					5.0	
2. Applied Computing:								
521151A	Applied Computing Project I	10.0			5.0		5.0	
3. Embedded Systems:								
521302A	Circuit Theory 1	5.0						5.0
521431A	Principles of Electronics Design	5.0						5.0
Supplementary Modules 15 ECTS cr								
	Change Sublementary Studies 15 ECTS cr	15.0			5.0	5.0	5.0	
Optional Studies 15 ECTS cr: 1. Information Processing Engineering or 3. Embedded Systems								
	Change Optional Studies 15 ECTS cr	15.0			5.0	8.0	2.0	
Optional Studies 15 ECTS cr: Applied Computing								
	Change Optional Sudies 15 ECTS cr	15.0			4.0	4.0	7.0	
Preparatory Module for the Orientation: 1. Information Processing Engineering:	30.0	30.0 30.0 30.0 30.0 30.0						
Preparatory Module for the Orientation: 1. Information Processing Engineering:	60.0	60.0 60.0						
Preparatory Module for the Orientation: 2. Applied Computing	30.0	30.0 30.0 30.0 30.0 30.0						
Preparatory Module for the Orientation: 2. Applied Computing	60.0	60.0 60.0						
Preparatory Module for the Orientation: 3. Embedded Systems	30.0	30.0 30.0 30.0 30.0 30.0						
Preparatory Module for the Orientation: 3. Embedded Systems	60.0	60.0 60.0						

SUPPLEMENTARY MODULES 2016-2017

Supplementary Module 15 ECTS cr

	Change Sublementary Studies 15 ECTS cr Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embedded Systems). In this case one additional course of 5 ECTS cr from the same field should be selected to complement the module.	15.0

Supplementary Module: 1. Information Processing Engineering, 15 ECTS cr						
521484A	Statistical Signal Processing	5.0				0.0
031022P	Numerical Analysis	5.0			0.0	
	Optional course	5.0				
Supplementary Module: 2. Applied Computing 15 ECTS cr						
521151A	Applied computing project I	10.0	0.0		0.0	
	Optional course	5.0				
Supplementary Module: 3. Embedded Systems 15 ECTS cr						
521302A	Circuit Theory 1	5.0			0.0	
521431A	Principles of Electronics Design	5.0			0.0	
	Optional course	5.0				
Another Supplementary Module						
Supplementary Module: 4. Electrical Engineering, 15 ECTS cr						
521302A	Circuit Theory 1	5.0				0.0
521431A	Principles of Electronics Design	5.0				0.0
521077P	Introduction to Electronics	5.0		0.0		
521329A	Hands-on Course in Wireless Communication	5.0	0.0			
521104P	Introduction to Material Physics	5.0			0.0	
521071A	Principles of Semiconductor Devices	5.0				0.0
521303A	Circuit Theory 2	5.0		0.0		
521432A	Electronics Design I	5.0	0.0			
521404A	Digital Techniques 2	5.0		0.0		
521384A	Basics in Radio Engineering	5.0	0.0			
521070A	Introduction to Microfabrication Techniques	5.0		0.0		
521304A	Filters	5.0			0.0	
521092A	Electronic Measurement Techniques	5.0				0.0
521307A	Laboratory Exercises on Analogue Electronics	5.0	0.0	0.0		
521484A	Statistical Signal Processing	5.0				0.0
Supplementary Module: 5. Information Processing Science, 15 ECTS cr						
810136P	Introduction to information processing sciences	5.0	0.0	0.0		
811122P	Introduction to Programming	5.0	0.0	0.0		
813316A	Business Process Modeling	5.0				0.0
811177P	Humans as Users and Developers of Information Technology	5.0		0.0		
811375A	User Interface Programming	5.0	0.0	0.0		
811379A	Introduction to Human-computer Interaction	5.0			0.0	
815345A	Software architectures	5.0			0.0	0.0
811174P	Introduction to Software Business	5.0				0.0
812341A	Object-oriented Programming	5.0				0.0
812342A	Object Oriented Analysis and Design	5.0	0.0			
812305A	Information Systems in Organizations	5.0		0.0		
811167P	Introduction to Information Systems Design	5.0			0.0	
812332A	Information systems planning	5.0		0.0		

811394A	Database systems	5.0				0.0
811395A	Basics of Databases	5.0			0.0	
810122P	Computer Architecture	5.0			0.0	
811168P	Information Security	5.0	0.0			
811391A	Requirements Engineering	5.0		0.0		
Supplementary Module: 6. Industrial Engineering and Management, 15 ECTS cr						
555225P	Basics of industrial engineering and management	5.0	0.0	0.0		
555285A	Project management	5.0	0.0			
555242A	Product development	5.0	0.0			
555286A	Process and quality management	5.0				0.0
555264P	Managing well-being and quality of working life	5.0			0.0	0.0
Supplementary Module: 7. Working life & Entrepreneurship, 15 ECTS cr						
910001S	Working Life and Studies	5.0	0.0	0.0		
910002S	Toward Entrepreneurial Mindsets	5.0	0.0			
910003S	Building Business through Creativity and Collaboration	5.0		0.0		
910004S	Turning Opportunities to Business	5.0			0.0	0.0
910005S	Entrepreneurial Field Project	5.0	0.0	0.0	0.0	0.0
Supplementary Module: 8. Economics and Management *, 15 ECTS cr						
	* The module is intended only for students of Applied Computing (in MSc).	0.0				
724103P	Strategic Management	5.0	0.0			
724105P	Management Accounting	5.0	0.0			
724106P	Principles of Marketing	5.0			0.0	
724109P	Investment Decisions	5.0		0.0		
724110P	Introductory Economics	5.0	0.0			
Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embed						
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University of Oulu

Engineering

Master's Programme in Computer Science and Engineering 2016-2017

Computer Science and Engineering, Master of Science (Technology), 120 ECTS Credits

I Information Processing Engineering Orientation

Information Processing Engineering Orientation, Basic Module, 35 ECTS cr										
031025A	Introduction to Optimization	5.0	5.0							
813621S	Research Methods	5.0	2.5	2.5						
521466S	Machine Vision	5.0			5.0					
521289S	Machine Learning	5.0			5.0					
521279S	Signal Processing Systems	5.0	5.0							
521288S	Multiprocessor Programming	5.0			2.5	2.5				
521260S	Programmable Web Project	5.0			2.5	2.5				
Information Processing Engineering Orientation, Advanced Modules (only one module is selected), 35 ECTS cr										
Advanced Module: 1. Signal Processing / Obligatory Courses, 15 ECS cr:										
521404A	Digital Techniques 2	5.0		5.0						
521281S	Application Specific Signal Processors	5.0					5.0			
521321S	Elements of Information Theory and Coding	5.0						5.0		
Advanced Module: 1. Signal Processing / Optional Courses, 20 ECTS cr:										
	Choose from the following courses total 20 ECTS cr	20.0	4.0	4.0		7.0		5.0		
521323S	Wireless Communications I	5.0		0.0				0.0		
521273S	Biosignal Processing I	5.0		0.0				0.0		
477607S	Advanced Control and Systems Engineering	5.0			0.0				0.0	
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521324S	Communication Signal Processing I	5.0			0.0				0.0	
521493S	Computer Graphics	7.0				0.0				0.0
521445S	Digital Techniques 3	6.0			0.0	0.0			0.0	0.0
521325S	Communication Signal Processing II	5.0	0.0				0.0			
Advanced Module: 2. Intelligent Systems / Obligatory Courses, 12 ECTS cr:										
521493S	Computer Graphics	7.0				7.0				
521285S	Affective Computing	5.0					5.0			
Advanced Module: 2. Intelligent Systems / Optional Courses, 23 ECTS cr:										
	Choose from the following courses total 23 ECTS cr	23.0	8.0	5.0			5.0	5.0		

521290S	Distributed Systems	5.0			0.0				0.0	
477624S	Control System Methods	5.0	0.0				0.0			
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521273S	Biosignal Processing I	5.0		0.0				0.0		
477607S	Advanced Control and Systems Engineering	5.0			0.0				0.0	
802633S	Statistical Pattern Recognition	10.0			0.0	0.0			0.0	0.0
521283S	Big Data Processing and Applications	5.0				0.0				0.0
477525S	Computational intelligence in automation	5.0		0.0				0.0		
Advanced Module: 3. Biomedical Engineering / Obligatory Courses, 10 ECS cr:										
521273S	Biosignal Processing I	5.0		5.0						
521282S	Biosignal Prosessing II	5.0				5.0				
Advanced Module: 3. Biomedical Engineering / Optional Courses, 25 ECS cr:										
	Choose from the following courses total 25 ECTS cr	25.0	4.0	4.0		2.0	10.0	5.0		
580402S	Biomedical Imaging Methods	1.0-5.0			0.0	0.0			0.0	0.0
764634S	Medical physics and imaging	6.0	0.0				0.0			
757314A	Basics of bioinformatics	5.0	0.0	0.0			0.0	0.0		
521285S	Affective Computing	5.0					0.0			
521284S	Biomedical Engineering Project	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521093S	Biomedical Instrumentation	5.0			0.0				0.0	
521097S	Wireless Measurements	5.0			0.0				0.0	
Supplementary Module, 17 ECTS cr *										
	Supplementary Module * Supplementary module can include for example courses from the basic module of another orientation.	17.0	2.0				10.0	5.0		
Common Obligatory Courses, 33 ECTS cr										
521013A	Advanced Practical Training	3.0			3.0					
521993S	Master's Thesis in Computer Engineering	30.0							10.0	20.0
Information Processing Engineering Orientation: 1. Advanced Module, Signal Processing	30.0	30.0	30.0	30.0						
Information Processing Engineering Orientation: 1. Advanced Module, Signal Processing	60.0	60.0								
Information Processing Engineering Orientation: 2. Advanced Module, Intelligent Systems	30.0	30.0	30.0	30.0						
Information Processing Engineering Orientation: 2. Advanced Module, Intelligent Systems	60.0	60.0								
Information Processing Engineering Orientation: 3. Advanced Module,	30.0	30.0	30.0	30.0						

Biomedical Engineering										
Information Processing Engineering Orientation: 3. Advanced Module, Biomedical Engineering	60.0	60.0								
II Applied Computing Orientation										
Basic Module, 37 ECTS cr										
521148S	Ubiquitous Computing Fundamentals	5.0	2.5	2.5						
813621S	Research Methods	5.0	2.5	2.5						
811395A	Basics of Databases	5.0			5.0					
521290S	Distributed Systems	5.0			5.0					
521147S	Mobile and Social Computing	5.0			5.0					
521260S	Programmable Web Project	5.0			2.5	2.5				
521479S	Software Project	7.0	3.5	3.5						
Advanced Modules, 35 ECTS cr										
Advanced Module: 1. Applied Computing Technology, Obligatory Courses, 10 ECTS cr										
521152S	Applied Computing Project II	10.0					2.5	2.5	2.5	2.5
Advanced Module: 1. Applied Computing Technology / Optional Courses, 25 ECTS cr										
	Choose from the following courses total 25 ECTS cr	25.0	8.0	5.0	7.0					5.0
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
812342A	Object Oriented Analysis and Design	5.0	0.0				0.0			
812341A	Object-oriented Programming	5.0				0.0				0.0
812331A	Interaction Design	5.0	0.0				0.0			
815657S	Open Source Software Development	5.0	0.0	0.0			0.0	0.0		
815305A	Real Time Distributed Software Development	5.0	0.0	0.0			0.0	0.0		
817603S	System Design Methods for Information Systems	5.0	0.0				0.0			
813625S	Information Systems Theory	5.0	0.0	0.0			0.0	0.0		
521283S	Big Data Processing and Applications	5.0				0.0				0.0
521493S	Computer Graphics	7.0				0.0				0.0
521285S	Affective Computing	5.0	0.0				0.0			
Advanced Module: 2. Applied Computing Business / Obligatory Courses, 10 ECTS cr										
		0.0								
724206A	Strategic Marketing Management	5.0				5.0				
724201A	Internationalization	5.0		5.0						
Advanced Module: 2. Applied Computing Business / Optional Courses, 25 ECTS cr										
	Choose from the following courses total 25 ECTS cr	0.0	3.0	5.0	2.0		5.0		5.0	5.0
806118P	Introduction to Statistics	5.0			0.0				0.0	
806119P	A Second Course in Statistics	5.0				0.0				0.0
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

555314S	Management Information Systems	5.0			0.0	0.0			0.0	0.0
724050A	Bachelor Thesis	10.0			0.0	0.0			0.0	0.0
724202A	Managing Multinationals	5.0			0.0				0.0	
724203A	Financial Statement Analysis	5.0	0.0				0.0			
724204A	Management Control	5.0			0.0				0.0	
724207A	Financial Decisions	5.0			0.0				0.0	
724208A	Portfolio Theory	5.0	0.0				0.0			
724209A	Monetary Economics	5.0	0.0				0.0			
724210A	Global Economics	5.0		0.0				0.0		
724205A	Distribution and Retail Management	5.0				0.0				0.0
Supplementary Module										
	Supplementary module can include for example courses from the basic module of another orientation.	15.0					10.0	5.0		
Common Obligatory Courses										
521013A	Advanced Practical Training	3.0			3.0					
521993S	Master's Thesis in Computer Engineering	30.0						10.0	10.0	10.0
Applied Computing Orientation: Advanced Module, 1. Applied Computing Technology	30.0	30.0	30.0	30.0						
Applied Computing Orientation: Advanced Module, 1. Applied Computing Technology	60.0	60.0								
Applied Computing Orientation: Advanced Module, 2. Applied Computing Business	30.0	30.0	30.0	30.0						
Applied Computing Orientation: Advanced Module, 2. Applied Computing Business	60.0	60.0								
III Embedded Systems Orientation										
Basic Module 32 ECTS cr										
521404A	Digital Techniques 2	5.0		5.0						
521340S	Communication Networks I	5.0		5.0						
521288S	Multiprocessor Programming	5.0			2.5	2.5				
521479S	Software Project	7.0	3.5	3.5						
521423S	Embedded System Project	5.0			2.5	2.5				
521279S	Signal Processing Systems	5.0	5.0							
Advanced Modules: 1. Embedded Systems Electronics / Obligatory Courses, 21 ECTS cr										
521281S	Application Specific Signal Processors	5.0					5.0			
521303A	Circuit Theory 2	5.0		5.0						
521431A	Principles of Electronics Design	5.0				5.0				
521445S	Digital Techniques 3	6.0			3.0	3.0				
Advanced Modules: 1. Embedded Systems Electronics / Optional Courses, 14 ECTS cr										
	Choose from the following courses total 14 ECTS cr	14.0	3.0		6.0		5.0			

813621S	Research Methods	5.0	0.0	0.0			0.0	0.0		
521405A	Electronic System Design	5.0	0.0				0.0			
521323S	Wireless Communications I	5.0		0.0				0.0		
521443S	Electronics Design II	5.0	0.0				0.0			
521088S	Optoelectronics	5.0			0.0				0.0	
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521484A	Statistical Signal Processing	5.0				0.0				0.0
521385S	Mobile Telecommunication Systems	5.0		0.0				0.0		
521304A	Filters	5.0			0.0				0.0	
521328A	Simulations and Tools for Telecommunications	5.0		0.0				0.0		
Advanced Modules: 2. Embedded Systems Software / Obligatory Courses, 10 ECTS cr										
521290S	Distributed Systems	5.0			5.0					
521260S	Programmable Web Project	5.0			2.5	2.5				
Advanced Modules: 2. Embedded Systems Software / Optional Courses, 25 ECTS cr										
	Choose from the following courses total 25 ECTS cr	25.0	4.0	4.0	5.0	2.0	5.0	5.0		
813621S	Research Methods	5.0	0.0	0.0			0.0	0.0		
812342A	Object Oriented Analysis and Design	5.0	0.0				0.0			
812341A	Object-oriented Programming	5.0				0.0				0.0
521323S	Wireless Communications I	5.0		0.0				0.0		
521489S	Research Work on Information Processing	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521281S	Application Specific Signal Processors	5.0	0.0				0.0			
521328A	Simulations and Tools for Telecommunications	5.0		0.0				0.0		
Supplementary Module, 20 ECTS cr										
	Supplementary module can include for example courses from the basic module of another orientation.	20.0					10.0	10.0		
Common Obligatory Courses, 33 ECTS cr										
521013A	Advanced Practical Training	3.0				3.0				
521993S	Master's Thesis in Computer Engineering	30.0							15.0	15.0
Advanced Modules, 1. Embedded Systems Electronics	30.0	30.0	30.0	30.0						
Advanced Modules, 1. Embedded Systems Electronics	60.0	60.0								
Advanced Modules: 2. Embedded Systems Software	30.0	30.0	30.0	30.0						
Advanced Modules: 2. Embedded Systems Software	60.0	60.0								

University of Oulu

Engineering

Master's Programme in Computer Science and Engineering 2016-2017

Computer Science and Engineering, Master of Science (Technology), 120 ECTS

Basic Module, 20 ECTS cr										
900017Y	Survival Finnish Course	2.0	2.0							
900013Y	Beginners' Finnish Course 1	3.0		3.0						
813621S	Research Methods	5.0		5.0						
521145A	Human-Computer Interaction	5.0		5.0						
521260S	Programmable Web Project	5.0			2.5	2.5				
Specialisation Options (only one options is selected), 67 ECTS cr										
Specialisation Options, 1. Computer Vision and Signal Processing , Compulsory Courses 52 ECTS cr										
521279S	Signal Processing Systems	5.0	5.0							
521321S	Elements of Information Theory and Coding	5.0						5.0		
031025A	Introduction to Optimization	5.0	5.0							
521466S	Machine Vision	5.0			5.0					
521289S	Machine Learning	5.0			5.0					
521493S	Computer Graphics	7.0				7.0				
521281S	Application Specific Signal Processors	5.0					5.0			
521288S	Multiprocessor Programming	5.0			2.5	2.5				
521285S	Affective Computing	5.0					5.0			
521273S	Biosignal Processing I	5.0		5.0						
Specialisation Options, 1. Computer Vision and Signal Processing , Recommended Optional Studies, 15 ECTS cr										
	Selected 15 ECTS credits	15.0					5.0		5.0	5.0
521495A	Artificial Intelligence	5.0							0.0	
521337A	Digital Filters	5.0							0.0	
521484A	Statistical Signal Processing	5.0								0.0
521147S	Mobile and Social Computing	5.0							0.0	0.0

521467A	Digital Image Processing	5.0					0.0			
521489S	Research Work on Information Processing	8.0					0.0	0.0		
521148S	Ubiquitous Computing Fundamentals	5.0					0.0	0.0		
521283S	Big Data Processing and Applications	5.0				0.0				0.0
Specialisation Options, 2. Ubiquitous Computing , Compulsory Courses 50 ECTS cr										
521148S	Ubiquitous Computing Fundamentals	5.0	2.5	2.5						
521151A	Applied Computing Project I	10.0	2.5	2.5	2.5	2.5				
521147S	Mobile and Social Computing	5.0			2.5	2.5				
521290S	Distributed Systems	5.0			5.0					
521152S	Applied Computing Project II	10.0					2.5	2.5	2.5	2.5
812331A	Interaction Design	5.0	5.0							
812650S	Advanced Topics in Human-Centred Design	5.0			5.0					
521283S	Big Data Processing and Applications	5.0				5.0				
Specialisation Options, 2. Ubiquitous Computing , Recommended Optional Studies, 17 ECTS cr										
	Selected 17 ECTS credits	17.0					6.0	6.0	2.5	2.5
521479S	Software Project	7.0					0.0	0.0		
521149S	Special Course in Information Technology	5.0-8.0					0.0	0.0	0.0	0.0
521489S	Research Work on Information Processing	8.0					0.0	0.0	0.0	0.0
521154S	UBISS - International UBI Summer School	5.0				0.0				0.0
815657S	Open Source Software Development	5.0					0.0	0.0		
815305A	Real Time Distributed Software Development	5.0					0.0	0.0		
817603S	System Design Methods for Information Systems	5.0					0.0			
813625S	Information Systems Theory	5.0					0.0	0.0		
521423S	Embedded System Project	5.0							0.0	0.0
521286A	Computer Systems	8.0					0.0	0.0		
521275A	Embedded Software Project	8.0						0.0	0.0	
812671S	Usability Testing (or 812650S)	5.0							0.0	0.0
Common 1. Compulsory, Computer Vision and Signal Processing, 33 ECTS cr										
	Advanced Practical									

[521013A]()	Training	3.0			3.0				
[521993S]()	Master's Thesis in Computer Engineering	30.0				5.0	5.0	10.0	10.0
Common 2. Ubiquitous Computing, 33 ECTS cr									
[521013A]()	Advanced Practical Training	3.0				3.0			
[521993S]()	Master's Thesis in Computer Engineering	30.0				5.0	5.0	10.0	10.0

1. Computer Vision and Signal Processing	30.0	30.0	30.0	30.0
1. Computer Vision and Signal Processing	60.0	60.0		
2. Ubiquitous Computing	30.0	30.0	30.0	30.0
2. Ubiquitous Computing	60.0	60.0		

University of Oulu

Engineering

Master's Programme in Biomedical Engineering: Signal and Image Processing 2016-2017

Biomedical Engineering: Signal and Image Processing, Master ofScience (Technology), 120 ECTS

Basic Module, Compulsory Courses										
[521273S]()	Biosignal Processing I	5.0		5.0						
[521282S]()	Biosignal Prosessing II	5.0				5.0				
[521149S]()	Special Course in Information Technology	5.0	5.0							
[521284S]()	Biomedical Engineering Project	5.0					2.5	2.5		
[580402S]()	Biomedical Imaging Methods	5.0			2.5	2.5				
[764634S]()	Medical physics and imaging	6.0	6.0							
[041201A]()	Basics in eHealth	5.0		5.0						
[521285S]()	Affective Computing	5.0					5.0			
[521289S]()	Machine Learning	5.0			5.0					
[521093S]()	Biomedical Instrumentation	5.0			5.0					
[813621S]()	Research Methods	5.0		5.0						
Recommended Optional Studies										
	Selected 31 ECTS credits	31.0	4.0	0.0	2.5	4.5	7.5	2.5	5.0	5.0
[900017Y]()	Survival Finnish Course	2.0	0.0							
[900013Y]()	Beginners' Finnish Course 1	3.0		0.0						
[900053Y]()	Beginners' Finnish Course 2	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
[521279S]()	Signal Processing Systems	5.0	0.0				0.0			

521124S	Sensors and Measuring Techniques	5.0	0.0				0.0			
031025A	Introduction to Optimization	5.0	0.0				0.0			
521288S	Multiprocessor Programming	5.0			0.0	0.0			0.0	0.0
521337A	Digital Filters	5.0			0.0				0.0	
521493S	Computer Graphics	7.0				0.0				0.0
521466S	Machine Vision	5.0			0.0				0.0	
521495A	Artificial Intelligence	5.0			0.0	0.0			0.0	0.0
521283S	Big Data Processing and Applications	5.0				0.0				0.0
521097S	Wireless Measurements	5.0			0.0				0.0	
521484A	Statistical Signal Processing	5.0				0.0				0.0
764664S	Analysis and simulation of biosystems	6.0		0.0				0.0		
080916S	Biomechanics of Human Movement	5.0			0.0	0.0			0.0	0.0
521149S	Special Course in Information Technology	5.0-8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521240S	Biophotonics and Biomedical Optics	5.0		0.0				0.0		
Common Compulsory, 33 ECTS cr										
521013A	Advanced Practical Training	3.0				3.0				
522987S	Master's Thesis in Biomedical Engineering	30.0						10.0	10.0	10.0
Sum	30.0	30.0	30.0	30.0						
Sum	60.0	60.0								

Tutkintorakenteet

International Master's Programme in Biomedical Engineering: Signal and Image Processing (BME-SIP)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Basic Module, Compulsory Courses (56 op)

521149S Special Course in Information Technology and 580402S Biomedical Imaging Methods:Required amount of credits is 5 ECTS!

521285S: Affective Computing, 5 op
521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op
041201A: Basics in eHealth, 5 op
521284S: Biomedical Engineering Project, 5 op
580402S: Biomedical Imaging Methods, 1 - 5 op
521093S: Biomedical Instrumentation, 5 op
521273S: Biosignal Processing I, 5 op
521282S: Biosignal Processing II, 5 op
521289S: Machine Learning, 5 op
764634S: Medical physics and imaging, 5 op
813621S: Research Methods, 5 op

Recommended Optional Studies (31 op)

A452294: Biomedical Engineering: Signal and Image Processing (BME-SIP), advanced module, optional studies, 31 op

BME-SIP, optional studies, 31 ECTS cr

900013Y: Beginners' Finnish Course 1, 3 op
900053Y: Beginners' Finnish Course 2, 5 op
521279S: Signal Processing Systems, 5 op
521124S: Sensors and Measuring Techniques, 5 op
031025A: Introduction to Optimization, 5 op
521288S: Multiprocessor Programming, 5 op
521337A: Digital Filters, 5 op
521493S: Computer Graphics, 7 op
521466S: Machine Vision, 5 op
521495A: Artificial Intelligence, 5 op
521283S: Big Data Processing and Applications, 5 op
521097S: Wireless Measurements, 5 op
764664S: Analysis and simulation of biosystems, 6 op
080916S: Biomechanics of Human Movement, 5 op
521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op
521240S: Biophotonics and Biomedical Optics, 5 op

Common Compulsory (33 op)

The Master's Thesis requires a written maturity test.

521013A: Advanced Practical Training, 3 op
522987S: Master's Thesis in Biomedical Engineering, 30 op
521009S: The Maturity Test for Master`s Degree, 0 op

International Master's Programme in Computer Science and Engineering 2016-

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Basic Module (20 op)

900013Y: Beginners' Finnish Course 1, 3 op
521145A: Human-Computer Interaction, 5 op
521260S: Programmable Web Project, 5 op
813621S: Research Methods, 5 op
900017Y: Survival Finnish Course, 2 op

Specialisation Options, Compulsory Courses (50 - 52 op)

Computer Vision and Signal Processing

521285S: Affective Computing, 5 op
521281S: Application Specific Signal Processors, 5 op
521273S: Biosignal Processing I, 5 op
521493S: Computer Graphics, 7 op
521321S: Elements of Information Theory and Coding, 5 op

031025A: Introduction to Optimization, 5 op
521289S: Machine Learning, 5 op
521466S: Machine Vision, 5 op
521288S: Multiprocessor Programming, 5 op
521279S: Signal Processing Systems, 5 op

Ubiquitous Computing

812650S: Advanced Topics in Human-Centred Design, 5 op
521151A: Applied Computing Project I, 10 op
521152S: Applied Computing Project II, 10 op
521283S: Big Data Processing and Applications, 5 op
521290S: Distributed Systems, 5 op
812331A: Interaction Design, 5 op
521147S: Mobile and Social Computing, 5 op
521148S: Ubiquitous Computing Fundamentals, 5 op

Specialisation Options, Recommended Optional Studies (15 - 17 op)

Computer Vision and Signal Processing

A452291: Computer Vision and Signal Processing, advanced module, optionals, 10 - 20 op
optionals
- 521495A: Artificial Intelligence, 5 op
- 521337A: Digital Filters, 5 op
- 521484A: Statistical Signal Processing, 5 op
- 521147S: Mobile and Social Computing, 5 op
- 521467A: Digital Image Processing, 5 op
- 521489S: Research Work on Information Processing, 8 op
- 521148S: Ubiquitous Computing Fundamentals, 5 op
- 521283S: Big Data Processing and Applications, 5 op

Ubiquitous Computing

A452292: Ubiquitous Computing, advanced module, optionals, 17 - 20 op
optionals
- 521479S: Software Project, 7 op
- 521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op
- 521489S: Research Work on Information Processing, 8 op
- 521154S: UBISS - International UBI Summer School, 5 op
- 815657S: Open Source Software Development, 5 op
- 815305A: Real Time Distributed Software Development, 5 op
- 817603S: System Design Methods for Information Systems, 5 op
- 813625S: Information Systems Theory, 5 op
- 521423S: Embedded System Project, 5 op
- 521286A: Computer Systems, 8 op
- 521275A: Embedded Software Project, 8 op
- 812671S: Usability Testing, 5 op

Common Compulsory (33 op)

521013A: Advanced Practical Training, 3 op
521993S: Master's Thesis in Computer Engineering, 30 op

MSc. Engineering, Computer Science and Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Module of the option (60 - 80 op)

Compulsory, choose one of the options (32 -37 ECTS cr). Advanced modules are approximately 35 ECTS cr in total.

Information Technology

A452221: Module of the Option, Information Technology, 34 - 35 op
  All compulsory
    031025A: Introduction to Optimization, 5 op
    813621S: Research Methods, 5 op
    521466S: Machine Vision, 5 op
    521289S: Machine Learning, 5 op
    521279S: Signal Processing Systems, 5 op
    521288S: Multiprocessor Programming, 5 op
    521260S: Programmable Web Project, 5 op

Applied computing

A452224: Module of the Option, Applied computing, 35 - 62 op
  Obligatory courses
    521148S: Ubiquitous Computing Fundamentals, 5 op
    813621S: Research Methods, 5 op
    811395A: Basics of Databases, 5 op
    521290S: Distributed Systems, 5 op
    521147S: Mobile and Social Computing, 5 op
    521260S: Programmable Web Project, 5 op
    521479S: Software Project, 7 op

Embedded Systems

A452223: Module of the Option, Embedded Systems, 30,5 - 32 op
  All compulsory
    521404A: Digital Techniques 2, 5 op
    521340S: Communications Networks I, 5 op
    521288S: Multiprocessor Programming, 5 op
    521479S: Software Project, 7 op
    521423S: Embedded System Project, 5 op
    521279S: Signal Processing Systems, 5 op

Advanced module (35 op)

Information Technology, 1. Advanced Module in Signal Processing

A452271: Advanced Module/Information Technology, Signal Processing (obligatory), 13,5 - 20 op
  Obligatory courses
    521404A: Digital Techniques 2, 5 op
    521281S: Application Specific Signal Processors, 5 op
    521321S: Elements of Information Theory and Coding, 5 op
A452272: Advanced Module/Information Technology, Signal Processing (optional), 15 - 22 op
  Optional courses: Is selected so that the advanced module size in total. 35 op
    521323S: Wireless Communications I, 5 op
    521273S: Biosignal Processing I, 5 op
    477607S: Advanced Control and Systems Engineering, 5 op
    521489S: Research Work on Information Processing, 8 op
    521324S: Statistical Signal Processing II, 5 op
    521493S: Computer Graphics, 7 op
    521445S: Digital Techniques 3, 6 op

521325S: Communication Signal Processing, 5 op

Information Technology, 2. Advanced Module in Intelligent Systems

A452273: Advanced Module/Information Technology, Intelligent Systems (obligatory), 14 - 17 op
Obligatory courses
521493S: Computer Graphics, 7 op
521285S: Affective Computing, 5 op
A452274: Advanced Module/Information Technology, Intelligent Systems (optional), 18 - 25 op
Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
521290S: Distributed Systems, 5 op
477624S: Control System Methods, 5 op
521489S: Research Work on Information Processing, 8 op
521273S: Biosignal Processing I, 5 op
477607S: Advanced Control and Systems Engineering, 5 op
802633S: Statistical Pattern Recognition, 10 op
521283S: Big Data Processing and Applications, 5 op
477525S: Computational intelligence in automation, 5 op

Information technology, Advanced Module: 3. Biomedical Information Engineering

A452275: Advanced Module/Information Technology, Biomedical Information Engineering (obligatory), 11 - 20 op
Obligatory courses
521273S: Biosignal Processing I, 5 op
521282S: Biosignal Processing II, 5 op
A452276: Advanced Module/Information Technology, Biomedical Information Engineering (optional), 20 - 24 op
Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
580402S: Biomedical Imaging Methods, 1 - 5 op
764634S: Medical physics and imaging, 5 op
757314A: Basics of bioinformatics, 5 op
521285S: Affective Computing, 5 op
521284S: Biomedical Engineering Project, 5 op
521093S: Biomedical Instrumentation, 5 op
521097S: Wireless Measurements, 5 op

(35 ECTS cr)

Applied Computing Technology, Advanced Module: 1. Applied Computing Technology

A452286: Advanced module/Applied computing technology (optional), 25 - 40 op
Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
521489S: Research Work on Information Processing, 8 op
812342A: Object Oriented Analysis and Design, 5 op
812341A: Object-Oriented Programming, 5 op
812331A: Interaction Design, 5 op
815657S: Open Source Software Development, 5 op
815305A: Real Time Distributed Software Development, 5 op
817603S: System Design Methods for Information Systems, 5 op
813625S: Information Systems Theory, 5 op
521283S: Big Data Processing and Applications, 5 op
521493S: Computer Graphics, 7 op
521285S: Affective Computing, 5 op
A452285: Advanced module/applied computing technology (obligatory), 10 - 40 op
Obligatory courses
521152S: Applied Computing Project II, 10 op

Applied Computing Technology, Advanced Module: 2. Applied Computing Business

A452287: Advanced module/Applied computing economy (obligatory), 10 - 40 op
Obligatory courses
724206A: Strategic Marketing Management, 5 op
724201A: Internationalization, 5 op
A452288: Advanced module/Applied computing economy (optional), 20 - 40 op

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
806118P: Introduction to Statistics, 5 op
806119P: A Second Course in Statistics, 5 op
521489S: Research Work on Information Processing, 8 op
555314S: Management Information Systems, 5 op
724050A: Bachelor's Thesis in Economics and Business Administration, 10 op
724202A: Managing Multinationals, 5 op
724203A: Financial Statement Analysis, 5 op
724204A: Management Control, 5 op
724207A: Financial Decisions, 5 op
724208A: Portfolio Theory, 5 op
724209A: Monetary Economics, 5 op
724210A: Global Economics, 5 op
724205A: Distribution and Retail Management, 5 op

Advanced Modules: Embedded Systems Electronics

(35 ECTS cr)

Embedded Systems, Advanced Modules: 1. Embedded Systems Electronics

A452281: Advanced Module/Embedded Systems, Embedded Systems Electronics (obligatory), 16 - 21 op
Obligatory courses
521281S: Application Specific Signal Processors, 5 op
521303A: Circuit Theory 2, 5 op
521431A: Principles of Electronics Design, 5 op
521445S: Digital Techniques 3, 6 op
A452282: Advanced Module/Embedded Systems, Embedded Systems Electronics (optional), 14 - 39 op
Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
813621S: Research Methods, 5 op
521405A: Electronic System Design, 5 op
521323S: Wireless Communications I, 5 op
521443S: Electronics Design II, 5 op
521088S: Optoelectronics, 5 op
521489S: Research Work on Information Processing, 8 op
521484A: Statistical Signal Processing, 5 op
521385S: Mobile Telecommunication Systems, 5 op
521304A: Filters, 5 op
521328A: Simulations and Tools for Telecommunications, 5 op

Embedded Systems, Advanced Modules: 2. Embedded Systems Software

A452283: Advanced Module/Embedded Systems, Embedded Systems Software (obligatory), 10 - 20 op
Obligatory courses
521266S: Distributed Systems, 6 op
521260S: Programmable Web Project, 5 op
A452284: Advanced Module/Embedded Systems, Embedded Systems Software (optional), 23 - 35 op
Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr
813621S: Research Methods, 5 op
812342A: Object Oriented Analysis and Design, 5 op
812341A: Object-Oriented Programming, 5 op
521323S: Wireless Communications I, 5 op
521489S: Research Work on Information Processing, 8 op
521281S: Application Specific Signal Processors, 5 op
521328A: Simulations and Tools for Telecommunications, 5 op

Supplementary module (15 - 30 op)

Choose optional courses so that your degree is the minimun of 120 cr.

Advanced practical training (3 op)

521013A: Advanced Practical Training, 3 op

Master's Thesis (30 op)

The Master's Thesis requires a written maturity test.

521993S: Master's Thesis in Computer Engineering, 30 op
521009S: The Maturity Test for Master`s Degree, 0 op

Degree Programme in Information Engineering, B.Sc.

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Basic and Intermediate Studies (130 op)

A452120: Basic and Intermediate Studies, Information Engineering, 120 - 150 op
- *Second official language, select 2*
  - 901048Y: Second Official Language (Swedish), Written Skills, 1 op
  - 901049Y: Second Official Language (Swedish), Oral Skills, 1 op
  - 900081Y: Second Official Language (Finnish), Written Skills, 1 - 2 op
  - 900082Y: Second Official Language (Finnish), Oral Skills, 1 - 3 op
- *Compulsory studies*
  - 521002P: Orientation to Computer Science and Engineering, 5 op
  - 031010P: Calculus I, 5 op
  - 031078P: Matrix Algebra, 5 op
  - 521141P: Elementary Programming, 5 op
  - 031075P: Calculus II, 5 op
  - 031021P: Probability and Mathematical Statistics, 5 op
  - 902011P: Technical English 3, 6 op
  - 031077P: Complex analysis, 5 op
  - 031023P: Mathematical Structures for Computer Science, 5 op
  - 030005P: Information Skills, 1 op
  - 031076P: Differential Equations, 5 op
  - 761113P: Electricity and magnetism, 5 op
- *Compulsory Intermediate Studies*
  - 521109A: Electrical Measurement Principles, 5 op
  - 521301A: Digital Techniques 1, 8 op
  - 521150A: Introduction to Internet, 5 op
  - 521286A: Computer Systems, 8 op
  - 521457A: Software Engineering, 5 op
  - 521145A: Human-Computer Interaction, 5 op
  - 811312A: Data Structures and Algorithms, 5 op
  - 031080A: Signal Analysis, 5 op
  - 521453A: Operating Systems, 5 op
  - 521495A: Artificial Intelligence, 5 op
  - 521337A: Digital Filters, 5 op
  - 521467A: Digital Image Processing, 5 op
  - 521330A: Telecommunication Engineering, 5 op
- *Complusory Bachelor's Thesis*
  - 523991A: Bachelor's Thesis / Information Engineering, 8 op
  - 900060A: Technical Communication, 2 op

Module preparing for the option (10 op)

Information Technology

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op
Compulsory studies
031022P: Numerical Analysis, 5 op
521484A: Statistical Signal Processing, 5 op

Applied computing

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op
Obligatory studies
521151A: Applied Computing Project I, 10 op

Embedded Systems

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op
Compulsory studies
521302A: Circuit Theory 1, 5 op
521431A: Principles of Electronics Design, 5 op

Optional Studies

Students can choose optional courses to complete the 15 credit. Practical training, 3 credits, can also be included. (521012A Practical Training)

521012A: Practical Training, 3 op

Supplementary modules

Recommended modules in the Finnish language study guide.

H452229: Other Supplementary Module (Computer Science and Engineering), 15 op
Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embedded Systems). In this case one additional course of 5 ECTS cr from the same field should be selected to complement the module. Another alternative is to select the supplementary module from the fields of Electrical Engineering, Information Processing Science, Industrial Engineering and Management, Working life & Entrepreneurship, or Economics and Management. In all cases the extent of the supplementary module is 15 ECTS cr.
A452121: Module Preparing for the Option, Information Technology, 10 - 30 op
Compulsory studies
031022P: Numerical Analysis, 5 op
521484A: Statistical Signal Processing, 5 op
A452149: Module Preparing for the Option, Applied computing, 10 - 30 op
Obligatory studies
521151A: Applied Computing Project I, 10 op
A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op
Compulsory studies
521302A: Circuit Theory 1, 5 op
521431A: Principles of Electronics Design, 5 op
Supplementary Module: Electrical Engineering (15 ECTS cr)
521302A: Circuit Theory 1, 5 op
521431A: Principles of Electronics Design, 5 op
521077P: Introduction to Electronics, 5 op
521329A: Hands-on Course in Wireless Communication, 5 op
521104P: Introduction to Material Physics, 5 op
521071A: Principles of Semiconductor Devices, 5 op
521303A: Circuit Theory 2, 5 op
521432A: Electronics Design I, 5 op
521404A: Digital Techniques 2, 5 op

521384A: Basics in Radio Engineering, 5 op
521070A: Introduction to Microfabrication Techniques, 5 op
521304A: Filters, 5 op
521092A: Electronic Measurement Techniques, 5 op
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521484A: Statistical Signal Processing, 5 op

Supplementary Module: Information Processing Science. (15 ECTS cr)

810136P: Introduction to Information Processing Sciences, 5 op
811122P: Introduction to Programming, 5 op
813316A: Business Process Modeling, 5 op
811177P: Humans as Users and Developers of Information Technology, 5 op
811375A: User Interface Programming, 5 op
811379A: Basics of Human Computer Interaction, 5 op
815345A: Software Architectures, 5 op
811174P: Introduction to Software Business, 5 op
812341A: Object-Oriented Programming, 5 op
812342A: Object Oriented Analysis and Design, 5 op
812305A: Information Systems in Organisations, 5 op
811167P: Introduction to Information Systems Design, 5 op
812332A: Information Systems Design, 5 op
811394A: Database systems, 5 op
811395A: Basics of Databases, 5 op
810122P: Computer Architecture, 5 op
811168P: Information Security, 5 op
811391A: Requirements Engineering, 5 op

Supplementary Module: Industrial Engineering and Management (15 ECTS cr)

555225P: Basics of industrial engineering and management, 5 op
555285A: Project management, 5 op
555242A: Product development, 5 op
555286A: Process and quality management, 5 op
555264P: Managing well-being and quality of working life, 5 op

Supplementary Module: Working life & Entrepreneurship (15 ECTS cr)

910001S: Working Life and Studies, 5 op
910002S: Toward Entrepreneurial Mindsets, 5 op
910003S: Building Business through Creativity and Collaboration, 5 op
910004S: Turning Opportunities to Business, 5 op
910005S: Entrepreneurial Field Project, 5 op

Supplementary Module: Economics and Management (15 ECTS cr) (The module is intended only for students of Applied Computing (in MSc).)*

724103P: Strategic Management, 5 op
724105P: Management Accounting, 5 op
724106P: Principles of Marketing, 5 op
724109P: Investment Decisions, 5 op
724110P: Introductory Economics, 5 op

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521155S: Computer Security, 5 op
521484S: Statistical Signal Processing, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, periods 1
Learning outcomes:
1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. has the ideas of wide applications of affective computing
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Face to face teaching
Learning activities and teaching methods:
The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Guoying Zhao
Working life cooperation:
-

521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5-8
Language of instruction:
English; Finnish when only Finnish-speaking students.
Timing:
Autumn and Spring, periods 1-4.
Learning outcomes:
The learning outcomes are defined based on the course topic.
Contents:
Varies yearly.
Mode of delivery:
Face-to-face teaching, also web-based teaching can be used.
Learning activities and teaching methods:
Lectures, exercises, design exercise, project work and seminars depending on the topic of the year. The implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.
Target group:
M.Sc. level students of Computer Science and Engineering; other students are accepted if there is space in the classes.
Prerequisites and co-requisites:
Will be defined based on the contents.
Recommended optional programme components:
No.
Recommended or required reading:
Will be announced at the first lecture
Assessment methods and criteria:
Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
CSE degree program professors.
Working life cooperation:
-

041201A: Basics in eHealth, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Medicine

Arvostelu: 1 - 5, pass, fail

Opettajat: Jarmo Reponen

Opintokohteen kielet: English

Leikkaavuudet:

ay041201A	Basics in eHealth (OPEN UNI)	5.0 op

ECTS Credits:
5 ECTS credit points / 135 hours of work

Language of instruction:
English
Timing:
2nd period
Learning outcomes:
The student can define central information and communication technological terms and solutions in healthcare, and can list respective applications in healthcare services and training.
The student can evaluate the societal and economic significance of information and communication technology in healthcare
Contents:
- terms and concepts
- societal dimensions
- delivery of health services
- electronic patient records
- data transfer within the health care system
- data transfer between the health care professionals and the patients
- citizens providing their own health data, mHealth-solutions
- national healthcare information exchange in Finland- remote consultations, radiologypsychiatry, teleradiology, telepsychiatry
- economical and functional assessment
- remote education
- future visions of health care information systems

Mode of delivery:
Web-based teaching
Learning activities and teaching methods:
Interactivity takes place in virtual learning environment Optima. The course consists of video-taped lectures, power point-presentations and links to other material available in the web. Performance of duties includes an essay, exam, participating in discussions on the grounds of the lectures.
Web lectures 15h / Web exam 40h / Written essay 40h / Self-study and participation to web discussion 40h
Target group:
Students of Medical Technology (medical and wellness technology, biomedical engineering, biophysics, other degree programs), Students of Health Sciences and information technology and everyone who is interested
Recommended or required reading:
All recommended or required reading are offered in Optima virtual learning environment
Assessment methods and criteria:
Web tasks, an essay and final exam
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Jarmo Reponen
Working life cooperation:
No
Other information:
Recommended literature:
Graig J Wootton R, Patterson V (Eds): An introduction to
Telemedicine,RSM Press 2006
Hämäläinen P, Reponen J, Winblad I, Kärki J, Laaksonen M, Hyppönen H, Kangas M (2013) eHealth and eWelfare of Finland, Check point 2011. THL Report 5/ 2013.
(https://www.julkari.fi/bitstream/handle/10024/104368/URN_ISBN_978-952-245-835-3.pdf?sequence=1)
Saranto K, Korpela M (toim) Tietotekniikka ja tiedonhallinta sosiaali-
ja terveydenhuollossa, WSOY, Porvoo-Helsinki-Juva 1999
Reponen J, Kangas M. Hämäläinen P, Keränen N (2015) Tieto- ja viestintäteknologian käyttö terveydenhuollossa vuonna 2014. Tilanne ja kehityksen suunta. [English summary] THL Raportteja 12/2015.
(http://www.julkari.fi/bitstream/handle/10024/126470/URN_ISBN_978-952-302-486-1.pdf?sequence=1)

Journals:
Journal of Telemedicine and Telecare
Telemedicine and e-Health
In addition: eLibrary in the Optima comprising updating of the topics of the lectures and some selected essays (by permission of the author)

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English.
Timing:
As part of the master level studies, in any period suitable to the student.
Learning outcomes:
1. has develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation.
Contents:
A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work and the interests of student. Main emphasis is on the development and application of methods and algorithms for biomedical data processing. Often the work includes programming with Matlab, C or Java languages.
Mode of delivery:
Self-study under supervision.
Learning activities and teaching methods:
First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, and documentation. Task assignments can be applied at any time all year round.
Target group:
Master-level students that are interested in biomedical engineering. Students of the University of Oulu.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Courses such as Biosignal processing I and II, Biomedical image processing and Machine learning are recommended. Programming skills, especially the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Literature and scientific articles depending on the task assignment.
Assessment methods and criteria:
Course assessment is based on the technical report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:
1-5 ECTS credit points / 27-135 hours of work.
Language of instruction:

English
Timing:
Master studies, 4th period. The course is not organized every year.
Learning outcomes:
The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.
Contents:
Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.
Target group:
Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging
Recommended or required reading:
Required literature is given in the lectures.
Assessment methods and criteria:
Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures
2 ECTS # participation in the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + practical assignment
5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam
Grading:
The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Associate Professor Simo Saarakkala
Working life cooperation:
No

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:
5
Language of instruction:
English.
Timing:
Period 3.
Learning outcomes:
After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can

present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:
Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures/exercises 42 h and self-study 100 h.
Target group:
Students interested in biomedical measurements.
Prerequisites and co-requisites:
None
Recommended optional programme components:
Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:
R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.
Assessment methods and criteria:
The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5.
Person responsible:
Igor Meglinski
Working life cooperation:
No.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.
Learning outcomes:
1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms
Contents:
Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.
Mode of delivery:

Face-to-face teaching and guided laboratory work.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.
Target group:
Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5
Language of instruction:
Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.
Timing:
Period 4
Learning outcomes:
1. knows the special characteristics of neural signals and the typical signal processing methods related to them

2. can solve advanced problems related to the neural signal analysis
Contents:
Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (8 h) and laboratory work (20 h), written exam.
Target group:
Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.
Prerequisites and co-requisites:
The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.
Recommended optional programme components:
-

Recommended or required reading:
The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading of the accepted exam is in the range 1-5.
Person responsible:
Jukka Kortelainen
Working life cooperation:
-

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01 Pattern Recognition and Neural Networks, Exam 0.0 op

521497S-02 Pattern Recognition and Neural Networks; Exercise Work 0.0 op

521497S Pattern Recognition and Neural Networks 5.0 op

ECTS Credits:
5
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
1. can design simple optimal classifiers from the basic theory and assess their performance.

2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.

3. can apply the basics of gradient search method to design a linear discriminant function.

4. can apply regression techniques to practical machine learning problems.
Contents:
Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.
Mode of delivery:
Face-to-face teaching, guided laboratory work and independent assignment.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.
Target group:
Students who are interested in data analysis technology. Students of the University of Oulu.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Miika Nieminen

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4th-5th Autumn (organized only during odd-numbered years or even more rarely)
Learning outcomes:
The student is able to define the physical principles on which various medical diagnostic and therapeutic devices are based upon.
Contents:
The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine, radiation therapy and methods of clinical neurophysiology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, calculus assignments 4 h, demonstrations 6 h, reporting 25 h, self-study 112 h
Target group:
Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.
Webster: Medical instrumentation: application and design, 4th ed, John Wiley & Sons, 2010.
Podgorsak: Radiation Oncology Physics – A handbook for teachers and students, IAEA, 2005 (http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf).

Additional literature depending on the lecturers.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Miika Nieminen, Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
Course website
The course will be organized using other code.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Arto Lanamäki

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:
Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.
Contents:
Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:
MSc students
Prerequisites and co-requisites:
Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:
Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.
Grading:
Pass or fail.

Person responsible:
Arto Lanamäki
Working life cooperation:
No

A452294: Biomedical Engineering: Signal and Image Processing (BME-SIP), advanced module, optional studies, 31 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

BME-SIP, optional studies, 31 ECTS cr

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900013Y	Beginners' Finnish Course 1 (OPEN UNI)	2.0 op

Proficiency level:

A1.2

Status:

The course is intended for the international students in every faculty of Oulu University.

Required proficiency level:

A1.1, Completion of the Survival Finnish course (900017Y) or the equivalent language skills.

ECTS Credits:

3 ECTS credits

Language of instruction:

As much Finnish as possible; English will be used as a help language.

Timing:

-

Learning outcomes:

By the end of the course the student can understand and use some familiar and common everyday expressions relating to her/himself and everyday situations. S/he can interact in a simple way provided the other person talks slowly and clearly and is willing to help. The student is able to read short simple texts and messages dealing with familiar topics. S/he also deepens her/his understanding of the Finnish language and communication styles.

Contents:

This is lower elementary course which aims to help students to learn communication skills in ordinary everyday situations. During the course, students broaden their vocabulary and knowledge of grammar and principles of pronunciation. They also practise to understand easy Finnish talk about everyday subjects, and reading and writing short and simple texts/messages.

The topics and communicative situations covered in the course are: talking about oneself, one's family, studies and daily routines, as well as asking about these things from other person, expressing opinions, describing people and things, talking about weather and seasons, the names of the months and colours.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, the genitive and partitive cases, possessive structure, some declension types for nouns (word types) and the basics of the local cases.

Mode of delivery:

Contact teaching and guided self study

Learning activities and teaching methods:

Lessons 2 times a week (26 h) and guided self study (50 h)

Target group:

International degree and post-graduate degree students and exchange students of the University

Prerequisites and co-requisites:

Completion of the Survival Finnish Course

Recommended optional programme components:

-

Recommended or required reading:

Gehring, S. & Heinzmann, S. Suomen mestari 1 (chapters 3 - 5)

Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grading scale is 1-5.

Person responsible:

Anne Koskela

Working life cooperation:

-

Other information:

Sign-up in WebOodi. The course will start right after the Survival Finnish course.

900053Y: Beginners' Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900053Y	Beginners' Finnish Course 2 (OPEN UNI)	4.0 op

Proficiency level:

A1.3

Status:

The course is intended for the international students in every faculty of Oulu University.

Required proficiency level:

A1.2, completion of the Beginners' Finnish course 1 (900013Y) or the equivalent language skills.

ECTS Credits:

5 ECTS credits

Language of instruction:

As much Finnish as possible; English will be used as a help language.

Timing:

-

Learning outcomes:

By the end of the course the student can understand and use some very common everyday expressions and sentences. S/he can communicate in easy and routine tasks requiring a simple and direct exchange of information on familiar everyday matters. The student understands different kinds of short texts. S/he can for example locate important information in them. In addition, s/he has acquired more detailed knowledge of the language and culture.

Contents:

This is a post-elementary course. During the course students learn more about communication in ordinary everyday situations in Finnish. They also extend their vocabulary and knowledge of grammar. Students practise understanding simple Finnish talk and short texts.

The topics and communicative situations covered in the course are: asking for and giving directions, asking for help/favours, carrying out transactions in shops and restaurants, talking about the past, asking for and expressing opinions and feelings, accommodation, travelling, vehicles, work, professions, food, drink and parties.

The structures studied are: the local cases, nominative plural (basic form plural), imperfect (past tense of verbs), part of the imperative, more declension types for nouns (word types), more about the change of the consonants k, p and t in verbs and nouns, declension of the demonstrative pronouns and personal pronouns, more about the partitive case, basics of the object cases, postpositions and some sentence types in Finnish.

Mode of delivery:

Contact teaching and guided self study

Learning activities and teaching methods:

Lessons 2 times a week (50 h) and guided self study (75 h)

Target group:

International degree and post-graduate degree students and exchange students of the University

Prerequisites and co-requisites:

Completion of the Beginners' Finnish Course 1

Recommended optional programme components:

-

Recommended or required reading:

Gehring, S. & Heinzmann, S.: **Suomen mestari 1** (kappaleet 6-9)

Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written midterm and final exams will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grading scale is 1-5.

Person responsible:

Anne Koskela

Working life cooperation:

-

Other information:

Sign-up in WebOodi. The lessons will be held **twice a week** during a 13-week period.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Rahtu
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

Learning outcomes:

1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:

Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).

Target group:

Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.

Prerequisites and co-requisites:

521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Igor Meglinski
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 1.

Learning outcomes:

After the course the student is capable to explain the operating principles of different sensors and can select a right sensor for each measuring target. He/she is able to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition the student is able to plan and design sensor signal conditioning circuits.

Contents:

Methods for measuring displacement, velocity, acceleration, torque, liquid level, pressure, flow, humidity, sound and temperature. Ultrasound, optical and nuclear measurement techniques and applications, material analyses such as pH measurement and gas concentration, pulp and paper measurements and smart sensors.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 26h, exercises 12h and self-study 100h.

Target group:

4 year students.

Prerequisites and co-requisites:

No.

Recommended optional programme components:

No.

Recommended or required reading:

H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture and exercise notes.

Assessment methods and criteria:

The course is passed by a final exam and passed exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall semester, periods 1-2

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h / Group work 20 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teemu Nyländen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Periods 3-4

Learning outcomes:

The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.
After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.

Contents:

Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization

Mode of delivery:

Starting lecture and independent exercises.

Learning activities and teaching methods:

The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.

Target group:

Students interested in signal processing, processor architectures, embedded systems programming. Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Digital filters, computer engineering, programming skills.

Recommended optional programme components:

Signal processing systems

Recommended or required reading:

Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.

Assessment methods and criteria:

The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Teemu Nyländen

Working life cooperation:

-

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Rahtu
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S	Computer Graphics	5.0 op

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. has the necessary basic skills to use these basic algorithms available in OpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures 30 h / Self-study and programming assignments 104 h

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:

The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5, zero stands for fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Heikkilä, Janne Tapani
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Spring, periods 3.

Learning outcomes:

1. can utilize common machine vision methods for various image analysis problems

2. can detect and recognize objects using features computed from images

3. can use motion information in image analysis

4. can use model matching in image registration and object recognition

5. can explain the basics of geometric computer vision

6. can calibrate cameras

7. can use stereo imaging for 3D reconstruction

8. can use Matlab for implementing basic machine vision algorithms

Contents:

Course provides an introduction to machine vision, and its applications to practical image analysis problems. Common computer vision methods and algorithms as well as principles of image formation are studied. Topics: 1. Introduction, 2. Imaging and image representation, 3. Color and shading, 4. Image features, 5. Recognition, 6. Texture, 7. Motion from 2D image sequences, 8. Matching in 2D, 9. Perceiving 3D from 2D images, 10. 3D reconstruction.

Mode of delivery:

Face-to-face teaching, homework assignments.

Learning activities and teaching methods:

Lectures (20 h), exercises (16 h) and Matlab homework assignments (16 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521467A Digital Image Processing

Recommended optional programme components:

521289S Machine Learning. This courses provide complementary information on machine learning methods applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Lecture notes and exercise material. The following books are recommended for further information: 1) Shapiro, L.G., Stockman,G.C.: Computer Vision, Prentice Hall, 2001. 2) R. Szeliski: Computer Vision: Algorithms and Applications, Springer, 2011. 3) D.A. Forsyth & J. Ponce: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:

The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Abdenour Hadid

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 3.

Learning outcomes:

1. is able to identify the types of problems that can be solved using methods of artificial intelligence.
2. knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence.
3. can also apply simple methods to reasoning under uncertainty and machine learning from observation.
4. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during period 3, the rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. More details on the course WWW page in Noppa.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Abdenour Hadid
Vili-Petteri Kellokumpu
Zinelabidine Boulkenafet

Working life cooperation:

-

Other information:

-

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. Will learn the principles of the current new technologies and utilize them on a basic level

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Susanna Pirttikangas

Working life cooperation:

Lecturers from industry.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: English

Leikkaavuudet:

521114S Wireless Measurements 4.0 op

521114S-01 Wireless Measurements, exam 0.0 op

521114S-02 Wireless Measurements, exercise work 0.0 op

ECTS Credits:

5 ECTS credits / 128h

Language of instruction:

In Finnish or in English if two or more foreign students participate.

Timing:

Period 3.

Learning outcomes:

1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements

Contents:

Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.

Target group:

Master level students regardless of master's programme.

Prerequisites and co-requisites:

No prerequirements, but basics of measurements systems are recomended.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Lecture notes and seminar reports is Optima.

Assessment methods and criteria:

The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

No.

764664S: Analysis and simulation of biosystems, 6 op

Voimassaolo: 01.01.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764364A	Analysis and simulation of biosystems	6.0 op

ECTS Credits:

6 credits

Language of instruction:

Finnish (or English)

Timing:

3th or 4th autumn (organized only during even-numbered years or even more rarely)

Learning outcomes:

The student is able to use modelling in the analysis of simple biosystems, with the utilization of the concept of analogies between different types of systems. Further, with those skills the student will be able to build simulations of relatively simple biosystems and analyze their properties.

Contents:

See 764364A Analysis and simulation of biosystems

Person responsible:

Iikka Salmela, Kyösti Heimonen

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

English

Timing:

Master studies, 3rd period

Learning outcomes:

The student can describe the main challenges of movement biomechanics and principles for motion analysis. The student knows basics of biomechanical measurement and modeling of movement. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice.

Contents:

Musculoskeletal biomechanics. Motion sensors and motion analysis. Biomechanical modeling ofmovement. Balance measurement. Fall biomechanics. Measurement of physical activity.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h / Assignment 54 h / Self-study 67 h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

It is recommended to have basic knowledge on anatomy and physiology, sensors and measurement techniques and signal processing.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted home exercises and assignments, written exam. The exam includes definition and explanation assignments and problems.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Jämsä

Other information:

This course is a part of the specialization of Health Technology.

521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5-8

Language of instruction:

English; Finnish when only Finnish-speaking students.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

The learning outcomes are defined based on the course topic.

Contents:

Varies yearly.

Mode of delivery:

Face-to-face teaching, also web-based teaching can be used.

Learning activities and teaching methods:

Lectures, exercises, design exercise, project work and seminars depending on the topic of the year. The implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.

Target group:

M.Sc. level students of Computer Science and Engineering; other students are accepted if there is space in the classes.

Prerequisites and co-requisites:

Will be defined based on the contents.

Recommended optional programme components:

No.

Recommended or required reading:

Will be announced at the first lecture

Assessment methods and criteria:

Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

CSE degree program professors.

Working life cooperation:

-

521240S: Biophotonics and Biomedical Optics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Igor Meglinski
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 2

Learning outcomes:

On successful completion of the course, students will be able to categorize the basic principles of modern optical and laser-based diagnostic modalities and instruments used in advanced biomedical research and clinical medicine. They will be able to demonstrate detailed understanding and evaluate the key biophotonics techniques underlying day-to-day clinical diagnostic and therapies and industrial applications in pharmacy, health care and cosmetic products. They can operate with the selected techniques of their choice.

Contents:

The course includes in-depth coverage of state-of-the-art optical imaging and spectroscopy systems for advanced biomedical research and clinical diagnosis, fundamental properties of light such as coherence, polarization, angular momentum, details of light interaction with tissue, and modern imaging system. Coherent Optical Tomography (OCT), Laser Doppler Flowmetry, Laser Speckle Imaging (LSI), Photo-Acoustic Tomography (PAT), Tissue polarimetry; Optical and Near-Infra-Red Spectroscopy (NIRS), Confocal and Fluorescence Microscopies; Tissue Optics: Light/matter interactions, index of refraction, reflection, optical clearing, absorption, Mie scattering, Rayleigh scattering, Monte Carlo modelling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

A new course

Recommended or required reading:

V.V Tuchin: Handbook of Optical Biomedical Diagnostics, SPIE Press, 2002; V.V Tuchin: Handbook of Coherent Domain Optical Methods, Springer, 2nd edition, 2013. D.A Boas, C. Pitris, N. Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011.

Assessment methods and criteria:

The course is passed by the final exam and with the assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S	Advanced practical training	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
Whole academic year. Periods 1-4.
Learning outcomes:
After the advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of study. The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training gives a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Students find their training jobs themselves.
Target group:
Computer Science and Engineering MSc students.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
-
Recommended or required reading:
None.
Assessment methods and criteria:
For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Jukka Kontinen
Working life cooperation:
Yes.

522987S: Master's Thesis in Biomedical Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30
Language of instruction:
English
Timing:
Second year of MSc
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
Contents:
Research project in the field of biomedical engineering and writing of the thesis.

Mode of delivery:
Face-to-face (supervision meetings)and independent work.
Learning activities and teaching methods:
Thesis can be made at different research groups of the university or in industry or health care system. The student writes the thesis independently supported by the supervisor. The topic and contents should be discussed with the professor beforehand.
Target group:
Second year MSc students (International Master’s Degree Programme in Biomedical Engineering).
Prerequisites and co-requisites:
-
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
-
Assessment methods and criteria:
Writing the thesis. Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale: 1 – 5
Person responsible:
Professor Tapio Seppänen
Working life cooperation:
Yes
Other information:
Detailed instructions:
http://www.oulu.fi/cse/studying/masters-thesis

521009S: The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900013Y	Beginners' Finnish Course 1 (OPEN UNI)	2.0 op

Proficiency level:
A1.2
Status:
The course is intended for the international students in every faculty of Oulu University.
Required proficiency level:
A1.1, Completion of the Survival Finnish course (900017Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
As much Finnish as possible; English will be used as a help language.
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some familiar and common everyday expressions relating to her/himself and everyday situations. S/he can interact in a simple way provided the other person talks slowly and clearly and is willing to help. The student is able to read short simple texts and messages dealing with familiar topics. S/he also deepens her/his understanding of the Finnish language and communication styles.
Contents:
This is lower elementary course which aims to help students to learn communication skills in ordinary everyday situations. During the course, students broaden their vocabulary and knowledge of grammar and principles of pronunciation. They also practise to understand easy Finnish talk about everyday subjects, and reading and writing short and simple texts/messages.

The topics and communicative situations covered in the course are: talking about oneself, one's family, studies and daily routines, as well as asking about these things from other person, expressing opinions, describing people and things, talking about weather and seasons, the names of the months and colours.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, the genitive and partitive cases, possessive structure, some declension types for nouns (word types) and the basics of the local cases.
Mode of delivery:
Contact teaching and guided self study
Learning activities and teaching methods:
Lessons 2 times a week (26 h) and guided self study (50 h)
Target group:
International degree and post-graduate degree students and exchange students of the University
Prerequisites and co-requisites:
Completion of the Survival Finnish Course
Recommended optional programme components:
-
Recommended or required reading:
Gehring, S. & Heinzmann, S. Suomen mestari 1 (chapters 3 - 5)
Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi. The course will start right after the Survival Finnish course.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, periods 2
Learning outcomes:
1. Knowledge of the Human Computer Interaction (HCI) fundamentals

2. Knowledge of evaluation techniques

3. Knowledge of prototyping techniques

4. Knowledge of how HCI can be incorporated in the software development process
Contents:
Human and computer fundamentals, design and prototyping, evaluation techniques, data collection and analysis.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures (20 h), exercises (20 h), and practical work (95 h). The course is passed with an approved practical work. The implementation is fully English.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
While no specific courses are not required, elementary programming and design skills are desired.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time. The course involves some basic programming.
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment is project-based. Students have to complete 4 individual exercises throughout the semester: 1: Using questionnaires; 2: Grouping & clustering; 3: Fitts' law; 4: Advanced evaluation & visualisations. Passing criteria: all 4 exercises must be completed, each receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Jorge Goncalves
Vassilis Kostakos

Working life cooperation:
-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:
The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.
ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, periods 3-4.
Learning outcomes:
1. Understands the main design concepts related to REST architectural style and ROA architecture

2. Is able to design, test and implement different components of a RESTful Web API

3. Understands what hypermedia is and how can it be used to build RESTful Web APIs

4. Is able to implement simple clients using Web technologies

5. Becomes familiar with basic technologies to store persitent data on the server and serialize data in the Web
Contents:
RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).
Mode of delivery:
Web-based teaching and face-to-face teaching.
Learning activities and teaching methods:
Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.
Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.
Prerequisites and co-requisites:
Elementary programming. Applied Computing Project I is recommended.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O’Reilly Media 2007. ISBN: 978-0-596-52926-0.
Assessment methods and criteria:
This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:

Ivan Sanchez Milara
Working life cooperation:
None.
Other information:
This course replaces the course “521260S Representing structured information”.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Arto Lanamäki

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:
Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master’s thesis and find more information on the method from scientific literature.
Contents:
Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master’s theses, evaluation of research.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:
MSc students
Prerequisites and co-requisites:
Completion of Bachelor’s studies

Recommended optional programme components:

Recommended or required reading:
Lecture slides and specified literature

Assessment methods and criteria:
Accepted learning diary.
Grading:
Pass or fail.

Person responsible:
Arto Lanamäki
Working life cooperation:
No

900017Y: Survival Finnish Course, 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900017Y	Survival Finnish Course (OPEN UNI)	2.0 op

Proficiency level:
A1.1
Status:
The course is intended for the international students in every faculty of Oulu University.
Required proficiency level:
No previous Finnish studies.
ECTS Credits:
2 ECTS credits
Language of instruction:
Finnish and English
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some very common everyday expressions and phrases, and s/he can locate informational content in simple texts and messages. The student also knows the basic characteristics of Finnish language and Finnish communication styles.
Contents:
This is an introductory course which aims to help students to cope with the most common everyday situations in Finnish. During the course, students learn some useful everyday phrases, some general features of the vocabulary and grammar, and the main principles of pronunciation.

The topics and communicative situations covered in the course are: general information about the Finnish language, some politeness phrases (how to greet people, thank and apologize), introducing oneself, giving and asking for basic personal information, numbers, some time expressions (how to tell and ask the time, days of the week, time of day), food, drink and asking about prices.

The structures studied are: personal pronouns and their possessive forms, forming affirmative, negative and interrogative sentences, the conjugation of some verbs, the basics of the partitive singular and some local cases for answering the ‘where'-question.
Mode of delivery:
Multi-modal teaching (Contact teaching, on-line teaching and independent work)
Learning activities and teaching methods:
Lessons 1–2 times a week (12–14 h) and guided self study (36 h)
Target group:
International degree and post-graduate degree students and exchange students of the University
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Will be provided during the course.
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi.

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, periods 1
Learning outcomes:
1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. has the ideas of wide applications of affective computing
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Face to face teaching
Learning activities and teaching methods:
The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Guoying Zhao

Working life cooperation:
-

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Boutellier, Jani Joosefi

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, period 1. Will be held next time in the autumn of 2016
Learning outcomes:
1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

3. Is capable of assembling a signal processor out of basic entities

4. Can match the processor performance and the application requirements

5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system
Contents:
Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.
Mode of delivery:
Lectures, independent work, group work.
Learning activities and teaching methods:
Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h
Target group:
Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.
Prerequisites and co-requisites:
521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Handouts.
Assessment methods and criteria:
Participation in mandatory classes and approved project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Jani Boutellier
Working life cooperation:
No.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.
Learning outcomes:
1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms
Contents:
Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.
Mode of delivery:
Face-to-face teaching and guided laboratory work.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.
Target group:
Students interested in biomedical engineering, at their master’s level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S Computer Graphics 5.0 op

ECTS Credits:
7
Language of instruction:
In English.
Timing:
Spring, periods 4.
Learning outcomes:
1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. has the necessary basic skills to use these basic algorithms available in OpenGL
Contents:
The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures 30 h / Self-study and programming assignments 104 h
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com /opengl_tutorial/what_is_opengl/text.php
Assessment methods and criteria:
The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5, zero stands for fail.
Person responsible:
Guoying Zhao, Jie Chen, Jukka Holappa
Working life cooperation:
No

521321S: Elements of Information Theory and Coding, 5 op

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521323S Wireless Communications 2 5.0 op

ECTS Credits:
5
Language of instruction:
English.
Timing:
Fall, period 2
Learning outcomes:
1. can use basic methodology of information theory to calculate the capacity bounds of communication and data compression systems.

2. can estimate the feasibility of given design tasks before the execution of the detailed design.

3. understands the operating principles of block codes, cyclic codes and convolutional codes.

4. can form an encoder and decoder for common binary block codes, and is capable of using tables of the codes and shift register when solving problems.

5. can represent the operating idea of a convolutional encoder as a state machine.

6. is able to apply the Viterbi algorithm to decoding of convolutional codes.

7. is capable of specifying principles of turbo coding and coded modulation.

8. can evaluate error probability of codes and knows practical solutions of codes by name.
Contents:
Entropy, mutual information, data compression, basics of source coding, discrete channels and their capacity, the Gaussian channel and its capacity, rate distortion theory, introduction to network information theory, block codes, cyclic codes, burst error correcting codes, error correcting capability of block codes, convolutional codes, Viterbi algorithm, concatenated codes, and introduction to turbo coding and to coded modulation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Face-to-face teaching (lectures and exercises) 64 h and group working.
Target group:
1 st year M.Sc. and WCE students
Prerequisites and co-requisites:
Signal Analysis, Telecommunication Engineering
Recommended optional programme components:
Wireless Communications I and the course support each other. Their simultaneous studying is recommended.
Recommended or required reading:
Parts from books Thomas M. Cover & Joy A. Thomas: Elements of Information Theory, 2nd ed. John Wiley & Sons, 2006 ISBN-13 978-0-471-24195-9, ISBN-10 0-471-24195-4, and S. Benedetto and E. Biglieri: Principles of Digital Transmission with Wireless Applications, 1999, Chapters 3, 10 and in part 11 and 12. Lecture notes and other literature.
Assessment methods and criteria:
The course is passed with weekly exams (only during lecture periods) or with final exam and possible additional course tasks defined in the beginning of the course.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Markku Juntti / Timo Kokkonen
Working life cooperation:
No

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall semester, periods 1-2
Learning outcomes:
After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.
Contents:
Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h / Group work 20 h.
Target group:
Students in Wireless Communication Engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra
Recommended optional programme components:
-
Recommended or required reading:
P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming
Assessment methods and criteria:
Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:
Keijo Ruotsalainen
Working life cooperation:
-
Other information:
-

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:
5
Language of instruction:

English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
1. can design simple optimal classifiers from the basic theory and assess their performance.

2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.

3. can apply the basics of gradient search method to design a linear discriminant function.

4. can apply regression techniques to practical machine learning problems.
Contents:
Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.
Mode of delivery:
Face-to-face teaching, guided laboratory work and independent assignment.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.
Target group:
Students who are interested in data analysis technology. Students of the University of Oulu.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
Spring, periods 3.
Learning outcomes:
1. can utilize common machine vision methods for various image analysis problems

2. can detect and recognize objects using features computed from images

3. can use motion information in image analysis

4. can use model matching in image registration and object recognition

5. can explain the basics of geometric computer vision

6. can calibrate cameras

7. can use stereo imaging for 3D reconstruction

8. can use Matlab for implementing basic machine vision algorithms

Contents:
Course provides an introduction to machine vision, and its applications to practical image analysis problems. Common computer vision methods and algorithms as well as principles of image formation are studied. Topics: 1. Introduction, 2. Imaging and image representation, 3. Color and shading, 4. Image features, 5. Recognition, 6. Texture, 7. Motion from 2D image sequences, 8. Matching in 2D, 9. Perceiving 3D from 2D images, 10. 3D reconstruction.
Mode of delivery:
Face-to-face teaching, homework assignments.
Learning activities and teaching methods:
Lectures (20 h), exercises (16 h) and Matlab homework assignments (16 h).
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521467A Digital Image Processing
Recommended optional programme components:
521289S Machine Learning. This courses provide complementary information on machine learning methods applied in machine vision. It is recommended to be studied simultaneously.
Recommended or required reading:
Lecture notes and exercise material. The following books are recommended for further information: 1) Shapiro, L.G., Stockman,G.C.: Computer Vision, Prentice Hall, 2001. 2) R. Szeliski: Computer Vision: Algorithms and Applications, Springer, 2011. 3) D.A. Forsyth & J. Ponce: Computer Vision: A Modern Approach, Prentice Hall, 2002.
Assessment methods and criteria:
The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Janne Heikkilä
Working life cooperation:
No.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:

Periods 3-4
Learning outcomes:
The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.
After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.
Contents:
Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization
Mode of delivery:
Starting lecture and independent exercises.
Learning activities and teaching methods:
The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.
Target group:
Students interested in signal processing, processor architectures, embedded systems programming.
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Digital filters, computer engineering, programming skills.
Recommended optional programme components:
Signal processing systems
Recommended or required reading:
Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.
Assessment methods and criteria:
The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Teemu Nyländen
Working life cooperation:
-

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
Autumn, period 1.
Learning outcomes:
1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:
Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.
Mode of delivery:
Lectures, independent work, group work.
Learning activities and teaching methods:
The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).
Target group:
Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.
Prerequisites and co-requisites:
521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture notes and exercise materials. Material is in English.
Assessment methods and criteria:
Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Esa Rahtu
Working life cooperation:
None.

812650S: Advanced Topics in Human-Centred Design, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/135 hours of work
Language of instruction:
English
Timing:
1 st – 2 nd year of Master’s studies, spring semester, period 3

Learning outcomes:
After completing the course, students are familiar with some state-of-the-art research results related to current themes and contexts in human-centred design, they understand the strengths and limitations of various methods and frameworks used in human-centred design and they can acquire knowledge and critically read relevant research articles on human-centred design research topics.
Contents:
The content of the course will change with time. The initial set of topics includes:

- Current themes
    - User experience as an object of analysis and design
    - Participatory design, end-user-design and living labs
    - Information ecologies and infrastructures
    - Design for all
    - Iterative and incremental design and development
    - The impact of human-centred design
    - Current development contexts:

- Open source software development
- Game development
- Development of ICT for children
- Ubiquitous computing

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 20h, assignments 100h, seminars 15h

Target group:

Prerequisites and co-requisites:
Course “812335A Interaction Design” or similar knowledge.

Recommended optional programme components:

Recommended or required reading:
A collection of research papers supported with lecture materials. Students also need to collect some study material by themselves.
Assessment methods and criteria:
Depending on the implementation group and/or individual assignments, evaluated according to predefined evaluation criteria.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1–5
Person responsible:
Kari Kuutti
Working life cooperation:
No

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

Leikkaavuudet:

521041A	Applied Computing Project I	8.0 op

ECTS Credits:
10
Language of instruction:
In English.
Timing:
Autumn and spring, periods 1-4.
Learning outcomes:
1. has basic understanding on how to collaboratively design a small-scale software project,

2. has basic understanding on how to implement and evaluate a small-scale software project,

3. is able to extensively document a small-scale software project,

4. is able to present and "pitch" a project work, i.e. give a good, concise presentation of the work
Contents:
Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:
3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives)
Learning activities and teaching methods:
Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.
Target group:
3rd year Computer Science and Engineering B.Sc. students and other Students of the University of Oulu.
Prerequisites and co-requisites:
While no specific courses are not required, elementary programming and design skills are desired.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).
Assessment methods and criteria:
The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Simo Hosio
Working life cooperation:
No

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:
10
Language of instruction:
English.
Timing:
Autumn and Spring, periods 1-4.
Learning outcomes:
1. has advanced understanding on how to collaboratively design a medium-scale software project,

2. has advanced understanding on how to implement and evaluate a medium-scale software project,

3. is able to extensively document a medium-scale software project,

4. has advanced skills in presenting and pitching a project work, i.e. give a good, concise presentation of the work,
Contents:
Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.
Mode of delivery:
3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives).
Learning activities and teaching methods:
Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.

Target group:
Computer Science and Engineering MSc students and other Students of the University of Oulu.
Prerequisites and co-requisites:
While no specific courses are not required, programming and design skills are desired.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).
Assessment methods and criteria:
The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Simo Hosio
Working life cooperation:
No

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. Will learn the principles of the current new technologies and utilize them on a basic level
Contents:
1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.
Mode of delivery:
Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:
12h lectures, 27h exercises, 32h seminar, independent studying.
Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.
Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.
Recommended optional programme components:
Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.
Recommended or required reading:
Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:
Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Susanna Pirttikangas

Working life cooperation:
Lecturers from industry.

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01 Distributed Systems, Exam 0.0 op

521266S-02 Distributed Systems, Exercise Work 0.0 op

521266S Distributed Systems 6.0 op

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, period 3.
Learning outcomes:
1. is able to explain the key principles of distributed systems

2. apply the principles in evaluating the major design paradigms used in implementing distributed systems

3. solve distributed systems related problems

4. design and implement a small distributed system
Contents:
Architectures, processes, com-munication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed web-based systems, distributed coordination-based systems.
Mode of delivery:
Face-to-face.
Learning activities and teaching methods:
Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Required literature: Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems – Principles and Paradigms, Second Edition, Prentice Hall, 2007, ISBN 978-0132392273, 704 pages.
Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:
Numerical scale 1-5; zero stands for a fail.
Person responsible:
Professor Timo Ojala
Working life cooperation:
None.

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/133 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st autumn semester.
Learning outcomes:
Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.
Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:
The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.
Mode of delivery:
Face-to-face teaching, self-study
Learning activities and teaching methods:
Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger
assignment 110 h and individual tasks 21 h.
Target group:

MSc students
Prerequisites and co-requisites:
Basic knowledge on human-computer interaction with usability and user-centered design.
Recommended or required reading:
Sharp et al. (2007) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-88, 134-215, 290-643) OR more recent version in electronic format NEEDS TO BE DISCUSSED WITH LIBRARY.
Assessment methods and criteria:
Accepted assignments.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Netta Iivari
Working life cooperation:
No
Other information:
The course book will be available in electronic format that would be very useful, as the book is updated regularly and we are using a very old
version.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Denzil Teixeira Ferreira

Opintokohteen kielet: Finnish

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521045S	Mobile Computing	5.0 op

Proficiency level:
English B2 - C2

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, periods 3-4
Learning outcomes:
1. Ability to implement mobile user interfaces

2. Ability to implement online social network applications

3. Ability to explain the fundamental concepts of context awareness

4. Ability to explain the fundamental concepts of online communities
Contents:
Mobile interface design and implementation, mobile sensor acquisition, context awareness, social platforms, crowdsourcing, online communities, graph theory.
Mode of delivery:
Face to face teaching + independent work.
Learning activities and teaching methods:
Lectures, exercises, and practical work. The course is passed with an approved practical work. The implementation is fully English.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:
Object oriented programming.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment is project-based. Students have to complete individual assignments throughout the semester and a final pair-based project: build a mobile application, conduct or analysis of data. Passing criteria: the assignments and the project must be must be completed, receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Denzil Ferreira
Working life cooperation:
None.

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, periods 1-2.
Learning outcomes:
1. has gained a good overview of the history and current state of ubiquitous computing

2. has learned to design, implement, and evaluate a ubiquitous computing system

3. has learned how to carry out a research project, from initial research problem formulation to concept development, and further to in-the-wild evaluation and reporting using an academic format
Contents:
Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.
Mode of delivery:
Lectures, group project
Learning activities and teaching methods:
Lectures 20 h, exercises 22 h, project work 50 h, self-study 43 h. Exercises and project work are completed as group work.
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.
Assessment methods and criteria:
The course is graded based on the following criteria: - Attendance - Summaries of selected scientific publications - Interim reports during project work - Final project report.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical scale 1-5; zero stands for a fail.
Person responsible:
Adjunct Professor Hannu Kukka
Working life cooperation:
The course teaches students how to design, implement, and evaluate an academic research project. Especially helpful to those students planning post-graduate studies.

A452291: Computer Vision and Signal Processing, advanced module, optionals, 10 - 20 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

optionals

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Abdenour Hadid

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 3.

Learning outcomes:

1. is able to identify the types of problems that can be solved using methods of artificial intelligence.
2. knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence.
3. can also apply simple methods to reasoning under uncertainty and machine learning from observation.
4. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during period 3, the rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. More details on the course WWW page in Noppa.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Abdenour Hadid
Vili-Petteri Kellokumpu
Zinelabidine Boulkenafet

Working life cooperation:

-

Other information:

-

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Denzil Teixeira Ferreira

Opintokohteen kielet: Finnish

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521045S	Mobile Computing	5.0 op

Proficiency level:

English B2 - C2

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

Learning outcomes:

1. Ability to implement mobile user interfaces

2. Ability to implement online social network applications

3. Ability to explain the fundamental concepts of context awareness

4. Ability to explain the fundamental concepts of online communities

Contents:

Mobile interface design and implementation, mobile sensor acquisition, context awareness, social platforms, crowdsourcing, online communities, graph theory.

Mode of delivery:

Face to face teaching + independent work.

Learning activities and teaching methods:

Lectures, exercises, and practical work. The course is passed with an approved practical work. The implementation is fully English.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Object oriented programming.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment is project-based. Students have to complete individual assignments throughout the semester and a final pair-based project: build a mobile application, conduct or analysis of data. Passing criteria: the assignments and the project must be must be completed, receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Denzil Ferreira

Working life cooperation:

None.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

1. understands the basic theory of digital image processing and knows its main applications.
2. is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression, segmentation and recognition.

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: http://www.ee.oulu.fi/research/imag/courses/dkk/). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Kukka
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. has gained a good overview of the history and current state of ubiquitous computing

2. has learned to design, implement, and evaluate a ubiquitous computing system

3. has learned how to carry out a research project, from initial research problem formulation to concept development, and further to in-the-wild evaluation and reporting using an academic format

Contents:

Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.

Mode of delivery:

Lectures, group project

Learning activities and teaching methods:

Lectures 20 h, exercises 22 h, project work 50 h, self-study 43 h. Exercises and project work are completed as group work.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.

Assessment methods and criteria:

The course is graded based on the following criteria: - Attendance - Summaries of selected scientific publications - Interim reports during project work - Final project report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5; zero stands for a fail.

Person responsible:

Adjunct Professor Hannu Kukka

Working life cooperation:

The course teaches students how to design, implement, and evaluate an academic research project. Especially helpful to those students planning post-graduate studies.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Susanna Pirttikangas
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. Will learn the principles of the current new technologies and utilize them on a basic level

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Susanna Pirttikangas

Working life cooperation:

Lecturers from industry.

A452292: Ubiquitous Computing, advanced module, optionals, 17 - 20 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

optionals

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning
Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

-

521149S: An introduction to computer vision methods for biomedical images (only for BME-SIP students), 5 - 8 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5-8

Language of instruction:

English; Finnish when only Finnish-speaking students.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

The learning outcomes are defined based on the course topic.

Contents:

Varies yearly.

Mode of delivery:

Face-to-face teaching, also web-based teaching can be used.

Learning activities and teaching methods:

Lectures, exercises, design exercise, project work and seminars depending on the topic of the year. The implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.

Target group:

M.Sc. level students of Computer Science and Engineering; other students are accepted if there is space in the classes.

Prerequisites and co-requisites:

Will be defined based on the contents.

Recommended optional programme components:

No.

Recommended or required reading:

Will be announced at the first lecture

Assessment methods and criteria:

Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

CSE degree program professors.

Working life cooperation:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521154S: UBISS - International UBI Summer School, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

English.

Timing:

Summer semester (June).

Learning outcomes:

Objective: Summer School provides students with hands on experience and insight on selected topics on the multidisciplinary fields of human-computer interaction, ubiquitous computing and urban informatics. A Summer School comprises of multiple parallel workshops that each have their specific topic and contents.
Learning outcomes: Defined based on the workshop topic.

Contents:

Varies yearly.

Mode of delivery:

Face-to-face teaching in workshops.

Learning activities and teaching methods:

Lectures, a project completed as group work, self-study.

Target group:

Computer Science and Engineering, MSc. level students.

Prerequisites and co-requisites:

Defined based on the workshop topic.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Reading package that is selected based on the workshop topic.

Assessment methods and criteria:

Written exam (50%), project (50%).

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Timo Ojala

Working life cooperation:

No.

815657S: Open Source Software Development, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Henrik Hedberg
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2.

Learning outcomes:

After passing the course, a student will be able to

- define the historical background and the ideology of Open Source Software (OSS),
- participate in OSS development project,
- evaluate the impact of the usage of OSS and OSS licenses on software development and exploitation, and
- view the phenomenon through the essential scientific research.

Contents:

The course introduces OSS development paradigm and current topics in OSS research. OSS affects both the way to produce software and the decisions of user organizations. It can be understood, for example, from different social, legal, economical, software engineering and data security viewpoints. The aim is to study from different perspectives, for example, what OSS is and what it is not, the history and organisation of OSS projects, methods of OSS development and usage, as well as licensing models and possible risks. The emphasis is on research work.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures and seminars about 40 h, exercises and peer reviews about 20 h, seminar article and presentation about 70 h

Target group:

MSc students

Prerequisites and co-requisites:

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work. The course allows passing Project following the OSS development principles, or writing Master's thesis on a OSS topic.

Recommended or required reading:

Fogel, K. (2005): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

Assessment methods and criteria:

Active participation, seminar article and other assignments

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Henrik Hedberg

815305A: Real Time Distributed Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

After completing the course, the student:

- Is able to analyse the characteristics of real-time distributed systems;
- Is able to acquire an object-oriented, model-based approach to solve the design problems found in real-time systems;
- Is able to detect and derive specific problems facing the real-time software designer, and to suggest design patterns to solve those problems.

Contents:

Introduction 1. Characteristics of real-time systems; 2. Resource management; 3. Safety and reliability; 4. Time constraints; 5. Concurrency; 6.
Scheduling; 7. Interrupts Characteristics of Distribution 1. Distribution architectures 2. Concept of time; 3. Synchronisation; 4. Latency and

jitter; 5. Quality of service; 6. Service discovery; 7. Networking primitives Real-Time UML Modelling Methodology Real-Time Design Patterns Design
Examples: Embedded, Ubiquitous, Mobile, Web/Internet.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40h, design exercises 15h, student project 80h.

Target group:

MSc students

Prerequisites and co-requisites:

Computer architecture, object-oriented analysis and design (UML), programming language C and/or Java.

Recommended or required reading:

Lecture notes. Course book: Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-
Wesley ISBN 0-201-69956-7. 500 p.

Assessment methods and criteria:

Exam and project evaluation

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Petri Pulli

817603S: System Design Methods for Information Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

After the course the student understands the complexity of business, organiza-tional, technical, and human aspects that affect ISD and the
selection of meth-ods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to
these defects and to other chal-lenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques the student is able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.

Contents:

After the course, the student understands the complexity of business, organizational, technical, and human aspects that affect ISD and the
selection of methods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to the
defects of it and also answer to other challenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques, students are able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments on which method is suitable for an ISD project in an organization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, exercises 18h, homework 36h, essay 26 h, examination 34h.

Target group:

MSc students

Prerequisites and co-requisites:

Bachelor studies recommended

Recommended optional programme components:

Recommended or required reading:

Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.
Research articles (to be announced during the course implementation).

Assessment methods and criteria:

Exercises, assignments, essay, and examination.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Pasi Karppinen

Working life cooperation:

No

813625S: Information Systems Theory, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

After completing the course, students will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems; will have good knowledge and understanding of information systems research and the process by which that research is produced; will have competence in critiquing research articles published in some of the leadingacademic journals and conference proceedings; will have competence in critical thinking, and analysis and synthesis of academic sources; will have competence in verbally presenting arguments in an academic fashion; will know how to write a literature review on an information systems research topic.

Contents:

Information Systems Research Overview, A contemporary selection of Information Systems research themes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h, seminars 10 h, individual and group assignments 100 h; or self-study: opening lecture 2 h, assignments 132 h.

Target group:

MSc students

Prerequisites and co-requisites:

Bachelor's degree or similar, Research Methods course. Recommended to take before Master's Thesis.

Recommended optional programme components:

Recommended or required reading:

Selection of scientific articles.

Assessment methods and criteria:

Accepted assignments

Grading:

Numerical scale 1-5 or fail

Person responsible:

Netta Iivari

Working life cooperation:

No

Other information:

Course material can be found at OPTIMA e-learning environment, Urkund is used for course work submissions.

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Lecturing in Finnish, material available in English

Timing:

Spring, periods 3-4.

Learning outcomes:

1. After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved.
2. In addition, the student can explain the roles of the client and the system developer during the requirements specification, and the role of the iteration phase as a part of the requirements specification phase. The student can explain the factors affecting to SW/HW partitioning process, and the concept of SW /HW dualism. The student can fairly analyze the factors affecting to the selection of the processor and the operating system. The student can recognize the basic development tools used and their possible advantages and disadvantages.
3. The student can compare various testing approaches. The student can explain how a design error affects to the final cost of the system in different phases of the development. The student can do some basic I/O programming using C programming language.

Contents:

The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing, I/O programming.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course is run in a project work in groups of two and follow up the progress reporting meetings. Lectures 20 h, laboratory exercise in period 1-3 120 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521412A Digital Techniques I
Also recommended 521275A Embedded Software Project, 521432A Electronics Design I.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Berger, Arnold S. (2002) Embedded Systems Design: An introduction to Processes, Tools, & Techniques, CMP Books, USA. ISBN:1578200733.

Assessment methods and criteria:

Project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

None.

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. Student understands the basic computer architecture and organization.

2. Student understands CPU operation and datapath in general.

3. Student knows different number systems and data representations in computers.

4. Student is familiar of I/O operation with peripheral devices in general.

5. Student is able to implement small programs with the C programming language for general-purpose computers for embedded systems.

6. Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Yleinen tietokoneen organisaatio ja arkkitehtuuri, keskusyksikkö, muistihierarkia ja muistinhallinta, tietotyypit, laiterekisterit ja I/O, yleinen tietokoneen ohjelmointi ja laiteläheisen ohjelmointi, C-kielen perusteet.

Mode of delivery:

Web-based and face-to-face teaching.

Learning activities and teaching methods:

Lectures (40h), course exercises (20h), laboratory exercise (3h) and course projects in groups.

Target group:

2nd year students of computer science and engineering and 3rd year students of electrical engineering.

Prerequisites and co-requisites:

Elementary programming 521141P.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Course material will be announced at the beginning of the course.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course projects in groups. Assessment is based on the exercises and the course projects. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

No.

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning, Teemu Tokola
Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

Material in English, lectures and guidance of individual groups available in English.

Timing:

Autumn and Spirng, periods 2-4.

Learning outcomes:

1. Can work independently on a non-trivial problem

2. Knows how to write a thesis and has gained lot of experience on refining text

3. Can make a scientific background study on a topic

4. Has increased experience on implementing an embedded software

5. Has improved group work and project skills

Contents:

This course familairizes the student with modern embedded system development with modern methods and tools. Topics: Development tools, practical application program for an embedded system. The students additionally work on the application topic through scientific papers and use their application program to produce a scientific work of their own.

Mode of delivery:

Face-to-face teaching, independent project work in groups.

Learning activities and teaching methods:

Pair project with monitoring meetings and a compulsory exercise. Lectures 30 h, design exercise in period 4-6 180 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521457A Software Engineering, 521286A Computer Systems or 521142A Embedded Systems Programming. In addition, 521453A Operating Systems be beneficial.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Course website, hardware data sheets and manuals, scientific publications.

Assessment methods and criteria:

Project report and a demonstrated implementation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

The topics of the course are relevant research topics with applications in the industry, and visiting lecturers are occasionally arranged to shed light on how the course topics are applied in the industry.

Other information:

The 521275A course offers the possibility to complete your Bachelor thesis in a structured course environment. The course is suitable also for students who do not use the course for their Bachelor Thesis.

812671S: Usability Testing, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English and Finnish

Timing:

The course is held in the spring semester, during periods 3 and 4.

Learning outcomes:

After completing the course, the student can:

- Design and follow through a usability testing process;
- Design usability test scenarios and tasks;
- Select test subjects;
- Plan and follow through usability tests as laboratory tests or field tests;
- Analyse and report the findings from usability tests.

Contents:

Basic terms and types of usability testing, usability tests process, usability test tasks and scenarios, test subjects, following through a usability test, analysing usability test material, reporting the findings from usability tests.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24h, assignment tutoring 13h, assignment 90h, seminar 7h.

Target group:

MSc students

Prerequisites and co-requisites:

Student is familiar with most common user interface design terms, design and evaluation methods as in “Introduction to Human-Computer Interactions” course.

Recommended optional programme components:

Recommended or required reading:

Dumas, J. S. & Redish, J. C. (1993): A Practical Guide to Usability Testing. Ablex Publishing Corporation.
Rubin, J. (1994): Handbook of
Usability Testing: How to Plan, Design, and Conduct Effective Tests. Chichester: John Wiley & Sons, Inc.

Assessment methods and criteria:

Assessment of the course is based on the learning outcomes of the course based on the written usability test plan, supervised usability tests, written usability test report and oral seminar presentation

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Mikko Rajanen

Working life cooperation:

No

Other information:

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S	Advanced practical training	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
Whole academic year. Periods 1-4.
Learning outcomes:
After the advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of study. The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training gives a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Students find their training jobs themselves.
Target group:
Computer Science and Engineering MSc students.
Prerequisites and co-requisites:
None.
Recommended optional programme components:

-
Recommended or required reading:
None.
Assessment methods and criteria:
For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Jukka Kontinen
Working life cooperation:
Yes.

521993S: Master's Thesis in Computer Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30
Language of instruction:
Finnish/English
Timing:
Second year of MSc studies
Learning outcomes:
The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. Depending on the nature of the work, the student is able to present the existing results or technological implementations so that the methods used in the work are justified in relation to the state of the art in the field of engineering or science in question. He is able to apply the knowledge and state of the art methods of the subject area in his work. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals and to consider their general significance to modern engineering or science, and assess the broader significance of the results to the company, organization or project. The student is able to produce smooth, clear and finalized text based on technical and scientific writing practices of the field.
Contents:
The thesis work is carried out independently. The student defines the content of the thesis under the guidance of the supervisor. The degree program committee approves the thesis topic and content.
The thesis is recorded in accordance with the orientation using the following codes:

- 521981S Master's Thesis in Information Processing Engineering, 30 ECTS cr
- 522985S Master's Thesis in Applied Computing, 30 ECTS cr
- 521984S Master's Thesis in Embedded Systems, 30 ECTS cr

Mode of delivery:
Face-to-face meetings with the supervisor and independent studying.
Learning activities and teaching methods:
Independent work under the guidance of the supervisor.
Target group:
Second year MSc students.
Prerequisites and co-requisites:
Compulsory advanced studies preceding the thesis (90 ECTS cr).
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
The thesis is assessed by two reviewers (supervisor and second reviewer) and approved by the degree program committee. Assessment Criteria at the University of Oulu can be found here.

Grading:
1-5 (1=sufficient, 2=satisfactory, 3=good, 4=very good, 5=excellent)
Person responsible:
Supervising professor or researcher
Working life cooperation:
Yes.
Other information:
Detailed instructions: http://www.oulu.fi/cse/studying/masters-thesis

A452221: Module of the Option, Information Technology, 34 - 35 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module of the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall semester, periods 1-2

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h / Group work 20 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Arto Lanamäki
Opintokohteen kielet: English
Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

Contents:

Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:

MSc students

Prerequisites and co-requisites:

Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:

Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

Working life cooperation:

No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Spring, periods 3.

Learning outcomes:

1. can utilize common machine vision methods for various image analysis problems

2. can detect and recognize objects using features computed from images

3. can use motion information in image analysis

4. can use model matching in image registration and object recognition

5. can explain the basics of geometric computer vision

6. can calibrate cameras

7. can use stereo imaging for 3D reconstruction

8. can use Matlab for implementing basic machine vision algorithms

Contents:

Course provides an introduction to machine vision, and its applications to practical image analysis problems. Common computer vision methods and algorithms as well as principles of image formation are studied. Topics: 1. Introduction, 2. Imaging and image representation, 3. Color and shading, 4. Image features, 5. Recognition, 6. Texture, 7. Motion from 2D image sequences, 8. Matching in 2D, 9. Perceiving 3D from 2D images, 10. 3D reconstruction.

Mode of delivery:

Face-to-face teaching, homework assignments.

Learning activities and teaching methods:

Lectures (20 h), exercises (16 h) and Matlab homework assignments (16 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521467A Digital Image Processing

Recommended optional programme components:

521289S Machine Learning. This courses provide complementary information on machine learning methods applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Lecture notes and exercise material. The following books are recommended for further information: 1) Shapiro, L.G., Stockman,G.C.: Computer Vision, Prentice Hall, 2001. 2) R. Szeliski: Computer Vision: Algorithms and Applications, Springer, 2011. 3) D.A. Forsyth & J. Ponce: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:

The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. can design simple optimal classifiers from the basic theory and assess their performance.

2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.

3. can apply the basics of gradient search method to design a linear discriminant function.

4. can apply regression techniques to practical machine learning problems.

Contents:

Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.

Mode of delivery:

Face-to-face teaching, guided laboratory work and independent assignment.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.

Target group:

Students who are interested in data analysis technology. Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

Learning outcomes:

1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:

Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).

Target group:

Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.

Prerequisites and co-requisites:

521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Periods 3-4

Learning outcomes:

The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.
After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.

Contents:

Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization

Mode of delivery:

Starting lecture and independent exercises.

Learning activities and teaching methods:

The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.

Target group:

Students interested in signal processing, processor architectures, embedded systems programming. Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Digital filters, computer engineering, programming skills.

Recommended optional programme components:

Signal processing systems

Recommended or required reading:

Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.

Assessment methods and criteria:

The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Teemu Nyländen

Working life cooperation:

-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

1. Understands the main design concepts related to REST architectural style and ROA architecture

2. Is able to design, test and implement different components of a RESTful Web API

3. Understands what hypermedia is and how can it be used to build RESTful Web APIs

4. Is able to implement simple clients using Web technologies

5. Becomes familiar with basic technologies to store persitent data on the server and serialize data in the Web

Contents:

RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).

Mode of delivery:

Web-based teaching and face-to-face teaching.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming. Applied Computing Project I is recommended.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

This course replaces the course “521260S Representing structured information”.

A452224: Module of the Option, Applied computing, 35 - 62 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Kukka
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. has gained a good overview of the history and current state of ubiquitous computing

2. has learned to design, implement, and evaluate a ubiquitous computing system

3. has learned how to carry out a research project, from initial research problem formulation to concept development, and further to in-the-wild evaluation and reporting using an academic format

Contents:

Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.

Mode of delivery:

Lectures, group project

Learning activities and teaching methods:

Lectures 20 h, exercises 22 h, project work 50 h, self-study 43 h. Exercises and project work are completed as group work.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.

Assessment methods and criteria:

The course is graded based on the following criteria: - Attendance - Summaries of selected scientific publications - Interim reports during project work - Final project report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5; zero stands for a fail.

Person responsible:

Adjunct Professor Hannu Kukka

Working life cooperation:

The course teaches students how to design, implement, and evaluate an academic research project. Especially helpful to those students planning post-graduate studies.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Arto Lanamäki

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

Contents:

Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:

MSc students

Prerequisites and co-requisites:

Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:

Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

Working life cooperation:

No

811395A: Basics of Databases, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.

Learning outcomes:

In addition, they have knowledge of modern non-relational database solutions (such as data warehouses and NoSQL-databases) and they have
commanding knowledge of making use of those non-relational databases (such as data mining and Big data techniques).

Contents:

Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalization), transactions.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 45 h, compulsory exercises 24 h, reading 20 h, exams 21 h and self-studying 23 h.

Target group:

Bachelor students

Prerequisites and co-requisites:

The student knows basics of programming.

Recommended or required reading:

Silberschatz, Korth & Sudarshan: Database system concepts. Elmasri & Navathe: Fundamentald of database systems.

Assessment methods and criteria:

The course is divided to five parts. All parts must be passed in a year. Students must show they achieve at least half of required knowledge of each part.

Grading:

fail, 1-5

Person responsible:

Jua Iisakka

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

1. is able to explain the key principles of distributed systems

2. apply the principles in evaluating the major design paradigms used in implementing distributed systems

3. solve distributed systems related problems

4. design and implement a small distributed system

Contents:

Architectures, processes, com-munication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed web-based systems, distributed coordination-based systems.

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Required literature: Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems – Principles and Paradigms, Second Edition, Prentice Hall, 2007, ISBN 978-0132392273, 704 pages.

Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5; zero stands for a fail.

Person responsible:

Professor Timo Ojala

Working life cooperation:

None.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Denzil Teixeira Ferreira

Opintokohteen kielet: Finnish

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521045S	Mobile Computing	5.0 op

Proficiency level:

English B2 - C2

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

Learning outcomes:

1. Ability to implement mobile user interfaces

2. Ability to implement online social network applications

3. Ability to explain the fundamental concepts of context awareness

4. Ability to explain the fundamental concepts of online communities

Contents:

Mobile interface design and implementation, mobile sensor acquisition, context awareness, social platforms, crowdsourcing, online communities, graph theory.

Mode of delivery:

Face to face teaching + independent work.

Learning activities and teaching methods:

Lectures, exercises, and practical work. The course is passed with an approved practical work. The implementation is fully English.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Object oriented programming.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment is project-based. Students have to complete individual assignments throughout the semester and a final pair-based project: build a mobile application, conduct or analysis of data. Passing criteria: the assignments and the project must be must be completed, receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Denzil Ferreira

Working life cooperation:

None.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

1. Understands the main design concepts related to REST architectural style and ROA architecture

2. Is able to design, test and implement different components of a RESTful Web API

3. Understands what hypermedia is and how can it be used to build RESTful Web APIs

4. Is able to implement simple clients using Web technologies

5. Becomes familiar with basic technologies to store persitent data on the server and serialize data in the Web

Contents:

RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).

Mode of delivery:

Web-based teaching and face-to-face teaching.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming. Applied Computing Project I is recommended.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

This course replaces the course “521260S Representing structured information”.

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning
Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

-

A452223: Module of the Option, Embedded Systems, 30,5 - 32 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Lahti
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.
2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic, Ivana Kovacevic

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 132,5 hours of work

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Upon completing the required coursework, the student is able to list and understand the functionalities of different layers of OSI and TCP/IP protocol models

2. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE, LTE, LTEA, IEEE802.xx systems and incoming 5G.

3. The student is able to describe the basic protocol model of the UMTS and LTE/LTEA radio interface and radio access network.

4. The student knows the basic properties of routing protocols in fixed, wireless and ad hoc networks.

5. He will achieve skills to describe the main principles of mobility control, network security, cross-layer optimization.

6. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transport layers, mobility management, cellular/multihop cellular networks, network security, network management, ad hoc and sensor networks, cross-layer optimization, complex networks, networks economics, examples of wireless communication networks. The goal is to present the fundamentals of the structure, protocol and structure of digital data transmission networks. Technical implementation and application of the common data and local networks are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and the compulsory design work with a simulation program (15 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Parts from: S. Glisic & B. Lorenzo: Wireless Networks: 4G Technologies (2nd ed.), 2009; S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies (2nd ed.), 2007.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. The final grade is based on examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Savo Glisic and Maria Kangas

Working life cooperation:

No

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Periods 3-4

Learning outcomes:

The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.

After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.

Contents:

Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization

Mode of delivery:

Starting lecture and independent exercises.

Learning activities and teaching methods:

The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.

Target group:

Students interested in signal processing, processor architectures, embedded systems programming. Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Digital filters, computer engineering, programming skills.

Recommended optional programme components:

Signal processing systems

Recommended or required reading:

Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.

Assessment methods and criteria:

The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Teemu Nyländen

Working life cooperation:

-

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

-

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Lecturing in Finnish, material available in English

Timing:

Spring, periods 3-4.

Learning outcomes:

1. After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved.
2. In addition, the student can explain the roles of the client and the system developer during the requirements specification, and the role of the iteration phase as a part of the requirements specification phase. The student can explain the factors affecting to SW/HW partitioning process, and the concept of SW /HW dualism. The student can fairly analyze the factors affecting to the selection of the processor and the operating system. The student can recognize the basic development tools used and their possible advantages and disadvantages.
3. The student can compare various testing approaches. The student can explain how a design error affects to the final cost of the system in different phases of the development. The student can do some basic I/O programming using C programming language.

Contents:

The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing, I/O programming.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course is run in a project work in groups of two and follow up the progress reporting meetings.
Lectures 20 h, laboratory exercise in period 1-3 120 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521412A Digital Techniques I
Also recommended 521275A Embedded Software Project, 521432A Electronics Design I.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Berger, Arnold S. (2002) Embedded Systems Design: An introduction to Processes, Tools, & Techniques, CMP Books, USA. ISBN:1578200733.

Assessment methods and criteria:

Project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

None.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

Learning outcomes:

1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:

Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).

Target group:

Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.

Prerequisites and co-requisites:

521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

A452271: Advanced Module/Information Technology, Signal Processing (obligatory), 13,5 - 20 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Lahti
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.
2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Boutellier, Jani Joosefi

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, period 1. Will be held next time in the autumn of 2016

Learning outcomes:

1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

3. Is capable of assembling a signal processor out of basic entities

4. Can match the processor performance and the application requirements

5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:

Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h

Target group:

Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.

Prerequisites and co-requisites:

521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Handouts.

Assessment methods and criteria:

Participation in mandatory classes and approved project work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Jani Boutellier

Working life cooperation:

No.

521321S: Elements of Information Theory and Coding, 5 op

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521323S	Wireless Communications 2	5.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Fall, period 2

Learning outcomes:

1. can use basic methodology of information theory to calculate the capacity bounds of communication and data compression systems.

2. can estimate the feasibility of given design tasks before the execution of the detailed design.

3. understands the operating principles of block codes, cyclic codes and convolutional codes.

4. can form an encoder and decoder for common binary block codes, and is capable of using tables of the codes and shift register when solving problems.

5. can represent the operating idea of a convolutional encoder as a state machine.

6. is able to apply the Viterbi algorithm to decoding of convolutional codes.

7. is capable of specifying principles of turbo coding and coded modulation.

8. can evaluate error probability of codes and knows practical solutions of codes by name.

Contents:

Entropy, mutual information, data compression, basics of source coding, discrete channels and their capacity, the Gaussian channel and its capacity, rate distortion theory, introduction to network information theory, block codes, cyclic codes, burst error correcting codes, error correcting capability of block codes, convolutional codes, Viterbi algorithm, concatenated codes, and introduction to turbo coding and to coded modulation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching (lectures and exercises) 64 h and group working.

Target group:

1 st year M.Sc. and WCE students

Prerequisites and co-requisites:

Signal Analysis, Telecommunication Engineering

Recommended optional programme components:

Wireless Communications I and the course support each other. Their simultaneous studying is recommended.

Recommended or required reading:

Parts from books Thomas M. Cover & Joy A. Thomas: Elements of Information Theory, 2nd ed. John Wiley & Sons, 2006 ISBN-13 978-0-471-24195-9, ISBN-10 0-471-24195-4, and S. Benedetto and E. Biglieri: Principles of Digital Transmission with Wireless Applications, 1999, Chapters 3, 10 and in part 11 and 12. Lecture notes and other literature.

Assessment methods and criteria:

The course is passed with weekly exams (only during lecture periods) or with final exam and possible additional course tasks defined in the beginning of the course.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Markku Juntti / Timo Kokkonen

Working life cooperation:

No

A452272: Advanced Module/Information Technology, Signal Processing (optional), 15 - 22 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: Is selected so that the advanced module size in total. 35 op

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01	Wireless Communications I, Exam	0.0 op
521395S	Wireless Communications I	5.0 op
521320S	Wireless Communications 2	8.0 op
521320S-01	Intermediate exam or final exam, Wireless Communications 2	0.0 op
521320S-02	Exercisework, Wireless Communications 2	0.0 op

ECTS Credits:

5 ECTS cr / lecture 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. can analyze the performance of multilevel digital modulation methods in AWGN channel

2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance

3. recognizes the suitable diversity methods for fading channel and related combining methods

4. can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them

5. can explain design methods signals for band-limited channels

6. can classify different channel equalizers, and perform the performance analysis

Contents:

Digital modulation methods and their performance in AWGN-channel, radio channel models, performance of digital modulation in fading channel, diversity techniques, channel equalizers in wireless communication channel, carrier and symbol synchronization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Target group:

1st year WCE students and M.Sc. students (i.e., 4th year in EE degree programme)

Prerequisites and co-requisites:

521330A Telecommunication Engineering 521316S Broadband Communications Systems

Recommended optional programme components:

-

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of book: J.G. Proakis: Digital Communications, 4th ed, McGraw Hill, 2001.

Assessment methods and criteria:

The course is passed with final examination and accepted design exercise. Grade is based on exam. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Jari Iinatti

Working life cooperation:

No

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ikonen, Mika Enso-Veitikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

470444S	Advanced Control Methods	6.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish (English if necessary)

Timing:

Period 3 (spring term)

Learning outcomes:

After completing the course the student can design the model based control systems, can formulate and solve state estimation problems, and discover research trends in control and systems engineering

Contents:

1. Model-based control: as DMC, QDMC; GPC. 2. State estimations: as Kalman filtering and particle filters. 3. Active research directions (elected annually)

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and demonstration exercises

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis, 477603A Control system design, 4776xxS Control system methods, 477605S Digital control theory recommended beforehand

Recommended optional programme components:

None

Recommended or required reading:

Materials distirbuted during the contact teaching and through the course web pages

Assessment methods and criteria:

Exam and homework
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1.5 or fail

Person responsible:

Professor Enso Ikonen

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521324S: Statistical Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521373S	Statistical Signal Processing 2	6.0 op
521373S-01	Exam, Communication Signal Processing I	0.0 op
521373S-02	Statistical Signal Processing 2, exercise work	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Spring, period 3. It is recommended to complete the course during the first year of master studies.

Learning outcomes:

1. is able to use the methodology of statistical signal processing in the design communication transceivers.

2. will be able to design and simulate various receiver algorithms.

3. use linear algebra, estimation theory and optimization theory to solve algorithm design problems.

4. knows the pricinples of adaptive filtering and filter parameter selection.

5. can use Matlab to model and simulate receiver algorithms and linear algebraic operations.

6. can use Simulink for performance simulations.

7. understands the principles of receiver algorithm design based on statistial models and optimization theory.

Contents:

Review of linear algebra, estimation and optimization, tasks and the structure of a communications transceiver, use of statistical optimization for algorithm design, optimal linear filters, matrix and adaptive algorithms, linear and nonlinear equalizers, parameter estimation and synchronization, spatial signal processing.

Mode of delivery:

Face-to-face teaching and independent simulation project group work.

Learning activities and teaching methods:

Lectures 32h, exercises 14h, group project work 30h, and self-study.

Target group:

1st year M.Sc. and WCE students.

Prerequisites and co-requisites:

Statistical signal processing, Matrix Algebra, Basics of Optimization, Telecommunication Engineering.

Recommended optional programme components:

Supports learning in Wireless Communications II. It is recommended to take the courses in parallel.

Recommended or required reading:

Lecture notes and material, other literature listed therein. Key references: J. Choi: Adaptive and Iterative Signal Processing in Communications, Cambridge University Press, 2006; S. Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996; J. M. Mendel: Lessons in Digital Estimation Theory, 2nd ed., Prentice-Hall, 1995.

Assessment methods and criteria:

The course is passed with a final examination and the simulation work report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1–5. In the numerical scale zero stands for a fail.

Person responsible:

Markku Juntti

Working life cooperation:

No

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S	Computer Graphics	5.0 op

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. has the necessary basic skills to use these basic algorithms available in OpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures 30 h / Self-study and programming assignments 104 h

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:

The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5, zero stands for fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

6

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Spring, peridos 3-4

Learning outcomes:

1. knows the phases of the design process of hardware parts of digital system implemented in FPGA or ASIC technologies, and understands their purpose, and the problems and aims associated with different design tasks

2. is able to use the tools needed in industrial design projects.

Contents:

1. Digital systems design process. 2. Assertion-based verification, 3. Universal verification methodology (UVM) 4. ASIC design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability). 5. Use of SystemC language in the modeling of digital circuits. 6. Architecture-level synthesis of digital circuits.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 20h/ exercises 20h (group work)/ independent work 120h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1 and Digital techniques 2

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No.

521325S: Communication Signal Processing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521360S	Synchronisation for Digital Receivers	4.0 op
521360S-01	Synchronization for Digital Receivers, exam	0.0 op
521360S-02	Synchronisation for Digital Receivers, exercise work	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period I. It is recommended to complete the course during the second year of master studies.

Learning outcomes:

1. is able to design and model communication receiver algorithms.

2. will be able to model and simulate the performance of a receiver modeling implementation imperfections.

3. knows how to design algorithms for fixed point and finite precision implementations.

4. can model and simulate a timely multiantenna receiver performance as an entity of several algorithms.

5. knows how to use baseband design tools to implement a receiver algorithm.

6. can model algorithms with c models and embed those in Matlab simulations.

Contents:

The structure of a communications transceiver, design and synthesis of synchronization algorithms, sampling rate conversion and filtering, I/Q imbalance, finite precision modeling of receive processing, implementation of receiver algorithms.

Mode of delivery:

Face-to-face teaching and independent simulation and design project.

Learning activities and teaching methods:

Lectures 16h, group project work 50h, and self-study.

Target group:

2nd year M.Sc. and WCE students.

Prerequisites and co-requisites:

Statistical signal processing, Digital Filters, Communications Signal Processing I, Wireless Communications I.

Recommended optional programme components:

Comminications Signal Processing I, Signal Processing Systems

Recommended or required reading:

Lecture notes and material, other literature listed therein. Key references: H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998; R. Fasthuber, F. Catthoor, P. Raghavan & F. Naessens, Energy-Efficient Communication Processors, Springer, 2013.

Assessment methods and criteria:

The course is passed with a final examination and the simulation work report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1–5. In the numerical scale zero stands for a fail.

Person responsible:

Markku Juntti

Working life cooperation:

No

A452273: Advanced Module/Information Technology, Intelligent Systems (obligatory), 14 - 17 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S Computer Graphics 5.0 op

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. has the necessary basic skills to use these basic algorithms available in OpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures 30 h / Self-study and programming assignments 104 h

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:

The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5, zero stands for fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. has the ideas of wide applications of affective computing

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Guoying Zhao

Working life cooperation:

-

A452274: Advanced Module/Information Technology, Intelligent Systems (optional), 18 - 25 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01 Distributed Systems, Exam 0.0 op

521266S-02 Distributed Systems, Exercise Work 0.0 op

521266S Distributed Systems 6.0 op

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

1. is able to explain the key principles of distributed systems

2. apply the principles in evaluating the major design paradigms used in implementing distributed systems

3. solve distributed systems related problems

4. design and implement a small distributed system

Contents:

Architectures, processes, com-munication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed web-based systems, distributed coordination-based systems.

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Required literature: Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems – Principles and Paradigms, Second Edition, Prentice Hall, 2007, ISBN 978-0132392273, 704 pages.

Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5; zero stands for a fail.

Person responsible:

Professor Timo Ojala

Working life cooperation:

None.

477624S: Control System Methods, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477614S	Control System Methods	3.0 op
477605S	Digital Control Theory	4.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish

Timing:

Period 1 (autumn term)

Learning outcomes:

After completing the course students can identify the problems of the sampled data systems, and know how to apply discrete time methods for systems analysis and control design.

Contents:

1. Control systems design by frequency-response methods. 2. Control systems design in state space methods 3. Sampled data systems: sampling, Z transformation of signals. 4. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 5. Analysis of discrete-time systems: z-plane, stability. 6. Discrete-time control design strategies: general RST structure, various pole-zero placement control algorithms, minimum-variance control, model-based control, state-space design methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercises include guided computer simulations

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis and 477603A Control system design recommended beforehand

Recommended optional programme components:

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Recommended or required reading:

Lecture handout. Dorf, R. (2010) Modern Control Systems. Prentice-Hall, New York, 1104 s, Ogata, K (2002) Modern Control Engineering. Prentice-Hall, New York, 964 s., Åström, K & Murray, R. (2009) Feedback Systems, An Introduction for Scientists and Engineers. Princeton University Press, New Jersey, 396 s., Landau, I. & Zito, G. (2005) Digital Control Systems, Springer. 485 pp. Åström, K.J. & Wittenmark, B. (1984, 1997) Computer Controlled Systems: Theory and Design. Prentice-Hall International. 544 pp.

Assessment methods and criteria:

Final written exam; to request an exam in English, contact the lecturer via email beforehand.

Grading:

Numerical grading scale 1-5 or fail

Person responsible:

University teacher Seppo Honkanen

Working life cooperation:

No

Other information:

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521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ikonen, Mika Enso-Veitikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

470444S	Advanced Control Methods	6.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish (English if necessary)

Timing:

Period 3 (spring term)

Learning outcomes:

After completing the course the student can design the model based control systems, can formulate and solve state estimation problems, and discover research trends in control and systems engineering

Contents:

1. Model-based control: as DMC, QDMC; GPC. 2. State estimations: as Kalman filtering and particle filters. 3. Active research directions (elected annually)

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and demonstration exercises

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis, 477603A Control system design, 4776xxS Control system methods, 477605S Digital control theory recommended beforehand

Recommended optional programme components:

None

Recommended or required reading:

Materials distirbuted during the contact teaching and through the course web pages

Assessment methods and criteria:

Exam and homework
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1.5 or fail

Person responsible:

Professor Enso Ikonen

Working life cooperation:

No

Other information:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition

-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. Will learn the principles of the current new technologies and utilize them on a basic level

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Susanna Pirttikangas

Working life cooperation:

Lecturers from industry.

477525S: Computational intelligence in automation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477505S	Fuzzy-neuromethods in Process Automation	4.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish and English

Timing:

Implementation in the autumn term, on hte 2nd period. Recommended for fourth year students (first M.Sc. year)

Learning outcomes:

After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and evolutionary computation. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models in Matlab-Simulink environment. The student recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. The student is able to explain the operation principles of genetic algorithms and to use them in tuning of fuzzy set systems and neural network models. Moreover, the student is able to describe alternative solutions for dynamic models, hyperplane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.

Contents:

Fuzzy logic and fuzzy set systems, fuzzy calculus, fuzzy modeling and control, neural computation, learning algorithms, neuro-fuzzy methods, linguistic equations, evolutionary computation, hyperplane methods, cellular automata, intelligent diagnostics and decision making, adaptive intelligent systems, hybrid systems.

Mode of delivery:

Tuition is implemented mainly as face-to-face teaching.

Learning activities and teaching methods:

The amount of guided teaching is 32 hrs, including lectures (16), exercises (10) and seminars 6). Totally 58 hrs are allocated for self-study, which consists of three parts: (1) a case study covering several topics applied in a chosen problem, (2) a seminar work concentrating on a single topic, and (3) the final report.

Target group:

M.Sc. students in process and environmental engineering, machine engineering, computer engineering and industrial engineering and management.

Prerequisites and co-requisites:

No specific prerequisites, but skills for simulation, and programming in Matlab are a benefit. See "Recommended optional programme components" below.

Recommended optional programme components:

Courses Simulation, and Programming in Matlab reinforce abilities for the exercises and the case study

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English.

Assessment methods and criteria:

The assessment of the course is based on the exercises, case study, seminar and the final report. Final exam is an alternative for the final report.
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment

Grading:

The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

D.Sc. (Tech.) Esko Juuso

Working life cooperation:

No

Other information:

-

A452275: Advanced Module/Information Technology, Biomedical Information Engineering (obligatory), 11 - 20 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kortelainen
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.

Timing:

Period 4

Learning outcomes:

1. knows the special characteristics of neural signals and the typical signal processing methods related to them

2. can solve advanced problems related to the neural signal analysis

Contents:

Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (8 h) and laboratory work (20 h), written exam.

Target group:

Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.

Prerequisites and co-requisites:

The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.

Recommended optional programme components:

-

Recommended or required reading:

The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading of the accepted exam is in the range 1-5.

Person responsible:

Jukka Kortelainen

Working life cooperation:

-

A452276: Advanced Module/Information Technology, Biomedical Information Engineering (optional), 20 - 24 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:

1-5 ECTS credit points / 27-135 hours of work.

Language of instruction:

English

Timing:

Master studies, 4^{th} period. The course is not organized every year.

Learning outcomes:

The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.

Contents:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Target group:

Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

Recommended or required reading:

Required literature is given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures
2 ECTS # participation in the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + practical assignment
5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam

Grading:

The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Miika Nieminen

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

English

Timing:

4th-5th Autumn (organized only during odd-numbered years or even more rarely)

Learning outcomes:

The student is able to define the physical principles on which various medical diagnostic and therapeutic devices are based upon.

Contents:

The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine, radiation therapy and methods of clinical neurophysiology.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, calculus assignments 4 h, demonstrations 6 h, reporting 25 h, self-study 112 h

Target group:

Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.
Webster: Medical instrumentation: application and design, 4th ed, John Wiley & Sons, 2010.
Podgorsak: Radiation Oncology Physics – A handbook for teachers and students, IAEA, 2005 (http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf).

Additional literature depending on the lecturers.
Course material availability can be checked here.

Assessment methods and criteria:

One written examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Miika Nieminen, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website
The course will be organized using other code.

757314A: Basics of bioinformatics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Biology

Arvostelu: 1 - 5, pass, fail

Opettajat: Lumi Viljakainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

750340A	Basics of bioinformatics	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish / English.

Timing:

B.Sc. studies, 3rd autumn.

Learning outcomes:

After the course the student knows and is able to use the basic methods for handling the nucleotide and protein sequences. The aim is that the student learns how to use the databases, understands the background and principles of the analytic methods, is able to take up a critical attitude towards the used methods and gets a good background for applying new methods that are developed continuously.

Contents:

Searching of material from the databases, inferring the function of a gene and structure of a protein based on sequence data, comparing the sequences and evaluating the differences between them as well as examining the evolution history of the genes.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

12 h lectures, 2 h seminar, 20 h exercises, independent work.

Target group:

BT: compulsory, recommended for all biologists. Suitable also for biochemists.

Prerequisites and co-requisites:

Course Concepts of genetics (757109P) or equivalent knowledge also Molecular evolution (757312A) is recommended.

Recommended optional programme components:

-

Recommended or required reading:

Jonathan Pevsner 2009: Bioinformatics and Functional Genomics.Wiley-Blackwell.
The availability of the literature can be checked from this link.

Assessment methods and criteria:

Reports or exam, exercises, seminar presentation, independent work and student activity.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5 / Fail.

Person responsible:

Doc. Lumi Viljakainen.

Working life cooperation:

No.

Other information:

-

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. has the ideas of wide applications of affective computing

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Guoying Zhao

Working life cooperation:

-

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English.

Timing:

As part of the master level studies, in any period suitable to the student.

Learning outcomes:

1. has develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work and the interests of student. Main emphasis is on the development and application of methods and algorithms for biomedical data processing. Often the work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study under supervision.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, and documentation. Task assignments can be applied at any time all year round.

Target group:

Master-level students that are interested in biomedical engineering. Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Courses such as Biosignal processing I and II, Biomedical image processing and Machine learning are recommended. Programming skills, especially the Matlab.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:

Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.

Assessment methods and criteria:

The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: English

Leikkaavuudet:

521114S Wireless Measurements 4.0 op
521114S-01 Wireless Measurements, exam 0.0 op
521114S-02 Wireless Measurements, exercise work 0.0 op

ECTS Credits:

5 ECTS credits / 128h

Language of instruction:

In Finnish or in English if two or more foreign students participate.

Timing:

Period 3.

Learning outcomes:

1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements

Contents:

Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.

Target group:

Master level students regardless of master's programme.

Prerequisites and co-requisites:

No prerequirements, but basics of measurements systems are recomended.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Lecture notes and seminar reports is Optima.

Assessment methods and criteria:

The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

No.

A452286: Advanced module/Applied computing technology (optional), 25 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A	Object Oriented Analysis and Design (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd autumn semester.

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use
cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know
principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They
understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Target group:

Bachelor students.

Prerequisites and co-requisites:

Course of elementary object-oriented programming is a compolsory prerequisite. Basic knowledge of object programming and information systems
analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Juha Iisakka

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilkka Räsänen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay812341A	Object-oriented Programming (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 82h.

Target group:

BSc students.

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

Timothy Budd: Introduction to object-orientedprogramming, 3rd edition.
Bruce Eckel: Thinkingin Java 3rd edition or later.

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Ilkka Räsänen

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.
Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:

The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.

Mode of delivery:

Face-to-face teaching, self-study

Learning activities and teaching methods:

Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger
assignment 110 h and individual tasks 21 h.

Target group:

MSc students

Prerequisites and co-requisites:

Basic knowledge on human-computer interaction with usability and user-centered design.

Recommended or required reading:

Sharp et al. (2007) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-88, 134-215, 290-643) OR more recent version in electronic format NEEDS TO BE DISCUSSED WITH LIBRARY.

Assessment methods and criteria:

Accepted assignments.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Netta Iivari

Working life cooperation:

No

Other information:

The course book will be available in electronic format that would be very useful, as the book is updated regularly and we are using a very old
version.

815657S: Open Source Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Henrik Hedberg

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2.

Learning outcomes:

After passing the course, a student will be able to

- define the historical background and the ideology of Open Source Software (OSS),
- participate in OSS development project,
- evaluate the impact of the usage of OSS and OSS licenses on software development and exploitation, and
- view the phenomenon through the essential scientific research.

Contents:

The course introduces OSS development paradigm and current topics in OSS research. OSS affects both the way to produce software and the decisions of user organizations. It can be understood, for example, from different social, legal, economical, software engineering and data security viewpoints. The aim is to study from different perspectives, for example, what OSS is and what it is not, the history and organisation of OSS projects, methods of OSS development and usage, as well as licensing models and possible risks. The emphasis is on research work.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures and seminars about 40 h, exercises and peer reviews about 20 h, seminar article and presentation about 70 h

Target group:

MSc students

Prerequisites and co-requisites:

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work. The course allows passing Project following the OSS development principles, or writing Master's thesis on a OSS topic.

Recommended or required reading:

Fogel, K. (2005): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

Assessment methods and criteria:

Active participation, seminar article and other assignments

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Henrik Hedberg

815305A: Real Time Distributed Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

After completing the course, the student:

- Is able to analyse the characteristics of real-time distributed systems;
- Is able to acquire an object-oriented, model-based approach to solve the design problems found in real-time systems;
- Is able to detect and derive specific problems facing the real-time software designer, and to suggest design patterns to solve those problems.

Contents:

Introduction 1. Characteristics of real-time systems; 2. Resource management; 3. Safety and reliability; 4. Time constraints; 5. Concurrency; 6.
Scheduling; 7. Interrupts Characteristics of Distribution 1. Distribution architectures 2. Concept of time; 3. Synchronisation; 4. Latency and
jitter; 5. Quality of service; 6. Service discovery; 7. Networking primitives Real-Time UML Modelling Methodology Real-Time Design Patterns Design
Examples: Embedded, Ubiquitous, Mobile, Web/Internet.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40h, design exercises 15h, student project 80h.

Target group:

MSc students

Prerequisites and co-requisites:

Computer architecture, object-oriented analysis and design (UML), programming language C and/or Java.

Recommended or required reading:

Lecture notes. Course book: Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-
Wesley ISBN 0-201-69956-7. 500 p.

Assessment methods and criteria:

Exam and project evaluation

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Petri Pulli

817603S: System Design Methods for Information Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

After the course the student understands the complexity of business, organiza-tional, technical, and human aspects that affect ISD and the
selection of meth-ods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to
these defects and to other chal-lenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques the student is able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.

Contents:

After the course, the student understands the complexity of business, organizational, technical, and human aspects that affect ISD and the
selection of methods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to the

defects of it and also answer to other challenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques, students are able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments on which method is suitable for an ISD project in an organization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, exercises 18h, homework 36h, essay 26 h, examination 34h.

Target group:

MSc students

Prerequisites and co-requisites:

Bachelor studies recommended

Recommended optional programme components:

Recommended or required reading:

Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.
Research articles (to be announced during the course implementation).

Assessment methods and criteria:

Exercises, assignments, essay, and examination.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Pasi Karppinen

Working life cooperation:

No

813625S: Information Systems Theory, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

After completing the course, students will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems; will have good knowledge and understanding of information systems research and the process by which that research is produced; will have competence in critiquing research articles published in some of the leadingacademic journals and conference proceedings; will have competence in critical thinking, and analysis and synthesis of academic sources; will have competence in verbally presenting arguments in an academic fashion; will know how to write a literature review on an information systems research topic.

Contents:

Information Systems Research Overview, A contemporary selection of Information Systems research themes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h, seminars 10 h, individual and group assignments 100 h; or self-study: opening lecture 2 h, assignments 132 h.

Target group:

MSc students

Prerequisites and co-requisites:

Bachelor's degree or similar, Research Methods course. Recommended to take before Master's Thesis.

Recommended optional programme components:

Recommended or required reading:

Selection of scientific articles.

Assessment methods and criteria:

Accepted assignments

Grading:

Numerical scale 1-5 or fail

Person responsible:

Netta Iivari

Working life cooperation:

No

Other information:

Course material can be found at OPTIMA e-learning environment, Urkund is used for course work submissions.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. Will learn the principles of the current new technologies and utilize them on a basic level

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Susanna Pirttikangas

Working life cooperation:

Lecturers from industry.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S	Computer Graphics	5.0 op

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. has the necessary basic skills to use these basic algorithms available in OpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures 30 h / Self-study and programming assignments 104 h

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:

The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5, zero stands for fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. has the ideas of wide applications of affective computing

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Guoying Zhao

Working life cooperation:

-

A452285: Advanced module/applied computing technology (obligatory), 10 - 40 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Simo Hosio
Opintokohteen kielet: English

ECTS Credits:

10

Language of instruction:

English.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

1. has advanced understanding on how to collaboratively design a medium-scale software project,

2. has advanced understanding on how to implement and evaluate a medium-scale software project,

3. is able to extensively document a medium-scale software project,

4. has advanced skills in presenting and pitching a project work, i.e. give a good, concise presentation of the work,

Contents:

Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives).

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.

Target group:

Computer Science and Engineering MSc students and other Students of the University of Oulu.

Prerequisites and co-requisites:

While no specific courses are not required, programming and design skills are desired.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:

The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Simo Hosio

Working life cooperation:

No

A452287: Advanced module/Applied computing economy (obligatory), 10 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

724206A: Strategic Marketing Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Tuula Lehtimäki

Opintokohteen kielet: English

Leikkaavuudet:

ay724206A	Strategic Marketing Management (OPEN UNI)	5.0 op
721412P	Product and Market Strategies	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period A, third year of studies

Learning outcomes:

After having passed this course, students are able to identify the concepts and tools linked to strategic marketing management. The course improves students' ability to evaluate different market situations among industries and propose solutions to strategic product/market decisions. Furthermore, students are able to explain strategy at different levels; corporation, SBU & functional. Students are able to apply concepts and tools of strategic marketing in global and local context that is, they understand the interdependency of macro- and microenvironments. In addition, students will demonstrate analytical thinking skills by applying different marketing strategies in practice and solving real-life business problems in a case exercise guided by the problem based learning (PBL) method. Students will apply oral and written communication skills appropriate for business situations by working in small groups throughout the course, playing various roles of marketing professional, presenting their case exercise in written and oral form and performing a peer review valuation of another group.

Contents:

1) Situation assessment, 2) Marketing strategies, 3) Strategy formulation 4) Implementation

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36 h lectures, related discussions and group works, case exercise with both written and verbal part (53 h), case presentations (14 h) and independent reading of the textbooks and related material (20 h). During the course students will work in small groups and meet regularly in order to solve a marketing challenge proposed by the case company (case company is the same for all groups). Problem based learning (PBL) method will be applied and students play different roles to simulate tasks of the real life marketing professionals. Relating to these roles, students will write a learning diary (10 h). In the end of the course students will return a written report as a solution for the marketing challenge and presents it to other students.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Kotler, P., Keller, K., Brady, M., Goodman, M. & Hansen, T. (2009 or 2012) Marketing Management (1st or 2nd European Edition) and other material named by the lecturer.

Assessment methods and criteria:

: Lectures and case exercise. The written part of the case exercise will determine 80% and the verbal part 20% of the grade. The assessment of the course unit is based on the learning outcomes of the course unit.

Grading:

This course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tuula Lehtimäki

Working life cooperation:

-

Other information:

The first two lectures are mandatory. Groups will be formed on September 5th and the company case will be presented on September 7th. The number of students is limited.

724201A: Internationalization, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Xiaotian Zhang

Opintokohteen kielet: English

Leikkaavuudet:

ay724201A Internationalization (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

Upon completion the students are able to understand and describe internationalization as an inward and outward process. The students are able to recognize and describe different international operation modes. The students are able to compare and evaluate the foreign operation modes in specific decision making situations. The students also recognize the basic aspects of strategic and financial planning in the context of SME internationalization. The students will also develop their understanding of entrepreneurship and cultural awareness in business context.

Contents:

The course introduces the basic international business operation modes. The contents cover exporting and importing, contractual and investment entry modes, ebusiness as a mode of international operation, and the role of venture capital in internationalization of SMEs. Content structure: Introduction and Instructions; What is Entrepreneurship? Different Types of Entrepreneurship; International Operation Modes; Internationalization Process; Venture Capital in Internationalization; Strategic Development in Internationalization; Cultural Differences and International Mindset; Summary

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36 h lectures and reflection (13 h), reading the course literature (40 h), preparing for the exam (40 h) and home-exam (4 h)

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of “Global perspectives”-module

Recommended or required reading:

Welch, L, Benito, G & S Petersen, B. (2007). Foreign Operation Methods. Theory, analysis, strategy. Edward Elgar Publishing Ltd. Cheltenham. Additional material will be assigned during the lectures.

Assessment methods and criteria:

Reflective learning diary, workshops, Examination.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.

Person responsible:

Xiaotian Zhang and Irina Atkova.

Working life cooperation:

-

Other information:

The number of students is limited. Students are advised to familiarize themselves with the course’s main literature source (Welch et al. 2007) before the beginning of the course.

A452288: Advanced module/Applied computing economy (optional), 20 - 40 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

806118P: Introduction to Statistics, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Päkkilä
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay806118P	Introduction to Statistics (OPEN UNI)	5.0 op
806113P	Introduction to Statistics A	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

3rd period

Learning outcomes:

After completing the course, student will be able to
- consider issues influencing to data collection
- describe data by appropriate methods (tables, statistics and graphical presentations)
- evaluate the effect size of the sample to the margin of error for instance in Gallup polls and in different market researches
- interpret output of a statistical software.

Contents:

- collecting data, e.g. sampling
- variables and measuring
- descriptive statistical methods and their selection
- margin of error of estimator for population mean and proportion
- statistical literacy
- basic analysis of data using statistical software

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

Target group:

Minor students

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams and/or final exam and possible homework.

Grading:

Fail, 1-5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

Other information:

-

806119P: A Second Course in Statistics, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806113P	Introduction to Statistics A	5.0 op
806109P	Basic Methods in Statistics I	9.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

4th period

Learning outcomes:

Upon completion of the course, student will be able to
- analyze continuous and categorical response in the most common experimental and observational studies
- critically evaluate scientific articles
- implement and interpret analyses of a statistical software concerning issues of the course.

Contents:

- Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened
- statistical literacy of scientific articles with quantitative methods

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

Target group:

Minor students

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the course: 806118P Introduction to Statistics or 806116P Statistics for Economic Sciences.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams and/or final exam and possible homework.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Jari Päkkilä

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

555314S: Management Information Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

Periods 3 - 4.

Learning outcomes:

Upon completion of the course, the student can explain the key concepts of management information systems. The student is familiar with the significance of information and information management in modern business process management. The student can define the information needs of management processes and understands how information systems can meet these needs.
After completing the course, the student is aware of the current trends in management information systems technologies and practices. After the course, the student has readiness to participate for enterprise information system designing, purchasing, and development tasks as a role of industrial engineer/process developer. During the course, the students will also develop their skills in reflective, self-directing learning. A student is able to find the relevant information sources related to MIS.

Contents:

Key concepts: what is management information systems (MIS), managerial information, different types of MIS applications.
Information systems in decision making and leadership, the effects of information technology in business processes.
Current trends in management information systems technologies and practices.
Structure of information systems, data governance models, principles of data management and IT architecture.

Special characteristics of ICT project management (procurement and implementation). Company examples about MIS in practice.

Mode of delivery:

The tuition will be implemented as face-to-face teaching.

Learning activities and teaching methods:

Lectures 18 h, self-study, learning diary and group work 117 h.

Target group:

Industrial Engineering and Management students.

Prerequisites and co-requisites:

B.Sc. in Industrial Engineering and Management or equivalent, 555313S Management.

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials. Other materials will be defined at the beginning of the course.

Assessment methods and criteria:

Learning diary and project work (group assignment). The course grading is based on the learning diary and the project work.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

D.Sc. Hanna Kropsu-Vehkaperä.

Working life cooperation:

No.

Other information:

Substitutes the course 555344S Management Information Systems.

724050A: Bachelor's Thesis in Economics and Business Administration, 10 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

724202A: Managing Multinationals, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Irene Lehto

Opintokohteen kielet: English

Leikkaavuudet:

ay724202A	Managing Multinationals (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

Upon completion of the course, the student is able to understand different perspectives on multinational corporations (MNCs) and recognize why MNCs exist, how they compete, and what is their impact on society. The student is able to analyse the role of cross-cultural management in MNCs as well as the differences between global and local context. The student pays attention to the diversified nature of MNCs and understands MNC as a network. The student identifies the ethical issues and the corporate responsibility in MNC.

Contents:

Lectures will include the following themes: 1) MNCs as actors in global economy, 2) Different perspectives to MNCs, 3) Changing MNCs (e.g. joint ventures, alliances, mergers and acquisitions), 4) Headquarter and subsidiary relationships, 5) MNCs as networks, 6) Cross-cultural management in MNCs and 7) MNCs in society.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course consist of compulsory lectures (36h), preparation for the lectures (9h), group works and exercises based on each course theme (40h), preparation for the exam and independent study (44h) and home exam (4h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of “Global perspectives”-module

Recommended or required reading:

Forsgren, Mats (2008). Theories of the Multinational Firm, article collection and lecture material provided in the course.

Assessment methods and criteria:

Assessment will be at two stages. The group works conducted related to each theme during the course will determine 50% of the grade and the final home exam 50% of the grade. The assessment of the course unit is based on the learning outcomes of the course unit.

Grading:

This course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Dr. Elina Pernu and Lauri Haapanen

Working life cooperation:

-

Other information:

The number of students is limited.

724203A: Financial Statement Analysis, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karjalainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724203A	Financial Statement Analysis (OPEN UNI)	5.0 op
721180P	Financial Statement Analysis	5.0 op
721180A	Financial Statement Analysis	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A (1st year).

Learning outcomes:

After this course student knows the content of financial statements and understands the main accounting principles in constructing financial statements. In the course student learns the difference between accrual-based –and cash-based accounting. Student understands different stages of financial statement analysis and recognizes main adjustments of the income statement and balance sheet items. The student can calculate and interpret different financial ratios describing profitability, leverage and liquidity of the firm. After this course the student can calculate and interpret the most commonly used market-based ratios. The student knows the main principles for establishment of cash flow statement, knows the content of the cash flow statements and is able to analyze cash flow based ratios. The student understands how different financial ratios are associated and how this information can be applied in the management decisions. Based on the financial statement information, the student recognizes the main leading signals of the firm's financial distress. During the course we practice basic principles for doing the long- and short-term financial planning. The student is able independently to construct large written financial statement analysis and presentation of the target company.

Contents:

The content of the firm's income statement, balance sheet and cash flow statements, main principles of the financial statement analysis, adjustments of the income statement and balance sheets items, calculation and interpretation of financial ratios, cash flow-based statements, main signals and stages of the firm's bankruptcy, tools for analyzing the connections of the ratios. Analytic financial statement and balance sheet, Investment- and financing decisions in analytic profit calculation.

Mode of delivery:

Face to face teaching, group work and self-study.

Learning activities and teaching methods:

Lectures 20 h, exercises and supervision of the assignment 16 h, exercises and assignment as a group work 50 h and examination as a self-study 49 h.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

The course is part of "Analytical skills" -module.

Recommended or required reading:

Salmi Ilari (2012). Mitä tilinpäätös kertoo? Edita Publishing Oy. Yritystutkimus-neuvottelukunta: Yritystutkimuksen tilinpäätösanalyysi (2005 or newer) Gaudeamus. Other material possibly announced during the lectures.

Assessment methods and criteria:

Lecture- and literature examination and practical work.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

KTT Pasi Karjalainen

Working life cooperation:

-

Other information:

The number of students is limited.

724204A: Management Control, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Sinikka Moilanen

Opintokohteen kielet: English

Leikkaavuudet:

721176A	Management Control	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

Upon completion of the course students can define the basic structure of a management control system. They are thus able to describe the design and development needs of management control systems. They can also identify and discuss viewpoints to be taken into account controlling multinational operations. Students can also apply basic accounting control tools, such as budgets and variance analysis, to simple control problems.

Contents:

Management control system design and development, cultural influences on management control systems, budgets and standards, variance analysis, profit centre accounting and transfer pricing, performance measurement.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures and exercises 36 h, self-study 129h, which includes case assignments.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of “Global perspectives”-module

Recommended or required reading:

Drury, C.: Management & Cost Accounting 7th Ed. 2008 (Parts 4 & 5, pp. 346-591), Cengage Learning EMEA; Merchant, K. A. & Van der Stede, W. A.: Management control systems – performance measurement, evaluation and incentives, Prentice-Hall, 2nd Ed. 2007; other material defined by the responsible teacher; lecture notes and exercises.

Assessment methods and criteria:

Students complete the course by completing case-based home assignmentS. The assessment of the course is based on the learning outcomes of the course unit, which means that in the home assignments they need to show both ability to describe theory in writing, and to apply basic control tools by calculations.

Grading:

This course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lecturer Sinikka Moilanen.

Working life cooperation:

-

Other information:

The number of students is limited.

724207A: Financial Decisions, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Mirjam Lehenkari

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724207A Financial Decisions (OPEN UNI) 5.0 op

ay721178P Fundamentals of Corporate Finance (OPEN UNI) 5.0 op

721178P Principles of Corporate Finance 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period C. It is recommended to complete the course at the 2nd spring semester.

Learning outcomes:

The course is an introduction to the theory and practice of capital structure decisions. Upon successful completion of the course, the student will be able to describe the most well-known capital structure theories and to identify factors that affect capital structure decisions in practice.

Contents:

1) short- and long-term financial planning, 2) cost of capital, 3) financial leverage, 4) capital structure theories, 5) capital structure decisions in practice, 6) risk management and firm value, 7) dividend policy in theory and practice

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

lectures 36h, self-study 93h, exam 4h

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Ross, Westerfield & Jordan: Fundamentals of Corporate Finance (4 th or later edition) / Corporate Finance Fundamentals, Irwin/McGraw-Hill

Assessment methods and criteria:

faculty examination

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

postdoctoral researcher Mirjam Lehenkari

Working life cooperation:

-

Other information:

The number of students is limited.

724208A: Portfolio Theory, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Andrew Conlin

Opintokohteen kielet: English

Leikkaavuudet:

721361P	Investments	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period C **(**3rd year of Bachelor Program)

Learning outcomes:

Upon completion of the course, students will be able to: quantitatively show the beneficial effects of diversification on portfolio expected return and variance; construct optimal portfolios from a limited number of assets; describe the relationship between risk aversion and an investor’s optimal complete portfolio; derive, compare, and contrast the CAPM and APT pricing models; define and discuss the Efficient Market Hypothesis; outline arguments of Behavioral Finance and discuss examples from the literature.

Contents:

This course is an introduction to the fundamentals of modern investment theory. Students will create portfolios from limited numbers of assets, and examine the portfolios’ return and risk characteristics. The course will cover the CAPM and APT equilibrium models of asset pricing. The Efficient Market Hypothesis, along with both supporting and contradictory evidence, will be presented. The course will also introduce theory and evidence from Behavioral Finance.

Mode of delivery:

Online

Learning activities and teaching methods:

Video lectures, discussions, assignments, mid-term and final exam.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies and business processes). Mathematical skills equivalent to 802158P and 806116P (math and statistics for business) are highly recommended.

Recommended optional programme components:

This course is part of “Analytical skills”-module

Recommended or required reading:

Bodie, Kane, & Marcus: Investments. Mc-Graw-Hill, 6th (or later) ed.

Assessment methods and criteria:

Assessment methods include a midterm and a final exam.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Doctoral Student Andrew Conlin.

Working life cooperation:

-

Other information:

The number of students is limited.

724209A: Monetary Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Svento, Rauli

Opintokohteen kielet: Finnish

Leikkaavuudet:

721115P	Theory of Money, Banking and Monetary Policy	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period C. It is recommended to complete the course at the 3rd autumn semester.

Learning outcomes:

After the course the students are able to explain the concept of money, the role of money in the economy and the principles according to which the demand and supply of money and the interest rates are determined. The students can describe in a basic level the functioning of financial markets, financial institutions and the central bank. They are also able to compare the objectives, tools and mechanisms of monetary policy to each other, and evaluate the effects of monetary policy actions on money markets and the real economy. Completing the course enables students to understand and scrutinize the practical statements and news about the monetary policy issues and functioning of markets for money given in the public media.

Contents:

Financial systems; the concepts of money and financial markets, determination of interest rates, monetary and financial institutions, supervision of banking, central banks; tools, objectives and mechanisms of monetary policy, the connection between monetary policy and aggregate demand and supply.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

36 hours lectures, and independent reading of the textbooks and other material distributed during the course (93 h). Exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

This course is part of “Analytical skills” -module

Recommended or required reading:

Mishkin, F.S.: The Economics of Money, Banking and Financial Markets, 10th ed. (2013), Pearson; Howells, P. & Bain, K.: Economics of money, banking and finance: A European text, 4th ed. (2008), Prentice Hall; the appropriate parts from both of these; other material possibly announced during the lectures.

Assessment methods and criteria:

Examination based on home assignments.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Exception: in spring semester 2017, the grading scale is failed/accepted.

Person responsible:

Juha Junttila

Working life cooperation:

-

Other information:

The number of students is limited.

724210A: Global Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Korhonen

Opintokohteen kielet: English

Leikkaavuudet:

721218A	Principles of International Economics	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

After the course the student is capable of explaining the impact of international trade on the economy. In addition the student can compare different instruments of trade policy and their welfare effects. Furthermore the student understands basic functioning of foreign exchange markets.

Contents:

Topics of the course include the basic concepts of international trade including the more recent literature on imperfect competition and strategic behaviour. In addition the course introduces issues of trade policy and international macroeconomics, particularly foreign exchange markets.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures, 12 hours of exercises and 93 hours of independent reading of the textbooks. Exam (4 hours)

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of “Global perspectives”-module

Recommended or required reading:

Feenstra, R. ja A.M. Taylor (2011): International Economics, 2. painos, Krugman, P. & M. Obstfeld, (2009): International Economics: Theory and Policy, 8. painos, Pearson/AddisonWesley.; other material announced during the lectures.

Assessment methods and criteria:

Lectures and exercises, literature examination.

Grading:

This course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Dr. Marko Korhonen.

Working life cooperation:

-

Other information:

The number of students is limited

724205A: Distribution and Retail Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Juga

Opintokohteen kielet: Finnish

Leikkaavuudet:

721428A	Retail Management	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period D (2nd year).

Learning outcomes:

Upon completion of this course the student knows the functions, flows and processes in distribution channels and can formulate distribution objectives within the context of current logistics and retail management. The student can assess the business concepts and formats of retail and understands the role of vertical and horizontal coordination in distribution channels. The student can identify dependencies of distribution activities and understands their impacts on competitiveness. The student has an understanding of the economic role and importance of distributive functions in society with a special view of sustainable business and economy.

Contents:

Structural, operational and social factors and models in distribution channels. Logistical activities, channel member roles and functions and retail models (e.g. franchising, cooperatives, e-commerce, multi-channel distribution). Functional inter-dependencies in distribution with illustrative cases and numerical examples.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

36 h lectures, reading the course literature (53 h), assignments (40 h) and exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

The course is part of “Analytical skills” -module.

Recommended or required reading:

Kautto, M., Lindblom A. & Mitronen, L.: Kaupan liiketoimintaosaaminen (Talentum, 2008) and other learning material specified during lectures.

Assessment methods and criteria:

Lecture- and literature examination and course assignments.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Jari Juga

Working life cooperation:

-

Other information:

The number of students is limited.

A452281: Advanced Module/Embedded Systems, Embedded Systems Electronics (obligatory), 16 - 21 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Boutellier, Jani Joosefi
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, period 1. Will be held next time in the autumn of 2016

Learning outcomes:

1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

3. Is capable of assembling a signal processor out of basic entities

4. Can match the processor performance and the application requirements

5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:

Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h

Target group:

Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.

Prerequisites and co-requisites:

521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Handouts.

Assessment methods and criteria:

Participation in mandatory classes and approved project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Jani Boutellier

Working life cooperation:

No.

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish
Leikkaavuudet:

521306A	Circuit Theory 2	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 2

Learning outcomes:

After the course the student can:
1. use Laplace transform for solving time and frequency response of electric circuits;
2. derive continuous-time transfer functions.;
3. solve their poles and zeros and understand the meaning of those;
4. draw the pole-zero map and Bode plots of any given transfer function;
5. construct 2-port parameter models of a given circuit

Contents:

Use of Laplace transform in network analysis. Properties of network functions, poles and zeros, Boden magnitude and phase plots. 2-port parameter models.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures, 22 h exercises, and simulation excerices.

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

Continuation for Circuit theory 1. Needed in most analog electronics courses.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 12-18.

Assessment methods and criteria:

Course is examined by a final exam. Obligatory simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical 1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS/CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Lahti
Opintokohteen kielet: Finnish

ECTS Credits:

6

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Spring, peridos 3-4

Learning outcomes:

1. knows the phases of the design process of hardware parts of digital system implemented in FPGA or ASIC technologies, and understands their purpose, and the problems and aims associated with different design tasks

2. is able to use the tools needed in industrial design projects.

Contents:

1. Digital systems design process. 2. Assertion-based verification, 3. Universal verification methodology (UVM) 4. ASIC design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability). 5. Use of SystemC language in the modeling of digital circuits. 6. Architecture-level synthesis of digital circuits.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 20h/ exercises 20h (group work)/ independent work 120h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1 and Digital techniques 2

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No.

A452282: Advanced Module/Embedded Systems, Embedded Systems Electronics (optional), 14 - 39 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Arto Lanamäki
Opintokohteen kielet: English
Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

Contents:

Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:

MSc students

Prerequisites and co-requisites:

Completion of Bachelor’s studies

Recommended optional programme components:

Recommended or required reading:

Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

Working life cooperation:

No

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period 1

Learning outcomes:

1. is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals.
2. is able to calculate problems, caused by electrical disturbances, crosstalk and non-idealities of electrical components.
3. can calculate reliability of an electrical device or system.
4. The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.

Contents:

Power supplies, thermal design, grounding, transmission of fast signals by using transmission lines, electrical disturbances, crosstalk, non-idealities of electrical components, reliability of electronics.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 30 h of lectures and 20 h of exercises.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Both Principles of Electronics Design and Analogue Electronics I must have been accepted.

Recommended optional programme components:

The course is an independent entity and does not require other studies carried out at the same time.

Recommended or required reading:

Lecture notes. Ward & Angus: Electronic Product Design, Hall&Hall&McCall: High speed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques. Eric Bogatin: Signal and Power Integrity – Simplified, 2. ed.

Assessment methods and criteria:

The course is passed by means of a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No.

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01	Wireless Communications I, Exam	0.0 op
521395S	Wireless Communications I	5.0 op
521320S	Wireless Communications 2	8.0 op
521320S-01	Intermediate exam or final exam, Wireless Communications 2	0.0 op
521320S-02	Exercisework, Wireless Communications 2	0.0 op

ECTS Credits:

5 ECTS cr / lecture 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. can analyze the performance of multilevel digital modulation methods in AWGN channel

2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance

3. recognizes the suitable diversity methods for fading channel and related combining methods

4. can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them

5. can explain design methods signals for band-limited channels

6. can classify different channel equalizers, and perform the performance analysis

Contents:

Digital modulation methods and their performance in AWGN-channel, radio channel models, performance of digital modulation in fading channel, diversity techniques, channel equalizers in wireless communication channel, carrier and symbol synchronization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Target group:

1st year WCE students and M.Sc. students (i.e., 4th year in EE degree programme)

Prerequisites and co-requisites:

521330A Telecommunication Engineering 521316S Broadband Communications Systems

Recommended optional programme components:

-

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of book: J.G. Proakis: Digital Communications, 4th ed, McGraw Hill, 2001.

Assessment methods and criteria:

The course is passed with final examination and accepted design exercise. Grade is based on exam. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Jari Iinatti

Working life cooperation:

No

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish (In English if needed).

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies

2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters
5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters

Contents:

Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 20h. Learning without guidance either privately or in a group 60h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Principles of electronics design, Electronics design I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, D. A. Johns & K. Martin: Analog integrated circuit design, Wiley & Sons 1997, chapters 1, 3, 4, 5, 7, chapter 8 partially, 11, 12 and 13. OR P. E. Allen &D. R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1, 3, 4, 5, 6, 8 and 10.

Assessment methods and criteria:

The course unit is passed by a final exam and a passed design work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521088S: Optoelectronics, 5 op

Voimassaolo: 01.01.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Kostamovaara
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

1. is able to explain the principles of operation of optical fibres and wavequides

2. is able to explain the principles of operation of semiconductor light sources and photo detectors, and knows the factors affecting their performance

3. is able to outline the circuit-level structures for optical transmitter circuits and photo detector preamplifiers

4. is able to compare their performance in terms of the main performance parameters

Contents:

Wave/particle dualism of optical radiation, optical waveguides and their properties, sources of radiation (LED- and laser structures), photo detectors (PIN- and AP-diodes,SPAD), light source modulation, preamplifiers and their bandwidth/stability/noise analysis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h, may include a seminar.

Target group:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Recommended or required reading:

Lecture notes, S. Kasap: Optoelectronics and Photonics, Principles and Practices, Prentice Hall 2013, 2nd Ed.

Assessment methods and criteria:

Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Kostamovaara

Working life cooperation:

Does not apply.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

521385S: Mobile Telecommunication Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Katz, Marcos Daniel

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Upon completing the required coursework, the student will be able to determine and fit the values of the main parameters for modern mobile telecommunication systems network planning. The course gives skills to describe mobility management, adaptive resource control and dynamic resource allocation in mobile networks.
The goal of this course is to provide the basic understanding of dimensioning and performance of mobile communications systems. In addition, the current mobile communications system standards as well as the ones being developed are also studied, preparing students to understand the structure, functionality and dimensioning of these systems.

Contents:

Concept and structures of modern mobile communications systems. Basics of radio network planning and capacity. Distributed transmission power control and mobility management. Resource allocation techniques: adaptive resource control, dynamic resource allocation. Cooperative communications. Examples of digital mobile telecommunication systems in practice.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h and the compulsory design work with a simulation program (16 h)

Target group:

2nd year M.Sc. and WCE students

Prerequisites and co-requisites:

Telecommunication Engineering, Broadband Communications Systems and Wireless Communications I.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course material will be defined at the beginning of the course.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Marcos Katz

Working life cooperation:

-

Other information:

Objective: The goal of this course is to provide the basic understanding of dimensioning and performance of mobile communications systems. In addition, the current mobile communications system standards as well as the ones being developed are also studied, preparing students to understand the structure, functionality and dimensioning of these systems.

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A	Filters	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 14 h exercises. A deign excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521369A	Simulations and Tools for Telecommunications	3.0 op
521369A-01	Simulations and Tools for Telecommunications, exam	0.0 op
521369A-02	Simulations and Tools for Telecomm. exercise	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Fall, period 2

Learning outcomes:

1. A student recognizes problems and limitations related to simulations.

2. She/he can select a suitable simulation method and knows how to validate the model.

3. Student knows how to generate signals, random numbers and noise.

4. She/he knows how to model fading channels.

5. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results.

6. She/he can explain principles of network level simulations.

7. A student knows basics of one or two fundamental simulation programs

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. Basics of MATLAB and OPNET simulation software (these could vary depending on needs/availability).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h (including program introductions), and the compulsory assignment with a simulation program (40 h).

Target group:

3rd year bachelor's degree students

Prerequisites and co-requisites:

Telecommunication Engineering

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition. Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. The final grade is based on exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

A452283: Advanced Module/Embedded Systems, Embedded Systems Software (obligatory), 10 - 20 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521266S: Distributed Systems, 6 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Leikkaavuudet:

521290S	Distributed Systems	5.0 op

Language of instruction:

In English.

Timing:

Spring, periods 4-5.

Learning outcomes:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.

Contents:

Architectures, processes, com-munication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed web-based systems, distributed coordination-based systems.

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Required literature: Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems – Principles and Paradigms, Second Edition, Prentice Hall, 2007, ISBN 978-0132392273, 704 pages.

Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5; zero stands for a fail.

Person responsible:

Professor Timo Ojala

Working life cooperation:

None.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

1. Understands the main design concepts related to REST architectural style and ROA architecture

2. Is able to design, test and implement different components of a RESTful Web API

3. Understands what hypermedia is and how can it be used to build RESTful Web APIs

4. Is able to implement simple clients using Web technologies

5. Becomes familiar with basic technologies to store persitent data on the server and serialize data in the Web

Contents:

RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).

Mode of delivery:

Web-based teaching and face-to-face teaching.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming. Applied Computing Project I is recommended.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

This course replaces the course “521260S Representing structured information”.

A452284: Advanced Module/Embedded Systems, Embedded Systems Software (optional), 23 - 35 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the adavanced module is 35 ECTS cr

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Arto Lanamäki
Opintokohteen kielet: English
Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

Contents:

Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:

MSc students

Prerequisites and co-requisites:

Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:

Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

Working life cooperation:

No

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A	Object Oriented Analysis and Design (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd autumn semester.

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use
cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know
principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They
understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Target group:

Bachelor students.

Prerequisites and co-requisites:

Course of elementary object-oriented programming is a compolsory prerequisite. Basic knowledge of object programming and information systems
analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Juha Iisakka

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812341A	Object-oriented Programming (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 82h.

Target group:

BSc students.

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

Timothy Budd: Introduction to object-orientedprogramming, 3rd edition.
Bruce Eckel: Thinkingin Java 3rd edition or later.

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Ilkka Räsänen

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01	Wireless Communications I, Exam	0.0 op
521395S	Wireless Communications I	5.0 op
521320S	Wireless Communications 2	8.0 op
521320S-01	Intermediate exam or final exam, Wireless Communications 2	0.0 op
521320S-02	Exercisework, Wireless Communications 2	0.0 op

ECTS Credits:

5 ECTS cr / lecture 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. can analyze the performance of multilevel digital modulation methods in AWGN channel

2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance

3. recognizes the suitable diversity methods for fading channel and related combining methods

4. can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them

5. can explain design methods signals for band-limited channels

6. can classify different channel equalizers, and perform the performance analysis

Contents:

Digital modulation methods and their performance in AWGN-channel, radio channel models, performance of digital modulation in fading channel, diversity techniques, channel equalizers in wireless communication channel, carrier and symbol synchronization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Target group:

1st year WCE students and M.Sc. students (i.e., 4th year in EE degree programme)

Prerequisites and co-requisites:

521330A Telecommunication Engineering 521316S Broadband Communications Systems

Recommended optional programme components:

-

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of book: J.G. Proakis: Digital Communications, 4th ed, McGraw Hill, 2001.

Assessment methods and criteria:

The course is passed with final examination and accepted design exercise. Grade is based on exam. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Jari Iinatti

Working life cooperation:

No

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

-

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Boutellier, Jani Joosefi

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, period 1. Will be held next time in the autumn of 2016

Learning outcomes:

1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

3. Is capable of assembling a signal processor out of basic entities

4. Can match the processor performance and the application requirements

5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:

Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h

Target group:

Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.

Prerequisites and co-requisites:

521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Handouts.

Assessment methods and criteria:

Participation in mandatory classes and approved project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Jani Boutellier

Working life cooperation:

No.

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521369A	Simulations and Tools for Telecommunications	3.0 op
521369A-01	Simulations and Tools for Telecommunications, exam	0.0 op
521369A-02	Simulations and Tools for Telecomm. exercise	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Fall, period 2

Learning outcomes:

1. A student recognizes problems and limitations related to simulations.

2. She/he can select a suitable simulation method and knows how to validate the model.

3. Student knows how to generate signals, random numbers and noise.

4. She/he knows how to model fading channels.

5. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results.

6. She/he can explain principles of network level simulations.

7. A student knows basics of one or two fundamental simulation programs

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. Basics of MATLAB and OPNET simulation software (these could vary depending on needs/availability).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h (including program introductions), and the compulsory assignment with a simulation program (40 h).

Target group:

3rd year bachelor's degree students

Prerequisites and co-requisites:

Telecommunication Engineering

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition. Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. The final grade is based on exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S	Advanced practical training	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
Whole academic year. Periods 1-4.
Learning outcomes:
After the advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of study. The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training gives a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Students find their training jobs themselves.
Target group:
Computer Science and Engineering MSc students.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
-
Recommended or required reading:
None.
Assessment methods and criteria:
For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Jukka Kontinen
Working life cooperation:
Yes.

521993S: Master's Thesis in Computer Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30
Language of instruction:

Finnish/English
Timing:
Second year of MSc studies
Learning outcomes:
The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. Depending on the nature of the work, the student is able to present the existing results or technological implementations so that the methods used in the work are justified in relation to the state of the art in the field of engineering or science in question. He is able to apply the knowledge and state of the art methods of the subject area in his work. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals and to consider their general significance to modern engineering or science, and assess the broader significance of the results to the company, organization or project. The student is able to produce smooth, clear and finalized text based on technical and scientific writing practices of the field.
Contents:
The thesis work is carried out independently. The student defines the content of the thesis under the guidance of the supervisor. The degree program committee approves the thesis topic and content.
The thesis is recorded in accordance with the orientation using the following codes:

- 521981S Master's Thesis in Information Processing Engineering, 30 ECTS cr
- 522985S Master's Thesis in Applied Computing, 30 ECTS cr
- 521984S Master's Thesis in Embedded Systems, 30 ECTS cr

Mode of delivery:
Face-to-face meetings with the supervisor and independent studying.
Learning activities and teaching methods:
Independent work under the guidance of the supervisor.
Target group:
Second year MSc students.
Prerequisites and co-requisites:
Compulsory advanced studies preceding the thesis (90 ECTS cr).
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
The thesis is assessed by two reviewers (supervisor and second reviewer) and approved by the degree program committee. Assessment Criteria at the University of Oulu can be found here.
Grading:
1-5 (1=sufficient, 2=satisfactory, 3=good, 4=very good, 5=excellent)
Person responsible:
Supervising professor or researcher
Working life cooperation:
Yes.
Other information:
Detailed instructions: http://www.oulu.fi/cse/studying/masters-thesis

521009S: The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

A452120: Basic and Intermediate Studies, Information Engineering, 120 - 150 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic and Intermediate Studies

Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Second official language, select 2

901048Y: Second Official Language (Swedish), Written Skills, 1 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

901060Y Second Official Language (Swedish), Written Skills 1.0 op
ay901048Y Second Official Language (Swedish), Written Skills (OPEN UNI) 1.0 op

901049Y: Second Official Language (Swedish), Oral Skills, 1 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

901061Y Second Official Language (Swedish), Oral Skills 1.0 op
ay901049Y Second Official Language (Swedish), Oral Skills (OPEN UNI) 1.0 op

900081Y: Second Official Language (Finnish), Written Skills, 1 - 2 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

900082Y: Second Official Language (Finnish), Oral Skills, 1 - 3 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

Compulsory studies

521002P: Orientation to Computer Science and Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521005P	Orientation Course for New CSE Students	1.0 op

ECTS Credits:

5

Language of instruction:

Main language is Finnish, but can be completed with English.

Timing:

Course will be arranged during Autumn / Spring in periods I-II. Course is obligatory for first year computer engineering students.

Learning outcomes:

1. Student understands the characteristics of studying in computer science and engineering program and knows about the devices and software related to the studies.

2. Student has created his personal study plan, participates in community activities, and is aware of the challenges related to studying.

3. Student has gained hands-on experience with computer gadgets, Linux systems, agile software development tools and scientific computing environment.

4. Student understands how microcontroller devices operate and how signal data can be manipulated using Matlab software environment.

5. Student has gained knowledge on scientific principles (academic responsibility, studying and ways of work) and understands the responsibility over his personal studies.

6. Student knows his degree program, key university personnel, tutor and small group.

7. Student has become acquainted with the degree structure, goals and content, and knows how to create a personal study plan (HOPS) to achieve the degree.

8. Student has practical knowledge about initializing his studies and utilizing Lukkari service to plan and manage his studies and time use.

Contents:

Comprises of the following sections: Study planning, studying in communities, introduction to Matlab computing environment, introduction to Linux systems, introduction to agile software development tools, and introduction to programmable gadgets.

Mode of delivery:

Course is based on blended teaching (web-based teaching + face-to-face teaching).

Learning activities and teaching methods:

Lectures: 2+4 h (student counseling) 4+4 h (seminars) 6 h (introduction to Matlab 4 h (introduction to Linux systems) = 24 h Group work: 20 h (small-group meetings) 7 h (introduction to programmable gadgets -> one day) 3*4h (introduction to agile tools) PSP Advising 2 h = 41 h Self-studying: 70 h (study planning and follow-up, self study) Linux-systems and programmable gadgets are organized as one-day courses. Introductions to Matlab and agile software development tools are given as three lectures. The courses give guided introductions to scientific computation environments, agile tools, Linux systems and programmable gadgets in order to get student acquainted with the tools and technologies they need in their further studies. The sections require attendance in the organized seminars, guided teaching sessions and small-group meetings as well as creating personal study plan, time tracking and reporting. To pass Orientation to computer science course and get credits, all sections of the course must be passed.

Target group:

Computer science and engineering students.

Prerequisites and co-requisites:

-

Recommended optional programme components:

The course is designed to carry out in the first year while planning and following obligatory studies in computer science and engineering.

Recommended or required reading:

Study material is provided during guided teaching and seminars.

Assessment methods and criteria:

The course utilizes continuous assessment. To pass sub-sections, student is required to attend in the organized seminars and guided teaching sessions, creating personal study plan, time tracking and reporting.

Grading:

The course will be graded as “pass / fail”.

Person responsible:

Riku Hietaniemi

Working life cooperation:

-

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P	Calculus I (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3.

Learning outcomes:

After completing the course the student identifies concepts of vector algebra and can use vector algebra for solving problems of analytic geometry. The student can also explain basic characteristics of elementary functions and is able to analyse the limit and the continuity of real valued functions of one variable. Furthermore, the student can solve problems associated with differential and integral calculus of real valued functions of one variable.

Contents:

Vector algebra and analytic geometry. Limit, continuity, differential and integral calculus and applications of real valued functions of one variable. Complex numbers.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 55 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Grossmann, S.I.: Calculus of One Variable; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations (partly); Adams, R.A.: A Complete Course Calculus (partly).

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Peltola
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031078P	Matrix Algebra (OPEN UNI)	5.0 op
031019P	Matrix Algebra	3.5 op

Ei opintojaksokuvauksia.

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Mika Rautiainen, Mika Oja
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and learning material are in Finnish. The course can be completed in English by self-studying from a book, completing assignments and exercises on the course learning environment, and delivering a final project.

Timing:

Fall, period 1. There is an option to extend the course to the 2nd period in cases where completing in one period doesn't fit the student's schedule.

Learning outcomes:

1. Is capable of solving problems in the computer's terms

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

5. Is able to use the internet to find information about programming

Contents:

Problem solving with programming, basic concepts of programming, writing Python code.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

30h of exercise groups, 105h self-studying in the web.

Target group:

1 st year students of computer science and engineering, electrical engineering, medical and wellness technology and industrial and engineering management, 2nd year students of physics, and other students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

Web material in an online learning environment. Address will be announced at the beginning of the course.

Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about assessment criteria at the University of Oulu webpage
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031075P	Calculus II (OPEN UNI)	5.0 op
031011P	Calculus II	6.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

The course gives the basics of theory of series and differential and integral calculus of real and vector valued functions of several variables. After completing the course the student is able to examine the convergence of series and power series of real terms. Furthermore, the student can explain the use of power series e.g. in calculating limits and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

Contents:

Sequences, series, power series and Fourier series of real terms. Differential and integral calculus of real and vector valued functions of several variables.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 28 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course Calculus I.

Recommended optional programme components:

-

Recommended or required reading:

Kreyszig, E.: Advanced Engineering Mathematics; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations.

Assessment methods and criteria:

Intermediate exams or a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031021P	Probability and Mathematical Statistics (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-6

Learning outcomes:

After completing the course the student knows the key concepts of probability and the most important random variables and is able to use them in calculating probabilities and parameters of probability distributions. In addition, the student is able to analyze statistical data by calculating interval and point estimates for the parameters. The student is also able to formulate statistical hypotheses and test them.

Contents:

The key concepts of probability, random variable, parameters of probability distributions, estimation of parameters, hypothesis testing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h/Exercises 22 h/Self-study 68 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisites are the course 031010P Calculus I and some parts of the course 031011P Calculus II.

Recommended optional programme components:

-

Recommended or required reading:

Milton, J.S., Arnold, J.C. (1992): Introduction to Probability and Statistics.

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

902011P: Technical English 3, 6 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1

Status:

This course is compulsory for the students who have chosen English as their foreign language. (See the foreign language requirements for your own degree programme.)

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

6 ECTS credits (The workload is 160 hours.)
STUDENTS OF ENGINEERING: The course consists of 3 x 2-ECTS modules.
STUDENTS OF ARCHITECTURE: The course consists of 2 x 3-ECTS modules.

Students with the matriculation exam grade *Laudatur* or *Eximia cum laude approbatur* will be exempted from part of the course (2 ECTS credits).

Language of instruction:

English

Timing:

STUDENTS OF ENGINEERING:
PYO, KO, TuTa: *1st & 2nd* years of studies, beginning 1st year autumn.
SO & CSE: 2nd & 3rd years of studies, beginning 2nd year autumn.
STUDENTS OF ARCHITECTURE:
1st & 2nd years of studies, beginning 1st year spring and continuing 2nd year autumn.

Learning outcomes:

By the end of the course, you will be able to

- demonstrate efficient strategies and methods for developing and maintaining your English proficiency
- communicate using the core vocabulary required for professional language use in your field
- apply language skills, intercultural awareness and presentation techniques necessary for working in a multicultural environment
- use language, culture and communication skills at a B2-C1 CEFR level in accordance with your own professional needs.

Contents:

In this course, you will focus on developing oral and written English language skills which enable you to follow developments in your own professional field and manage successfully in an international, intercultural working environment.

STUDENTS OF ENGINEERING:
The course consists of three modules:

1. first, **Professional English for Technology** (PET, 2 ECTS credits),
2. then **two modules** (2 ECTS credits each) from a free-choice module menu, in which each module has its own content. These modules allow you to develop further skills in specific core areas. Read the module descriptions with care so that you choose modules which match your own needs, interests and level.

   TuTa students, however, take ONE module from the free-choice menu and then, in second year autumn,
   the 902143Y, Company Presentations module, which is integrated with a course in their own department
   (555226A Operations and production) .

STUDENTS OF ARCHITECTURE:
The course consists of two modules:

See the course description of each module (902011P-38 module A and 902011P-39 module B for a detailed explanation of the course content.

Mode of delivery:

STUDENTS OF ENGINEERING: The mode of delivery varies according to the modules you take. See the course descriptions for the individual modules.
STUDENTS OF ARCHITECTURE: face-to-face teaching in the premises of your own department and independent study

Learning activities and teaching methods:

STUDENTS OF ENGINEERING: The teaching methods and learning activities depend on which free-choice modules you choose. See the course descriptions for the individual modules.
STUDENTS OF ARCHITECTURE:
The classroom teaching comprises about 50% of the total student workload for the course and includes mini-lectures, group and teamwork, student presentations. The independent work component comprises online work and independent study in preparation for classroom activities.

Target group:

Students of the Faculty of Technology
- all Engineering Departments
- the Department of Architecture

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials will be provided by the teacher.

Assessment methods and criteria:

Assessment methods vary according to the individual modules taken. The assessment criteria are based on the learning outcomes of the module.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass / fail.

Person responsible:

Each department in the Technical Faculty has its own Languages and Communication contact teacher for questions about English studies.

Working life cooperation:

-

Other information:

See the Languages and Communication Study Guide, English, TTK.

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op
031018P	Complex Analysis	4.0 op

Ei opintojaksokuvauksia.

031023P: Mathematical Structures for Computer Science, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Peltola
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031023P	Mathematical Structures for Computer Science (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3

Learning outcomes:

After completing the course the student is able to apply result of logic to find the truth value of logical statement. He can express sentences of natural language by symbols of logic. He can use arithmetic operations on different number bases. The student is able to apply formal methods of discrete mathematics to model simple information processing problems.

Contents:

Elementary logic. Mathematical induction. Boolean algebra and set theory. Theory of automata and formal languages. Some graph theory.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h / Group work 20 h.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Rosen K.H.: Discrete Mathematics and Its Applications. Gersting J.L.: Mathematical Structures for Computer Science.

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Matti Peltola

Working life cooperation:

-

Other information:

-

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opettajat: Sassali, Jani Henrik, Ursula Heinikoski
Opintokohteen kielet: Finnish
Leikkaavuudet:

030004P	Introduction to Information Retrieval	0.0 op

ECTS Credits:

1 ECTS credit

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.

Contents:

Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student's own choice

Learning activities and teaching methods:

Training sessions 8h, group working 7h, self-study 12h

Target group:

Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology, physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material https://wiki.oulu.fi/display/030005P.

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail

Person responsible:

Science and Technology Library Tellus, tellustieto (at) oulu.fi

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031076P	Differential Equations (OPEN UNI)	5.0 op
800320A	Differential equations	5.0 op
031017P	Differential Equations	4.0 op

Ei opintojaksokuvauksia.

761113P: Electricity and magnetism, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op
761119P-02	Electromagnetism 1, lab. exercises	0.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 credits

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Spring

Learning outcomes:

The student is able to describe the basic concepts of electricity and magnetism and to apply those when solving the problems related to electromagnetism.

Contents:

Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology.
Contents in brief: Coulomb’s law. Electric field and potential. Gauss’s law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and magnetic fields, and applications. Ampère’s law and Biot-Savart law. Electromagnetic induction and Faraday’s law. Inductance and inductors. R-L-C circuits, alternating current and AC circuits.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 6 exercises (12 h), 2 laboratory exercises (8 h), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus are needed.

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 21-31. Also older editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Course material availability can be checked here.

Assessment methods and criteria:

Three mini examinations and end examination or final examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761113P/

Compulsory Intermediate Studies

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 136h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Laboratory exercises and the exam can be done in English.

Timing:

Periods 1-2.

Learning outcomes:

1. is able to measure basic measurements with a multimeter,

2. is able to measure basic measurements with an oscilloscope,

3. is able to operate signal and function generators.

4. is able to estimate the validity of their measurements.

Contents:

Units of measures, standards of measures, analysis of errors, most commonly used analog and digital measuring methods, equipment and electrical safety regulations.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 20h, laboratory exercises 16 h and self-study 100h.

Target group:

Course is compulsory for electrical engineering, information engineering and wellness technology students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

None.

521301A: Digital Techniques 1, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Mäntyniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521412A-02	Digital Techniques 1, Exercise Work	0.0 op
521412A	Digital Techniques 1	6.0 op
521412A-01	Digital Techniques, Exam	0.0 op

ECTS Credits:

8

Language of instruction:

Finnish

Timing:

Periods 3-4

Learning outcomes:

1. After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze of simple digital circuits.

2. In addition, they are also able to use in their designs graphical symbols specified in the dependency notation standard (SFS4612 ja IEEE/ANSI Std.91-1991) and different descriptions of function and structure of state machines.
3. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components.
4. After having assimilated the basic knowledge of digital technique, students are able to understand also the function and structure of micro controllers and micro processors.

Contents:

The principles of digital devices, Boolean algebra, numeral systems, operating principle, analysis and synthesis of combinational logic, flip-flops, operating principle, analysis and synthesis of sequential logic (state machines), physical characteristics of CMOS technology, registers and register transfers, computer memory, instruction set architecture, computer design basics, interfaces and data transmission.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lessons 40 h, guidance of the project work 20 h.

Target group:

Primarily 1st year electrical engineering and computer science and engineering BSc students. The course can be taken by the students of the university of Oulu.

Prerequisites and co-requisites:

-

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Text books, MIT OpenCourseWare and execise literature.

Assessment methods and criteria:

Project work, home assignment and exam. Partial exams are recommended.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Project work pass/fail. Numerical grading 1-5 for exam. Final grading is based on exam.

Person responsible:

Antti Mäntyniemi

Working life cooperation:

-

521150A: Introduction to Internet, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Koskela

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

All materials are in English, lectures are given in Finnish.

Timing:

Spring, period 4.

Learning outcomes:

1. is able to explain the design principles, architecture, functionality and challenges of the public internet

2. understands data link layer's role and most important access network technologies

3. is able to explain the structure and most important protocols of the TCP/IP protocol stack

4. knows most important internet applications and their protocols

5. understands the principles of internet security and multimedia applications

6. is able to solve simple internet related problems

7. is able to program a small internet application

Contents:

Internet’s design principles and architecture, data link layer and most important access network technologies, TCP/IP protocol stack and its most important protocols, most important Internet applications, principles of Internet security and multimedia, internet's challenges and Future Internet.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32 h / problem solving exercises 14 h / laboratory exercises 12 h / course work 25 h / self-study 52 h. Problem solving exercises, laboratory exercises and course work are completed as group work.

Target group:

Computer Science and Engineering students, Information Processing Science students, other students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

Announced at the beginning of the course.

Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory course work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course uses numerical grading scale 1-5.

Person responsible:

Dr. Timo Koskela.

Working life cooperation:

-

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. Student understands the basic computer architecture and organization.

2. Student understands CPU operation and datapath in general.

3. Student knows different number systems and data representations in computers.

4. Student is familiar of I/O operation with peripheral devices in general.

5. Student is able to implement small programs with the C programming language for general-purpose computers for embedded systems.

6. Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Yleinen tietokoneen organisaatio ja arkkitehtuuri, keskusyksikkö, muistihierarkia ja muistinhallinta, tietotyypit, laiterekisterit ja I/O, yleinen tietokoneen ohjelmointi ja laiteläheisen ohjelmointi, C-kielen perusteet.

Mode of delivery:

Web-based and face-to-face teaching.

Learning activities and teaching methods:

Lectures (40h), course exercises (20h), laboratory exercise (3h) and course projects in groups.

Target group:

2nd year students of computer science and engineering and 3rd year students of electrical engineering.

Prerequisites and co-requisites:

Elementary programming 521141P.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Course material will be announced at the beginning of the course.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course projects in groups. Assessment is based on the exercises and the course projects. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

No.

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521457A	Software Engineering (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Material available in English.

Timing:

Spring, periods 3.

Learning outcomes:

After finishing the course, the student knows the basic concepts of software and real-time systems, the different areas of project management, the phases of software development and the goals and tasks of them,
is able to use structural methods for defining systems and knows the principles of object-oriented design and analysis.
After the course, the student has basic knowledge of utilizing software tools for structural analysis and design.

Contents:

Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics: design, metrics, risk management, resource management, follow up, quality control, product control, 4. software testing methods and strategies, 5. introduction to object-oriented analysis and design. 6. Agile software development.

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

The course consists of lectures and a laboratory design exercise. The course is completed by a final exam and a successfully completed exercise. Lectures 30 h, laboratory design (in period 3) 12 h, the rest of the self-study.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005, chapters 1-11, 13-14 and 21-27. Older editions (4th and 5th) can also be used as a reference. In this case the lectures are based on chapters 1-20.

Assessment methods and criteria:

Final exam and accepted laboratory exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

-

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 2

Learning outcomes:

1. Knowledge of the Human Computer Interaction (HCI) fundamentals

2. Knowledge of evaluation techniques

3. Knowledge of prototyping techniques

4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Human and computer fundamentals, design and prototyping, evaluation techniques, data collection and analysis.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures (20 h), exercises (20 h), and practical work (95 h). The course is passed with an approved practical work. The implementation is fully English.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

While no specific courses are not required, elementary programming and design skills are desired.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. The course involves some basic programming.

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment is project-based. Students have to complete 4 individual exercises throughout the semester: 1: Using questionnaires; 2: Grouping & clustering; 3: Fitts' law; 4: Advanced evaluation &

visualisations. Passing criteria: all 4 exercises must be completed, each receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Jorge Goncalves
Vassilis Kostakos

Working life cooperation:

-

811312A: Data Structures and Algorithms, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Vesanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521144A	Algorithms and Data Structures	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. One English exercise group will be arranged.

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd study year.

Learning outcomes:

After completing the course, the student can describe the concept of algorithm and explain what correctness and time complexity of algorithms
mean. Furthermore, the student is able to explain the design paradigms presented in the course and to describe the complexity classes of relevant sorting algorithms. The student can analyse simple algorithms, i.e. to prove their correctness and evaluate their time complexity. Moreover, the student is able to describe the basic data structures and apply essential graph algorithms. Finally, the student can construct suitable data structures and algorithms for given problems; the student can also justify the choice of a data structure or an algorithm for an application.

Contents:

The concept and analysis of algorithms, sorting and searching algorithms and their complexity, algorithm design paradigms, the concept of data
structure and basic data struc-tures, hash tables, binary search trees, graphs and their algorithms.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 48h, exercises 21h, assignment (27), independent work 39h.

Target group:

BSc students.

Prerequisites and co-requisites:

Mastery of subject matter of the course “Discrete Structures” is required.

Recommended optional programme components:

Recommended or required reading:

Cormen, Leiserson, Rivest, Stein: Introduction to algorithms, 2nd edition, MIT Press 2001 (or later). From this edition chapters 1–4, 6–13, 15–16, 22–24, Appendix A and B are covered.

Assessment methods and criteria:

Exam and assignment. Exam will be graded 1-5 if accepted. Assignment graded accepted/failed. Final grade will be the same as exam's grade.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Ari Vesanen

Working life cooperation:

No

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

Ei opintojaksokuvauksia.

521453A: Operating Systems, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521453A	Operating Systems (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish, material available in English

Timing:

Spring, period 4

Learning outcomes:

1. is capable of explaining the basic structure and functioning of operating system

2. is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems

3. is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems

4. is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

Contents:

Operating system structure and services, process management, process synchronization, deadlocks, memory management, virtual memory, file-systems

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, laboratory exercise 6 h, the rest as independent work. The laboratory work, including pre-exercise and guided exercise performed in a group of one or two students in the unix environment, covers core topics of the course.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and 521267A Computer Engineering

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes (in Finnish) and exercise material. Silberschatz A., Galvin P., and Gagne G.: Operating System Concepts, 6th edition (or newer), John Wiley & Sons, Inc., 2003. Chapters 1-12.

Assessment methods and criteria:

The course is passed the final examination and accepted laboratory working.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Röning

Working life cooperation:

-

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Abdenour Hadid

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 3.

Learning outcomes:

1. is able to identify the types of problems that can be solved using methods of artificial intelligence.
2. knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence.
3. can also apply simple methods to reasoning under uncertainty and machine learning from observation.
4. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during period 3, the rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. More details on the course WWW page in Noppa.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Abdenour Hadid
Vili-Petteri Kellokumpu
Zinelabidine Boulkenafet

Working life cooperation:

-

Other information:

-

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A Digital Filters (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

1. understands the basic theory of digital image processing and knows its main applications.
2. is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression, segmentation and recognition.

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: http://www.ee.oulu.fi/research/imag/courses/dkk/). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

521330A: Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521357A	Telecommunication Engineering 1	3.0 op
521361A	Basics of Digital Communications	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish. The course can be completed in other languages e.g. in English as a book examination.

Timing:

The course is held in the spring semester, during period IV. It is recommended to complete the course at the 2nd spring semester.

Learning outcomes:

1. can tell and explain the essential blocks and their operation in time & frequency domains for frequently used analog and digital carrier and pulse modulation methods.
2. understands essential differences both between linear and non-linear modulations, and between coherenr and non-coherent modulations.
3. understands in which system applications each analog or digital modulation is typically used.
4. can tell limitations on system performance caused by noise interference and various transmission channels, and can propose methods to suppress interference both in analog and digital transmission.
5. can perform system analysis, and can calculate performances of analog and digital modulations based on simple assumptions regarding channel models.
6. can compare modulations from the standpoints of resource use (transmitted power and bandwidth needed) and implementation complexity.
7. understands the meanings of various equalizing, diversity and coding methods from the standpoint of improvement for digital transmission reliability.
8. understands various standards and specifications of new digital transmission systems.
9. can apply gained knowledge in working life to design of systems and their sub-system units, and can also perform computer simulations.
10. understands the principles of information theory, source coding and error-control coding, and masters various most commonly used coding methods.

Contents:

Essential and optional blocks of coherent and non-coherent analog and digital transmission systems and their operation principles. Linear (amplitudemodulation) and non-linear (anglemodulation) modulation principles, and differences in their performance and operation. Carrier and pulse modulation principles and their differences. The most important analog (DSB, AM, SSB, VSB, PM, FM, PAM,PWM, PPM) and digital (ASK/MASK, PSK/MPSK, FSK/MFSK, DPSK, QPSK/OQPSK, MSK/GMSK, QAM, MCM/OFDM, TCM, DM, PCM) carrier and pulse modulation methods and their performance analysis (SNR, BEP) and comparison based on the AWGN channel model. Influence of single-tone carrier radiofrequency interference (RFI) in the case of analog modulations. The threshold effect in the case of non-linear modulations and non-linear detectors. Mixing-principle and superheterodyne receiver. Phase-lock loop techniques, and FDM, TDM and QM-multiplexing methods. Matcher filter and correlation receiver principles. Characteristics and modelling of radio channels. Influence of band-limiting and multi-path propagation (inter-symbol interference ISI & fading) on system performance. Diversity, channel equalizing and MCM/OFDM methods for reducing channel interference. Spread-spectrum technique, and benefits & limitations & applications of that principle. Cellular system idea. Basics of information theory, source coding and error-control coding methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Face-to-face teaching 52 h. No separate times for class-ecercises. Exercises are integrated as part of face-to-face teaching event. Self-study 73 h. Total 125 h.

Target group:

Second year B.Sc.(Tech.) students in electrical engineering and computer engineering degree programmes.

Prerequisites and co-requisites:

031080A Signal analysis course.

Recommended optional programme components:

No connections to other courses.

Recommended or required reading:

Lecture slides in Finnsih are stored into the TTK-OPTIMA environment. The course and lecture slides are based on the book: R.E. Ziemer & W.H. Tranter: Principles of Communications: Systems, Modulation and Noise, 7th edition, 2015, John Wiley & Sons, Partially chapters: Ch 1 (ss. 1-16), Ch 3 (112-151), Ch 4 (ss. 156-184, 194-209), Ch 5 (ss. 215-216, 225-239), Ch 8 (ss. 349-361, 370-380, 384-390), Ch 9 (ss. 396-468), Ch 10 (ss. 477-516, 528-532, 540-546, 553-557), Ch 12 (ss. 615-647, 657-664, 668-670, 679-683).

Assessment methods and criteria:

Course can be passed either with several mini-exams during course, or with final exam.

Grading:

Course can be passed either with several mini-exams during course, or with final exam.
Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

Other information:

This course replaces the following candidate level courses: 521357A Telecommunication Engineering I (3 ECTS) and 521361A Telecommunication Engineering II (3 ECTS).

Complusory Bachelor's Thesis

523991A: Bachelor's Thesis / Information Engineering, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish. Bachelor's thesis can be written also in English.

Timing:

All periods

Learning outcomes:

The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. The student is able to use sources of information critically. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals, and produce smooth, clear and finalized text based on technical and scientific writing practices of the field.

Contents:

The student selects the topic together with the supervisor.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Course is completed at the end of bachelor's studies, typically, in the spring semester of the third study year. The work may be a theoretical or practically oriented study from a topic provided by a company or a research group.

Target group:

Computer Science and Engineering students.

Prerequisites and co-requisites:

Compulsory basic and intermediate studies and the module preparing for the option.

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Bachelor's thesis and the maturity test. Assessment Criteria at the University of Oulu can be found here. Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass / fail

Person responsible:

Professors and researchers in the Department of Computer Science and Engineering.

Working life cooperation:

Yes

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900060A	Technical Communication (OPEN UNI)	2.0 op
470218P	Written and Oral Communication	3.0 op

Proficiency level:

-

Status:

This course unit is compulsory for students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Required proficiency level:

-

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

1st year: Process and Environmental Engineering
3rd year: Mechanical Engineering; Electrical Engineering, Computer Science and Engineering and Communications Technologies

Mode of delivery:

Multimodal teaching

Learning activities and teaching methods:

Contact hours ca. 20 h and independent group work or self-study ca. 34 h.

Target group:

Bachelors students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Kauppinen, Anneli & Nummi, Jyrki & Savola, Tea: Tekniikan viestintä: kirjoittamisen ja puhumisen käsikirja (EDITA); Nykänen, Olli: Toimivaa tekstiä: Opas tekniikasta kirjoittaville (TEK) and material in Optima study environment.

Assessment methods and criteria:

Active participation in contact teaching, independent study and completion of given assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass / fail

Person responsible:

Kaija Oikarainen
Toropainen, Outi

Working life cooperation:

-

Other information:

All students are required to attend the first meeting of the course unit so the work groups can be formed and work started in a timely and efficient manner. When signing up for the course unit, you should keep in mind that completing it requires a responsible attitude and a strong commitment to the work because the teamwork-based exercises rely heavily on the participation and activity of the students.
If the student is involved in the University's student associations or functions in a position of trust in university government, student union administration or Oulun Teekkariyhdistys ry (or in its subordinate guilds), he/she may be relieved of some of the group communication exercises. These compensatory actions must always be agreed upon separately with the course unit's teacher. The student must present an official statement from a person in charge of the governing body or association, which details the student's tasks and involvement with that body or association. Participation that took place over five years ago does not entitle the student to any compensation.

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Marko Huhtanen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-5

Learning outcomes:

The student recognizes what numerical solution methods can be used to solve some spesific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.

Contents:

Numerical linear algebra. Numerical methods for systems of equations, Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations and Matrix algebra.

Recommended optional programme components:

-

Recommended or required reading:

J. Douglas Faires and Richar L. Burden, Numerical methods; Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, Numerical mathematics

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Heikkilä, Janne Tapani
Opintokohteen kielet: Finnish
Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory studies

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Simo Hosio
Opintokohteen kielet: English
Leikkaavuudet:

521041A	Applied Computing Project I	8.0 op

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

1. has basic understanding on how to collaboratively design a small-scale software project,

2. has basic understanding on how to implement and evaluate a small-scale software project,

3. is able to extensively document a small-scale software project,

4. is able to present and "pitch" a project work, i.e. give a good, concise presentation of the work

Contents:

Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives)

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.

Target group:

3rd year Computer Science and Engineering B.Sc. students and other Students of the University of Oulu.

Prerequisites and co-requisites:

While no specific courses are not required, elementary programming and design skills are desired.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:

The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Simo Hosio

Working life cooperation:

No

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS/CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521012A: Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521019A	Practical training	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3
Language of instruction:
Finnish.

Timing:
Periods 1-6.
Learning outcomes:
After the practical training the student can describe the job in question and its working environment from the point of view of his or her studies. The student can identify problems in the work and suggest improvements. The student can find connections between work and studies.
Contents:
The training offers students general insight into working life and to support and to support theoretical studying. Likewise the training has to acquaint the trainee with the social points and work safety in the work place.
Mode of delivery:
Independent work.

Learning activities and teaching methods:
The students find their training jobs themselves.
Target group:
Computer Science and Engineering BSc students.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
None.
Assessment methods and criteria:
For BSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. Detailed instructions for training report are available on the WWW pages of the degree program.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Computer Science and Engineering Planing Officer or Laboratory Engineer Jukka Kontinen
Working life cooperation:
Yes.
Other information:
Practical training is compulsory in the BSc. Tech degree for students who started in 2010 or earlier. For students starting 2011 or later, practical training (521012A) is optional.

H452229: Other Supplementary Module (Computer Science and Engineering), 15 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Supplementary Module / Bachelor's Degree

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embedded Systems). In this case one additional course of 5 ECTS cr from the same field should be selected to complement the module. Another alternative is to select the supplementary module from the fields of Electrical Engineering, Information Processing Science, Industrial Engineering and Management, Working life & Entrepreneurship, or Economics and Management. In all cases the extent of the supplementary module is 15 ECTS cr.

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-5

Learning outcomes:

The student recognizes what numerical solution methods can be used to solve some spesific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.

Contents:

Numerical linear algebra. Numerical methods for systems of equations, Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations and Matrix algebra.

Recommended optional programme components:

-

Recommended or required reading:

J. Douglas Faires and Richar L. Burden, Numerical methods; Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, Numerical mathematics

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory studies

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Simo Hosio
Opintokohteen kielet: English
Leikkaavuudet:

521041A	Applied Computing Project I	8.0 op

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

1. has basic understanding on how to collaboratively design a small-scale software project,

2. has basic understanding on how to implement and evaluate a small-scale software project,

3. is able to extensively document a small-scale software project,

4. is able to present and "pitch" a project work, i.e. give a good, concise presentation of the work

Contents:

Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives)

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.

Target group:

3rd year Computer Science and Engineering B.Sc. students and other Students of the University of Oulu.

Prerequisites and co-requisites:

While no specific courses are not required, elementary programming and design skills are desired.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:

The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Simo Hosio

Working life cooperation:

No

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS /CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

Supplementary Module: Electrical Engineering (15 ECTS cr)

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course

Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS/CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521077P: Introduction to Electronics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521077P Introduction to Electronics (OPEN UNI) 5.0 op

521209A Electronics Components and Materials 2.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the 2nd period. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

1. Student understands the block structures of electronic devices and their signal processing paths.

2. Student can identify the interfaces of analog and digital electronics and the software operations.

3. Student is able to identify and classify electronics components and compare their properties.

4. Students can describe electric conductivity and apply the phenomenon on designing and choosing resistors

5. Student is able to estimate the difference between dielectric materials and how they affect the properties of a capacitor.

6. Student can compare properties of magnetic materials and how identify they effect on inductive components.

7. Student can identify semiconductivity and is able to list typical semiconductor components.

8. Student can classify different circuit board techniques and is able to choose proper coupling techniques.

9. Student can identify the future technologies of electronics materials.

Contents:

Structures and interfaces of electronic devices. Electromagnetic properties of materials (conductivity, dielectricity, magnetism and semiconductivity).Electronics components (resistors, capacitors, inductive components and semiconductors). Interconnection technologies and circuit board technologies. The future of electronic materials and application areas.

Mode of delivery:

Face-to-face teaching and independent work.

Learning activities and teaching methods:

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 48 hours of guided teaching events and 84.5 hours of teaching without guidance either privately or in a group.

Target group:

First year electrical engineering students.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

-

Recommended or required reading:

Lecture material; Materials science and engineering: an introduction / Willam D. Callister, chapters 1, 18 and 20; Electronic components and technology / S. J. Sangwine. Chapters 1,2,3,5 and 7

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are two intermediate exams. In addition students will make course work which are graded. The assessment of the course is based on the learning outcomes of the course. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Jari Hannu

Working life cooperation:

No

521329A: Hands-on Course in Wireless Communication, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during first period. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

1. has become acquainted with wireless communication technologies with the aid of small laboratory measurement works, which do not require prior courses on telecommunication engineering.

2. has observed and learned the operation principles, properties and limitations of existing wireless communication systems.

3. has learned how to use measurement techniques and methods with the aid of modern measurement instruments in laboratory environment.

4. knows how to approach different kinds of wireless communication problems by utilizing hands-on engineering work practices.

Contents:

Students are introduced to the wireless communication systems and corresponding phenomena with the aid of guided laboratory exercises. The course utilizes within reasonable limits various existing wireless communication systems, in order to create simple connections between various equipments and modules in a laboratory environment.

Mode of delivery:

Face-to-face teaching and guided laboratory exercises. Self-studying at home between work themes. Writing of final report.

Learning activities and teaching methods:

Course consist of few small separate measurement problems dealing with wireless transmission. Before each work theme relevant theory and work instructions needed to complete the work are given. Students will participate in briefing lectures (appr. 2 h/theme) which introduce the theory needed to conduct each laboratory work problem. In addition, instructions to perform the work are given. After each lecture students will move to a measurement laboratory, and will study a given problem with the aid of measuring instruments in a laboratory environment under teacher's quidance. Work subjects are done within a group of several students, and measuremnt results are summarized in a written final report. Course contains face-to-face teaching and quided laboratory work among themes, and self-study between work themes. For the end, students perform discussion and reporting of results. Final exam is not arranged.

Target group:

Second year bachelor level electrical engineering students.

Prerequisites and co-requisites:

No prerequisities.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

No course book. Lecture slides, and problem assignments together with work instruction available. Materials will be placed into TTK-OPTIMA environment during the course.

Assessment methods and criteria:

All students of a group will participate in introductory face-to-face teaching and will prepare a final report according teacher’s instructions. Participation in all introductory lectures and laboratory exercises is mandatory for all members of a group. In addition, final report has to be in form required by a course teacher, and the content has to be satisying from acceptance standpoint.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Work grading accepted/rejected. No numerical grading.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

521104P: Introduction to Material Physics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish.

Timing:

Spring semester period 3

Learning outcomes:

1. is able to explain the principal solid state crystal structures

2. can explain how propagating waves and electrons in a crystal lattice can be presented

3. can explain the free electron model of metals and the formation of the energy band structure in crystals and their significance to the electrical properties of materials

4. is able to explain the basic phenomena related to semiconductors and is able to calculate the charge carrier concentrations in them

Contents:

Crystal structures, cohesion and defects. Reciprocal lattice and waves in crystals. Statistical mechanics and thermal vibration. Free electron model of metals. Energy bands in crystal. Basic phenomena of semiconductors.

Mode of delivery:

Will be notified in the beginning of lectures

Learning activities and teaching methods:

Will be notified in the beginning of lectures

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

Basic physics and mathematics.

Recommended optional programme components:

Basic course for 521071A Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes (in Finnish). English material for instance parts from books: H.M. Rosenberg: The Solid State, Clarendon Press, Oxford, 1988 and B. Streetman: Solid State Electronic Devices, Prentice Hall, New Jersey, 1995.

Assessment methods and criteria:

Will be notified in the beginning of lectures.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Will be notified in the beginning of lectures. Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Juha Hagberg

Working life cooperation:

No

521071A: Principles of Semiconductor Devices, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

Leikkaavuudet:

521205A	Principles of Semiconductor Devices	4.5 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

Spring semester period 4

Learning outcomes:

1. will be able to explain physical phenomena in semiconductor materials and junctions; describe main types and characteristics of semiconductor diodes and transistors
2. will be able to explain physical principles of operation and to estimate ideal characteristics of the devices

Contents:

Junctions. Semiconductor diodes and lasers. Bipolar junction transistors. Field effect transistors. Switching devices.

Mode of delivery:

Will be notified in the beginning of lectures.

Learning activities and teaching methods:

Will be notified in the beginning of lectures.

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

521104P Introduction to materials physics.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes (in Finnish). Book: Streetman, B.: Solid state electronic devices, Prentice-Hall, New Jersey, 2000 (chapters 5 - 8, 11).

Assessment methods and criteria:

Will be notified in the beginning of lectures.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Hagberg

Working life cooperation:

No.

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521306A	Circuit Theory 2	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 2

Learning outcomes:

After the course the student can:
1. use Laplace transform for solving time and frequency response of electric circuits;
2. derive continuous-time transfer functions.;
3. solve their poles and zeros and understand the meaning of those;
4. draw the pole-zero map and Bode plots of any given transfer function;
5. construct 2-port parameter models of a given circuit

Contents:

Use of Laplace transform in network analysis. Properties of network functions, poles and zeros, Boden magnitude and phase plots. 2-port parameter models.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures, 22 h exercises, and simulation excerices.

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

Continuation for Circuit theory 1. Needed in most analog electronics courses.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 12-18.

Assessment methods and criteria:

Course is examined by a final exam. Obligatory simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical 1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to recount the principles covering the design of multistage amplifiers

2. should be able to analyze and set the frequency response of a transistor amplifier

3. should be able to make use of feedback to improve the properties of an amplifier in the desired manner

4. should be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability

5. should be able to describe the principles governing the design of power amplifiers

6. should be able to make widespread use of operational amplifiers for realizing electronic circuits and to

take account of the limitations imposed by the non-idealities inherent in operational amplifiers

7. should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers

8. should be able to recount the basic principles governing the functions and properties of emitter-coupled logic

Contents:

Frequency response of a transistor amplifier, differential amplifier, feedback, stability and nonidealities of a feedback amplifier, comparator, output stages and power amplifiers, applications of operational amplifier, oscillators, tuned amplifiers and ECL logic.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Principles of electronic design

Recommended optional programme components:

This course is required when participating in Laboratory Exercises on Analogue Electronics.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 10-13-8 and 14, partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 7,8,9,13 and partially 11 and 12.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.

2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No

521384A: Basics in Radio Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Salonen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, 1st period

Learning outcomes:

1. can define what radio engineering is and list its separate areas.

2. understands the meaning of Maxwell's equations and can solve the propagation of radio waves in a homogeneous medium

3. can solve EM-fields at an interface of two lossless media.

4. knows main properties of most common transmission line types and can solve EM-fields for coaxial lines and rectangular waveguides.

5. can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas.

6. understands the meaning of Y-, Z-, and S-matrix and can use S-parameters for solving charasteristics of microwave circuits.

7. can describe the operation of passive transmission line devices, resonators, filters and circuits based on the semiconductor devices.

8. knows the terms to describe antenna charasteristics and can define radiation patterns of simple antennas and antenna arrays.

9. knows different propagation phenomena and can evaluate, which phenomena are relevant in different radio systems in different frequency bands.

10. can describe the structure of a typical radio system and can calculate the S/N-ratio linkbudget for a radio system on a free-space radio link.

Contents:

Introduction to radio waves and radio engineering. Fundamentals of electromagnetic fields. Transmission lines and waveguides. Impedance matching. Microwave circuit theory. Passive transmission line and waveguide devices. Resonators and filters. Circuits based on semiconductor devices. Antennas. Propagation of radio waves. Radio system. Applications of radio engineering. Biological effects and safety standards.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h including graded exercise problems.

Target group:

3 rd year bachelor's degree students.

Prerequisites and co-requisites:

Elementary knowledge of the electromagnetic theory.

Recommended optional programme components:

-

Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2011; also older versions of the book can be used as a course book. In English: Antti V. Räisänen & Arto Lehto: Radio Engineering for Wireless Communication and Sensor Applications, Artech House, 2003. Additional reading in Finnish: Jyrki Louhi & Arto Lehto: Radiotekniikan harjoituksia. Otatieto, 1995.

Assessment methods and criteria:

The course is passed with a final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Erkki Salonen

Working life cooperation:

-

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teirikangas, Merja Elina
Opintokohteen kielet: Finnish
Leikkaavuudet:

521218A	Introduction to Microelectronics and Micromechanics	4.0 op
521218A-02	Introduction to Microelectronics and Micromechanics, demonstration	0.0 op
521218A-03	Introduction to Microelectronics and Micromechanics, exercise	0.0 op
521218A-01	Introduction to microelectronics and micromechanics, exam	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

2^{nd} period

Learning outcomes:

1. Can present the process of source materials used to manufacture micro- and nanoelectronics /mechanics and analyse the required material properties depending of the application

2. Can explain the fabrication methods and discuss the characteristic features of each fabrication method, inculding their utilisation and restrictions.

3. Is capable of designing a fabrication process for a simple microelectronics application and is able to indetify the process steps also in complex application.

Contents:

The content of the course covers fabrication methods of micro-, nano- and optoelectronics as well as MEMS systems. 1. Fabrication methods for silicon based electronics and MEMS systems 2. Additive manufacturing methods 3. Nanomaterials and fabrication.

Mode of delivery:

Face-to face teaching

Learning activities and teaching methods:

Lectures (20 hours) and exercises (10 +10).

Target group:

Electrical engineering bachelor degree students.

Prerequisites and co-requisites:

Course content of 521104P Introduction to Materials Physics and 521071A Principles of Semiconductor Devices.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, Franssila Sami: Introduction to Microfabrication

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Lectures: Merja Teirikangas Exercise: Hanna Kähäri

Working life cooperation:

No

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A	Filters	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 14 h exercises. A deign excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521092A: Electronic Measurement Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521171A	Electronic Measurement Techniques	6.5 op
521171A-01	Electronic measurement techniques, exam	0.0 op
521171A-02	Electronic measurement techniques, exercise work	0.0 op
521430A	Electronic Measurement Techniques	6.0 op

ECTS Credits:

5 ECTS credits / 136 h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Calculation exercises, laboratory exercises and the exam can be done in English.

Timing:

Period 4

Learning outcomes:

1. can name the electrical measurement technique terminology associated to measurement systems, sensors and buses to candidate level.

2. can plan and implement complicated measurements with oscilloscopes

3. can plan and implement basic measurements with spectrum analyzers

4. can plan and implement basic measurements with light detectors

5. can name common sources of noise and interference

6. name means to control noise and interference

7. can name methods to realize electrical quantities

Contents:

Broad view to electronic measurements.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures and calculation exercises 30h, laboratory exercises 16 h and self-study 90h

Target group:

Course is compulsory for most electrical engineering students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

Electrical Measurement Principles, Analogue Electronics I, Digital Techniques I.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

None.

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

1. is able to design basic electronic structural blocks and verify their functionality in a CAD simulation environment.

2. is able independently to realize and test a small-scale design object employing analogue circuit techniques.

Design exercises to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I.

Contents:

Passive RC-circuits, diodes and their applications, bipolar transistor amplifiers, operational amplifiers and their applications, MOS-transistor, tuned circuit and amplifier, oscillator.

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

Independent design and simulating excercise 26 h and guided laboratory work 15 h. Group size is 1 - 2 students.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Student must participate to courses Principles of Electronics Design and Electronics Design I, or he/she must have passed these courses earlier.

Recommended optional programme components:

Parallel to Electronics Design I.

Recommended or required reading:

Lecture notes of Principles of Ekectronic design and Electronics design 1.

Assessment methods and criteria:

Teacher accepts student's design work and measurement results in laboratory.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

Supplementary Module: Information Processing Science. (15 ECTS cr)

810136P: Introduction to Information Processing Sciences, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay810136P	Introduction to information processing sciences (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during periods 1. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

Student is able to discuss and report on course subject areas using terms, concepts and models presented in the course. Student can search information about course topics, selecting and judging the relevance of found information, and write short reports based on the information, including referencing to sources.

Contents:

The course gives an overview of the whole bachelor/master curriculum and to various disciplines behind the curriculum. This is connected with lectures on how practical IT work is conducted in various organizations. Additionally the course discusses about information seeking, source criticism, and report writing.

Mode of delivery:

Face-to-face teaching, self-study.

Learning activities and teaching methods:

Lectures 20 h, tutored exercise work sessions 20 h, self-study 95 h.

Target group:

BSc students

Recommended optional programme components:

Recommended or required reading:

Lectures, additional material in Optima, material searched by students themselves.

Assessment methods and criteria:

1. Participatory way: 5 weekly assignments (a 10%) + final essay (50%) -- 2. self-study way: essay (50%) + final exam (50%)

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Kari Kuutti

811122P: Introduction to Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811122P	Introduction to Programming (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during periods 1. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

After completing the course the student is able to design a programme by splitting main problem into solvable sub problems.The outcome of design process is modules which she/he is able to write by using chosen programming language. Student is able to use selection and loop structures to control execution of a module and control execution between modules. Student is able to use basic data types for saving and processing data and she/he is able to use right operations to this data. Student is able to use arrays to handle large amounts of same type of data and is able to use control structures to flexibly manipulate the data of arrays. Student is able to use pointers for example to enhance passing large amount of data between modules and at the same time taking care of the risks of using pointers. Student is able to use structured data types that contain fields of different data types and is able to manipulate the fields of these data structures. Student is able to programmatically use files to save permanently large amount of data she/he is able programmatically read data from files for further processing.

Contents:

1. Software design method (waterfall) 2. Problem solving 3. Stepwise refinement 4. Control structures 5. Modular programming, calling
modules, communication between modules 6. Data types 7. Arrays 8. Pointers 9. Character strings 10. Data structures 11. File processing

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, home programming assignment 24h, self-study 70h.

Target group:

BSc students

Recommended or required reading:

Course book: Deitel, Deitel: C HOW TO PROGRAM; Pearson Education Inc. 2007

Assessment methods and criteria:

1. Final exam and exercise points and programming assignment. OR 2. Weekly exams and exercise points and home programming assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Ilkka Räsänen

813316A: Business Process Modeling, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

After completing the course, students are able to model and develop business processes, as well as use a computer-based process modeling tool. The students are able to distinguish between business process change on the enterprise level, business process level and the implementation level, and to and evaluate these business process changes.

Contents:

Process architecture and how it can be fitted to the organisation, process modelling, process performance measurement, understanding process-related problems, process development, software tools for modelling and analysing processes, exercises.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 26h (or exam), exercises 12h, individual assignments (lecture assignments, small process model, etc.) 25h, case study assignment (group
work) 30h, large process model (group work) 40h.

Target group:

BSc students.

Recommended optional programme components:

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Recommended or required reading:

Harmon, Paul (2007). Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. Morgan Kaufmann Publishers. Additional material to be announced during the course.

Assessment methods and criteria:

This course unit utilizes continuous assessment. Students can either participate in the lectures (min. 85% attendance required) or take the exam. All students will write lecture assigments, a case study report, and will create a process models with a software tool. The assessment of the course unit is based on the learning outcomes of the course unit.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Karin Väyrynen (on leave, substitute Jukka Kontula)

Working life cooperation:

No

811177P: Humans as Users and Developers of Information Technology, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811177P	Humans as Users and Developers of Information Technology (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish.

Timing:

The course is held in the autumn semester, during period 2. It is a recommended to compelete the course at the 1st autumn semester.

Learning outcomes:

After completing the course, students will be able to examine humans as both users and developers of information technology. The student learns core concepts of the phenomenon, and understands their meaning in relation to practice. Students are also familiar with the background of usability research and some of its scientific theories. Students are able to observe and specify a variety of use situations and user experiences of information technologies. Students also understand the challenges of the information technology developers when targeting to create pleasant use experiences for the users of these technologies. After completing the course, students also realize they have started their own journey to become an expert in information technology development.

Contents:

The key themes and concepts of the course are the diversity of information technology, humans as users and developers of information technology, usability, use and user experience, user-centred design.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures (24h), home assignments and written task based on required reading (about 106h).

Target group:

BSc students.

Recommended or required reading:

Antti Oulasvirta (ed.): “Ihmisen ja tietokoneen vuorovaikutus” (2011), parts I and II. In addition, the material during lectures and other supplementary material.

Assessment methods and criteria:

Course assessment is mainly based on the pre-assignment, home assignments, and individual essay based on the required reading. In addition, one may improve one’s own grade by optional advanced assignment. Assessment criteria will be available in the web-based learning environment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Minna Isomursu

811375A: User Interface Programming, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lappalainen, Jouni Esko Antero

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish

Timing:

3 rd year, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student can implement a software application that utilises a database for storage and has a graphical user interface. The GUI (as well as the entire application) must be developed by implementing usability design principles from the beginning of the development process.

Contents:

The course deals with the following: UI elements, foundations of the Swing library, UI design principles, layout managers, MVC-paradigm, event-driven programming, web-usability, JSP, programmatically utilising databases, JDBC, web-programming.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Exercise 33h, coursework 75h, independent study 26h.

Target group:

BSc students

Prerequisites and co-requisites:

Knowledge and skills of the course "811380A Basics of Databases" and fundamentals of user interface design. In addition, the knowledge and skills of object-oriented programming are needed.

Recommended optional programme components:

Recommended or required reading:

Lectures in textual format within the course web space. In addition (if needed), for example Kosonen, Peltomäki & Silander (2005). Java 2 ohjelmoinnin peruskirja. Docendo. In addition, Lauesen, S. 2005. User Interface Design: A Software Engineering Perspective.

Assessment methods and criteria:

The student must submit coursework that fulfils the given requirements (defined during the course).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Jouni Lappalainen

Working life cooperation:

No

811379A: Basics of Human Computer Interaction, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811379A Basics of Human Computer Interaction (OPEN UNI) 5.0 op

812327A Introduction to HCI design 4.0 op

ECTS Credits:

5 ECTS credits/133 hours of student's work

Language of instruction:

Finnish

Timing:

2nd year, period 3, bachelor level.

Learning outcomes:

Upon completion of the course, the student will be able to define basic concepts of user interface design, introduce basic design process with design and evaluation methods and tasks, and apply graphical user interface design from the viewpoint of a certain user group and system.

Contents:

Basic concepts of user interface design and usability evaluation; user-centred design process; gathering of user data, analysis, expert evaluation and design by prototyping, user-based evaluation; universal design and user support; user interface description.

Mode of delivery:

Face-to-face teaching, self-study.

Learning activities and teaching methods:

Lectures (20 h), guided group assignment tasks in exercises (21 h) and without guidance in assignment groups (58 h); seminar (3h) individual tasks (31 h).

Target group:

2nd year, bachelor level students.

Prerequisites and co-requisites:

Humans as Users and Developers of Information Technology (811177P) -course or related knowledge.

Recommended optional programme components:

Recommended or required reading:

Dix et al. (2004, third or later edition) *Human-Computer Interaction* and lecture and assignment materials.

Assessment methods and criteria:

During the course, the students will be compiling the group assignments and integration tasks on their implementation. These will be assessed based on the learning outcomes of the course. The assessment criteria and the requirements will be explained in detail during the opening lecture of the course.

Grading:

1–5, fail

Person responsible:

Anna-Liisa Syrjänen

Working life cooperation:

No

815345A: Software Architectures, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juustila, Antti Juhani

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish

Timing:

3 rd year, periods 3-4

Learning outcomes:

The goal of the course is to give the students an overview of the concepts and techniques related to software architectures. The focus of
the architectural solutions is in the objec oriented systems, but the course addresses also generic architectural models and techniques supporting
architectures. After the course, the student is able to identify and analyse different architecturalsolutions and understands the pros and cons of
these, from the perspective of building and running software, as well as from the viewpoint of qualityand maintainability. The student is albe to describe architectural solutions and elements of these, as well as different interfaces, using the modelingtechniques of UML. The student is able to create alternative architectural solutions based on functional and non-functional requirements, usingdifferent design methods and techniques of architectural design, as well as evaluate the solutions' fit to use. The student is able to differentiate the design of product and producet
family architectures from the design of more usual software architectures.

Contents:

The fundamentals of software architectures. Documenting software architectures. Components and interfaces, Software dependencies. Design
patterns. Architectural styles. Product line architectures. Frameworks, Evaluation methods of software architectures.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 20 h, exercise work as group work 90 h.

Target group:

BSc students.

Prerequisites and co-requisites:

The knowledge of the software development process in general, the basics of UML in modelling, introductory experience in object oriented
programming (e.g. courses 811335A 34 of 104 15.08.2016 11:37 Ohjelmistotekniikka, 812346A Oliosuuntautunut analyysi ja suunnittelu, 812347A Olio-ohjelmointi). Recommended previous course is the Olio-ohjelmoinnin jatkokurssi.

Recommended optional programme components:

Advanced Object-oriented Programming is a recommended prerequisite.

Recommended or required reading:

Robert Hanmer: Pattern-Oriented Software Architecture For Dummies, 2013; K. Koskimies, T. Mikkonen: Ohjelmistoarkkitehtuurit. Talentum
2005; L. Bass, R. Clements, R. Kazman: Software Architecture in Practice. Addison-Wesley 2003; Other material mentioned in the course.

Assessment methods and criteria:

The evaluation of the course is based on the learning outcomes of the course. The course is passed by participating in the course assignments
as well as by evaluation of the exercise work. Detailed evaluation principles are announced in the Noppa page of the course.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Antti Juustila

Working life cooperation:

No

Other information:

Course is potentially implemented in cooperation with the Tampere university of technology.

811174P: Introduction to Software Business, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Marianne Kinnula

Opintokohteen kielet: Finnish

Leikkaavuudet:

811178P	Technology Business and Innovations	5.0 op
ay811174P	Introduction to Software Business (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester.

Learning outcomes:

After completing the course, a student can:

- Explain how the industry is structured;
- Describe the software industry's business logic as typically used in business models and the reasoning behind their use;
- Describe the important areas of the software business.

Contents:

This course provides an overview of software business from three different viewpoints: software industry, business logic, and functions of a software company. The course topics include history of software business, structuring and clusters of software industry, business models in software industry, networking and outsourcing, growth and development of a software company, software marketing and sales, and internalization of a
software company.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26-30h, exercises 20h, independent work 54-58h, take home examination 30h.

Target group:

BSc students.

Recommended optional programme components:

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Recommended or required reading:

Course material and related literature.

Assessment methods and criteria:

Assignments, take home examination.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Marianne Kinnula

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812341A	Object-oriented Programming (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 82h.

Target group:

BSc students.

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

Timothy Budd: Introduction to object-orientedprogramming, 3rd edition.
Bruce Eckel: Thinkingin Java 3rd edition or later.

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Ilkka Räsänen

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A	Object Oriented Analysis and Design (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd autumn semester.

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use
cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know
principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They
understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Target group:

Bachelor students.

Prerequisites and co-requisites:

Course of elementary object-oriented programming is a compolsory prerequisite. Basic knowledge of object programming and information systems
analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Juha Iisakka

812305A: Information Systems in Organisations, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, the student: Is able to explain the importance of information systems in organizations, is able to define the conditions for the successful operation of the information in the organization, is able to explain the main features of the development of information systems.

Contents:

The basics issues of organization, structure, and operation, the basics of a digital organization, information types and roles of the organizations,
interaction between information and organization, the role of information systems in the management of organizations and decision-making, formation of organizational knowledge and management, enterprise resource planning (ERP) systems, organizational reform of information systems and the economic importance of information systems.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 20h, ndependent study of the course literature, weekly tasks and scientific essay 110h.

Target group:

BSc students.

Recommended or required reading:

Lectures and Wallace, Patricia: Information Systems in Organizations, People, Technology, and Processes. Pearson 2013.

Assessment methods and criteria:

Weekly tasks and scientific essay.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Seppo Pahnila

811167P: Introduction to Information Systems Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811167P	Introduction to Information Systems Design (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 2nd spring semester.

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, the student will be able to Explain the main areas of the information system design on technical level, main design
process models for the information system design, basics of the requirement gathering, basics of the information system initialization, and basics of how to evaluate information systems.; Produce use-case descriptions, use-case diagrams and other types of diagrams and descriptions needed to model the operational environment of the information system.

Contents:

Basic concepts of Information Systems, Information System Design, Information System Modeling, Operational Environment Modeling, Process models for Information System Development, Evaluation of Information Systems

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 27 h, exercises 21 h, assignment 85 h, exam 3 h.

Lectures (27h), Exercises (21h), Assignment (85h), Exam (3h).

Target group:

BSc students.

Recommended or required reading:

Satzinger, Jackson ja Burd (2007), Systems Analysis and Design in a Changing World. Hoffer, George and Valacich (2008), Modern systems Analysis and Design, 5. painos.

Assessment methods and criteria:

Exam and mandatory assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Mikko Rajanen

812332A: Information Systems Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work.

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 3rd autumn semester.

Learning outcomes:

After completing the course, the student is able to understand the link between information system design and organizational development, and to
apply such a system design method in an organizational context.

Contents:

During the course the students complete a group exercise (typically in groups of 4 persons) using Contextual Design method and its design stages
that lead to actual information systems implementation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 18 h, seminar 12 h.

Target group:

BSc students

Prerequisites and co-requisites:

Prerequisites are 811169P Introduction to Information Systems Design and 812346A Object Oriented Analysis and Design.

Recommended or required reading:

Beyer, H. Holtzblatt, K. (1998): Contextual Design: Defining Customer-Centered Systems. San Francisco: Morgan Kaufmann Publishers, Inc.

Assessment methods and criteria:

The course is normally completed as group work, and the output is presented in a course seminar. The work follows the stages of Contextual Design method and the exercise assignments support the completion of the course work. Course work reports are presented and reviewed in a final
seminar. In special circumstances the course can also be completed as individual work.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Pasi Karppinen

811394A: Database systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish, no possiblity for non-Finnish to pass the course.

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 2nd study year.

Learning outcomes:

After completing the course, students have constructed a small database application. They are able to buil simple XML- database and they can use
object-relational database with object oriented program.

Contents:

Realational database application, Object- and XML extensions in relational databases. Modern database solutions and the use of them.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures and seminars 41h, computer exercises 54, self-study 32h.

Target group:

Bachelor students.

Prerequisites and co-requisites:

Basics of database -course (such as 811380A) and Object oriented analysis and design course (such as 812346A) are compolsory prerequisities.

Recommended or required reading:

Will be anounced in lectures.

Assessment methods and criteria:

Will be anounced in lectures.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Juha Iisakka.

811395A: Basics of Databases, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.

Learning outcomes:

In addition, they have knowledge of modern non-relational database solutions (such as data warehouses and NoSQL-databases) and they have
commanding knowledge of making use of those non-relational databases (such as data mining and Big data techniques).

Contents:

Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalization), transactions.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 45 h, compulsory exercises 24 h, reading 20 h, exams 21 h and self-studying 23 h.

Target group:

Bachelor students

Prerequisites and co-requisites:

The student knows basics of programming.

Recommended or required reading:

Silberschatz, Korth & Sudarshan: Database system concepts. Elmasri & Navathe: Fundamentald of database systems.

Assessment methods and criteria:

The course is divided to five parts. All parts must be passed in a year. Students must show they achieve at least half of required knowledge of each part.

Grading:

fail, 1-5

Person responsible:

Jua Iisakka

810122P: Computer Architecture, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Oivo, Markku Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521267A	Computer Engineering	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st study year.

Learning outcomes:

After completing the course, students understand and manage platforms for software execution and performance of the structure and activities related to performance, resource needs, and error situations. Students master the basic vocabulary, which is enables to communicate and document the software development, particularly in the close to device level applications such as embeddedsoftware, mobile systems, multimedia and scientific computing.

Contents:

Basics of digital logic and components of a processor Formats of digital information The processor and its functions The processor instruction set Assembly language Memory management Input and output Interrupts, device drivers and BIOS Multimedia support Mobile processors Parallel computing.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40h, home exercises 15h, laboratory exercises 15h, examination either through 2 intermediate exams (preparation 65h) or through
final exam (preparation 65h).

Target group:

BSc students.

Recommended or required reading:

Comer, D.E., Essentials of Computer Architecture. Pearson/Prentice Hall. ISBN 0-13-106426-7. 2005. 369 s. Luennoilla esimerkkejä kirjoista: Tanenbaum A.S., Structured Computer Organisations. 4 thEdition. Prentice Hall. 1999. 700 s. Stallings, W., Computer Organization and Architecture. 5 th Edition. Prentice Hall. 2000. 768 s.

Assessment methods and criteria:

Exam and assignments.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Markku Oivo.

811168P: Information Security, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mari Karjalainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811168P	Information Security (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 2nd spring semester.

Learning outcomes:

After completing the course a student is able to define essential information security concepts, is aware of the common types of security risks, and their managerial and technical protection mechanisms. She/he

recognizes the different phases of secure systems development and can
describe the fundamental characteristics of risk management. The student gets familiar with basics of technical information security methods.

Contents:

1. Information security concepts and their application 2. Information security risks, threats, and vulnerabilities 3. Frameworks for information security management 4. Risk management 5. Encryption and access control 6. Software security

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Contact teaching (lectures and group exercises) 30 h, technical exercises
12 h, home exercises 26 h, exam preparation 64 h

Target group:

Recommended optional programme components:

Recommended or required reading:

Lecture and exercise materials, relevant articles, and text book: Whitman & Mattord (2012). Principles of information security.

Assessment methods and criteria:

Individual and group exercised pass/fail, exam 0-5

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Mari Karjalainen

811391A: Requirements Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811391A	Requirements Engineering (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 3rd autumn semester.

Learning outcomes:

After completing this course, the student can analyse the requirements from the problem-domain and solution-domain viewpoints, and understands the special issues associated with these viewpoints. The student can distinguish the roles of problemdomain
and solution-domain requirements for the customer and developer; he/she is able to identify various project types and knows which requirement
style fits best to each project type. The student will be familiar with various requirement definition styles

together with their pros and cons, and is able to use some of the most important definition styles. Several requirements of elicitation techniques will be added to the student's toolbox with the skills of mastering some of them. The principles of requirements management, validation and verification during the product life cycle will be familiar to the student at the end of this course.

Contents:

Concepts of problem and solution domain. Requirements in different use contexts. Description styles for functional and non-functional
requirements. Validation and verification of requirements. Requirements negotiation and prioritisation. Release planning. Requirements
management during the product life cycle.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32h, weekly assignments and project assignment about 102h.

Target group:

BSc students

Prerequisites and co-requisites:

We assume the basic skills from the following courses: 811169P Introduction to Information System Design, 812346A Object-Oriented Analysis
and Design, 811380A Basics of Databases, 811335A Software Engineering and 812334A Information Systems Planning.

Recommended optional programme components:

Recommended or required reading:

S. Lauesen, Software Requirements – Styles and Techniques. Pearson Education 2002; chapters 1–4 and 6–9. A.M. Davis, Just Enough Requirements Management, Dorset House Publishing 2005; parts. Lecture slides.

Assessment methods and criteria:

Two ways of passing: 1) Active participation: weekly assignments and project assignment (only for Finnish-speaking students); 2) Conventional
exam

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Piiastiina Tikka

Working life cooperation:

No

Supplementary Module: Industrial Engineering and Management (15 ECTS cr)

555225P: Basics of industrial engineering and management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Majava

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555225P	Basics of industrial engineering and management (OPEN UNI)	5.0 op

555221P Introduction to Production 2.0 op
555220P Basic Course in Industrial Engineering and Management 3.0 op

Language of instruction:

Finnish. English material is also used.

Timing:

Periods 1-2.

Learning outcomes:

Upon completion of the course the student should be able to describe what operations management means. The student can explain the core concepts of business operations and utilize these concepts in describing and analyzing organizational operations. In addition, he/she can explain in general terms the factors that affect economic performance of organizations. The student is able to utilize the terminology used in operations management, describe the financial processes of companies and based on this describe the use of cost accounting in organizational decision-making. The student can also calculate unit costs in various simplified settings, calculate various alternatives, as well as perform planning and goal oriented calculations based on given data, and draw conclusions based on the calculation results.

Contents:

Operations and productivity, operations strategy, forecasting, cost accounting, investments, sustainability, capacity management, location decisions, layout strategies, human resources management, supply chain management, subcontracting, inventory management, production planning, MRP & ERP, production scheduling, Just-in-Time & Lean operations, maintenance.

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Web-based lectures 20 h / exercises 18 h / self-study 96 h.

Target group:

: Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555285A Project management, 555242A Product development, 555264P Managing well-being and quality of working life, and 555286A Process and quality management.

Recommended or required reading:

Lecture and exercise materials. Heizer, J. & Render, B. (2014) Operations management: sustainability and supply chain management, 11th ed. Pearson.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are nine mandatory weekly assignments. At least half of the assignments must be passed.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

D.Sc. Jukka Majava.

Working life cooperation:

No.

Other information:

Substitutes courses 555220P Basic Course in Industrial Engineering and Management 3 ECTS cr and 555221P Introduction to Production 2 ECTS cr.

555285A: Project management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Kirsi Aaltonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

555288A Project Management 5.0 op
ay555285A Project management (OPEN UNI) 5.0 op
555282A Project Management 4.0 op
555280P Basic Course of Project Management 2.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish. English material may also be used.

Timing:

Period 1.

Learning outcomes:

The objective of the course is to familiarise the student with the basics and the basic methods of project management. Upon completion the student can explain the essential concepts related to project management. He/she can present the main features of a project plan and can use different methods of partitioning a project. The student can also schedule a project and estimate its costs. The student can explain the terms related to Earned value method and can apply the method on simple tasks. Upon completion the student recognizes the essential tasks of project risk management.

Contents:

Defining project management, project planning, organising and scope management, schedule management, cost management, earned value calculation and project risk management, project stakeholder management.

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Lectures or web-based lectures 16h, self-study 118h

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes555225P Basics of industrial engineering and management, 555242A Product development, 555264P Managing well-being and quality of working life, and 555286A Process and quality management.

Recommended or required reading:

Lecture material, exercise book, Artto, Martinsuo & Kujala 2006. Projektiliiketoiminta. WSOY

Assessment methods and criteria:

The course includes three mandatory assignments, exercise book and exam. The course grading is based on the exam. Well completed assignments and exercise book may raise grading.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Jaakko Kujala.

Working life cooperation:

No.

Other information:

Substitutes courses 555280P Basic Course of Project Management + 555282A Project Management.

555242A: Product development, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Haapasalo, Harri Jouni Olavi

Opintokohteen kielet: English

Leikkaavuudet:

ay555242A	Product development (OPEN UNI)	5.0 op
555240A	Basic Course in Product Development	3.0 op

ECTS Credits:

5 ECTS credits**.**

Language of instruction:

English.

Timing:

Period 1.

Learning outcomes:

This course introduces product development and innovations management in a company environment. The course provides fundamental understanding over tools and frameworks that can be used for analysing and managing products, innovations, and technology development. The aim is to create a connection between product development and other company functions. Upon completion of the course a student is capable of explaining the role of product development as a company function. The student understands the difference between innovation activities and systematic product development, and knows the difference between different phases of product development process and its activities. Student learns how to transform customer needs into requirements for product development process and finally into product features. Additionally, the student is able to define the meaning of other company functions to product development activities.

Contents:

Meaning of products for the operations of an industrial enterprise, product development paradigm and defining relevant concepts, realising product development methodologically (U&E model, Cooper's stage-gate model, QFD), managing innovations, and product development success factors.

Mode of delivery:

The tuition will be implemented as blended teaching.

Learning activities and teaching methods:

Lectures 20 h / exercises 6 h / group work and self-study 108 h.

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

555226A Operations and production.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555225P Basics of industrial engineering and management, 555285A Project management, 555264P Managing well-being and quality of working life, and 555286A Process and quality management..

Recommended or required reading:

Handouts, course work, and a collection of articles. Ulrich, K. & Eppinger, S. (2008) Product Design and Development. McGraw-Hill. 358 p.

Assessment methods and criteria:

Assignment and final exam.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail..

Person responsible:

Professor Harri Haapasalo.

Working life cooperation:

No.

Other information:

Substitutes course 555240A Basic Course in Product Development.

555286A: Process and quality management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Osmo Kauppila

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555286A	Process and quality management (OPEN UNI)	5.0 op
555281A	Basic Course of Quality Management	5.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish.

Timing:

Period 4.

Learning outcomes:

Upon completion the student is able to explain the role of process and quality management in a business organization. The student is capable of developing business processes based on the principles of quality management and appropriate tools.

Contents:

Foundations of total quality management, planning of quality, performance measurement, process management, people management in relation to quality management, implantation of total quality management.

Mode of delivery:

The tuition will be implemented as face-to-face teaching (integrated classroom lectures and exercises).

Learning activities and teaching methods:

20 h lectures, 114 h independent study including tutored group work.

Target group:

Industrial Engineering and Management students and other students studying Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555225P Basics of industrial engineering and management, 555285A Project management, 555242A Product development, and 555264P Managing well-being and quality of working life.

Recommended or required reading:

Oakland, J.S. (2014) Total quality management and operational excellence (4th ed.). Routledge, 529 pp. and material handed out during the course.

Assessment methods and criteria:

To pass the course, the student must pass the course exam and complete the classroom exercises and the group work. The course grade is calculated based on the exam and group work grades.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Osmo Kauppila.

Working life cooperation:

No.

Other information:

Substitutes course 555281A Basic Course of Quality Management.

555264P: Managing well-being and quality of working life, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555264P Managing well-being and quality of working life (OPEN UNI) 5.0 op

555261A Basic Course in Occupational Psychology 3.0 op

555262A Usability and Safety in Product Development 3.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish.

Timing:

Periods 3-4.

Learning outcomes:

After the course the student is capable of using the central concepts related to well-being at work, can set targets for it, and is able to choose appropriate methods from the management and personal career point of views. Furthermore, the student is able to develop well-being at work in the contexts of labour legislation, good practices, productivity, occupational safety expertise, management and human resources. The student can utilise basic knowledge, search for more information and knows the key players in the field. Also, the student knows the key sources of information, typical goal-setting and management practices and the methods for assessing the performance of an individual employee, supervisor, company and entrepreneur. The student can assess the impact of well-being at work from the economic perspective, especially in cases of work ability, occupational health, job satisfaction, occupational safety, productivity and the overall quality of working life. The student knows essential national and international regulation and strategic goal setting practices, good practices of the case companies, current trends, and methods in research. In brief, the focus of the course is to learn key factors for guaranteeing successful contribution of humans in issues of production.

Contents:

The course gives the student a vision of building sustainable, productive and satisfactory career for the work community he/she leads - and for himself/herself as an employee or a supervisor. The contents cover the whole area of basic quality issues of working life analysing them in the following framework "Well-being at work means safe, healthy, and productive work in a well-led organisation by competent workers and work communities who see their job as meaningful and rewarding, and see work as a factor that supports their life management".

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Lectures 22 h / self-study 100 h / group work & exercises 12 h.

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial Engineering and Management that also includes 555225P Basics of industrial engineering and management**,** 555285P Project Management, 555242A Product development, and 555286A Process and quality management.

Recommended or required reading:

Essential background information can is available from Arnold, J. et al. (2010), Work Psychology; Understanding Human Behaviour in the Workplace. 5th Edition. Financial Times/Prentice Hall. Other literature will be informed during the course.

Assessment methods and criteria:

This course utilizes continuous assessment including exercises during the lectures (weight 20 %), seminar work (weight 30 %) and examination (weight 50 %).

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Seppo Väyrynen

Working life cooperation:

No.

Other information:

Lecturers: Seppo Väyrynen and Henri Jounila along with visiting lecturers and exercise supervisors. Substitutes courses 555261A Basic Course in Occupational Psychology + 555262A Usability and Safety in Product Development.

Supplementary Module: Working life & Entrepreneurship (15 ECTS cr)

910001S: Working Life and Studies, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

Group 1 (Finnish) and Group 2 (English)

Timing:

Part A (3 ECTS): Working life (online course Group 1 and Group 2) September 28 – November 30.

Learning outcomes:

After the course the students will have understanding how to analyse and appraise their interest areas, skills and competences, networks and objectives regarding their planned career options. The students will know how to seek work, prepare work applications and prepare for work interviews and prepare a competence portfolio. They will also learn what are their rights and responsibilities regarding intellectual property at work.

Contents:

Consists of parts A (3 ECTS) and B (2 ECTS) . Working life A focuses on career planning and career skills and competences during studies. It is for students who want to analyse their potential and build competences, knowledge, and networks for their career. The course highlights the role of active learning and networking throughout studies. The course gives the students the basics tools needed for seeking work, writing the applications and preparing for interviews and selection processes in the modern working environment. Working life B focuses on immaterial property rights and their role business. The course covers different forms of intellectual property, IP ownership, and IP protection. The course considers IP both form personal and business perspectives.

Mode of delivery:

Online studies and face-to-face teaching

Learning activities and teaching methods:

Self-studying through online materials, online rehearsals, and reporting of the learning activities and exercises through the online system. Following the lectures and lecture discussion and rehearsals.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials available in Optima. Lecture notes.

Assessment methods and criteria:

Assessment based on self-learning reports submitted to Optima.

Grading:

Pass or Fail.

Person responsible:

Tiina Salmijärvi (Group 1) and Jaana Liimatainen (Group 2)

Working life cooperation:

-

Other information:

The number of students is restricted

910002S: Toward Entrepreneurial Mindsets, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Fall (period A)

Learning outcomes:

After the course the students will have understanding over the different forms of entrepreneurial activity, and have the skills for assessing the risks and opportunities related to their entrepreneurial career options. They will also be familiar with the key stakeholders around the business creation network. In addition, this course will enhance overall entrepreneurial mindset and attitude amongst the participants.

Contents:

The course outlines what entrepreneurship is and discusses its different forms and roles in society and for individuals in or considering entrepreneurial career options. The focus is on entrepreneurial mindsets and what entrepreneurship calls for from individuals, especially from the “me as entrepreneur”, standpoint through the process where ideas for enterprising are turned into a real business idea. This process is promoted by real entrepreneurs. The students’ attention is guided toward assessing the safety and risks of entrepreneurship, to the different stages in the process of establishing a company, and to the role of networks and supporting services for the entrepreneurial activity. The key processes of entrepreneurial action, such as planning, selling, marketing, funding and financial planning are covered together with the experts’ support in those areas

Mode of delivery:

Face-to-face teaching and workshops together with real-life experts in different areas.

Learning activities and teaching methods:

Learning takes place in intensive lectures, visitor presentations, and discussions, workshops and exercises both in the class and at different places with real-life entrepreneurship professionals for example at Business Kitchen and Business Oulu.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials available in optima

Assessment methods and criteria:

Assessment is based on learning diary type reflection report prepared by the students based on the lectures and meetings with entrepreneurship professionals and in addition, course materials.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.

Person responsible:

Anne Keränen

Working life cooperation:

-

Other information:

The number of students is restricted

910003S: Building Business through Creativity and Collaboration, 5 op

Voimassaolo: 01.08.2014 - 31.07.2017

Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Oulu Business School
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Fall (Period C)

Learning outcomes:

During the course the students will get familiar with concepts of learning, collaboration, creativity and emotions. They will explore entrepreneurship from the perspective of artistic process, experience and learn the process of artistic creation in teams, experience and analyse emotions; such as uncertainty, frustration, enthusiasm and joy alone and in teams. The students will produce a piece of art as an outcome of the course workshops, and organise and host an art exhibition together.

Contents:

This course employs creative collaborative methods to learn and experience entrepreneurship through art. This process enables outside-of-the-box thinking, creative propositions and getting to know multidisciplinary team members through concrete learning by doing approach. Art is used as an illustration, as materials for case studies, and as a place to work and develop business oriented thinking. The art world is a new metaphor to describe our economy based on innovations and digitalization. The participants will learn a creative mindset and bonding of closer ties in teams.

Mode of delivery:

Participating in the face-to-face sessions and workshops

Learning activities and teaching methods:

Producing a piece of art and presenting it in an exhibition together with others. Reflecting the learning experiences in a personal learning diary during the course. Returning the learning diary latest one week after the course.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials provided during the course.

Assessment methods and criteria:

Active participation in the teamwork. Learning diary assessment.

Grading:

Pass or Fail.

Person responsible:

Johanna Bluemink

Working life cooperation:

-

Other information:

The number of students is restricted
Find the Facebook group: "Building Business through Creativity and Collaboration"
https://www.facebook.com/groups/108738746124019/

910004S: Turning Opportunities to Business, 5 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Oulu Business School
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Spring

Learning outcomes:

After the course the students have learned to assess and develop business opportunities, they know the basic concepts related to business context or environment and the factors defining or influencing business opportunities. They will also learn how to build and assess business context specific future scenarios for planning alternative business model for their business opportunity. The students will learn how to build, present and evaluate sales presentations, and how to pitch their business to potential investors.

Contents:

The contents comprise business development especially through business opportunity development, business idea, concept and business model basics and the key processes of strategic decision-making. The business environment and its changes are discussed by using the through scenario methodology. Key concepts of selling and sales presentations, both to customers and potential investors, are covered and practiced.

Mode of delivery:

Face-to-face teaching , workshops

Learning activities and teaching methods:

The course applies anticipatory action learning as a pedagogic approach. Students will learn in face-to-face discussions and workshops by applying in teams strategic management concepts, processes, tools, and templates.

Target group:

Open to all.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials provided during the course

Assessment methods and criteria:

Assessment is based on final report that presents and discusses the whole of the workshop outcomes generated during the course.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.

Person responsible:

Petri Ahokangas

Working life cooperation:

-

Other information:

The number of students is restricted

910005S: Entrepreneurial Field Project, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Apply for Demola projects on **Demola website** by September 15, read more here. (Press ctrl+enter to open the links)

Learning outcomes:

After the course the students have learned to solve in a multidisciplinary team a real-life business related challenge or problem given by a company or other organization. The problem solving process provides the students multicultural teamwork skills, business skills, problem solving skills and communications and pitching skills.

Contents:

The entrepreneurial field project is organized within the international Demola collaboration and the project comprises facilitated and supported real-life problem definition, data collection, problem solving, implementation and communication. For doctoral students it is possible to bring their own problem or challenge to the course.

Mode of delivery:

Facilitated and supported project.

Learning activities and teaching methods:

Learning takes place during the project as a team learning and problem solving, with feedback from the responsible teachers and problem owning company or organization.

Target group:

Open to all. Doctoral students can bring their own project to the course if they wish.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials vary according to the assignment.

Assessment methods and criteria:

Assessment based on participation and project outcomes.

Grading:

Pass or Fail.

Person responsible:

Mia Kemppaala

Working life cooperation:

-

Other information:

The number of students is restricted

Supplementary Module: Economics and Management (15 ECTS cr) (The module is intended only for students of Applied Computing (in MSc).)*

724103P: Strategic Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Sari Laari-Salmela, Anniina Rantakari

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724103P	Strategic Management (OPEN UNI)	5.0 op
721519P	Business Management	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A (2nd year).

Learning outcomes:

After the course students understand the purpose of the different schools of strategic management and recognize their role in organizations' strategy formation. Students are able to define the core concepts of strategic management, analyze the relations between strategy, markets and operations, and are able to communicate strategies with clear market value.

Contents:

The course aims at analyzing how we could model organizational change processes involving genuine uncertainties, and, at the same time, model individuals and organizations as being able to make strategic choices. The purpose of this course is twofold: First, the aim is to introduce the basic concepts, historical developments and schools of strategic management. Second, the course explores the contemporary developments in strategic thinking.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Intensive contact learning with 18 hours of functional lectures with reflection (54 h) and with 18 hours of workshop sessions with cases (54 h). In addition, the students are required to independently read the course literature and prepare for the workshops (25 h). Further details will be provided by the responsible person in the first session.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Johnson, G., K. Scholes & R. Whittington. Exploring corporate strategy (Prentice Hall); Check the availability of course material from this link
Mintzberg, H., B. Ahlstrand & J. Lampel. Strategy safari: the complete guide through the wilds of strategic management (Prentice Hall/Financial Times); Check the availability of course material from this link
Article collection

Assessment methods and criteria:

Assessment will be based on group assignment and individual assignments based on the criteria presented during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Sari Laari-Salmela and Anniina Rantakari

Working life cooperation:

-

Other information:

The number of students is limited.

724105P: Management Accounting, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Järvinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724105P	Management Accounting (OPEN UNI)	5.0 op
721172P	Management Accounting	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

English (course is lectured separately in Finnish and in English).

Timing:

Period C

Learning outcomes:

After passing the course, the student knows the basic cost concepts and the elements of cost accounting systems. Students are also able to apply the basic cost information in the company's decision making and explain which costs should be included in these calculations under different circumstances.

Contents:

Theoretical framework for understanding cost accounting, cost concepts, cost recording, different product costing methods, cost-volume-profit analysis, using cost accounting information in decision making.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

20 h lectures, 16 h exercises and independent reading of study materials (97 hours).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Drury, C.: Management and cost accounting. Thomson Business Press, 5th ed. 2000 or newer. Chapters 1-13;
Check the availability of course material from this link.
Supplementary material: Järvenpää. M.-Länsiluoto, A.-Partanen, V. –Pellinen, J.: Talousohjaus ja kustannuslaskenta, WSOYpro, chapters 1-8.
Check the availability of course material from this link.

Assessment methods and criteria:

Lectures and literature examination.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor in Management Accounting.

Working life cooperation:

-

Other information:

The number of students is limited.

724106P: Principles of Marketing, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Nätti

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724106P	Principles of Marketing (OPEN UNI)	5.0 op
ay721409P	Principles of Marketing (OPEN UNI)	5.0 op
721409P	Firm in the Network Contexts	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period C (1st year).

Learning outcomes:

Upon completion of this course, students are able describe the role of marketing in any organization and its linkages to other organizational activities (units, strategy and other processes). Basic concepts of marketing and their linkages become familiar for the student (customer value, value based market analysis and strategy, segmenting, targeting, positioning and marketing mix). After completing this course the student is able to use different types of methods and concepts of marketing to aid decision making and evaluate the suitability of these decisions. The student understands what customer-oriented approach means in the organization.The student also realizes the role that marketing partakes in everyday actions in one's personal life and professional development.

Contents:

Following themes in the field of marketing are covered: 1) definitions of marketing, central concepts and current phenomena, both in B-to-B and consumer marketing, 2) central elements of customer-oriented marketing strategy; value creation, customer strategies, marketing mix and segmentation, for example, 3) basics of consumer behavior, 4) basics of B-to-B marketing, 5) integrated marketing communication, 6) digital marketing communication and 7) marketing channels. Business simulation is conducted to give understanding of basic practices and business in the company, likewise the role of marketing decisions in the entity.

Mode of delivery:

Face-to-face teaching and business simulation in the groups

Learning activities and teaching methods:

36 hours of lectures, exam (4h). Independent reading of the textbook, articles and other material given during the lectures (43 h) and exercises (50 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

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Recommended optional programme components:

This course is part of "Introduction to business studies" -module

Recommended or required reading:

Kotler, P & Armstrong, G. (2013). Principles of marketing, 15th ed, and other material given during the course.
Check the availability of course material from this link.

Assessment methods and criteria:

To pass the course, students participate business simulation in small groups and do the final exam.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Satu Nätti

Working life cooperation:

-

Other information:

The number of students is limited.

724109P: Investment Decisions, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Mirjam Lehenkari

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724109P Investment Decisions (OPEN UNI) 5.0 op
ay721178P Fundamentals of Corporate Finance (OPEN UNI) 5.0 op
721178P Principles of Corporate Finance 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period B. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

The course is an introduction to the theory and practice of capital budgeting. Upon successful completion of the course, the student will be able to evaluate the profitability of an investment project using various capital budgeting techniques.

Contents:

1) the most common capital budgeting techniques, 2) cash flow calculations, 3) determining the appropriate discount rate for a project, 4) sensitivity, scenario, and break-even analysis, 5) capital rationing, 6) leasing, 7) real options, 8) capital budgeting in practice, 9) mergers & acquisitions

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

lectures 36h, self-study 93h, exam 4h

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Ross, Westerfield & Jordan: Fundamentals of Corporate Finance (4 th or later edition) / Corporate Finance Fundamentals, Irwin/McGraw-Hill
Check the availability of course material from this link.

Assessment methods and criteria:

faculty examination

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

postdoctoral researcher Mirjam Lehenkari

Working life cooperation:

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Other information:

The number of students is limited.

724110P: Introductory Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Korhonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724110P	Introductory Economics (OPEN UNI)	5.0 op
721211P	Principles of Economics	10.0 op
721210P	Principles of Economics	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A. It is recommended that students complete the course during the first autumn semester.

Learning outcomes:

After completing the course students (i) understand the basic concepts of economics and the rudiments of economic theory, (ii) can explain the determination of resource allocation and prices in a market economy, (iii) know how the aggregate economy operates in the short and long run, and (iv) how economic policy affects the Finnish economy and also the European economy.

Contents:

The course introduces students to the tools and ideas economics uses to describe and explain economic phenomena. The topics include:

- the long-term development of the Finnish and World economy
- basic ideas and principles of economics
- opportunity cost and comparative advantage
- market equilibrium: demand and supply
- how well does market economy work?
- firms and competition in market economy
- aggregate economic activity and its measurement
- business cycles
- monetary and fiscal policy
- economic growth

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

36 lectures including problem sets. Students are expected to do the problem sets on their own and familiarize themselves with the required and recommended materials (93 h). Exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

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Recommended optional programme components:

This course is part of “Introduction to business studies” -module

Recommended or required reading:

Material posted at the webpage. Textbook: N. Gregory Mankiw ja Mark P. Taylor, Economics. 2014. 3. ed. Cengage Learning. Check the availability of course material from this link.
Extra readings: Timothy Taylor, The Instant Economist. Everything You Need to Know About How the Economy Works. 2012. A Plume Book (Penguin), New York NY. Check the availability of course material from this link.
Robert P. Murphy, Lessons for the Young Economist. Ludvig von Mises Institute 2010; http://mises.org/books/lessons_for_the_young_economist_murphy.pdf

Assessment methods and criteria:

Final Exam.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Mikko Puhakka

Working life cooperation:

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Other information:

The number of students is limited.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

521484S: Statistical Signal Processing, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
In Finnish.
Timing:
Periods 4-6.
Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (30 h), exercises (24 h) and Matlab design exercise (10 h).

Target group:

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Prerequisites and co-requisites:

Matrix Algebra, Probability and Mathematical Statistics

Recommended optional programme components:

Digital Filters, Signal Analysis

Recommended or required reading:

J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.

Grading:

Numeric scale 1-5

Person responsible:

Janne Heikkilä

Working life cooperation:

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Other information:

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