

**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
1.5 Level of study	Master
1.6 Study directions	Astrophysics, elementary particles and computational physics

**2. Informations about discipline**

2.1 Subject matter	Fields in interaction						
2.2 Course	Conf. dr. Cosmin Crucean						
2.3 Seminar	Conf. dr. Cosmin Crucean						
2.4 Discipline code	AP 2301						
2.5 Year of study	II	2.6 Semester	II	2.7 Type of evaluation	E	2.8 Subject category	DO

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

<b>3.1 Number of teaching hours on week</b>	2	from which course	2	seminar	2	laboratory	
<b>3.2. Number of hours on semester</b>	56	from which course	28	seminar	28	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.....							
<b>3.4 Total hours of individual study</b>	<b>104</b>						
<b>3.5 Total hours on semester <sup>1</sup></b>	<b>160</b>						
<b>3.6 Credits</b>	<b>7</b>						

**4. Preconditions (where appropriate)**


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1 Numărul total de ore nu trebuie să depășească valoarea (Număr credite) x 27 ore

4.1 of curriculum	•
4.2 of competences	•

### 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 quantum field theory) .</li> <li>• Deep understanding (of basic notions, of physical parameters in order to understand the complex calculations from Quantum field theory) .</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>
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>

### 7. Objectives (reieșind din grila competențelor specifice acumulate)

7.1 Main obiectiv	<ul style="list-style-type: none"> <li>• Acquiring basic knowledge about quantum field theory</li> <li>• Understanding of the fundamental principles of QED</li> </ul>
7.2 Specific objectives	<ul style="list-style-type: none"> <li>• Basic notions needed to construct the interaction theory</li> <li>• Developing the skills needed to perform complex calculations in QED</li> </ul>

### 8. Table of contents

<b>8.1 Course</b>	<b>Teaching methods</b>	<b>Observations</b>
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1. Recapitulation of the theory of free fields. Dirac field and electromagnetic field.	Interacting teaching using the blackbord Googlemeet	4 hours
2. The theory of interaction between Dirac field and electromagnetic field	Interacting teaching using the blackbord Googlemeet	4 hours
3. The theory of interaction between charged scalar field and electromagnetic field	Interacting teaching using the blackbord Googlemeet	2 hours
4. Reduction formalism. Construction of the S matrix and Feynmann diagrams	Interacting teaching using the blackbord Googlemeet	6 hours
5. Processes in the first order of perturbation theory	Interacting teaching using the blackbord Googlemeet	2 hours
6. Processes in the second order of perturbation theory	Interacting teaching using the blackbord Googlemeet	4 hours
7. Scattering cross sections calculation	Interacting teaching using the blackbord Googlemeet	2 hours
8. Renormalization of QED	Interacting teaching using the blackbord Googlemeet	4 hours

**References**

1. V.Novacu, Teoria cuantica a campului (Editura Tehnica, Bucuresti 1984).
2. S. Weinberg, The Quantum Theory of Fields (Cambridge University Press, Cambridge, 1995).
3. C.Itzykson, J.B.Zuber , Quantum Field Theory (Mc Graw-Hill Inc. 1980).
4. S.Drell and J.D.Bjorken, Relativistic Quantum Fields (Mc Graw-Hill Book Co., New York 1965).

<b>8.2 Seminar</b>	<b>Teaching methods</b>	<b>Observations</b>
1. Particle reduction from in-out states	Interacting teaching using the blackbord Googlemeet	2 hours
2. Coulomb scattering of fermions and scalar particles	Interacting teaching using the blackbord Googlemeet	3 hours
3. Amplitudes in the second order of perturbation theory.	Interacting teaching using the blackbord Googlemeet	2 hours
4. Electron-electron scattering. (Moller scattering)	Interacting teaching using the blackbord Googlemeet	3 hours
5. Bhabha scattering	Interacting teaching using the blackbord Googlemeet	3 hours
6. Electron-positron pair annihilation	Interacting teaching using the blackbord Googlemeet	3 hours
7. Compton scattering.	Interacting teaching using the blackbord Googlemeet	3 hours
8. Processes in the forth order of perturbation theory. Photon-photon scattering	Interacting teaching using the blackbord Googlemeet	2 hours
9. Calculation of the scattering cross sections for the processes in the second order of perturbation theory	Interacting teaching using the blackbord Googlemeet	4 hours
10. Photon self energy diagram. Electron self energy diagram	Interacting teaching using the blackbord Googlemeet	3 hours

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<b>8.3 Laboratory</b>	<b>Teaching methods</b>	<b>Observations</b>

### References

1. V.Novacu, Teoria cuantica a campului (Editura Tehnica, Bucuresti 1984).
2. S. Weinberg, The Quantum Theory of Fields (Cambridge University Press, Cambridge, 1995).
3. C.Itzykson, J.B.Zuber , Quantum Field Theory (Mc Graw-Hill Inc. 1980).
4. S.Drell and J.D.Bjorken, Relativistic Quantum Fields (Mc Graw-Hill Book Co., New York 1965).

### 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: 15.09.2023

Semnatura titularului de curs:

Conf.dr. Cosmin CRUCEAN

Semnătura titularului de seminar :

Conf.dr. Cosmin CRUCEAN

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Semnătura director departament:

Conf.dr. Catalin MARIN

