NATIONAL INSTITUTE OF PHYSICS

COLLEGE OF SCIENCE
University of the Philippines
Diliman, Quezon City 1101 Metro-Manila

Course	**PHYSICS 72 (ELEMENTARY PHYSICS II)** 1st Semester AY 2014-2015		
Credit	4 units		
Course Description	An introduction to the classical theory of electricity, magnetism and light.		
Prerequisites	Physics 71, Math 53	**Co-requisite**	Math 54
Course Goal	To understand the basic laws governing electricity, magnetism and light		
Course Requirements		**Pre-final grade / Final grade if exempted from Final Exam**	**Final grade if not exempted from Final Exam**
	3 Long Exams	60%	60%
	1 Final Exam	20% X average of 3 LEs	20%
	Recitation	15%	15%
	Lecture	5%	5%
References	**UNIVERSITY PHYSICS, 12th Edition by Young and Freedman** PHYSICS for Scientist and Engineers, 4th Edition by Paul Tipler		
Important Dates	1st Long Exam	**Monday, September 22, 2014, 12:15-2:15PM**	
	2nd Long Exam	**Monday, October 27, 2014, 12:15-2:15PM**	
	3rd Long Exam	**Monday, December 1, 2014, 12:15-2:15PM**	
	Deadline for Dropping of Subjects	Thursday, November 6, 2014	
	Deadline for Filing LOA	Wednesday, November 19, 2014	
	End of Classes	Friday, December 5, 2014	
Lecturer: Faculty Room: Consultation Schedule: Email:		**Recitation Teacher**: Faculty Room: Consultation Schedule: Email:	

COURSE POLICIES

A. General Policies

1. There are four exams (three long exams and one final exam) to be taken on the scheduled date and time. Each exam is multiple-choice type and has 40 items. Calculators and other electronic devices are not allowed during exams.
2. A student can be excused for only *one* missed long exam. A valid excuse includes death in the immediate family, or illness. The student should present an excuse letter, duly signed by his/her College Secretary or a medical certificate issued by the UP Health Service, to his/her lecturer on the first class meeting he/she is able to come back.
3. A student who missed a long exam due to valid reasons should take the make-up exam. There is *no* make-up for the final exam.
4. A student who missed an exam (long exam/final exam) without a valid excuse will automatically get zero for that exam.
5. A student may be exempted from taking the final exam if he/she has:
   a. taken all long exams whether regular or make-up exam.
   b. passed each long exam.
   c. passing recitation grade.
   d. pre-final grade of at least 2.25.
6. If the conditions in (5) above are satisfied and the student chooses *not* to take the final exam, his effective final exam score is the average of all the three long exams.

Grading System	
Grade(%) ≥ 90.00	**1**
90.00 > Grade(%) ≥ 85.00	**1.25**
85.00 > Grade(%) ≥ 80.00	**1.5**
80.00 > Grade(%) ≥ 75.00	**1.75**
75.00 > Grade(%) ≥ 70.00	**2**
70.00 > Grade(%) ≥ 65.00	**2.25**
65.00 > Grade(%) ≥ 60.00	**2.5**
60.00 > Grade(%) ≥ 55.00	**2.75**
55.00 > Grade(%) ≥ 50.00	**3**
50.00 > Grade(%) ≥ 45.00	**4**
45.00 > Grade(%)	**5**

B. Lecture and Recitation classes

1. Homework, quizzes, problem sets, and attendance incentives are included in the 5% lecture grade.
2. Recitation activities are given every Thursday during class hours in the designated recitation rooms.
3. A student who missed a recitation activity for valid reasons should present his/her excuse letter, duly signed by his/her College Secretary or a medical certificate issued by the UP Health Service, to his/her recitation instructor

on the first recitation class meeting he/she is able to come back. A student who missed a recitation activity without a valid excuse will automatically get zero for that activity.
4. The weight of the *excused* missed recitation will be removed from the total final recitation grade.
5. Only three missed recitations can be excused. Beyond the three excused missed recitations, the student will be given a grade of zero.

C. Attendance

1. University rules apply for attendance. A grade of 5.0 will automatically be given to a student who missed at least 12 class meetings (excused or unexcused).

D. Grading System

1. A student who missed a long exam and its corresponding make-up exam due to valid reasons will be given a grade of INC only if his/her class standing (assuming a zero score in the missed long exam) is at least 4.0.
2. A student who missed the final exam due to valid reasons will be given a grade of INC only if his/her class standing (assuming a zero score in the final exam) is at least 4.0.
3. A grade of 4.0 can only be removed by taking a removal exam. A student must be enrolled during the semester he/she takes the removal exam. Credit for the course, however, can be obtained upon passing the course at re-enrollment. If the student does not re-enroll or take the removal exam within one year from this semester, the grade of 4.0 will automatically become a grade of 5.0.
4. There is *no* forced drop. The lecturer will only give a grade of DRP upon the request of the student and upon the completion of the online dropping module.
5. A student granted an LOA would only be given a grade of either DRP or 5.0. A grade of 5.0 is given if the LOA is granted after ¾ of the semester has lapsed and the student's standing is failing; otherwise DRP is given.

E. Removal Exam

1. The removal exam for this semester is a 16-item problem solving type of exam. Calculators and other electronic devices are not allowed during the exam.
2. Removal exam will only be given to students with completed removal exam forms.

F. Student conduct and discipline

1. **University rules apply for cheating. Any form of cheating in examinations or any act of dishonesty in relation to studies, such as plagiarism, shall be subject to disciplinary action.**
2. Observe courtesy during exams and class hours by turning off all electronic devices (i.e. laptops, tablet computers, cellphones, etc.).
3. Any form of vandalism is strictly prohibited in the NIP building. A student who is found guilty will be subject to disciplinary action.
4. There are CCTV cameras at different places inside and outside the NIP building that monitor and record any untoward incidents 24/7.

COURSE COVERAGE

Chapter 21: Electric Charge and Electric Field — 5 meetings

Section	Objectives
21-1 Electric Charge	• Discuss the dichotomy, quantization and conservation of electric charge • Given the initial/final charge distribution, calculate the final/initial charge distribution using conservation principles
21-2 Conductors, Insulators, and Induced Charges	• Predict charge distributions, and the resulting attraction or repulsion, in a system of charged insulators and conductors • Outline, verbally and diagrammatically, the process of charging
21-3 Coulomb's Law	• Calculate the net electric force on a point charge exerted by a system of point charges • 21.1, 21.7, 21.10, 21.12, 21.13, 21.24
21-4 Electric Field and Electric Forces	• Describe the electric field due to a point charge quantitatively and qualitatively • Establish the relationship between the electric field and the electric force on a test charge • Predict the trajectory of a massive point charge in a uniform electric field • 21.25, 21.27, 21.31, 21.32, 21.33, 21.41
21-5 Electric Field Calculations	• Evaluate the electric field at a point in space due to a system of arbitrary charge distributions • 21.45, 21.47, 21.48, 21.50, 21.54, 21.55, 21.56
21-6 Electric Field Lines	• Given the electric field lines, deduce the electric field vectors and nature of electric field sources • 21.62
21-7 Electric Dipoles	• Discuss the motion of an electric dipole in a uniform electric field • 21.66, 21.71

Chapter 22: Gauss's Law **4 meetings**

Section	Objectives
22-1 Charge and Electric Flux & 22-2 Calculating Electric Flux	• Evaluate the electric flux through a surface given the electric field • Relate the electric flux thru a closed surface to the total charge inside and outside the surface • 22.6, 22.8
22-3 Gauss' Law	• Express Gauss's law verbally and mathematically • 22.10, 22.15
22-4 Applications of Gauss' Law	• Use Gauss's law to calculate the electric field generated at a point by highly symmetrical charge distributions • 22.21, 22.22, 22.23
22-5 Charges on Conductors	• Predict the charge distribution induced on the surface of a conductor in the presence of a static charge and external electric field • 22.28, 22.30, 22.31

Chapter 23: Electric Potential **4 meetings**

Section	Objectives
23-1 Electric Potential Energy	• Relate the electric potential with work, potential energy and electric field • 23.1, 23.5, 23.7, 23.8
23-2 Electric Potential	• Evaluate the potential at any point in a region containing point charges • 23.14, 23.16, 23.21, 23.28, 23.29, 23.31
23-3 Calculating Electric Potential	• Determine the electric potential function at any point due to continuous charge distributions • 23.32, 23.33, 23.35, 23.37, 23.41, 23.44
23-4 Equipotential Surfaces	• Given the equipotential lines, evaluate the electric field vector, nature of the electric field sources and electrostatic potential • Calculate the work done on a point charge relative to a set of equipotential surfaces/lines • Predict the distribution of charges at the surface of an arbitrarily shaped conductor • 23.45
23-5 Potential Gradient	• Given a mathematical function describing the potential in a region of space, calculate the electric field in the region and vice versa • 23.47, 23.48

Chapter 24: Capacitance and Dielectrics **3 meetings**

Section	Objectives
24-1 Capacitance and Capacitors	• Deduce the effects on the capacitance, charge, and potential difference of simple capacitors (e.g. parallel-plate, spherical, cylindrical) when the geometry, potential difference, or charge is changed • 24.2, 24.3, 24.5, 24.8
24-2 Capacitors in Series and Parallel	• Calculate the equivalent capacitance of a network of capacitors connected in series/parallel • Given capacitors connected in series/parallel, determine the total charge, the charge on, and the potential difference across each capacitor in the network • 24.25
24-3 Energy Storage in Capacitors and Electric-field Energy	• Given the geometry and the potential difference across the capacitor, determine the potential energy stored inside the capacitor • Predict the effects on the final potential difference and change in potential energy of a capacitor when either the geometry or charge is changed • Determine the energy density and the electric field inside a capacitor with a given configuration • 24.28, 24.30, 24.33, 24.37
24-4 Dielectrics	• Describe the effects of inserting dielectric materials on the capacitance, charge and electric field of a capacitor • 24.39, 24.44, 24.45, 24.47

Chapter 25: Current, Resistance, and Electromotive Force **3 meetings**

Section	Objectives
25-1 Current	• Relate the drift velocity of a collection of charged particles to the electrical current and current density

	• 25.3, 25.4
25-2 Resistivity	• Describe the ability of a material to conduct current in terms of resistivity and conductivity • 25.10, 25.12, 25.17, 25.24, 25.30
25-3 Resistance	• Determine the effect of a conductor's geometry on its ability to conduct current • Differentiate ohmic and non-ohmic materials in terms of their I-V curves • 25.31, 25.35, 25.37
25-5 Energy and Power in Electric Circuits	• Given an emf source connected to a resistor, determine the power supplied or dissipated by each element in a circuit • 25.48, 25.53

Chapter 26: Direct-Current Circuits **3 meetings**

Section	Objectives
26-1 Resistors in Series and Parallel	• Given a network of resistors connected in series and/or parallel, evaluate the equivalent resistance, current and voltage • Evaluate the voltage drop and current passing thru each circuit element • 26.4, 26.5, 26.7, 26.8, 26.11, 26.13
26-2 Kirchhoff's Rules	• Given a circuit diagram, calculate the current through and voltage across a circuit element using Kirchhoff's loop and junction rules • 26.22, 26.23
26-4 R-C Circuits	• Describe the behavior of current, potential, and charge as a capacitor is charging or discharging in terms of the initial, transient, and steady-state conditions • 26.38, 26.41, 26.47, 26.49

1st LONG EXAM **September 22, 2014 (MON) 12:15-2:15PM**

Chapter 27: Magnetic Field and Magnetic Forces **5 meetings**

Section	Objectives
27-1 Magnetism	• Describe the interaction between poles of magnets
27-2 Magnetic Field	• Differentiate electric interactions from magnetic interactions • Determine the net force on a moving point charge in the presence of both magnetic and electric fields • 27.1, 27.2, 27.5
27-3 Magnetic Field Lines and Magnetic Flux	• Given the magnetic field lines, deduce the magnetic field vector and the magnetic force on a moving charged particle • Argue why the magnetic flux on a closed surface is zero • Evaluate the total magnetic flux through an open surface • 27.10, 27.11, 27.12
27-4 Motion of Charged Particles in a Magnetic Field	• Describe the motion of a charged particle in a magnetic field in terms of its speed, acceleration, cyclotron radius, cyclotron frequency, and kinetic energy • 27.14, 27.15, 27.18, 27.22, 27.24, 27.27
27-6 Magnetic Force on a Current-Carrying Conductor	• Evaluate the magnetic force on an arbitrary wire segment placed in a uniform magnetic field • 27.35, 27.38, 27.40
27-7 Force and Torque on a Current Loop	• Discuss the motion of a magnetic dipole in a uniform magnetic field • 27.44, 27.45, 27.46

Chapter 28: Sources of Magnetic Field **4 meetings**

Section	Objectives
28-1 Magnetic Field of a Moving Charge	• Evaluate the magnetic field vector at a given point in space due to a moving point charge • 28.1, 28.1 28.5, 28.7
28-2 Magnetic Field of a Current Element	• Evaluate the magnetic field vector at a given point in space due to an infinitesimal current element • 28.9, 28.12, 28.13
28-3 Magnetic Field of a Straight Current-Carrying Conductor	• Evaluate the magnetic field vector at any point in space due to a straight current-carrying conductor • Use superposition principle to calculate the magnetic field due to one or more straight wire conductors • 28.16, 28.17, 28.19, 28.24

28-4 Force Between Parallel Conductors	• Calculate the force per unit length on a current carrying wire due to the magnetic field produced by other current-carrying wires • 28.25, 28.26, 28.27, 28.28, 28.29
28-5 Magnetic Field of a Circular Current Loop	• Evaluate the magnetic field vector at any point along the axis of a circular current loop • 28.30, 28.31, 28.33, 28.34
28-6 Ampere's Law & 28-7 Applications of Ampere's Law	• Use Ampere's law to calculate magnetic fields for highly symmetric current configurations • 28.35, 28.36, 28.37, 28.38, 28.39, 28.44

Chapter 29: Magnetic Induction **4 meetings**

Section	Objectives
29-1 Induction Experiments	• Identify the factors that affect the magnitude of the induced emf and the magnitude and direction of the induced current
29-2 Faraday's Law	• Calculate the induced emf in a closed loop due to a time-varying magnetic flux using Faraday's Law • 29.1, 29.3, 29.6, 29.7, 29.8, 29.9, 29.14
29-3 Lenz's Law	• Describe the direction of the induced electric field, magnetic field and current on a conducting/non-conducting loop using Lenz's Law • 29.15, 29.16, 29.18, 29.19, 29.20
29-4 Motional Electromotive Force	• Given the velocity and the orientation of a conductor in a uniform magnetic field, determine the induced emf, electric field, magnetic field and current • 29.21, 29.22, 29.24, 29.25, 29.26
29-5 Induced Electric Fields	• Compare and contrast electrostatic electric field and non-electrostatic/induced electric field • 29.28, 29.29, 29.30, 29.33
29-7 Displacement Current and Maxwell's Equations	• Calculate the displacement current in circuits with discontinuous currents • 29.35, 29.37, 29.38, 29.39

Chapter 30: Inductance **4 meetings**

Section	Objectives
30-1 Mutual Inductance	• Calculate mutually-induced emf given the mutual inductance between two circuits • 30.1, 30.2, 30.5
30-2 Self-inductance and Inductors	• Calculate self-induced emf given the self-inductance of the circuit • 30.6, 30.9, 30.11
30-3 Magnetic-Field Energy	• Calculate the total magnetic energy stored in an inductor and its magnetic energy density after current is increased from zero to a final steady-state value • 30.12, 30.13, 30.16, 30.17
30-5 The L-C Circuit	• Describe the charge and current variation in time in an L-C circuit • 30.28, 30.31, 30.32, 30.35, 30.36
30-6 The L-R-C Series Circuit	• Describe the charge, voltage and current variation in time for underdamped, critically-damped, and overdamped L-R-C circuits • 30.38, 30.39, 30.40, 30.41

Chapter 31: Alternating Current **4 meetings**

Section	Objectives
31-1 Phasors and Alternating Currents	• Use phasor diagrams to represent sinusoidally-varying voltage and current • Calculate root-mean-square (rms) values of sinusoidal voltage and current • 31.1, 31.2, 31.3
31-2 Resistance and Reactance	• Identify the amplitude and phase relationship between voltage and current for a resistor, inductor or capacitor in an AC circuit • Determine the respective inductive and capacitive reactance of an inductor and capacitor in an AC circuit • 31.4, 31.5, 31.6, 31.7, 31.12
31-3 The L-R-C Series Circuit	• Calculate the impedance of a series L-R-C circuit • Relate resistance, inductance, and capacitance to the resulting phase angle between voltage and current in the L-R-C series circuit • 31.14, 31.15, 31.19, 31.20, 31.21, 31.23

31-4 Power in Alternating-Current Circuits	• Differentiate between instantaneous and average power delivered to various circuit elements • Calculate the average power and power factor of a series L-R-C circuit • 31.26, 31.27, 31.29, 31.30
31-5 Resonance in Alternating-Current Circuits	• Identify conditions for resonance in a series L-R-C circuit • Describe what happens to the impedance and current of a series L-R-C circuit at resonance • 31.32, 31.33, 31.36

2nd LONG EXAM **October 27, 2014 (MON) 12:15-2:15PM**

Chapter 32: Electromagnetic Waves 3 meetings

Section	Objectives
32-1 Maxwell's Equations and Electromagnetic Waves	• Identify the physical implications of each of the four Maxwell's equations • Relate the wavelength and frequency of an electromagnetic (EM) wave • Explain the principle of producing EM waves
32-2 Plane Electromagnetic Waves and Speed of Light	• Relate the amplitudes of electric- and magnetic-field of an electromagnetic wave in vacuum and in any medium • Relate the speed of an electromagnetic wave in vacuum and in any medium to the permittivity and permeability • 32.1, 32.3, 32.40
32-3 Sinusoidal Electromagnetic Waves	• Given the wave equation, identify the direction of the electric and magnetic field and its direction of propagation • 32.5, 32.7, 32.9
32-4 Energy and Momentum in Electromagnetic Waves	• Determine the direction and magnitude of either of the three: the electric field, the magnetic field or the Poynting vector, given the other two • Describe the relationship between the Poynting vector, intensity, and energy transport in an electromagnetic wave • Use the concept of radiation pressure to calculate the force experienced by totally reflecting and absorbing surfaces • 32.16, 32.25, 32.27

Chapter 33: Nature and Propagation of Light 4 meetings

Section	Objectives
33-1 The Nature of Light	• Use the concept of wavefront and rays to describe wave propagation • 33.1, 33.3, 33.7, 33.9, 33.13
33-2 Reflection and Refraction	• Predict the direction of the reflected light using the Law of Reflection • Evaluate the index of refraction of a material and its effect on the path, wavelength, and speed of light • Predict the direction of the refracted light using Snell's Law • 33.19, 33.21, 33.23
33-3 Total Internal Reflection	• Given the indices of refraction of different materials, determine when total internal reflection occurs
33-4 Dispersion	• Relate dispersion to the color separation of white light as it travel through a prism at non-normal incidence • Deduce the speed of light in a medium from its dispersion curve
33-5 Polarization	• Identify the different types of polarization and the different methods of polarizing light • Determine the polarizing angle given the indices of refraction of the incidence and transmission side • Use Malus' Law to calculate the intensity of the transmitted light after passing through a series of polarizers • 33.25, 33.27, 33.31
(Optional) 33-6 Scattering of Light	• Describe qualitatively the intensity of the scattered light as it varies with wavelength

Chapter 34: Geometric Optics **6 meetings**

Section	Objectives
34-1 Reflection and Refraction at a Plane Surface	• Given an object in front of a plane mirror: ▪ Calculate the location of the image ▪ Calculate the lateral magnification of the image ▪ Determine whether the image will be real or virtual, and upright or inverted ▪ 34.1, 34.2, 34.3, 34.61
34-2 Reflection at a Spherical Surface	• Given an object in front of a spherical mirror: ▪ Calculate the location of the image ▪ Calculate the lateral magnification of the image ▪ Determine whether the image will be real or virtual, and upright or inverted • Given an object placed in front of a spherical mirror, draw the principal rays and locate the image • 34.5, 34.9, 34.13, 34.14
34-3 Refraction at a Spherical Surface	• Given an object in front of a spherical surface or interface separating two media: ▪ Calculate the location of the image ▪ Calculate the lateral magnification of the image ▪ Determine whether the image will be real or virtual, and upright or inverted • Calculate the apparent depth of an object when observed across a boundary of changing indices of refraction • 34.17, 34.18, 34.19, 34.82
34-4 Thin Lens	• Differentiate a converging lens from a diverging lens • Given an object in front of a lens or series of lenses: ▪ Calculate the location of the image ▪ Calculate the magnification of the image ▪ Determine whether the image will be real or virtual, and upright or inverted • Given an object placed in front of a lens or series of lenses, draw the principal rays and locate the image • Relate the radii of curvature of the lens in air and its index of refraction to the focal length of the lens • 34.23, 34.27, 34.30, 34.34

Chapter 35: Interference **3 meetings**

Section	Objectives
35-1 Interference and Coherent Sources	• Determine the conditions for interference to occur • Relate path difference to two types of interference (constructive and destructive interference) • 35.1, 35.5, 35.7, 35.44
35-2 Two-source interference of Light	• Locate the spatial points where constructive and destructive interference takes place • 35.9, 35.12, 35.16, 35.18
35-3 Intensity in Interference Patterns	• Relate path difference to phase difference • Identify the type of interference, given the path difference and the phase difference • Relate the effects of the slit separation, screen and slit distance, and wavelength on the interference pattern • 35.19, 35.21, 35.22, 35.25
35-4 Interference in Thin Films	• Predict the occurrence of constructive and destructive reflection from thin films, based on its thickness, index of refraction, and wavelength of illumination • 35.27, 35.28, 35.36, 35.57

Chapter 36: Diffraction **2 meetings**

Section	Objectives
36-2 Diffraction from Single Slit	• Locate the dark fringes of the diffraction pattern and determine the width of the central maximum • 36.1, 36.8, 36.13, 36.55
36-3 Intensity in Single-slit Pattern	• Relate the effects of the slit width, screen and slit distance, and wavelength on the diffraction pattern • 36.14, 36.15, 36.17, 36.57
36-4 Multiple Slits	• Describe the combined effects of diffraction and interference on the pattern produced by two or more slits with finite width • Calculate the number of fringes within the central maximum • 36.22, 36.24, 36.25, 36.26

3rd LONG EXAM **December 1, 2014 (MON) 12:15-2:15PM**