NATIONAL INSTITUTE OF PHYSICS

COLLEGE OF SCIENCE
University of the Philippines
Diliman, Quezon City1101 Metro–Manila

Course	Physics 71 Elementary Physics I	
Credit Units	4 units	
Course Description	Mechanics of particles, rigid bodies and fluids	
Corequisite	Math 53, Math 63, or Math 100	
References	**University Physics, 13th Edition by Young and Freedman** Physics for Scientist and Engineers, 4th Edition by Paul A. Tipler Physics, 5th Edition by Resnick et.al. Conceptual Physics, 8th Edition by Paul G. Hewitt	
Course Goal	The course aims to develop the students' understanding of basic concepts and ability to systematically solve a wide variety of problems on mechanics, fluids and wave motion using Newton's Laws and Conservation Principles.	
Course Requirements	**3 Long Exams**	60%
	Final Exam	25%
	Recitation	10%
	Quizzes & Problem Set	5%
Important Dates	**First Long Exam**	**February 27, 2017** (Mon) 09:00-11:00 AM
	Second Long Exam	**April 03, 2017** (Mon) 09:00-11:00 AM
	Third Long Exam	**May 15, 2017** (Mon) 09:00-11:00 AM
	Final Exam	**May 20, 2017** (Sat) 01:45-03:45 PM
	Deadline of Dropping Subjects	**April 07, 2017** (Fri)
	Deadline of Filling LOA	**April 28, 2017** (Fri)
	End of Classes	**May 15, 2017** (Mon)
Lecturer: **Consultation Room:** A101 **Consultation Schedule:** **Email Address:**		**Recitation Teacher** **Consultation Room:** A101 **Consultation Schedule:** **Email Address:**

COURSE POLICIES

A. Exam Policies

1. The **three long exams** and the **final exam** are departmental and are taken on the scheduled date and time. Each exam is **multiple-choice type** and has **40 items**.
2. A student is allowed to take **ONLY ONE** make-up exam when he/she misses a long exam **and** has a **valid** reason for missing the exam. In the case of illness, bereavement, or official UP duty, a medical certificate, death certificate, or official endorsement, respectively, **must be submitted as soon as possible**. The make-up exam, which is multiple-choice type and has 40 items, is given one week after the missed long exam. **There is no make-up exam for the final exam**.
3. A student who **missed the make-up exam** due to a **valid reason** will be given a score of **zero for his/her missed exam**.
4. A student who missed a **long exam** or a **make-up exam** without a valid excuse will automatically get **zero** for that exam.
5. There will be **no exemptions** for the final exam.
6. Students must **carefully shade** the information box in the answer sheet of the long and final exam. A student who provided/shaded wrong student number in the answer sheet shall be given a grade of **zero** for that long/final exam.

Grading System	
Grade (%) $\geq$ 90.00	**1.00**
90.00 > Grade (%) $\geq$ 85.00	**1.25**
85.00 > Grade (%) $\geq$ 80.00	**1.50**
80.00 > Grade (%) $\geq$ 75.00	**1.75**
75.00 > Grade (%) $\geq$ 70.00	**2.00**
70.00 > Grade (%) $\geq$ 65.00	**2.25**
65.00 > Grade (%) $\geq$ 60.00	**2.50**
60.00 > Grade (%) $\geq$ 55.00	**2.75**
55.00 > Grade (%) $\geq$ 50.00	**3.00**
50.00 > Grade (%) $\geq$ 45.00	**4.00**
45.00 > Grade (%)	**5.00**

B. Lecture and Recitation Grade

1. Lecture grades such as quizzes, attendance, etc. are included to the **5% grade**.
2. **Recitation classes** are held every **Friday** during class hours at 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 of a medical certificate issued by UP Health Service, to his/her recitation instructor on the first recitation class meeting he/she us 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 recitation grade.

C. Attendance

1. University rules apply for attendance (lecture and recitation).
   a) If the student reached **13 absences,** majority of which are **excused**, then the student will be **"forced drop"**.
   b) If the student reached **13 absences**, majority of which are **unexcused**, then the student will be given a grade of **"5.00"**.
   c) If the student reached more than **13 absences**, then the student will be given a grade of **"5.00"**.
2. **Valid reasons** include but are not limited to the following:
   a) Illness
   b) Death of the immediate family member
   c) Official UP representation.
3. **All excuse documents** must be submitted within **two (2) days** after the student come back to the class.

D. Grading System, Removal Exam, and Completion of Grade

1. 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 4.00**. The student must take the final exam in Physics 71 **within one (1) academic year** of incurring the INC; otherwise, the final grade will be computed with a score of zero for the missed exam.
2. A student granted a **LOA** will only be given a grade of **either DRP** or **5.00**. A grade of **5.00** is given if the **LOA is granted after ¾ of the semester** has lapsed and the student's class standing is failing; **otherwise a grade of DRP is given**.
3. If a grade of **4.00** has been incurred, he/she will have to apply for a **removal exam permit** and take the **removal exam within an academic year**.
4. The removal exam is a **problem solving type exam** covering the course objectives of the semester.
5. When removing grades of **4.00** or **INC**, the student **must be enrolled during the term** the removal/completion exam is taken.

E. Student Conduct and Discipline

1. **Any form of cheating in examinations or any act of dishonesty in relation to studies, such as plagiarism, shall be subjected to disciplinary action**.
2. Observe **courtesy during exams and class hours**. Using any **electronic gadgets** (e.g. mobile phones, laptops, cameras, etc.) is **strictly prohibited** in the class.
3. Any form of **vandalism** is strictly prohibited in NIP building. A student who is found guilty will be subjected to disciplinary action.
4. The corridors, rooms, entry and exit points of the National Institute of Physics are **under CCTV surveillance**.

COURSE COVERAGE

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Orientation	▪ Explain what is expected of you to get good marks in this class ▪ Explain the expected role of your teacher ▪ Explain the expected role of your book ▪ Explain the expected role of your lecture classes ▪ List the materials you will need for this course	0

Chapter 1: Units, Physical Quantities, and Vectors (~ 2 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Standards and units Unit consistency and conversions Uncertainty and significant figures	Suggested Readings: 1.3, 1.4, 1.5 Suggested Exercises: 1.8, 1.10, 1.14, 1.15 ▪ Describe what physical quantities are. ▪ Convert quantities into different units. ▪ Recognize the importance of significant figures. ▪ Express quantities in scientific notation. ▪ Justify the dimensional consistency of a relation.	1
Vectors and vector addition Components of vectors Unit vectors	Suggested Readings: 1.7, 1.8, 1.9 Suggested Exercises: 1.28, 1.31, 1.38, 1.43 ▪ Differentiate vector and scalar quantities. ▪ Express a vector from magnitude-direction form to component form and vice versa. ▪ Perform addition on vectors.	2

Chapter 2: Motion along a Straight Line (~ 3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Displacement, time, and average velocity Instantaneous velocity	Suggested Readings: 2.1, 2.2 Suggested Exercises: 2.1, 2.3, 2.5, 2.9, 2.10 ▪ Define distance, average speed and instantaneous speed. ▪ Define displacement, average velocity and instantaneous velocity. ▪ Describe motion in one dimension in terms of the kinematical quantities above.	3
Average and instantaneous acceleration	Suggested Readings: 2.3 Suggested Exercises: 2.12, 2.13, 2.16 ▪ Define average and instantaneous acceleration. ▪ Describe motion in one dimension in terms of average and instantaneous accelerations. ▪ Analyze one-dimensional motion using verbal, graphical and algebraic representations.	4
Motion with constant acceleration Freely falling bodies	Suggested Readings: 2.4, 2.5 Suggested Exercises: 2.21, 2.23, 2.30, 2.31, 2.35, 2.43, 2.46, 2.47 ▪ Familiarize with the four kinematic equations. ▪ Solve problems involving motion with constant acceleration. ▪ Define free-fall motion. ▪ Solve problems involving motion including freely falling bodies.	5

Chapter 3: Motion in Two or Three Dimensions (~ 4 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Position and velocity vectors Acceleration vector	Suggested Readings: 3.1, 3.2 Suggested Exercises: 3.1, 3.3, 3.5, 3.6, Q3.3, Q3.4, Q3.5, Q3.6 ▪ Express position, velocity, and acceleration in two and three dimensions using vector representation. ▪ Interpret the components of a body's acceleration parallel to and perpendicular to its path. ▪ Solve kinematic problems in two and three dimensions.	6
Projectile motion	Suggested Readings: 3.3 Suggested Exercises: 3.9, 3.13, 3.16, 3.17, 3.21 ▪ Describe the characteristics of a projectile.	7

	▪ Discuss the consequences of the independence of vertical and horizontal components of projectile motion. ▪ Solve problems involving projectile motion.	
Motion in a circle	Suggested Readings: 3.4	8
	▪ Differentiate uniform and non-uniform circular motions. ▪ Solve problems involving circular motion.	
Relative velocity	Suggested Readings: 3.5 Suggested Exercises: 3.31, 3.33, 3.35, 3.37	9
	▪ Describe motion using the concept of relative velocities in one and two dimensions. ▪ Solve problems involving relative motion.	

Chapter 4: Newton's Laws of Motion (~ 2 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**Topic no.**
Force and interactions Mass and weight Newton's first law Inertial frames of reference	Suggested Readings: 4.1, 4.2, 4.4 Suggested Exercises: Q4.3, Q4.7, 4.1, 4.6, 4.5, 4.17, 4.19	10
	▪ Identify all contact and non-contact forces acting on a body. ▪ Differentiate mass and weight. ▪ Cite examples where Newton's first law is observed. ▪ Define inertial frames of reference.	
Free-body diagrams Newton's second law Newton's third law	Suggested Readings: 4.3, 4.5, 4.6 Suggested Exercises: 4.9, 4.13, 4.27, 4.29, 4.21, 4.24, 4.25	11
	▪ Draw the appropriate free-body diagrams for a given body. ▪ Cite examples where Newton's second law is observed. ▪ Cite examples where Newton's third law is observed. ▪ Identify action-reaction pairs.	

Chapter 5: Applying Newton's Laws (~ 4 meetings)

Newton's 1st law: particles in equilibrium	Suggested Readings: 5.1 Suggested Exercises: 5.1, 5.5, 5.7, 5.8, 5.9	12
	▪ Apply Newton's laws to obtain conclusions about the contact and non-contact forces acting on a body in equilibrium.	
Newton's 2nd law: dynamics of particles	Suggested Readings: 5.2 Suggested Exercises: 5.13, 5.15, 5.17	13
	▪ Apply Newton's 2nd law and kinematics to obtain conclusions about the velocity and acceleration of one or more bodies, and the contact and non-contact forces acting on them.	
Frictional forces	Suggested Readings: 5.3 Suggested Exercises: 5.25, 5.27, 5.28, 5.29, 5.31, 5.35	14
	▪ Differentiate the properties of static friction and kinetic friction. ▪ Compare the magnitude of sought after quantities such as frictional force, normal force, threshold angles for sliding, acceleration etc. ▪ Apply Newton's laws and kinematics equations to obtain conclusions about the velocity and acceleration of one or more bodies, and the contact and non-contact forces acting on one or more bodies with friction. ▪ Qualitatively analyze the effect of fluid resistance on moving object.	
Dynamics of circular motion	Suggested Readings: 5.4 Suggested Exercises: 5.45, 5.47, 5.49, 5.53	15
	▪ Apply Newton's 2nd law and kinematics to obtain conclusions about velocity and acceleration of one or more bodies undergoing circular motion, and the contact and non-contact forces acting on them.	

FIRST LONG EXAM
Date: February 27, 2017 (Monday) Time: 09:00 am - 11:00 AM Room: TBA

Chapter 6: Work and Kinetic Energy (~ 3 Meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Scalar product Work	Suggested Readings: 6.1, 1.10 Suggested Exercises: 6.1, 6.3, 6.5, 6.7, 6.9	16

	▪ Calculate the scalar product of two vectors. ▪ Define work. ▪ Determine the work done by a constant force acting on a system. ▪ Determine the total work done on a system by several constant forces.	
Work and kinetic energy	Suggested Readings: 6.2 Suggested Exercises: 6.15, 6.16, 6.19, 6.29	17
	▪ Relate the work done by a constant force to the change in kinetic energy of a system. ▪ Apply the work-kinetic energy theorem to systems with constant forces.	
Work and energy with varying forces Power	Suggested Readings: 6.3, 6.4 Suggested Exercises: 6.31, 6.35, 6.37, 6.39, 6.41, 6.49	18
	▪ Determine the work done by a varying force on a system from a force-vs-displacement graph. ▪ Apply the work-kinetic energy theorem to systems with varying forces. ▪ Define power. ▪ Relate power to work, energy, force and velocity.	

Chapter 7: Potential Energy and Energy Conservation (~ 4 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Gravitational potential energy Conservation of mechanical energy (gravitational force only) Conservative and non-conservative forces	Suggested Readings: 7.1, 7.3 Suggested Exercises: 7.1, 7.3, 7.5, 7.9, 7.11, 7.27, 7.29	19
	▪ Define the gravitational potential energy in terms of the work done on an object by a uniform gravitational force. ▪ Apply the conservation of mechanical energy to analyze the motion of an object (or a system of objects) subject to uniform gravitational force. ▪ Differentiate conservative forces from non-conservative forces. ▪ Calculate the work done by a non-conservative force.	
Elastic potential energy Conservation of mechanical energy	Suggested Readings: 7.2, Suggested Exercises: 7.15, 7.17, 7.19, 7.23, 7.25	20
	▪ Relate the elastic potential energy of an object-spring system to the work done by the spring. ▪ Apply the conservation of mechanical energy to analyze the motion of an object attached to an ideal horizontal spring. ▪ Express the conservation of mechanical energy qualitatively and quantitatively. ▪ Apply the conservation of mechanical energy to systems subject to spring force and uniform gravitational force.	
Force and potential energy Energy diagrams	Suggested Readings: 7.4, 7.5 Suggested Exercises: Q7.21, Q7.24, 7.38, 7.86	21
	▪ Construct the force vs position graph given a potential energy vs position graph. ▪ Predict the direction of a conservative force based on a monotonic potential energy function. ▪ Locate the stable, unstable, and neutral equilibrium points given the potential energy or force as functions of position.	

Chapter 8: Momentum, Impulse, and Collisions (~ 4 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Momentum and impulse	Suggested Readings: 8.1 Suggested Exercises: 8.1, 8.5, 8.7, 8.13	22
	▪ Define momentum and impulse. ▪ Relate the momentum, impulse, force, and time of contact in a system.	
Conservation of momentum Momentum conservation and collisions	Suggested Readings: 8.2, 8.3 Suggested Exercises 8.17, 8.19, 8.21, 8.25, 8.27, 8.33, 8.35, 8.37, 8.39, 8.41	23
	▪ Enumerate the conditions for conservation of linear momentum. ▪ Apply conservation of momentum to physical systems. ▪ Solve problems involving inelastic collisions using momentum conservation. ▪ Utilize the concept of mechanical energy and momentum conservation in solving inelastic collision problems.	
Elastic collisions	Suggested Readings: 8.4 Suggested Exercises: 8.47, 8.48	24

	▪ Solve problems involving systems in one and two dimensions where linear momentum is conserved. ▪ Determine if a collision is elastic or inelastic. ▪ Predict the motion of constituent particles for different types of collisions.	
Center of mass	Suggested Readings: 8.5 Suggested Exercises: 8.51, 8.53, 8.55	25
	▪ Locate the center of mass of a system. ▪ Relate the motion of the center of mass with the momentum and net external force acting on the system.	

Chapter 9: Rotation of Rigid Bodies (~ 3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Angular velocity and acceleration Rotation with constant angular acceleration	Suggested Readings: 9.1, 9.2 Suggested Exercises: 9.1, 9.2, 9.8, 9.9, 9.11, 9.13, 9.17, 9.19	26
	▪ Distinguish rotational and translational quantities. ▪ Apply the rotational kinematic relations in rotating objects.	
Relating linear and angular kinematics	Suggested Readings: 9.3 Suggested Exercises: 9.21, 9.23, 9.31, 9.33, 9.35, 9.41, 9.43, 9.45	27
	▪ Relate the equations of rotational and translational quantities. ▪ Apply the rotational kinematic relations in rotating objects.	
Energy in rotational motion Parallel-axis theorem	Suggested Readings: 9.4, 9.5 Suggested Exercises: 9.55, 9.57	28
	▪ Define moment of inertia. ▪ Calculate the moment of inertia about a given axis of a given multiple objects. ▪ Apply conservation of energy in rotational motions to physical systems. ▪ Discuss parallel-axis theorem.	

Chapter 10: Dynamics of Rotational Motion (~ 4 meetings)

Vector product Torque	Suggested Readings: 1.10, 10.1 Suggested Exercises: 10.1, 10.3, 10.5	29
	▪ Calculate the vector product of two vectors. ▪ Define torque.	
Torque and angular acceleration for a rigid body	Suggested Readings: 10.2 Suggested Exercises: 10.9, 10.11, 10.13	30
	▪ Relate torque to the angular acceleration of a rigid body. ▪ Apply Newton's second law of rotation and conservation of energy to physical systems that involves rotation about a stationary axis.	
Rigid-body rotation about a moving axis	Suggested Readings: 10.3 Suggested Exercises: 10.19, 10.21, 10.25	31
	▪ Compare translational and rotational kinetic energies of a rolling object. ▪ Apply Newton's second law of rotation and conservation of energy to physical systems that involves rotation about a moving axis.	
Angular momentum Conservation of angular momentum	Suggested Readings: 10.5, 10.6 Suggested Exercises: 10.37, 10.39, 10.41, 10.43, 10.45, 10.47, 10.49	32
	▪ Define angular momentum for a point particle and for a rigid body. ▪ Explain the conditions for conservation of angular momentum. ▪ Apply conservation of angular momentum to physical systems.	

SECOND LONG EXAM
Date: April 03, 2017 (Monday) Time: 09:00 - 11:00 AM Room: TBA

Chapter 11: Equilibrium and Elasticity (~ 2-3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Conditions for equilibrium Center of gravity	Suggested Readings: 11.1, 11.2 Suggested Exercises: Q11.1, Q11.6, 11.1, 11.3,	33
	▪ Enumerate the necessary and sufficient conditions for static equilibrium. ▪ Solve problems involving center of gravity.	
Solving rigid-body equilibrium problems	Suggested Readings: 11.3, 11.4, 11.5 Suggested Exercises: 11.5, 11.7, 11.9, 11.11, 11.13, 11.25, 11.27	

Stress, strain, and elastic moduli Elasticity and plasticity	▪ Apply conditions for equilibrium to rigid bodies. ▪ Define tensile/compressive stress, strain and elastic moduli. ▪ Compare elasticity and plasticity.	34

Chapter 12: Fluid Mechanics (~ 3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Density Pressure in a fluid	Suggested Readings: 12.1, 12.2 Suggested Exercises: 12.3, 12.5, 12.7, 12.9, 12.21	35
	▪ Relate density, specific gravity, mass and volume; pressure, area and force; pressure, density and depth. ▪ Apply the above relationships in solving fluid statics problems. ▪ Apply Pascal's principle in analyzing fluids in various systems.	
Buoyancy	Suggested Readings: 12.3 Suggested Exercises: 12.27, 12.29, 12.31	36
	▪ Apply the concept of buoyancy and Archimedes' principle to various systems involving fluids and objects in fluids.	
Fluid flow Bernoulli's equation	Suggested Readings: 12.4, 12.5 Suggested Exercises: 12.35, 12.37, 12.41, 12.43, 12.45	37
	▪ Enumerate the properties of an ideal fluid. ▪ Apply Bernoulli's principle and continuity equation to problems involving fluid flow.	

Chapter 13: Gravitation (~ 2-3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Newton's law of gravitation Weight	Suggested Readings: 13.1, 13.2 Suggested Exercises: 13.1, 13.3, 13.5, 13.7, 13.9, 13.11, 13.13	38
	▪ Determine the net gravitational force on each mass given a system of point masses. ▪ Describe the gravitational force, weight, and acceleration due to gravity based on Newton's law of gravitation.	
Gravitational potential energy Motion of satellites Kepler's laws and the motion of the planets	Suggested Readings: 13.3, 13.4. 13.5 Suggested Exercises: 13.17, 13.19, 13.21, 13.23, Q13.17	39
	▪ Define gravitational potential energy using Newton's law of gravitation. ▪ Solve problems involving gravitational potential energy in physical systems. ▪ Differentiate closed and open orbits. ▪ Calculate planetary or satellite motion-related quantities. ▪ Relate Kepler's three laws with Newton's law of gravitation and conservation of angular momentum.	

Chapter 14: Periodic Motion (~ 4 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Describing oscillation Simple harmonic motion	Suggested Readings: 14.1, 14.2 Suggested Exercises: 14.2, 14.3, 14.5, 14.6, 14.7, 14.11	40
	▪ Relate the quantities associated with oscillating systems. ▪ Recognize the necessary conditions for an object to undergo simple harmonic motion.	
Energy in simple harmonic motion	Suggested Readings: 14.3 Suggested Exercises: 14.27, 14.31, 14.32	41
	▪ Relate mechanical energy to the quantities associated with simple harmonic motion. ▪ Apply conservation laws to systems undergoing simple harmonic motion.	
Applications of simple harmonic motion The simple pendulum The physical pendulum	Suggested Readings: 14.4, 14.5 Suggested Exercises: 14.37, 14.45, 14.48, 14.49	42
	▪ Identify the period and the frequency of spring-mass system, simple pendulum and physical pendulum. ▪ Analyze the motion of an oscillating system in terms of period, frequency and energy.	

Damped Oscillations Forced Oscillations	Suggested Readings: 14.6, 14.7, 14.8 Suggested Exercises: 14.52, 14.55, 14.59, 14.63 ▪ Distinguish the different regimes of damped oscillations. ▪ Explain the effects of driving conditions on forced oscillations.	43

Chapter 15: Mechanical Waves (~ 3 meetings)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Types of mechanical waves Periodic waves Mathematical description of wave Speed of a transverse wave	Suggested Readings: 15.1, 15.2, 15.3, 15.4 Suggested Exercises: 15.1,15.3, 15.5, 15.7, 15.15, 15.19, 15.21 ▪ Describe and distinguish mechanical wave, periodic wave, and sinusoidal wave. ▪ Relate wave quantities of a sinusoidal wave. ▪ Identify wave quantities from a given sinusoidal wave function and vice versa.	44
Energy in wave motion Wave interference, boundary conditions, and superposition	Suggested Readings: 15.5, 15.6 Suggested Exercises: 15.25, 15.27, 15.33 ▪ Relate speed and amplitude with energy and power of waves on a string qualitatively. ▪ Describe the intensity of waves that travel in 3D, such as sound waves and seismic waves. ▪ Describe qualitatively the superposition of waves. ▪ Describe the consequences of different boundary conditions of waves on a string.	45
Standing waves on a string Normal modes of a string	Suggested Readings: 15.7, 15.8 Suggested Exercises: 15.37, 15.41, 15.43, 15.45, 15.49 ▪ Describe standing waves on a string. ▪ Describe the condition for standing waves on a string. ▪ Identify the normal modes of a string.	46

Chapter 16: Sound and Hearing (~ 1 meeting)

Topics	**Objectives** **After the discussion and lined up activities, you should be able to:**	**topic no.**
Doppler effect	Suggested Readings: 16.8 Suggested Exercises: 16.43, 16.45, 16.47, ▪ Relate the frequency and wavelength of sound with the motion of the source and the listener.	47

THIRD LONG EXAM
Date: May 15, 2017 (Monday) Time: 09:00 - 11:00 AM Room: TBA

(write the following in your index cards to be collected by your instructor)

I hereby conform with the Physics 71 Course guidelines by affixing my signature:

_____

(Signature over printed name)