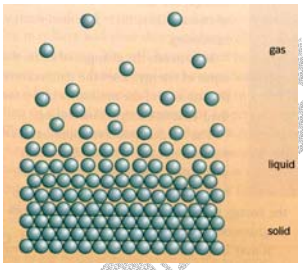
GENERAL PHYSICS

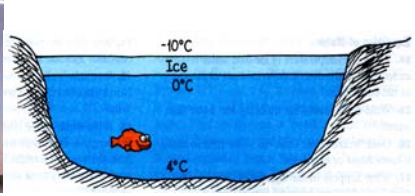
FOR ENGINEERS

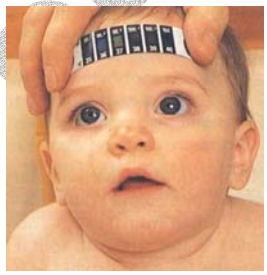
308191 – SPRING 2003

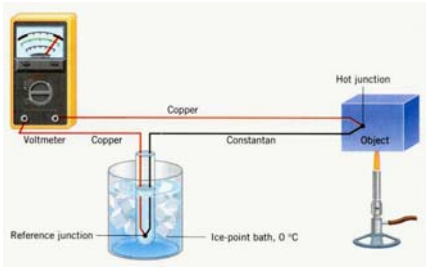
By

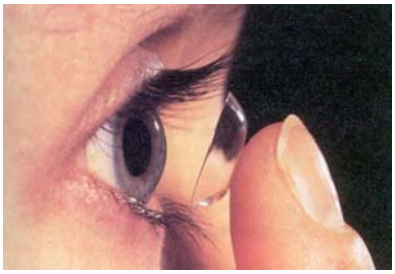
Dr. Ilham Al-Qaradawi
Physics Department











General Physics
Physics 308191 – Spring 2003

General Information:

3 Credit Hours

Time: Saturday 10:30 – 11:30, Monday 10:30-12:30, Wednesday 10:30 – 11:30, Room S2??

Course Lecturer:

Dr. Ilham Y. Al-Qaradwi, Physics Department.

How to contact me:

Office telephone: ext. 2126

E-mail address: ilham@qu.edu.qa

My Personal Web Page: http://www.ilhamalqaradawi.com
Course Web Page: http://www.ilhamalqaradawi.com/courses/191

Office Hours: Saturday 11:30-12:30, Mon & Wed 09:30-10:30, room S113.
Sun & Tue 15:30 -16:30 (by appointment only please)

Midterm tests: Mon 31st March, Mon 5th May 2003.

Final Exam: Saturday June 4th, 2003, 11:00-13:00.

Textbooks:

- Physics for Scientists and Engineers, Giancoli, 3rd edition, Prentice Hall.
- *University Physics,* Hough D. Young, 8th Edition, Addison Wesley.
- Physics, Cutnell and Johnson, 4th edition, Wiley.
- (or any similar general physics book).

Syllabus:

The syllabus is given out with these notes. There is also a calendar showing approximately the topics that will be covered during each lecture.

Discussion Sessions (Tutorials)

There will be regular discussion sessions (tutorials), which will take place normally on Mondays for the second half of the session. Those sessions will focus on developing good problem solving ability, and concentrate on further explaining the more difficult subjects of the course. They are also a good chance for asking questions.

Course Requirements

1. **Homework Assignments:**

Homework problems will be assigned, on average, every two weeks. Problems are to be returned on the date indicated. Problems returned after the deadline will receive a grade of **0**. Solutions to the homework problems will be given in the discussion sessions in the classroom as well as posted on the Web

You are encouraged to work together with fellow students to **discuss homework concepts**, and you are allowed to work out the solutions together. Each problem set handed in should include **EITHER** the ***honour pledge*** (if you did it by yourself) **OR** a statement indicating the name of the student with whom the work was done. Be aware that, when working together with a fellow student, you should actually attempt to solve the problems together, not just copy answers and solutions. Homework will account for 15% of the final grade.

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2. **Projects:**

A short essay, poster or a presentation (in the form of power point or webpage) in a subject related to the course material will be required as part of the course requirements. A separate sheet giving more details will be handed out.
It is hoped that some active work on the students' side could be achieved to encourage students to search for information on a certain subject and then organize this information in an interesting way and present it with explanation to their fellow students during lectures or office hour sessions.
Each student should prepare an essay, poster, presentation or a website that explains the assigned subject in a clear, concise, and attractive way. There will be voting at the end of term for the best three projects. Those will be assigned 1st, 2nd, and 3rd places. The proposed subjects are part of the material that will be covered in this course. A tentative list follows:

- Aerosol Cans
- Digital Thermometers
- Car Suspension
- Digital Keypads
- Cameras
- Vision Correction
- Green house effect and global warming
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The project grading however, does not depend only on how good it is compiled, but also on how much you have understood the subject and how good your presentation is. The main issue being preparing what you have been asked to prepare. If you prepare an essay or a poster on a different subject from the one allocated to you, your grade will be **zero** no matter how good your poster is.

3. **Midterm Exams:**

There will be two closed book midterm exams, given **only** on the dates shown in the course calendar, each lasting an entire class period, and each counting 20% of the final grade. The exams will consist of various types of questions as well as problems, and they will cover all the material covered **until the last lecture before the exam**.

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4. **Final Exam:**

The Final exam will be given only on the date shown in the syllabus. It will consist of multiple choice questions as well as short questions and problems addressing **all the material covered** in the course.

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5. Extras:

- Short assignments are given frequently during lecture or most probably at the end of a lecture in preparation for the next topic to be discussed.
- Those should normally be one page or less but need to be handed in the following lecture in most cases.
- This is useful for developing your search skills and can gain you some marks.

Grading:

Final grades will be determined by the following components:

Homework	15%
Project	5%
2 midterm exams	40%
Final exam	40%
Extras	not fixed
TOTAL	100%

What is Physics?

Physics is concerned with the most basic principles that underlie all phenomena in the universe. Physicists ask, "How does the world work?" They search for the most elementary particles; they seek understanding of the behavior of collections of particles ranging from quarks in nuclei and electrons in atoms to stars in galaxies; they strive for insights into the nature of space and time; and they explore the behavior of matter and energy.
On a more human scale, physicists study an enormous range of topics including all the devices of modern electronics, complex biological molecules, the atmosphere, and all forms of energy and its uses. Physics is the basis for much of engineering and technology. Studying physics prepares some students to push back the boundaries of knowledge in this most fundamental of the natural sciences. For others it provides training in the concepts and methods of science for application in many professional areas, and for many others it gives a more substantial basis for understanding many aspects of modern society.

Useful web sites:

You may use the internet to search for help you with the course material. There is loads of useful and interesting material to help you. I list here only some of those sites:

http://physicsweb.org
http://www.iop.org/
http://www.physics2000.com
http://www.aip.org/
http://www.pparc.ac.uk/
http://teachspacescience.stsci.edu/cgi-bin/ssrtop.plex
http://www.physlink.com/
http://dir.yahoo.com/Science/Physics/
http://www.ucl.ac.uk/Resources/MAPS/Physics.html

With my best wishes for Happy Surfing.

P.S.: if you're interested you can find a more comprehensive list on my website. If you come across another useful website you may send the link to me by email.

Feedback:

Your comments, questions, and suggestions about this course are greatly welcomed. You may use either the attached form to express any concern and hand it in to me, or come for a chat about your concerns during office hours or just send an email. If you wish you may send an email message to me to establish contact. You will receive some interesting sites and info whenever I come across them on the web.

What's on your mind?

Course Web Page:

You are encouraged to visit the course website at:
http://www.ilhamalqaradawi.com/courses/191
You will find updated information about the course, which you may print or download. You will also find a number of educational links related to the course material which could be quite useful in emphasizing the theoretical ideas and principles. Some might contain solved problems and examples as well.

With my very best wishes for your physics' success

Dr. Ilham Al-Qaradawi

General Physics for Engineers 308 191 Course Syllabus

Chapter (1) Thermal Physics (3 Weeks)

- Temperature and States of Matter
- Thermometry and Temperature measurement
- Thermal Expansion
- Phase Change
- Heat Capacity
- Heat Transfer
- Air Pressure
- Gas laws
- The Ideal Gas
- Kinetic Theory of Gases
- Mean Free Path
- Distribution of Molecular Speeds

Assignment (1)

Chapter (2) Thermodynamics (2 Weeks)

- Thermal Equilibrium
- Internal Energy
- Joule's Experiment
- The First Law of Thermodynamics
- Heat Engines
- Applications of Heat and Thermodynamics
- Thermal Power Plants and Energy Resources
- The second law of thermodynamics
- Heat pumps
- Refrigerators

Assignment (2)

First Periodical Test

Chapter (3) Oscillations (2 Weeks)

- Periodic motion
- Sinusoidal Oscillation: Frequency, wavelength, amplitude
- Phase
- Sinusoidal oscillation equation
- Velocity of Waves
- Simple harmonic motion
- Simple harmonic motion related to uniform circular motion
- Hook's law
- The simple pendulum
- Phase angles
- Damped Oscillation

Assignment (3)

Chapter (4) Wave Motion (2 Weeks)

- Interaction of Waves: waves at boundaries
- Interference
- Principle of superposition
- Reflection
- Refraction
- Total Reflection and its applications
- Diffraction: its relation to wavelength
- Standing Waves on a string

Assignment (4)

Chapter (5) Sound and Ultrasound Waves (2 Weeks)

- Sound Waves: Loudness, Pitch, Echo
- Interference of sound: beats
- Resonance and Standing Waves
- Doppler effect
- Shock waves
- Ultrasound
- Applications of Ultrasound

Assignment (5)

Second Periodical Test

Chapter (6) Electromagnetic Radiation (2 Weeks)

- Electromagnetic Spectrum
- Properties and applications of the various types of waves

Assignment (6)

Chapter (7) Light and Optics (2 Weeks)

- Reflection and mirrors
- Refraction and lenses
- Snell's Law
- Total internal Reflection and its applications
- Optical fibre and its applications
- Polarization
- Interference: double slit experiment
- Interference in thin films
- Diffraction: Diffraction Grating, X-ray diffraction
- Optical instruments
- Lasers: properties and uses

Assignment (7)

Final Exam

With my best wishes of happy physics

Dr. Ilham Al-Qaradawi

General Physics 308191

Course Calendar Spring 2003

Day / Date	Saturday	Monday	Wednesday	Notes
Feb 15 – 19	Course orientation	Units and dimensions	Thermal Physics and Thermometry	
Feb 22 – 26	Thermal Physics and Thermometry	Phases of Matter / Gas Laws	The Ideal Gas / The Kinetic Model	
Mar 1 – 5	Thermal Equilibrium / Phase Change / States of Matter	Evidence for Existence of Particles	The Mole / Avogadro's Number / Atomic and Molecular Mass	1st Assignment
Mar 8 – 12	The Ideal Gas Law	Standard Conditions / Molecular Basis for The Gas Law & KT	rms Speed / Molecular Speed Distribution	
Mar 15 – 19	Mean Free Path / Thermal Expansion	Anomalous Water Expansion / Phase Change	Phase Diagram / Latent Heat	2nd Assignment
Mar 22 – 26	Evaporation / Vapour Pressure	Specific Heat Capacity	Heat Transfer	
Mar 29– Apr2	Periodic Motion SHM / Hook's law	**1st Periodic Test**	Velocity & Acceleration of SHM	3rd Assignment
Apr 5 – 9	Phase Angle / The Simple Pendulum	Energy in SHM / Damped Oscillation	Types of Waves / Intensity of Waves	
Apr 12 – 16	Waves at Boundaries / Standing Waves	Resonance / Sound Properties	Test Discussion	4th Assignment
Apr 19 – 23	Hearing & The Ear / Sound Level	Sound Pressure Level	Standing Waves / Beats	
Apr 26 – 30	Room Acoustics / Sound Diffraction	Doppler Effect	Ultrasound / Supersonic Speed	5th Assignment
May 3 – 7	Shock Waves / EM Waves	**2nd Periodic Test**	Types of EM waves	
May 10 – 14	X-Rays / Gamma Rays / Energy of EM Waves	Light & Optics/ Mirrors	Refraction of Light/ Snell's Law	6th Assignment
May 17 – 21	Lenses	Optical Instruments	Total Internal Reflection	
May 24 – 28	Optical Fibres/ Dispersion	Polarization/	Diffraction/ Lasers	7th Assignment
May 31– Jun4				
Jun 7 – 11	**Final Exam Wed 4th June 2003**			Exam papers back Sat 7th June

With my best wishes,
Dr. Ilham Al-Qaradawi

Learning Outcomes
Physics 308 191

At the end of each section you should be able to:

Units and Dimensions:

1. Quote quantities in their Correct SI units;
2. Find the dimension of any quantity;
3. Use estimates and orders of magnitude

Phases of matter:

4. Define and use the term density and relative density;
5. Describe the arrangement of molecules in solids liquids and gases;
6. Use the mole and the Avogadro constant correctly
7. Explain the significance of kinetic and potential energies in determining the phase of matter;
8. Define and use the term specific latten heat;
9. Define and use the term pressure
10. Explain how the effect of pressure on a fluid gives to a buoyancy force on an object within the fluid, and why bodies float.

Temperature:

1. Define the ideal gas temperature and know that it is the same as the thermodynamic temperature;
2. Use the Kelvin and Celsius temperature scale;
3. Use empirical temperature scale;
4. Suggest suitable thermometers for any use.

Gases:

1. State and use boyel's law;
2. Use the universal gas law equation for an ideal gas;
3. Describe the kinetic theory for an ideal gas;
4. Relate the kinetic theory of molecules to temperature;
5. describe quntitevly the distribution of molecular speeds within a gas;

Transfer of thermal energy:

1. Explain the two mechanisms of thermal conductors;
2. Use the term thermal conductivity correctly, and use it in calculations;
3. Explain why convection occurs;
4. Explain why radiation is important in establishing the temperature of a body.

Thermodynamics:

1. Define and use the terms System, Closed System, Open System, Isolated System;
2. Define and use the term internal energy;
3. State a general form of the first law of thermodynamics.
4. Apply the first law of thermodynamics to a gas;
5. relate the specific heat capacity at constant volume for a gas to its specific heat capacity at constant pressure;
6. Use the terms Isobaric process, Isothermal process, Isochoric process, Adiabatic process correctly;
7. Define and use the term Heat Engine, How does it work,
8. Find the Efficiency of a heat engine;
9. Describe the idea of Refrigerators, Heat Pumps, Air Conditioners;
10. See the need for the second law of thermodynamics.

Oscillations:

1. Define and use the term frequency, period, displacement and amplitude;
2. Describe the conditions necessary for simple harmonic motion and calculate its period;
3. Calculate the energy of a body in simple harmonic motion;
4. Distinguish between free, damped and forced oscillations;
5. Describe examples of resonance.

Wave motion:

1. Define and use the term frequency, period, wave length, displacement and amplitude when applied to progressive waves;
2. Relate the frequency and the wavelength to the velocity of the wave
3. Distinguish between transverse and longitudinal wave;
4. Describe reflections and refractions as wave phenomena;
5. Use the cathode ray oscilloscope for quantative measurements;
6. List characteristics of the various parts of the electro magnetic spectrum.

Optics:

1. Quote and use the laws of reflections and refractions;
2. Describe the conditions under which total internal reflection takes place;
3. Define and find experimentally the focal length and the power of the lens;
4. Use ray diagrams and lens equation to find the position of images;
5. Calculate magnification and angular magnification;
6. Describe the eye the camera and the telescope as optical instruments;
7. Explain long and short sight and their corrections.

Wave interactions

1. Use the principle of superposition;
2. Explain what is meant by the term stationary wave and explain how stationary waves are formed;
3. Explain the meaning of the words interference and diffraction;
4. Explain what is meant by the term resolution;
5. Measure the wave length of light using a diffraction grating

Text book Sections covered:
Giancoli, Physics for Scientists and Engineers, 3rd edition, Prentice Hall

1. Introduction

1-3 Measurement and uncertainty; Significant figures
1-4 Units, Standards, and the SI System
1-6 Order of Magnitude
1-7 Dimensions

17. Temperature, thermal expansion and the ideal gas law

17-1 Atomic theory of matter
17-2 Temperature and thermometers
17-3 Thermal equilibrium and the zeroth law of thermodynamics
17-4 Thermal expansion
17-6 The gas laws and the absolute temperature
17-7 The ideal gas law
17-8 Problem solving with the ideal gas law
17-9 Ideal gas law in terms of molecules: Avogadro's constant
17-10 Ideal gas temperature scale-a standard

18. Kinetic theory of gases

18-2 Distribution of molecular speeds
18-3 Real gases and changes of phase
18-4 Vapor pressure and humidity
18-5 Van der waals equation of state
18-6 Mean free path
18-7 Diffusion

19. Heat and the first law of thermodynamics

19-1 Heat as energy transfer
19-2 Internal energy
19-3 Specific heat
19-4 Calorimetry-solving problems
19-5 Latent heat
19-6 The first law of thermodynamics
19-7 Applying the first law of thermodynamics; calculating the work
19-8 Molar specific heats for gases and the equipartition of energy
19-9 Adiabatic expansion of gas
19-10 Heat transfer: conduction, convection, radiation

20. Second law of thermodynamics; heat engines

20-1 The second law of thermodynamics
20-2 Heat engines
20-3 Reversible and irreversible processes; the Carnot engine
20-4 Refrigerators, air conditioners and heat pumps

14. Oscillations

14-1 Oscillations of a spring
14-2 Simple harmonic motion
14-3 Energy in the simple harmonic oscillator
14-4 Simple harmonic motion related to uniform circular motion
14-5 The simple pendulum
14-7 Damped harmonic motion
14-8 Forced vibration, resonance

15. Wave motion

15-1 Characteristics of wave motion
15-2 Wave types
15-3 Energy transported by waves
15-4 Mathematical representation of a traveling wave
15-5 The wave equation
15-6 The principle of superposition
15-7 Reflection and transition
15-8 Interference
15-9 Standing waves; resonance
15-10 Refraction
15-11 Diffraction

16. Sound

16-1 Characteristics of sound
16-2 Mathematical representations of longitudinal waves
16-3 Intensity of sound; decibels
16-4 Sources of sound: vibrating strings and air columns
16-5 Quality of sound and noise
16-6 Interference of sound waves; beats
16-7 Doppler effect
16-8 Shock waves and the sonic boom
16-9 Applications; ultrasound and ultra sound imaging

33. Light: reflection and refraction

33-1 The ray model of light
33-2 The speed of light and index of refraction
33-3 Reflection; image formation by a plain mirror

33-4 Formation of images by spherical mirrors
33-5 Refraction: Snell's law
33-6 Visible spectrum and dispersion
33-7 Total internal reflection; fiber optics
33-8 Refraction at a spherical surface

34. Lenses and optical instruments

34-2 The lens equation
34-5 Cameras
34-6 The human eye; corrective lens
34-7 Magnifying glass
34-8 Telescopes
34-9 Compound microscopes

35. Wave nature of light interference

35-1 Huyges' principle and diffraction
35-3 Interference- young's double-slit experiment

36. Diffraction and polarization

36-1 Diffraction by a single slit
36-5 Resolution of telescopes and microscopes the λ limit
36-6 Resolution of the human eye and useful magnification
36-7 Diffraction grating
36-8 The spectrometer and spectroscopy
36-10 x-rays and x-ray diffraction
36-11 Polarization
36-12 Scattering of light by the atmosphere