Syllabus of III Semester Physics

Program Outcomes:	
1.	Disciplinary knowledge
2.	Communication Skills
3.	Critical thinking, Reflective thinking, Analytical reasoning, Scientific reasoning
4.	Problem-solving
5.	Research-related skills
6.	Cooperation/ Teamwork/ Leadership readiness/Qualities
7.	Information/ Digital literacy/Modern Tool Usage
8.	Environment and Sustainability
9.	Multicultural competence
10.	Multi-Disciplinary
11.	Moral and ethical awareness/Reasoning
12.	Lifelong learning / Self-Directed Learning

Course Content Semester – III

Wave Motion and Optics

Course Title: Wave Motion and Optics	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Prerequisites

i.	Fundamentals of waves

Course Learning Outcomes

At the end of the course students will be able to:

i.	Identify different types of waves by looking into their characteristics.
ii.	Formulate a wave equation and obtainthe expression for different parameters associated with waves.
iii.	Explain and give a mathematical treatment of the superposition of waves under different conditions, such as, when they overlap linearly and perpendicularly with equal or different frequencies and equal or different phases.
iv.	Describe the formation of standing waves and how the energy is transferred along the standing wave in different applications, and mathematically model in the case of stretchedstring and vibration of a rod.

v.	Give an analytical treatment of resonance in the case of open and closed pipes in general and Helmholtz resonators in particular.
vi.	Describe the different parameters that affect the acoustics in a building, measure it and control it.
vii.	Give the different models of light propagation and phenomenon associatedand measure the parameters likethe wavelength of light using experiments like Michelson interferometer, interference and thin films.
viii.	Explain diffraction due to different objects like singles slit, two slits, diffraction of grating, oblique incidence, circular aperture and give the theory and experimental setup for the same.
ix.	Explain the polarization of light and obtain how the polarization occurs due to quarter wave plates, half wave plates, and through theoptical activity of a medium.

Course Articulation Matrix

Mapping of Course Outcomes (CO) Program Outcomes

CourseOutcomes/ProgramOutcomes		1	2	3	4	5	6	7	8	9	10	11	12
i.	Identify different types of waves by looking into their characteristics.	X	X	X	X	X	X					X	X
ii.	Formulate a wave equation and obtainthe expression for different parameters associated with waves.	X	X	X	X	X	X					X	X
iii.	Explain and give a mathematical treatment of the superposition of waves under different conditions such as when they overlap linearly and perpendicularly with equal or different frequencies and equal or different phases.	X	X	X	X	X	X					X	X
iv.	Describe the formation of standing waves and how the energy is transferred along the standing wave in different applications, and mathematically model in the case of stretched string and vibration of a rod.	X	X	X	X	X	X					X	X
v.	Give an analytical treatment of resonance in the case of open and closed pipes in general and Helmholtz resonators in particular.	X	X	X	X	X	X					X	X
vi.	Describe the different parameters that	X	X	X	X	X	X					X	X

	affect the acoustics in a building,measure it and control it.												
vii.	Give the different models of light propagation and phenomenon associatedand measure the parameters likethe wavelength of light using experiments like Michelson interferometer, interference and thin films.	X	X	X	X	X	X					X	X
viii.	Explain diffraction due to different objects like singles slit, two slits, diffraction grating, oblique incidence, circular aperture and give the theory and experimental setup for the same.	X	X	X	X	X	X					X	X
ix.	Explain the polarization of light and obtain how the polarization occurs due to quarter wave plates, half wave plates, and through the optical activity of a medium.	X	X	X	X	X	X					X	X

Wave Motion and Optics

Unit – 1 -Waves and Superposition of Harmonic Waves

The Portion to be Covered

Waves: Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation, Wave Equation – Differential form (derivation). Particle and Wave Velocities: Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). **(6 Hours)**

Superposition of Harmonic Waves : Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies .Concept of Beats and its analytical treatment. Superposition of two perpendicular Harmonic Oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. Problems **(7 Hours)**

Topic Learning Outcomes

At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	Explain the difference between plane and spherical	**L2**	**1**	**1-6, 11-12**

	waves,longitudinal and transverse waves and give their characteristics.			
ii.	Write down an equation for the progressive wave in its differential form.	**L2**	**1**	**1-6, 11-12**
iii.	Obtain the relation between particle and wave velocity.	**L2**	**1**	**1-6, 11-12**
iv.	Obtain an expression for intensity of progressive waves.	**L2**	**1**	**1-6, 11-12**
v.	Obtain Newton's formula for the velocity of sound and discuss the factors for which sound velocity is dependent.	**L2**	**2**	**1-6, 11-12**
vi.	Apply the Laplace's correction to the equation of motion of a progressive wave.	**L2**	**2**	**1-6, 11-12**
vii.	With examples explain ripple and gravity waves.	**L1**	**2**	**1-6, 11-12**
viii.	Give the theory of superposition of two linear waves having equal frequencies and different frequencies.	**L2**	**3**	**1-6, 11-12**
ix.	Discuss the formation of different Lissajousfigures under different conditions of amplitude and frequency when they superimpose perpendicularly.	**L2**	**3**	**1-6, 11-12**
x.	Give some applications of an Lissajousfigures.	**L1**	**3**	**1-6, 11-12**
xi.	Higher order problems.	**L3**	**1,2,3**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self-DirectedLearning etc

Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities

Activity No. 1	We know that sound is produced because of vibration. Look into at least 10 musical instruments and identify the regions of vibrations that produces the sound and those parts which enhances the sound because of reverberation. 1. Identify one common element in all of these. 2. Identify equipment's which creates beats and try to explain the underlying basic principles. Demonstrate the examples of beats using two tuning forks. 3. Identify what will happen when you drop a stone in a standing water,

	and when your drop two stones side by side. 4. Make your observations sketch them and comment on it in a report.
Activity No. 2	Draw two sine waves (Amplitude vs time) one shifted with other in phase. Identity where the resonation occurs for each phase shift. Plot phase vs time taken for resonance.
Activity No. 3	Take smooth sand, place a pointed edged pen vertically on the sand. To the mid of the pen, connect two perpendicular threads. Pull these perpendicular threads by varying the forces and timings. Note down the different shapes produced on the sand. Try to interpret the shapes. Make a report of it
Activity No. 4	Hang a pot with sand, which has a hole in the bottom. Gently pull the pot on one side and observe the pattern formed by the sand on the floor. Report the observations.
Activity No. 5	Design a coupled pendulum. Study the impact of the motion of one pendulum over the other pendulum by varying the length, direction of the motion of one pendulum and mass of pendulum and observe the resultant changes. Trace the path of the bobs and make a report.
Activity No. 6	**Note for the teachers for the activity:** Make 3 groups among students and assign each group the activity of drawing one of the 3 graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take a stretched spring. Stretch it across two edges. Put a weight on the string, pluck it and measure the amplitude of the vibration. All group will measure the total damping time of oscillating spring. (Using mobile or scale) And plot a graph of the- 1. Varying load on the spring and amplitude at the centre. 2. Take another weight and put that in another place and measure the amplitude of vibration at the centre. 3. Vary the load in the centre of the spring and measure the amplitude at the centre.

Wave Motion and Optics

Unit – 2 - Standing Waves and Acoustics

The Portion to be Covered

Standing Waves : Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gases (derivation). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. Problems **(7 Hours)**

Acoustics:

Concept of sound, properties of sound, Musical sound and noises, Characteristic of musical sound,Distingustion between music and noise ,Intensity and loudness of sound-decibels. Intensity level- musical note and scale.Acoustics of building: Reverberation and time of reverberation-absorption coefficient. Derivation of Sabine's formula. Measurement of reverberation time. Acoustic aspects of hall and auditorium.**Problems (6 Hours)**

Topic Learning Outcomes

At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	Discuss the Transverse waves produced in stretched string and obtain the expression for the same.	L2	3	1-6, 11-12
ii.	Give a qualitative treatment of vibration of a string when it's both ends are fixed and free.	L2	3	1-6, 11-12
iii.	Explain normal modes of a stretched string.Obtain an expression for the energy density and discuss how this energy is transported along a stretched string.	L2	3	1-6, 11-12
iv.	Quantitatively bring about the mode of vibrations created in a rod.	L2	4	1-6, 11-12
v.	Explain types of waves that are produced in gas.Obtain an expression for the same.	L2	4	1-6, 11-12
vi.	With an analytical treatment explain the concept of resonance using the normal modes of vibrations of open and closed pipes.	L2	5	1-6, 11-12
vii.	Give the theory of Helmholtz resonator and explain how it is used to calculate some parameters of the way the standing waves are set in there.	L2	5	1-6, 11-12

viii.	Define Reverberation,Reverberation time and absorption coefficient of a material.	**L1**	**5**	**1-6, 11-12**
ix.	Obtain Sabine'sReverberation formula and discuss what are the factors on which the Reverberation timedepends on.	**L2**	**5**	**1-6, 11-12**
x.	List out which are different parameters within a building which effects the acoustics.	**L1**	**6**	**1-6, 11-12**
xi.	Explain what are good acoustics of a building and how acoustics is measured in terms of intensity and pressure inside a building.	**L2**	**6**	**1-6, 11-12**
xii.	Higher order problems.	**L3**	**4,5,6**	**1-6, 11-12**

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self-Directed Learning etc.

Formative Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Suggested Activities

Activity No. 7	List different phenomenon where standing waves are found in nature. Identify the phenomena and reason for standing waves. Also identify the standing waves in musical instruments. Make a report of it**.**
Activity No. 8	1. Go to 5 different newly constructed houses when they are not occupied and when they are occupied. Make your observations on sound profile on each room. Give the reasons. Make a report of it**.** 2. Visit three very good auditoriums, list out different ways in which the acousticarrangements have been done (as decoration and Civil works). Look for the reasons in Google and identify which is acoustically the best auditorium among the three you visited. Make a report of it**.**
Activity No. 9	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment.

	2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO4) solution. Place a small non oily floating material (ex: thin plastic) on the surface of the liquid. Drop a marble on the liquid at the centre of the bowl. Repeat the experiment by dropping the marble from the different heights. Plot a graph of- 1. Height v/s time of oscillation 2. Weight of the marble v/s time of oscillation
Activity No. 10	**Note for the teachers for the activity:** Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Take two marbles of same weight. Drop both the marbles on the surface of the liquid from some height. With the help of the mobile take the picture and measure the position of interface of two wave fronts formed in the liquid. Plot graphs for different activities by doing the following activities. 1. By dropping two marbles of same weight from different heights. 2. By dropping two marbles of different weight from the same height

Wave Motion and Optics

Unit – 3 - Nature of light and Interference

The Portion to be Covered

Nature of light : Theories of light :- Newton's Corpuscular, Wave theory, Electromagnetic theory and Quantum theory of light.**(3 Hours)**

Interference of light by division of wave front: Huygens'sTheory-Concept of wave-front-Interference pattern produced on the surface of water-Coherence-Interference of light waves by division of wave-front- Young's double slit experiment- derivation of expression for fringe width-Fresnel Biprism- Interference with white light .Problems**(5 Hours)**

Interference of light by division of amplitude: Interference by division of amplitude-Interference by a plane parallel film illuminated by a plane wave-Interference by a film with two non-parallel reflecting surfaces- colour of thin films—Newton's rings due to reflected light and transmitted light -Michelson Interferometer-Determination of wavelength of light. Problems**(5 Hours)**

Topic Learning Outcomes **At the end of the topic, students should be able to:**				
SL No	**TLO's**	**BL**	**CO**	**PO**
i.	Explain using Michelson interferometer how to determine the wavelength of light.	**L2**	**7**	**1-6, 11-12**
ii.	Give an account of the different possible shapes that are obtained in Michelson interferometer experiment and their relevance.	**L2**	**7**	**1-6, 11-12**
iii.	Discuss the wave model and the Corpuscular model of light.	**L2**	**7**	**1-6, 11-12**
iv.	ExplainMaxwells electromagnetic waves.	**L2**	**7**	**1-6, 11-12**
v.	Give an account of the phenomenon of wave-particle duality.	**L1**	**7**	**1-6, 11-12**
vi.	Give the Huygens theory of wave-front.	**L1**	**7**	**1-6, 11-12**
vii.	DefineInterference.Give some examples of Interference.	**L1**	**7**	**1-6, 11-12**
viii.	Give the theory of interference due to two coherent sources of light and obtain an expression for the wavelength of monochromatic source of light (Young's double slit experiment)	**L2**	**7**	**1-6, 11-12**
ix.	Explain how using personal biprism,a monochromatic coherent source of light is obtained.Using this experimental setup explain how the wavelength of monochromatic sources of light is determined.	**L2**	**7**	**1-6, 11-12**
x.	Give the theory of interference due to division of amplitude by parallel and non-parallel plates.	**L1**	**7**	**1-6, 11-12**
xi.	Explain how Newton's rings are obtained and discuss how the wavelength of light is determined using this experiment.	**L2**	**7**	**1-6, 11-12**
xii.	Higher order problems.	**L3**	**7**	**1-6, 11-12**
Teaching and Learning Methodology				
Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.				
Formative Assessment Techniques				
One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc				
Suggested Activities				

Activity No. 11

In the table given below explore which phenomenon can be explained by what and make a report of it**.**

Sl No	Phenomenon	Particle of Light	Wave Nature	Dual Nature
	Pinhole camera			
1.	Formation of images on lenses			
2.	Formation of images on mirror			
3.	Interference			
4.	Polarization			
5.	Diffraction due to single slit			
6.	Black body radiation			
7.	Photoelectric effect			
8.	De-Broglie hypothesis			
9.	Devison&Germer Experiment			

Activity No. 12

Why colour strips are seen in paddles on roads in rainy seasons try to simulate the same. Give the reasons. Make a report of it**.**

Activity No. 13

Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.

1. The first slide will explain the process of doing the experiment.
2. In the second slide. Students will show the graph of measurement.
3. In the third slide, they will list three observations from that study.

Activity: Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO4) solution. Place a small non-oily floating material (ex: thin plastic) on the surface of the liquid. Drop two marbles of same weight (mass) from the same height on to the surface of the water but at the different time intervals. Plot graph for the different observations.

For teachers: Demonstrate the formation of Lissajous Figure using a CRO. Give different shapes of Lissajous Figure with varying frequency and amplitude. Ask the students to comment on the observations.

Wave Motion and Optics

Unit – 4 - Diffraction and Polarisation

The Portion to be Covered

Fresnel Diffraction- Fresnel's Diffraction. Half Period Zone using rectilinear propagation of light. Zone plate: Construction, theory and working. Comparison between zone plate and convex lens.Problems.**(3 Hours)**

Fraunhofer diffraction : Fraunhofer's diffraction at single slit. Diffraction grating. Theory of plane transmission grating. Resolving power. Rayleigh's criteria. Resolving power of prism. Resolving power of telescope. Resolving power of grating (qualitative).**Problems (5 Hours)**

Polarisation:

Transverse nature of light waves- plane of vibration and plane of polarisation. Malu's law. Double refraction. Positive and negative plates. Retardation plates: Quarter wave plate and half wave plate. Polaroids and its types, Production of Circular and elliptical polarization, Optical Activity: Fresnel's Theory of optical activity. Specific rotation,Determination of specific rotation of sugar solution using polarimeter.**Problems(5 Hours)**

Topic Learning Outcomes

At the end of the topic, students should be able to:

SL No	TLO's	BL	CO	PO
i.	DefineFraunhofer diffraction.	L2	8	1-6, 11-12
ii.	Give a qualitative treatment of single slit/diffraction double slit diffraction.	L2	8	1-6, 11-12
iii.	Explain the theory of diffraction due to grating and the normal and oblique incidence.	L2	8	1-6, 11-12
iv.	Explain how the resolving power of a grating depends of the number of slits used.	L2	8	1-6, 11-12
v.	Give the theory of Fresnel half period zones.	L2	8	1-6, 11-12
vi.	Discuss zone plates with respect to convex lenses.	L2	8	1-6, 11-12
vii.	Explain optical polarization and polaroid.	L2	9	1-6, 11-12
viii.	Give different types of polaroid.	L2	9	1-6, 11-12
ix.	Give the theory of phenomenon of double refraction and explain what are ordinary and extraordinary rays.	L2	9	1-6, 11-12
x.	Give the theory of quarter wave plates and half wave plates.	L2	9	1-6, 11-12
xi.	Explain optical activity with theory. Give an experimental method to measure the optical activity of a material.	L2	9	1-6, 11-12
xii.	Higher order problems.	L3	8,9	1-6, 11-12

Teaching and Learning Methodology	
Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self-Directed Learning etc.	
Assessment Techniques	
One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc	
Suggested Activities	
Activity No. 14	Explain polarization of light through a chart. List out the surfaces that reflect polarized light. Learn how polarization of light can be done by both transmission and reflection. Perform an experiment and make a report. USING CDs AND DVDs AS DIFFRACTION Gratings Ref:https://www.nnin.org/sites/default/files/files/Karen_Rama_USING_CDs_AND_DVDs_AS_DIFFRACTION_GRATINGS_0.pdf Obtain the diffraction spectra using a CD and design an experiment to find the distance between the tracks on it) (Ref: https://www.brighthubeducation.com/science-lessons-grades-9-12/39347-diffraction-experiment-measuring-groove-spacing-on-cds/, https://silo.tips/download/diffraction-from-a-compact-disk)
Activity No. 15	What is the physics behind making 3D movies? Group Discussion (https://www.slideserve.com/rae/physics-behind-3d-movies-powerpoint-ppt-presentation)Make a report of it**.**
Activity No. 16	List out different types of zone plates and look for their applications in day to day life. Make a report of it**.**
Activity No. 17	Collect information and study how optically polarizing lenses are made. Visit a nearby lens making facility. Learn the principle behind sunglasses.Make a report of it**.**
Activity No. 18	**Note for the teachers for the activity:** Make 3 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment.

	2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. **Activity:** Identify any 3 sharp edges of varying thickness and assign them to 3 groups. Shine a laser light pointing towards the edge of the needle. Observe the patterns formed on the wall or screen and measure the distance between the bands. Correlate the distance between the bands formed with the thickness of the edge and the distance from the edge to the screen. By this, calculate the wavelength of the laser light used.

Textbooks

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	The Physics of Waves and Oscillations,	N K Bajaj	Tata McGraw-Hill Publishing Company Ltd., Second Edition,	1984
2	Waves and Oscillations	N Subramanyam and Brij Lal	Vikas Publishing House Pvt. Ltd., Second Revised Edition	2010
3	A Text Book of Sound	D R Khanna and R S Bedi	Atma Ram & Sons, Third Edition	1952
4	Oscillations and Waves	Satya Prakash	PragathiPrakashan, Meerut, Second Edition	2003
5	Optics	AjoyGhatak	McGraw Hill Education (India) Pvt Ltd	2017
6	A text Book of Optics	Brij Lal, M N Avadhanulu& N Subrahmanyam	S. Chand Publishing	2012

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Berkeley Physics Course – Waves,	Frank S Crawford Jr.	Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition,.	2011
2	Optics	Eugene *Hecht*	Pearson Paperback	2019
3	Introduction To Optics	Pedrotti and Frank L ,	Pearson India	3rd Edition
4	Fundamentals of Optics	Francis Jenkins Harvey White	McGraw Hill Education	2017

Formative Assessment

Assessment	Marks
Internal Assessment	20

REU based Group Activity (Conduct,Report,Presentation)	20
Total	40

List of Experiments to be performed in the Laboratory Note: Minimum Eight experiments has to be performed	
1.	Velocity of sound through a wire using Sonometer.
2.	Frequency of AC using Sonometer.
3.	Study of Lissajous' Figures using CRO.
4.	Determination of frequency of tuning fork by transverse vibration using Melde's apparatus.
5.	Helmholtz resonator using tuning fork.
6.	Helmholtz resonator using electrical signal generator.
7.	To determine refractive index of the Material of a prism using sodium source.
8.	To determine the R P of telescope, compare the R P with theoretical value by Two Wire gauze.
9.	To determine the dispersive power of a prism using mercury source.
10.	To determine the wavelength of sodium source using Michelson's interferometer.
11.	To determine wavelength of sodium light using Fresnel Biprism.
12.	To determine wavelength of sodium light using Newton's Rings
13.	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
14	To determine wavelength of (1) Na source and (2) Spectral lines of Hg source using plane diffraction grating.
15	To determine dispersive power of a plane diffraction grating.
16	To determine resolving power of a plane diffraction grating.
17	To determine the specific rotation of sugar solution-using Laurent's half shade polarimeter.

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Advanced Practical Physics for students	B.L. Flint and H.T. Worsnop	Asia Publishing House.	1971
2	A Text Book of Practical Physics	I. Prakash & Ramakrishna	Kitab Mahal, 11th Edition	2011
3	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn	Heinemann Educational Publishers, 4th Edition	1985
4	A Laboratory Manual of Physics for undergraduate classes	D.P.Khandelwal	Vani Publications.	1985

OPEN ELECTIVE SUBJEST

Year	2	**Course Code: 21BSC3O3PHY3**	**Credits**	03
Sem.	3	**Course Title: CLIMATE SCIENCE**	**Hours**	40
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Unit No.	**Course Content**
Unit I	**Atmosphere:** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. (10 hours)
Unit II	Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds. **Climate Science:** Overview of meteorological observations, measurement of: temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). (10 hours)
Unit III	Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more. (10 hours)
Unit IV	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. (10 hours)
	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200^{o}C. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place. 4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).

References:

1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010.
2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.