SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computer Science**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**High Performance Computing and Big Data Analytics**

2. Information regarding the discipline

2.1 Name of the discipline	**Scientific Data Visualization** (MME8059)						
2.2 Course coordinator	**Lecturer Professor PhD. Prejmerean Vasile**						
2.3 Seminar coordinator	**Lecturer Professor PhD. Prejmerean Vasile**						
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Compulsory**

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	**4**	Of which: 3.2 course	**2**	3.3 seminar/laboratory	**1sem +1pr**
3.4 Total hours in the curriculum	**56**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					**28**
Additional documentation (in libraries, on electronic platforms, field documentation)					**28**
Preparation for seminars/labs, homework, papers, portfolios and essays					**28**
Tutorship					**14**
Evaluations					**21**
Other activities:					

3.7 Total individual study hours	**119**
3.8 Total hours per semester	**175**
3.9 Number of ECTS credits	**7**

4. Prerequisites (if necessary)

4.1. curriculum	• Ability to work with an integrated development environment
4.2. competencies	• Average programming skills in a visual programming language

5. Conditions (if necessary)

5.1. for the course	• An LCD projector
5.2. for the seminar /lab activities	• Laboratory with twelve computers; high level programming language environment

6. Specific competencies acquired

Professional competencies	• Ability to apply knowledge of computing and mathematics appropriate to the discipline; • Ability to analyze a problem, and identify and define the computing requirements appropriate to its solution; • Ability to identify and to specify computing requirements of an application and to design, implement, evaluate, and justify computational solutions; • Ability to use current techniques and skills to integrate available theory and tools necessary for applied computing practices.
Transversal competencies	• Ability to apply mathematical foundations, algorithmic principles, and computer science theory; • Ability to apply design and development principles in the construction of software systems; • Ability to acquire knowledge properly in an application domain in the modeling and design; • Ability to work effectively in a team.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Be able to apply theories, principles and concepts with technologies to design, develop, and verify computational solutions; • Be able to use data visualization (technique tool used to help researchers understand and/or interpret data)
7.2 Specific objective of the discipline	• To assimilate data visualization techniques and the visualization as a method of studying the real phenomenon. To gain skils related to problem solving through visualization of data. • To teach the students the concepts used in the field of modeling and visualization of simulation and to acquire the methods for validation of simulation using *Scientific Data Visualization*. • After promotion the students should be able to use data visualization as a method of solving real problems.

8. Content

8.1 Course	Teaching methods	Remarks
1. Scientific Data - data-formats used in science or engineering referred as scientific data; - scientific data as massive and digital data with a variety of data formats - floating-point data, integer data, image data, and clip data; - format and data dimensions (1-D, 2-D, 3-D, …)	Expositions: description, explanation, class lectures, Use of problems: use of problem questions, problems and problem situations. Other methods: company examples.	
2. Data Visualization - technique tool used to help researchers understand or interpret data; - similar techniques used in other visualization; - data analysis methods and techniques.	Expositions: description, explanation, dialog-based lectures, current lectures, Use of problems: problems and problem situations.	
3. Visualization Techniques - plotting (data analysis), mapping (graphics) - color image interpreting (image processing) - volume rendering (volume visualization) - graphics (Glut, OpenGL, …), animation - virtual reality (CaveLib, openGL, …) - internet, database and data management	Expositions: description, explanation, class lectures, dialog-based lectures, current lectures. Other methods: case study; company examples, discussion of material.	

4. Data Visualization Tools - Data Visualization Software; - Basic TecPlot guide.	Expositions: description, explanation, class lectures.	
5. Current issues in scientific visualization - scientific visualization models; - validation visualization; - design for scientific visualization.	Expositions: description, explanation, class lectures, dialog-based lectures, lectures.	
6. Data modeling - data representation; - modeling volumes; - unevenly distributed data modeling; - modeling by triangulation.	Expositions: description, explanation, class lectures, dialog-based lectures, lectures. Use of problems: use of problem questions	
7. Visual interactive simulation - what is simulation, when to use simulation, types of modeling and simulation,advantages of simulation, the steps of a simulation study. - visualization techniques for validation.	Expositions: description, explanation, introductive lectures, Other methods: case study; company examples.	
8. Visual interactive modeling and problem solving - visual onteractive models - sensitivity analysis, calibration, input-output data analysis for simulations	Expositions: description, explanation, class lectures, Use of problems: use of problem questions.	
9. Techniques needed for data visualization - applications of visualization; - data analysis and visualization; - visualizing multidimensional data; - data visualization unevenly distributed.	Expositions: description, explanation, dialog-based lectures, current lectures, Use of problems: problems and problem situations.	
10. Creative visualization - constructing isosurfaces, direct volume rendering, streamlines, streaklines, and pathlines, table, matrix, charts (pie chart, bar chart, histogram, function graph, scatter plot, etc.), graphs (tree diagram, network diagram, flowchart, existential graph, etc.), maps. - parallel coordinates - a visualization technique aimed at multidimensional data, treemap - a visualization technique aimed at hierarchical data, Venn diagram, Timeline, Euler diagram, Chernoff face, Hyperbolic trees, brushing and linking, Cluster diagram or dendrogram, Ordinogram	Expositions: description, explanation, class lectures, dialog-based lectures, current lectures. Other methods: case study; company examples, discussion of material.	
11. Interactive simulation and visualization applications - *Automatic 3-D animation and visualization* - *Interactive 3-D Model Construction* - *Surgical Simulation* - *3D MRI Aquisition and Visualization* - *Virtual Morphological Modelling*	Expositions: description, explanation, class lectures, dialog-based lectures, current lectures. Use of problems: use of problem questions, problems and problem situations.	
12. Data visualization in Business Analytics (visual technologiies, and data visualization). - visual analysis, scorecards, dshboards, 3D virtual reality.	Expositions: description, explanation, class lectures. Use of problems: use of problem questions.	

13. Visual data analysis - Development tools, components, and libraries	Expositions: description, explanation	
14. Manipulate and visualize datasets, toolkits for image and signal processing	Expositions: description, explanation	

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8.2 Seminar		Teaching methods	Remarks
1.	The first two seminars are dedicated to surveying information sources available on Internet and Intranet, and planning of the papers and projects.	**Expositions**: description, explanation, introductive lectures. **Conversations**: debate, dialog, introductive conversations. **Other methods**: individual study, exercise, homework study.	
2.			
3.	The next seven seminars (from three to nine) are dedicated to paper presentations.	**Conversations**: debate, dialog, conversations for knowledge consolidation, conversations to systematize and synthesize knowledge. **Use of problems**: use of problem questions, problems and problem situations. **Other methods**: case study; cooperation, individual study, homework study, company examples, discussion of material.	
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10.	*PV-WAVE* - Visual data analysis: - Development tools, components, and libraries - toolkits for image and signal processing	**Conversations**: debate, dialog, conversations for knowledge consolidation, conversations to systematize and synthesize knowledge.	
11.			
12.	The project demos will be scheduled in the last three seminars.	**Conversations**: debate, dialog. **Discovery**: discovery by documenting. **Other methods**: discussion of material.	
13.			
14.			

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9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- This course exists in the curriculum of many universities in the world;
- The results of course are considered by companies of software particularly useful and topical.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic elements and concepts of the Scientific Data Visualization;	Written exam	50%
10.5 Seminar / Project	- complexity, importance and degree of timeliness of the synthesis made	Paper presentation	15%
	- apply the course concepts - problem solving	Project presentation	35%
10.6 Minimum performance standards			
➢ At least grade 5 at written exam, paper presentations and project realised.			

Date	Signature of course coordinator	Signature of seminar coordinator
April 21, 2018	**Lect. Dr. PREJMEREAN Vasile**	**Lect. Dr. PREJMEREAN Vasile**

Date of approval ..... Signature of the head of department .....