جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Basic Principles of Physics - MSE 100

Division	Physical Science and Engineering Division
Course Number	MSE 100
Course Title	Basic Principles of Physics
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Tue Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Christos Chatzichristidis	CHRISTOS.CHATZICHRISTIDIS@KAUST.EDU.SA	+966128087427	4348 (Building 9)	Available to students anytime I am in my office (daily 8:00 - 12:00 and 13:00 - 18:00) or email for an appointment.

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The course provides an introduction to cover key aspects of physics based on the research spectrum offered by KAUST faculty. The emphasis is on basic principles, concepts, and applications of electromagnetism. A brief introduction to the fundamental concepts of Quantum physics and Thermodynamics will also be presented. A comprehensive list of the topics covered can be found below: 1. Electric charge, conductors, and insulators, induced charges, Coulomb's law, electric field and electric forces, electric field lines, electric dipoles, applications of integrals in computing the electric field of a charged object. 2. Electric flux, Gauss's law, and its applications, charges on conductors. 3. Electric potential energy, electric potential, equipotential surfaces, potential gradient. 4. Capacitors and capacitance, capacitors in series and parallel, energy in capacitors, dielectrics and induced charge. 5. Current, resistivity, resistance, electromotive force and electric circuits, Ohm's law, energy and power in circuits, metallic conduction. 6. Resistors in series and parallel, Kirchhoff's rules, electrical measuring instruments, RC circuit. 7. Magnetism, magnetic field, magnetic field lines and magnetic flux, the motion of charged particles in a magnetic field, the magnetic force on a current, torque on a current loop, direct-current motor. 8. Magnetic field of a moving charge, magnetic field of a current element, magnetic field of straight and circular currents, the force between parallel conductors, Ampere's law and its applications, magnetic materials. 9. Electromagnetic induction, Faraday's law, Lenz's law, motional electromotive force, induced electric fields, displacement current, Maxwell equations. 10. Light, reflection, and refraction, total internal reflection, dispersion, polarization, and scattering of light. 11. Wave Theory of Light: Diffraction, single-slit diffraction, multiple-slit diffraction, diffraction grating, circular diffraction. 12. Quantum Mechanics I: Key Experiments and Wave-Particle Duality, Photoelectric Effect. 13. Quantum Mechanics II: Heisenberg's Uncertainty Principle, wave function, probability density function. 14. Quantum Mechanics III: The Schrödinger Equation, Quantization of Energy, Particle in a Box. 15. Quantum Mechanics IV: Time-Dependent Schrödinger Equation. 16. Thermodynamics: Revision of the zeroth and first laws of thermodynamics and the concepts of temperature, work, heat, and enthalpy.
Course Description from Program Guide	This course is a review of physics content normally taught at the senior undergraduate level. The course will cover electric field and potential, DC and AC current circuits, magnetism, magnetic induction, electromagnetic waves, and optical phenomena (transmission, reflection, diffraction, interference, etc). Further topics will include Blackbody radiation, photoelectric effect, atomic line spectra, Bohr hydrogen atom, de Broglie waves, Heisenberg Uncertainty Principle, free particle, particle in a box, particle on a ring, simple harmonic oscillation, quantum numbers, and angular momentum. Finally, an overview of the first, second, and third laws of Thermodynamics along with heat capacity, enthalpy, thermal conduction is presented.
Goals and Objectives	By the end of the course, students should be able to mathematically describe the ways in which the concepts taught come into play in particular research situations. Students are expected to calculate the outcomes in such situations, based on their "working" understanding of the following concepts: 1) Electric Charge and Electric Field, Gauss's Law, Electric Potential, Capacitance, Current and Resistance 2) Magnetic Field and Magnetic Forces, Sources of Magnetic Field, Electromagnetic Induction, and Inductance 3) Electromagnetic Waves, Interference, and Diffraction 4) Wave-particle duality: Light Waves Behaving as Particles, Particles Behaving as Waves, wave function, Schrödinger Equation for 1D, and Quantum tunneling.
Required Knowledge	There are no formal prerequisites
Reference Texts	Young, H. D., Freedman, R. A., Ford, A. L., & Sears, F. W. (2012). *Sears and Zemanskys university physics: with modern physics*. Boston: Addison-Wesley.

Method of evaluation	**45.00**% - Final exam **15.00**% - Quiz(zes) **20.00**% - Exam 2 **20.00**% - Exam 1
Nature of the assignments	There are three components to the final grade: three quizzes, two tests, and the final exam. The contribution of each component to the course grade is as follows: 1. Quizzes -- 15% in total 2. Tests -- 20% each 3. Final Exam -- 45% The 3 quizzes have a duration of 30 minutes and will be held at the beginning of the following Thursday lectures: Feb. 22; March 29; May 3. The two 80-minute tests will be held during lecture time on March 13 and April 24. The final exam is on May 17, during normal class time. Problem sets will be given as ungraded homework. The quizzes will be based on these sets. To pass the course the final grade should be at least 70%. The grading system is S(Satisfactory)/U(Unsatisfactory).
Course Policies	If a student is absent more than 15% of the classes, he/she will be disqualified for the final exam. The students are expected to attend all lectures and to take notes. Students that do not show up for a quiz, a test or for the exam should expect a zero in that assessment. All quizzes, tests and final exam are closed book and closed notes. Students are provided with a formula sheet and are allowed to use calculators during exams and quizzes.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Tue 01/30/2018 Thu 02/01/2018	**Electric charge**: conductors, and insulators, induced charges, Coulomb's law. **Electric Field**: electric forces, electric field lines, electric dipoles, applications of integrals in computing the electric field of a charged object.
2	Tue 02/06/2018 Thu 02/08/2018	**Gauss's Law I:** charge and electric flux, Gauss' law, calculating Electric Flux. **Gauss's Law II:** Applications of Gauss' Law, charges on conductors.
3	Tue 02/13/2018 Thu 02/15/2018	**Electric Potential :** Calculating Electric Potential Energy, Equipotential Surface, potential gradient. **Capacitance and Dielectrics:** Capacitors and capacitance, capacitors in series and parallel, energy in capacitors.
4	Tue 02/20/2018 Thu 02/22/2018	**Capacitance and Dielectrics II:** Electric-Field Energy, dielectrics and induced charge. **1st Quiz**. **Current, Resistance, and Electromotive Force I:** Current, resistivity, resistance, electromotive force, and electric circuits.
5	Tue 02/27/2018 Thu 03/01/2018	**Current, Resistance, and Electromotive Force II:** Ohm's law, energy, and power in circuits, metallic conduction. **Direct-Current Circuits:** Resistors in series and parallel, Kirchhoff's rules, electrical measuring instruments, RC circuit.
6	Tue 03/06/2018 Thu 03/08/2018	**Magnetic Field:** Magnetism, magnetic field, magnetic field lines and magnetic flux, the motion of charged particles in a magnetic field. **Magnetic Forces:** magnetic force on a current, torque on a current loop, direct-current motor.
7	Tue 03/13/2018 Thu 03/15/2018	**Midterm Exam** **Sources of Magnetic Field I:** Magnetic field of a moving charge, magnetic field of a current element, magnetic field of straight and circular currents, the force between parallel conductors
8	Tue 03/20/2018 Thu 03/22/2018	**Sources of Magnetic Field II:** Ampere's law and its applications, magnetic materials. **Electromagnetic Induction I:** Faraday's law, Lenz's law, motional electromotive force.
9	Tue 03/27/2018 Thu 03/29/2018	**Electromagnetic Induction II:** induced electric fields, displacement current, Maxwell equations. **2nd Quiz. The Nature and Propagation of Light I:** Light, reflection and refraction, total internal reflection, dispersion.
10	Tue 04/03/2018 Thu 04/05/2018	**Spring Break**
11	Tue 04/10/2018 Thu 04/12/2018	**The Nature and Propagation of Light II:** dispersion, polarization, and the scattering of light. **Wave Theory of Light:** Diffraction, single-slit diffraction, multiple-slit diffraction, diffraction grating, circular diffraction.
12	Tue 04/17/2018 Thu 04/19/2018	**Quantum Mechanics I:** Key Experiments and Wave-Particle Duality, Photoelectric Effect. **Quantum Mechanics II:** Heisenberg's Uncertainty Principle, wave function, probability density function.
13	Tue 04/24/2018 Thu 04/26/2018	**2nd Exam.** **Quantum Mechanics III:** The Schrödinger Equation, Quantization of Energy, Particle in a Box.
14	Tue 05/01/2018 Thu 05/03/2018	**Quantum Mechanics IV:** Time-Dependent Schrödinger Equation. **3rd Quiz. Thermodynamics I:** Revision of the zeroth and first laws of thermodynamics and the concepts of temperature, work, heat, and enthalpy.

15	Tue 05/08/2018 Thu 05/10/2018	**Thermodynamics II:** The First Law, enthalpy. **Thermodynamics III:** The Second Law, Final Exam Revision
16	Tue 05/15/2018 Thu 05/17/2018	**FINAL EXAM**
17	Tue 05/22/2018 Thu 05/24/2018	
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Note

The instructor reserves the right to make changes to this syllabus as necessary.