İZMİR UNIVERSITY OF ECONOMICS

# Faculty of Arts and Sciences
## Physics
## PHYS 306 - Mathematical Methods in Physics

### COURSE INTRODUCTION AND APPLICATION INFORMATION

| Course Name | Mathematical Methods in Physics |
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| Code | Semester | Theory (hour/week) | Application/Laboratory (hour/week) | Local Credits | ECTS |
|---|---|---|---|---|---|
| PHYS 306 | Spring | 2 | 2 | 3 | 6 |

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| **Prerequisites** | None |
| **Course Language** | English |
| **Course Type** | Required |
| **Course Level** | First Cycle |
| **Mode of Delivery** | Online |
| | * Discussion<br>* Problem Solving<br>* Lecture / Presentation |
| **Course Coordinator** | - |
| **Course Lecturer(s)** | * Prof. Dr. Gürsoy Bozkurt AKGÜÇ |
| **Course Assistants** | * Araş. Gör. Hülya KARAASLAN |

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| **Course Objectives** | This course aims to provide the students with various mathematical tools and techniques which are commonly required to analyse physics problems. |
| **Course Learning Outcomes** | The students who succeeded in this course;<br>* use the methods of linear algebra for solving problems in physics.<br>* define the properties of various special mathematical functions that prove to be relevant in physics.<br>* apply the Sturm-Liouville theory in physics problems. |

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| | * compare Fourier analysis of differential equations with standard methods.<br>* discuss the general properties of complex valued functions.<br>* evaluate integrals using the technique of contour integration. |
| **Course Description** | This course includes the topics of linear algebra, diagonalization of matrices, vector analysis, dirac-delta function, beta and gamma functions, Sturm-Liouville theory, Legendre, Bessel, Hermite and Laguerre functions, Fourier series, Laplace and Fourier transformations, partial differential equations, functions of complex variables, contour integration, and tensors. |

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| **Course Category** | Core Courses | X |
| | Major Area Courses | |
| | Supportive Courses | |
| | Media and Managment Skills Courses | |
| | Transferable Skill Courses | |

## WEEKLY SUBJECTS AND RELATED PREPARATION STUDIES

| Week16 | Subjects | Related Materials |
|---|---|---|
| **1** | Linear algebra | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 3. ISBN: 9780471198260 |
| **2** | Eigenvalues, eigenvectors, and diagonalization | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 3. ISBN: 9780471198260 |
| **3** | Vector Analysis, Gauss, Green and Stoke Theorems | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 6. ISBN: 9780471198260 |
| **4** | Coordinate transformations and tensors | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 10. ISBN: |

9780471198260

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| **5** | Differentials and integrals | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 4-5. ISBN: 9780471198260 |
| **6** | Sturm-Liouville theory | George B. Arfken, Hans J. Weber, and Frank E. Harris, Mathematical Methods For Physicists, 7th edn. (Elsevier, 2012). Chapter 8. ISBN: 9789381269558 |
| **7** | Legendre, Bessel, Hermite and Laguerre functions | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 11-12. ISBN: 9780471198260 |
| **8** | Midterm exam 1 | |
| **9** | Fourier series, Fourier and Laplace transforms | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 7-8. ISBN: 9780471198260 |
| **10** | Fourier series, Fourier and Laplace transforms | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 7-8. ISBN: 9780471198260 |
| **11** | Partial differential equations | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 13. ISBN: 9780471198260 |
| **12** | Functions of complex variables | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 14. ISBN: 9780471198260 |
| **13** | Contour integration | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 14. ISBN: 9780471198260 |

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| **14** | Contour integration | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). Chapter 14. ISBN: 9780471198260 |
| **15** | Semester review | |
| **16** | Final Exam | |

## SOURCES

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| **Course Notes / Textbooks** | Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edn. (Wiley, 2005). ISBN: 9780471198260 |
| **Suggested Readings/Materials** | George B. Arfken, Hans J. Weber, and Frank E. Harris, Mathematical Methods For Physicists, 7th edn. (Elsevier, 2012). ISBN: 9789381269558 |

## EVALUATION SYSTEM

| Semester Activities | Number | Percentage of Grade |
|---|---|---|
| Participation | 1 | 10 |
| Laboratory / Application | - | - |
| Field Work | - | - |
| Quiz/Studio Critic | - | - |
| Portfoilo | - | - |
| Homework Assignment | 1 | 25 |
| Presentation/Jury | - | - |
| Project | - | - |
| Seminar/Workshop | - | - |
| Oral Exam | - | - |
| Midterm | 1 | 25 |
| Final | 1 | 40 |
| **Total** | 4 | 100 |

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| **WEIGHTING OF SEMESTER ACTIVITIES ON THE FINAL GRADE** | **3** | **60** |
| **WEIGHTING OF END-OF-SEMESTER ACTIVITIES ON THE FINAL GRADE** | **1** | **40** |
| **Total** | 4 | 100 |

## ECTS / WORKLOAD TABLE

| Semester Activities | Number | Duration (Hours) | Total Workload |
|---|---|---|---|
| Course Hours (Including Exam Week: 16 x Total Hours) | 16 | 2 | 32 |
| Laboratory / Application Hours | 16 | 2 | 32 |
| Study Hours Out of Class | 12 | 4 | 48 |
| Field Work | - | - | - |
| Quiz / Studio Critique | - | - | - |
| Portfolio | - | - | - |
| Homework / Assignment | 1 | 3 | 3 |
| Presentation / Jury | - | - | - |
| Project | - | - | - |
| Seminar / Workshop | - | - | - |
| Oral Exam | - | - | - |
| Midterm | 1 | 15 | 15 |
| Final | 1 | 23 | 23 |
| | | **Total Workload** | **180** |

## THE RELATIONSHIP BETWEEN COURSE LEARNING OUTCOMES AND PROGRAM QUALIFICATIONS

| # | Program Qualifications / Outcomes | * Level of Contribution | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | To be able master and use fundamental phenomenological and applied physical laws and applications, | | | | | X |
| 2 | To be able to identify the problems, analyze them and produce solutions based on scientific method, | | | | X | |
| 3 | To be able to collect necessary knowledge, able to model and self-improve in almost any area where physics is applicable and able to criticize and reestablish his/her developed models and solutions, | | | | X | |
| 4 | To be able to communicate his/her theoretical and technical knowledge both in detail to the experts and in a simple and understandable manner to the non-experts comfortably, | | | | | |
| 5 | To be familiar with software used in area of physics extensively and able to actively use at least one of the advanced level programs in European Computer Usage License, | | | | | |
| 6 | To be able to develop and apply projects in accordance with sensitivities of society and behave according to societies, scientific and ethical values in every stage of the project that he/she is part in, | | | | | |
| 7 | To be able to evaluate every all stages effectively bestowed with universal knowledge and consciousness and has the necessary consciousness in the subject of quality governance, | | | | | |
| 8 | To be able to master abstract ideas, to be able to connect with concreate events and carry out solutions, devising experiments and collecting data, to be able to analyze and comment the results, | | | | | |
| 9 | To be able to refresh his/her gained knowledge and capabilities lifelong, have the consciousness to learn in his/her whole life, | | | | | |
| 10 | To be able to conduct a study both solo and in a group, to be effective actively in every all stages of independent study, join in decision making stage, able to plan and conduct using time effectively. | | | | | |
| 11 | To be able to collect data in the areas of Physics and communicate with colleagues in a foreign language ("European Language Portfolio Global Scale", Level B1). | | | | | |
| 12 | To be able to speak a second foreign at a medium level of fluency efficiently | | | | | |
| 13 | To be able to relate the knowledge accumulated throughout the human history to their field of expertise. | | | | | |

*1 Lowest, 2 Low, 3 Average, 4 High, 5 Highest