# Course Information

## COURSE INFORMATION

| Course Title | Code | Semester | L+U Hour | Credits | ECTS |
|---|---|---|---|---|---|
| Quantum Mechanics II | FZK496 | 8. Semester | 2 + 2 | 3.0 | 7.0 |

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|---|---|
| **Prerequisites** | None |
| **Language of Instruction** | English |
| **Course Level** | Bacheclor's Degree (First Cycle) |
| **Course Type** | Elective |
| **Mode of delivery** | Face to face |
| **Course Coordinator** | Assist. Prof. Dr. Ayşe KÜÇÜKARSLAN |
| **Instructors** | |
| **Assistants** | |
| **Course Objectives** | Angular Momentum, The Schrodinger Equation in Three Dimension, Hydrogen Atom, The Interaction of Charged Particle with the Electromagnetic Field, Matrix Representation of Operators, Spin, The Interaction of Charged Particles with the Electromagnetic Field, Time-Independent Perturbation Theory, Identical Particles. |
| **Course Content** | Angular Momentum, The Angular Momentum Commutation Relations,Raising and Lowering Operators for Angular Momentum,The Schrodinger Equation in Three Dimensions and the Hydrogen Atom, The Central Potential,The Hydrogen Atom, The Energy Spectrum,The Free Particle, Particle in an Infinite Spherical Well The Interaction of Charged Particles with the Electromagnetic Field, Classical Electrodynamics,The Schrodinger Equation for an Electron in Interaction with an Electromagnetic Field,Midterm exam Matrix Representations of Angular Momentum Operators, General Relations in Matrix Mechanics Spin, Eigen states of Spin 1/2,The Intrinsic Magnetic Moment of Spin 1/2 Particles, Paramagnetic Resonance Addition of Two Spins, The Addition of Spin 1/2 and Orbital Angular Momentum,Matrix Representation of Operators, Matrices in Quantum Mechanics,Degenerate perturbation theory, Stark effect,Time independent perturbation theory, energy Eigen values and degenerate Eigen states,Final |
| **Course Learning Outcomes** | 1) Apply the operator notation in solutions<br>2) Explain general formalism of quantum mechanics<br>3) Solve three dimensional quantum systems<br>4) Define angular momentum and spin<br>5) Make calculation with approximation methods<br>6) Apply symmetry and transformations in quantum mechanics |

## WEEKLY COURSE CONTENT

| Week | Topics | Teaching and Learning Methods and Techniques | Study Materials |
|---|---|---|---|
| 1. Week | Angular Momentum, The Angular Momentum Commutation | Lecture, Problem | |

Quick Access

Physics
- Qualification Awarded
- Level of Qualification
- Qualification Requirements and Regulations
- Specific Admission Requirements
- Recognition of Prior Learning
- Profile of the Program
- Program Key Learning Outcomes
- Occupational Profile of Graduates
- Access to Further Studies
- Course Structure & Credits
- Exam Regulations & Assessment & Grading
- Graduation Requirements
- Mode of Study
- Programme Director(or Equivalent)
- Evaluation Questionnaire
- TYYÇ

Course Information
- Course Information
- Weekly Course Content
- Resources
- Course Category
- CONTRIBUTION OF COURSE LEARNING OUTCOMES TO PROGRAMME OUTCOMES
- ECTS credits and course workload

| | | | |
|---|---|---|---|
| | Relations | solving, Homework | |
| 2. Week | Raising and Lowering Operators for Angular Momentum | Lecture, Problem solving, Homework | |
| 3. Week | The Schrodinger Equation in Three Dimensions and the Hydrogen Atom, The Central Potential | Lecture, Problem solving, Homework | |
| 4. Week | The Hydrogen Atom, The Energy Spectrum | Lecture, Problem solving, Homework | |
| 5. Week | The Free Particle, Particle in an Infinite Spherical Well | Lecture, Problem solving, Homework | |
| 6. Week | The Interaction of Charged Particles with the Electromagnetic Field, Classical Electrodynamics | Lecture, Problem solving, Homework | |
| 7. Week | The Schrodinger Equation for an Electron in Interaction with an Electromagnetic Field | Lecture, Problem solving, Homework | |
| 8. Week | Midterm exam | Exam | |
| 9. Week | Matrix Representations of Angular Momentum Operators, General Relations in Matrix Mechanics | Lecture, Problem solving, Homework | |
| 10. Week | Spin, Eigen states of Spin 1/2 | Lecture, Problem solving, Homework | |
| 11. Week | The Intrinsic Magnetic Moment of Spin 1/2 Particles, Paramagnetic Resonance | Lecture, Problem solving, Homework | |
| 12. Week | Addition of Two Spins, The Addition of Spin 1/2 and Orbital Angular Momentum | Lecture, Problem solving, Homework | |
| 13. Week | Matrix Representation of Operators, Matrices in Quantum Mechanics | Lecture, Problem solving, Homework | |
| 14. Week | Degenerate perturbation theory, Stark effect | Lecture, Problem solving, Homework | |
| 15. Week | Time independent perturbation theory, energy Eigen values and degenerate Eigen states | Lecture, Problem solving, Homework | |
| 16. Week | Final Exam | Exam | |

## RESOURCES

| Recommended Sources |
|---|
| Quantum Mechanics, E.Merzbacher,2nd.Edition (John Wiley and Sons,New York NY,1970) |
| Modern Quantum Mechanics, J.J. Sakurai, (Benjamin/Cummings, Menlo Park CA,1985) |
| The Principles of Quantum Mechanics, P.A.M.Dirac, (Oxford University Press, Oxford,UK,1958) |
| The Feynman Lectures on Physics, R.B.Leighton and M.Sands,Volume III (Addison-Wesley,Reading MA,1965) |

## ASSESSMENT

| Measurement and Evaluation Methods and Techniques |
|---|
| Midterm exam, Homework, Final exam |

## COURSE CATEGORY

| Course Category | Percentage |
|---|---|
| Support Courses | % 100 |

## CONTRIBUTION OF COURSE LEARNING OUTCOMES TO PROGRAMME OUTCOMES

| Programme Outcomes | Contribution Level | DK1 | DK2 | DK3 | DK4 | DK5 | DK6 |
|---|---|---|---|---|---|---|---|
| PY1 | 4 | 4 | 4 | 5 | 3 | 4 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PY2 | 4 | 3 | 5 | 3 | 4 | 5 | 4 |
| PY3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY4 | 3 | 2 | 4 | 3 | 4 | 2 | 3 |
| PY5 | 3 | 2 | 4 | 3 | 4 | 2 | 3 |
| PY6 | 4 | 3 | 5 | 5 | 3 | 4 | 4 |
| PY7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY9 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| PY10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PY13 | 3 | 3 | 2 | 4 | 4 | 3 | 2 |
| PY14 | 3 | 4 | 3 | 3 | 2 | 4 | 2 |
| PY15 | 3 | 3 | 3 | 2 | 4 | 3 | 3 |

*DK = Course's Contrubution.

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Level of contribution** | None | Very Low | Low | Fair | High | Very High |

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## ECTS CREDITS AND COURSE WORKLOAD

| Event | Quantity | Duration (Hour) | Total Workload (Hour) |
|---|---|---|---|
| Final Exam | 1 | 4 | 4 |
| Class Hours (14 weeks) | 14 | 4 | 56 |
| Further Study | 14 | 3 | 42 |
| Mid Term Exam 1 | 1 | 3 | 3 |
| Assignment 1 | 2 | 15 | 30 |
| Final Exam Preparation | 1 | 23 | 23 |
| Mid Term Exam Preparation | 1 | 20 | 20 |
| | | **Total Workload** | 178 |
| | | **Total Workload / 25.5 (s)** | 6.98 |
| | | **ECTS Credit of the Course** | 7 |