# AYDIN ADNAN MENDERES UNIVERSITY
# COURSE INFORMATION FORM

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|---|---|---|---|---|---|---|---|---|---|
| Course Title | Perturbation Applications in Physical Systems | | | | | | | | |
| Course Code | FİZ441 | | Couse Level | First Cycle (Bachelor's Degree) | | | | | |
| ECTS Credit | 7 | Workload | 180 *(Hours)* | Theory | 3 | Practice | 0 | Laboratory | 0 |
| Objectives of the Course | Introduction to perturbation theory which is the one of the most important approximation methods in physics | | | | | | | | |
| Course Content | Application of perturbation expansion to the differential equations, Lagrange expansion and its applications , Perturbation in classical mechanics and quantum mechanics. | | | | | | | | |
| Work Placement | N/A | | | | | | | | |
| Planned Learning Activities and Teaching Methods | Explanation (Presentation), Discussion | | | | | | | | |
| Name of Lecturer(s) | | | | | | | | | |

| **Assessment Methods and Criteria** | | |
|---|---|---|
| Method | Quantity | Percentage (%) |
| Midterm Examination | 1 | 30 |
| Final Examination | 1 | 70 |
| Quiz | 10 | 10 |

| **Recommended or Required Reading** | |
|---|---|
| 1 | Quantum Mechanics (Tekin Dereli, Abdullah Verçin) |
| 2 | Introduction to Quantum Mechanics ( David J. Griffiths ) |

| Week | Weekly Detailed Course Contents | |
|---|---|---|
| 1 | Theoretical | What is perturbation ? |
| 2 | Theoretical | Perturbation expansion |
| 3 | Theoretical | Application of perturbation expansion to the differential equations |
| 4 | Theoretical | Lagrange expansion |
| 5 | Theoretical | Applications of Lagrange expansion |
| 6 | Theoretical | Perturbation on boundary value problem |
| 7 | Theoretical | Perturbation in classical mechanics |
| 8 | Intermediate Exam | Midterm Exam |
| 9 | Theoretical | Anharmonic oscillator |
| 10 | Theoretical | WKB approximation |
| 11 | Theoretical | Time-independent perturbation in quantum mechanics |
| 12 | Theoretical | Selection rules |
| 13 | Theoretical | Perturbation in degenerative systems |
| 14 | Theoretical | Time dependent perturbation |
| 15 | Theoretical | Periodic perturbation and Fermi’s golden rule |

| **Workload Calculation** | | | | |
|---|---|---|---|---|
| Activity | Quantity | Preparation | Duration | Total Workload |
| Lecture - Theory | 14 | 6 | 3 | 126 |
| Quiz | 10 | 2 | 1 | 30 |
| Midterm Examination | 1 | 10 | 2 | 12 |
| Final Examination | 1 | 10 | 2 | 12 |
| | | | Total Workload (Hours) | 180 |
| | | | [Total Workload (Hours) / 25*] = **ECTS** | 7 |
| **25 hour workload is accepted as 1 ECTS* | | | | |

| **Learning Outcomes** | |
|---|---|
| 1 | Ability of solving the nonlinear differential equations by using perturbation methods |

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|---|---|
| 2 | Ability of solving problems in classical mechanics which do not have exact solution through perturbation method in the mean of approximation. |
| 3 | Ability of solving problems in quantum mechanics which do not have exact solution through perturbation method in the mean of approximation. |
| 4 | Be able to have knowledge about nonlinear equations |
| 5 | Be able to solve physics problems involving nonlinear equations |

| **Programme Outcomes** *(Physics)* | |
|---|---|
| 1 | To understand the importance of physics by understanding the general concepts of physics, matter and energy |
| 2 | To be able to define the movements of matter and to distinguish the characteristics of movements under different force (potential) |
| 3 | Be able to say the meaning of Lagrange and Hamiltonian formulations of the movement and apply them to simple problems, |
| 4 | To be able to express the fundamental concepts such as time, space, force, momentum and energy in the movements of matter close to the speed of light and be able to solve and interpret the simple problems related to |
| 5 | To be able to establish the relationship between electric and magnetic forces and to be able to illustrate their applications to technology and solve problems related to the movement of particles in electric and magnetic fields |
| 6 | Be able to say the basic laws of electromagnetics and apply them to problems, illustrate their applications to simple technology |
| 7 | To be able to tell the reasons of the differences between the classical cases and the quantum scale and explain the reasons |
| 8 | Explain the concepts of discontinuity, uncertainty, matter-antimatter, indecisiveness of quantum physics with examples and explain simple problems related to the subject. |
| 9 | To be able to solve the problems of micro-particles under different simple potentials and be able to say their meanings |
| 10 | To be able to establish the relationship between the movements and properties of multi-particle systems and the laws of probability and solve simple problems |
| 11 | To be able to illustrate the laws, meanings and applications of thermodynamics and use them |
| 12 | Be able to use their knowledge about quantum physics and mechanics in explaining some properties of atoms and nuclei |
| 13 | To be able to show the meanings of some theoretical concepts by experimenting, and develop a strong relationship between thought and the real world, develop analytical thinking |
| 14 | To be able to apply the meanings of the basic laws of physics, their comprehension of universality and the relations between them and the unity of the laws of nature. |
| 15 | Use computer to solve physics problems |
| 16 | To be able to understand the problems by using their analytical knowledge skills and to propose solutions by dealing with the laws of physics |
| 17 | Be able to use the knowledge of physics to understand new technologies |
| 18 | To be able to tell the relations between symmetry and conservation laws in laws of physics |

**Contribution of Learning Outcomes to Programme Outcomes** *1:Very Low, 2:Low, 3:Medium, 4:High, 5:Very High*

| | L1 | L2 | L3 |
|---|---|---|---|
| P1 | | 2 | 2 |
| P2 | | 3 | 3 |
| P7 | | 2 | 2 |
| P8 | 3 | 2 | 4 |
| P9 | 3 | 2 | 5 |
| P10 | 3 | 2 | 5 |
| P12 | 3 | 2 | 5 |
| P14 | 1 | 2 | 3 |
| P15 | 2 | 2 | 2 |
| P16 | 3 | 3 | 3 |
| P18 | 2 | 2 | 3 |