

PHY3204: WAVES AND OPTICS

Effective Term

Semester A 2022/23

Part I Course Overview

Course Title

Waves and Optics

Subject Code

PHY - Physics

Course Number

3204

Academic Unit

Physics (PHY)

College/School

College of Science (SI)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

- (1) PHY1101 Introductory Classical Mechanics or AP1201/PHY1201 General Physics I or equivalent*
- (2) MA1200 Calculus and Basic Linear Algebra I or equivalent
- (3) MA1201 Calculus and Basic Linear Algebra II or equivalent

Precursors

MA2158 Linear Algebra and Calculus

Equivalent Courses

AP3204 Waves and Optics

Exclusive Courses

Nil

Additional Information

* This pre-requisite requirement is waived for Advanced Standing I students, Advanced Standing II students and GREAT students.

Part II Course Details

Abstract

Vibrations, mechanical waves, light waves, and ray optics are commonly found and used in daily life. As fundamental topics in physics, waves and optics are important for more advanced courses in applied optics program. This course aims to lay down the foundation knowledge in waves and optics and its applications in such a way that the students can identify the appropriate concepts required in given physics problems and apply them to formulate suitable physics solutions.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 DEC-A2 DEC-A3 app.)			
1	Identify and describe the vibration and wave natures of representative systems in daily life.	20	x		
2	Identify the wave properties in optics.	10	x		
3	Apply the basic concepts and theories on the wave formations and propagations in media to explain and predict phenomena in daily life.	30		x	
4	Apply basic superposition theory to solve simple problems in interference and diffraction.	30		x	
5	Recognize the disasters caused due to the improper use of vibrations and waves.	10		x	

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

TLAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lectures	Present basic theories, concepts and examples	1, 2, 3, 4, 5	2 hours/week
2	Tutorials	Provide additional explanations and help the students to practice what they learn in the lectures	1, 2, 3, 4, 5	0.5 hour/week
3	Laboratory Exercise	Provide laboratory exercise on the related topics	1, 2, 3, 4, 5	1 hour/week

Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4, 5	30	
2	Quizzes	1, 2, 3, 4, 5	15	
3	Laboratory Reports	1, 2, 3, 4, 5	15	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)**Assessment Task**

1. Assignments

Criterion

The student completes all assessment tasks/activities and the work demonstrates excellent understanding of the scientific principles and the working mechanisms.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not reaching marginal level

Assessment Task

2. Quizzes

Criterion

The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not reaching marginal level

Assessment Task

3. Laboratory Reports

Criterion

The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not reaching marginal level

Assessment Task

4. Examination

Criterion

The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not reaching marginal level

Part III Other Information**Keyword Syllabus**

- Vibrations
Natural, damped and forced vibrations. System response. Energy dissipation. Q-factor, resonance. Superposition.
- Wave models
|Waves and wave equation. Wave packet, relation between ω and k , Phase and group velocities.
- Wave behaviours
Huygen' s principle, reflection and refraction. Interference.
- Wave transmission
Power transmission in mass-spring system and waves on a string. Boundary conditions, impedance, impedance matching. Standing waves.
- Sound waves
Characteristics, intensity, loudness of sound waves. Doppler effect.
- Light wave basic
Light waves, coherence, interference, polarization.
- Light wave interference and diffraction
Diffraction (Fraunhofer and Fresnel). Diffraction grating. Interferometry, holography.
- Geometrical optic
Reflection, refraction. Image formation, lenses. Imaging systems.
- Optical instrument
Magnification and resolution.

Reading List**Compulsory Readings**

Title	
1	R A Serway, Physics for Scientists and Engineers, Saunders (latest edition), Open University, S271 Discovering Physics – Block B, Unit 6 Vibrations, Unit 7 Waves. (QC23 .S46 2004)

Additional Readings

Title	
1	F W Sears, M W Zemansky and H D Young, University Physics, Addison-Wesley (latest ed.). (QC21.2 .S36 1987)
2	I G Main, Vibrations and Waves in Physics, Cambridge U Press (latest ed.). (QC136 .M34 1993)
3	A P French, Vibrations and Waves, Van Nostrand Reinhold (latest ed.). (QC235 .F74 1982)