Zał. nr 4 do ZW 64/2012

FACULTY OF INFORMATICS AND MANAGEMENT / DEPARTMENT……

SUBJECT CARD

Name in Polish: Wstęp do grafiki komputerowej
Name in English: Introduction to Computer Graphics
Main field of study (if applicable): Informatics
Specialization (if applicable): ……..
Level and form of studies: 1st level, full-time
Kind of subject: optional
Subject code INZ0271Wl
Group of courses YES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	crediting with grade	Examination / crediting with grade*	crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course	X				
Number of ECTS points			2		
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows elementary notions and computational methods of linear algebra and geometry in 2D and 3D
2. Is fluent in Java or C++ programming and knows basic general purpose algorithms and data types
3. Knows one of popular development environments for C++ or Java

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SUBJECT OBJECTIVES

C1 The students should know and understand the methods of 2D image rendering and 2D visualization, deeply understand how they work and what are their features and limitations.

C2 The students should know how to use practically standard software components supporting 2D and 3D CG application development in Java environment

C3 The students should be able to select appropriate methods and software components according to the particular needs related to the CG application domain and build CG application that renders plain image or 3D scene view using these software components

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Knows color spaces used in CG and understands differences between them
PEK_W02 Knows principles of transformation composition in homogenous coordinates
PEK_W03 Understands principles of curves modeling in 2D
PEK_W04 Knows properties of commonly used 3d rendering methods
PEK_W05 Knows and understands stages of typical 3D rendering pipeline
PEK_W06 Knows most popularly used geometry representation techniques for 3D
PEK_W07 Knows and correctly interprets components of Phong lighting model formula

relating to skills:

PEK_U01 Can implement procedural pattern rendering of regular 2D using raster and vector approach
PEK_U02 Is able to design and implement graphical UI using standard software components available in Java
PEK_U03 Can construct the transformation matrix in homogenous coordinates corresponding to visually specified transformation
PEK_U04 Can implement simple CG applications for 3D rendering based on OpenGL usage
PEK_U05 Can select scene description methods according to specified CG application and is able to find out reasons of defects appearing in obtained images
PEK_U06 Is able to evaluate efficiency of low-level methods and algorithms used in 2D and 3D CG

relating to social competences:

PEK_K01 Understands and appreciates the role of graphical interfaces in applications not directly related to computer science
PEK_K02 Is able to compose GUI and visualization methods appropriate to needs of end users not being IT specialists

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec 1	Introduction, defining the scope of computer graphics, relation to other computer engineering domains, basic definitions and notions, raster graphics and vector graphics	2
Lec 2	CG program architecture, components for GUI building in Java2D and Swing	2
Lec 3	Color spaces in CG	2
Lec 4	Transformations in homogenous coordinates, general principles and advantages, affine transformation, derivation of transformation matrices for scaling rotation and translation	2
Lec 5	Derivation of transformation matrix for compound transformations in homogenous transformations, transformation superposition, examples	2
Lec 6	Bilinear interpolation of image attributes, application in image transformations, Gouraud shading	2
Lec 7	Curves modeling in 2D, Lagrange and Bezier curves, piecewise defined curves, B-splines	2
Lec 8	Introduction to 3D image synthesis, basic notions, scene	2

	description elements, lighting model, local and global illumination	
Lec 9	3D scene geometry description, boundary representation, CSG, implicit surfaces, metaballs, volumetric representations, lighting models, Phong lighting model	2
Lec 10	Rendering pipeline, geometric transformations in 3D, observer coordinate system, projections from 3D to 2D	2
Lec 11	Visibility analysis methods, algorithms based on face sorting z-buffer algorithm, displaying transparent objects with z-buffer	2
Lec 12	OpenGL library, core functionality, rendering program organization for OpenGL, examples of visual effects available in OpenGL programs	2
Lec 13	Providing geometry to OpenGL, defining geometric transformations, application of transformation matrix stack, defining observer parameters, analysis of exemplary programs	2
Lec 14	Other 3D rendering component packages review: Direct3D and Java3D. Brief review of advanced 3D rendering methods, backward ray tracing, radiosity, photon mapping	2
Lec 15	Final test	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl 1		
Cl 2		
Cl 3		
Cl 4		
..		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	Lab scope safety regulations grading policy presentation, installation of IDE, short introduction to CG packages in Java	2
Lab2	Procedural rendering of 2D patterns using BufferedImage class	2
Lab3	Vector graphics components usage in interactive graphics, simple animation using vector graphics components	2
Lab4	GUI implementation using Swing components	2
Lab5	Image composition using affine transformations	4
Lab6	Bilinear and bicubic color interpolation, application to image scaling	2
Lab7	Implementation of Gouraud shading - displaying polygons with Gouraud shading	2
Lab8	Simple rendering of 3D scenes with Phong lighting model	2
Lab9	3D shape modeling by curve rotation and translation - conversion to triangle mesh, implementation of wireframe display of triangle meshes	4
Lab10	Scene rendering program based on OpenGL or java3D	2
Lab11	3D visualization program with observer interactive setting	4
Lab12	Summary, presentation of implemented 3D programs, final grading	2
	Total hours	30

Form of classes - project		Number of hours
Proj1		
Proj2		
Proj3		
Proj4		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
Sem2		
Sem3		
…		
	Total hours	

TEACHING TOOLS USED
N1. Multimedia presentation used in lectures N2. Compilers and development environment for Java and C++ N3. Freeware and open source programs for 3D scene modeling N4. E-learning system used to publish presentations, documents and other data related to the lecture and lab assignments

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation(F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1 - Lab2	PEK_U01	Each assignment Lab2-Lab11 will be evaluated in the scale 2.0 - 5.0. The elements being evaluated: conformance with the assignment specification, ability to make small extensions and modifications to home-prepared code, relevance of used methods, efficiency, ability to predict results of processing of specified input data set , code clarity
F2 - Lab3	PEK_U01 PEK_U02	As in the case of grading of assignment in Lab2
F3 - Lab4	PEK_W02 PEK_U02 PEK_K01 PEK_K02	As in the case of grading of assignment in Lab2

F4 - Lab5	PEK_W01 PEK_W02 PEK_U03	As in the case of grading of assignment in Lab2
F5 - Lab6	PEK_W01 PEK_U02	
F6 - Lab7	PEK_W04 PEK_W05 PEK_U05 PEK_U06	As in the case of grading of assignment in Lab2
F7 - Lab8	PEK_W01 PEK_W04 PEK_W05 PEK_W07 PEK_U05	As in the case of grading of assignment in Lab2
F8 - Lab9	PEK_W03 PEK_W06 PEK_U04 PEK_U05	As in the case of grading of assignment in Lab2
F9 - Lab10	PEK_W04 PEK_W05 PEK_U02 PEK_U04 PEK_U05	As in the case of grading of assignment in Lab2
F10 - Lab11	PEK_W04 PEK_U02 PEK_U04	As in the case of grading of assignment in Lab2

C - the final grade will be calculated as equally weighted average of the grade being the evaluation of the final test carried out at the last lecture (FT) and the grade form the lab which in turn will be computed as equally weighted average of grades obtained from the assignments Lab2-Lab11. The test will be graded based on the total number of scores given for all tests elements according to the scale:

0 - 50% of total scores - 2.0
51 - 60% of total scores - 3.0
61 - 70% of total scores - 3.5
80 - 89% of total scores - 4.0
90 - 95% of total scores - 4.5
96 - 100% of total scores - 5.0

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Foley J.D. et al. Computer Graphics, Principles and Practice, Third Edition, Addition-Wesley, 2013
[2] Klawonn F., Introduction to Computer Graphics: Using Java 2D and 3D, Second edition, Springer 2012
[3] Shreiner D. et al., OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3 (8th Edition)

SECONDARY LITERATURE:

[1] Ammerall L., Zhang K., Computer Graphics for Java Programmers, John Wiley & Sons, 2007
[2] McReynolds T., Blythe D., Advanced Graphics Programming Using OpenGL, Elsevier 2005

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Jerzy Sas, jerzy.sas@pwr.wroc.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to Computer Graphics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Informatics

AND SPECIALIZATION (not defined)

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives***	Programme content***	Teaching tool number***
PEK_W01 (knowledge)	K1INF_W23	C1	Lec1,Lec3	N1,N4
PEK_W02	K1INF_W01, K1INF_W23	C1,C3	Lec4,Lec5	N1,N4
PEK_W03	K1INF_W01, K1INF_W23	C1	Lec7	N1,N4
PEK_W04	K1INF_W23	C1,C3	Lec8,Lec9,Lec10,Lec15	N1,N4
PEK_W05	K1INF_W23	C1	Lec8,Lec9,Lec10,Lec11	N1,N4
PEK_W06	K1INF_W23, K1INF_W08	C1,C3	Lec7,Lec8,Lec9	N1,N4
PEK_W07	K1INF_W23	C1,C3	Lec9,Lec12	N1,N4
PEK_U01 (skills)	K1INF_U04, K1INF_U09, K1INF_U12, K1INF_U16	C2	Lec1,Lec2,La2	N2,N4
PEK_U02	K1INF_U04, K1INF_U12, K1INF_U16	C2,C3	Lec2,La3,La4	N2,N4
PEK_U03	K1INF_W01, K1INF_U11	C1,C3	Lec4,La5	N1,N4
PEK_U04	K1INF_U04, K1INF_U12, K1INF_U16	C2	Lec12,Lec13, La10,La11	N2,N3,N4
PEK_U05	K1INF_U06, K1INF_U11	C3	Lec6,Lec8,Lec9, La7,La8,La9	N1,N3,N4
PEK_U06	K1INF_U07, K1INF_U11	C1,C3	Lec6,La6,La7	N1,N2,N3,N4
PEK_K01 (competences)	K1INF_K02, K1INF_K07	C3	Lec1,Lec2,La3,La4,La5	N1,N4
PEK_K02	K1INF_K02, K1INF_K07	C3	Lec1,Lec2,Lec14,Lec15,La3,La4, La5	N1,N2,N3,N4

** - enter symbols for main-field-of-study/specialization educational effects

*** - from table above