

## SUBJECT CONTENT

### 1. Informations about program

1.1 Institution	West University of Timisoara
1.2 Faculty	Faculty of Physics
1.3 Department	Physics Department
1.4 Domain for university master studies	Exact science - Physics
1.5 Level of study	Master
1.6 Study directions	Astrophysics, elementary particles and computational physics

### 2. Informations about discipline

2.1 Subject matter	Gravitation and Cosmology						
2.2 Course	Prof.univ.dr. Dumitru Vulcanov						
2.3 Seminar	Prof.univ.dr. Dumitru Vulcanov						
2.4 Laboratory							
2.5 Year of study	I	2.6 Semester	II	2.7 Type of evaluation	V	2.8 Subject category	Ob

### 3. The total estimated time (hours of teaching activities on semester)

<b>3.1 Number of teaching hours on week</b>	3	from which course	2	seminar	1	laboratory	
<b>3.2. Number of hours on semester</b>	42	from which course	28	seminar	14	laboratory	
<b>3.3.Time distribution:</b>							<b>ore</b>
Study of course notes,tutorials, bibliography and other notes							40
Supplementary study in library, on media etc.							30
Preparation of seminars / laboratory, homework, reports, portofolio and essay							30
Tutoring							
Exams							4
Other activities.....							20
<b>3.4 Total hours of individual study</b>	<b>120</b>						



<b>3.5 Total hours on semester <sup>1</sup></b>	<b>162</b>	
<b>3.6 Credits</b>	<b>6</b>	

#### 4. Preconditions (where appropriate)

4.1 of curriculum	<ul style="list-style-type: none"> <li>Complements of theoretical physics</li> </ul>
4.2 of competences	<ul style="list-style-type: none"> <li>Computer manipulation skills and algebraica programming in Maple</li> </ul>

#### 5. Condition (where appropriate)

5.1 of the course	
5.2 of the seminars	
5.3 of the laboratory	

#### 6. Specific competences

Professional competences	<ul style="list-style-type: none"> <li>Basic knowledge (fundamental concepts of General Relativity and Cosmology) .</li> <li>Deep understanding (of basic notions, of physical parameters in order to understand the complex calculations from General Relativity and Cosmology) .</li> <li>Physical interpretation of the calculations results and their applications.</li> <li>Capacity of analyze and synthesize (realization of synthesis and comparisons).</li> <li>Capacity to plan and organize theoretical applications .</li> <li>Bibliography investigation .</li> <li>Knowledge of foreign languages (English) .</li> </ul>
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<sup>1</sup> Numărul total de ore nu trebuie să depășească valoarea (Număr credite) x 27 ore



Transversal competences	<ul style="list-style-type: none"> <li>effective use of information sources and training assistance (Internet portals, specialized software, data bases, online courses, etc..) both in romanian and in a foreign language (english)</li> </ul>
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### 7. Objectives (reieșind din grila competențelor specifice acumulate)

7.1 Main objective	<ul style="list-style-type: none"> <li>Acquiring basic knowledge about General Relativity and Cosmology</li> <li>Understanding of the fundamental principles of General Relativity and modern Cosmology</li> <li>To get familiar and to understand notions such as curved space-time, gravitational field, stress-energy tensor, etc</li> </ul>
7.2 Specific objectives	<ul style="list-style-type: none"> <li>Basic notions needed to construct the cosmological models</li> <li>Developing the skills needed to perform complex calculations in General Relativity and Cosmology</li> </ul>

### 8. Table of contents

8.1 Course	Teaching methods	Observations
1. Basics of differential geometry	Interacting teaching using the blackbord, ppt, comuters	4 h
2. Principles of General Relativity. Einstein equations	-----/ /----	4 h
3. Exact solutions to the Einstein equations	-----/ /----	4 h
4. Schwartzschild solution. Tests of GR	-----/ /----	4 h
5. Robertson-Walker metric. Friedman equations	-----/ /----	4 h
6. Processes in the first order of perturbation theory	-----/ /----	4 h
7. Basic principles of modern cosmology	-----/ /----	4 h
8. Problems in modern cosmology	-----/ /----	4 h



<b>Minimal References</b>		
1. D. Vulcanov – curs minimal de gravitație – ed. Mirton, Timisoara, 1999		
2. R. DiInverno – Modern gravitation and general relativity, Cambridge Univ.press, 2003		
3. MTW- Gravitation, Freeman, 1973		
4. B.F. Schutz – A first course in general relativity, Cambridge univ. press, 2000		
<b>8.2 Seminar</b>	<b>Teaching methods</b>	<b>Observations</b>
1. Riemannian geometry. Calculations	Interacting teaching using the blackboard	4 h
2. exact solutions of Einstein equations (complete calculations and derivations)	Interacting teaching using the blackboard	4 h
3. Cosmology – The Standard Cosmological Model – construction and derivation + calculations	Interacting teaching using the blackboard	3 h
4. scalar fields minimally coupled with gravity	Interacting teaching using the blackboard	2 h
5. quintessence and dark matter	Interacting teaching using the blackboard	1 h
<b>Minimal References</b>		
1. D. Vulcanov – curs minimal de gravitație – ed. Mirton, Timisoara, 1999		
2. R. DiInverno – Modern gravitation and general relativity, Cambridge Univ.press, 2003		
3. MTW- Gravitation, Freeman, 1973		
4. B.F. Schutz – A first course in general relativity, Cambridge univ. press, 2000		
<b>8.3 Laboratory</b>	<b>Teaching methods</b>	<b>Observations</b>

## 9. Evaluation

Activity	Evaluation criteria	Evaluation methods	Percentage of final mark
9.1 Course	answers at exams ( final evaluation)	oral	50%
9.2 Seminar	Problems	written	50%



9.3 Laboratory			
9.4 Minimum performance standards			
correct formulation of the proposed subject without demonstrations			

Data completării:

30.09.2016

Titular curs (Semnătura):

Prof.univ.dr. Dumitru Vulcanov



  
UNIVERSITATEA DE VEST DIN TIMISOARA  
**Facultatea de Fizică**

