Bangalore University
Department of Physics

Jnanabharathi Campus
Bengaluru – 560 056

Syllabus for
3rd & 4th Semester Physics Papers
Under-Graduate(UG) Program

Framed according to the National Education Policy (NEP 2020)

(Effective from the Academic Year 2021-22)

Board of Studies in Physics (UG) Members

Professor Usha Devi A R (Chairperson)	Dept. Physics, Bangalore University, Bengaluru-56
Sri Nanjundaiah	The Rural College, Kanakapura-562 117
Sri. Balakrishna M T	The Rural College, Kanakapura-562 117
Dr. Wajeeha Sulthana	Maharani Science College for Women, Bengaluru-01
Dr Manjunath H C	Govt. Boys College, Kolar-563 101

Board of Studies Members as Invitees

Professor Ramakrishna Damle	Dept. Physics, Bangalore University, Bengaluru-56
Smt Seeta Vasudevrao	Head of Dept. Physics, First Grade College, Kengeri, Bengaluru-60

Date: 23.08.2021
Place: Bengaluru

Department of Physics
Bangalore University, Bangalore-56

Proceedings of the BoS (UG) Physics meeting
held at 11.30 am on 23rd August 2022 at the Department of Physics, BUB

The following agenda was discussed: (1) B.Sc 3rd and 4th Semester Syllabus of Physics papers (2) Panel of Examiners for UG for the academic year 2022-2023 and BOE (Proposed) for the academic year 2022-23. After elaborate discussions and suitable modifications, the members of the BoS approved both the agenda.

Sl. No.	Name & Affiliation of the BoS Member	Signature
1	Dr. Usha Devi A R, Professor & Chairperson Dept. Physics, Bangalore University, Bengaluru-56	
2	Dr. Venkateshappa Y Govt. First Grade College, Vijayanagar, Bengaluru-04	- ABSENT -
3	Sri Nanjundaiah The Rural College, Kanakapura-562 117	
4	Sri Ramesh T Govt. First Grade College, Channapattana-571 501.	- ABSENT -
5	Sri. Balakrishna M T The Rural College, Kanakapura-562 117	
6	Dr. Wajeeha Sulthana Maharani Science College for Women, Bengaluru-01	Wajeeha Sulthana 23/08/22
7	Sri Krishnappa H Fattepur (Superannuated) The National Degree College, Basavanagudi, Bengaluru-04	- ABSENT -
8	Dr Manjunath H C Govt. Boys College, Kolar-563 101	H.C. M 23/8/22
	Invitees	
9	Professor Ramakrishna Damle Dept. Physics, Bangalore University, Bengaluru-56	R@amle
10	Smt Seeta Vasudevrao Head of Dept. Physics, First Grade College, Kengeri, Bengaluru-60	Seeta V 23/08/202

The Chairperson 23.08.2022
Department of Physics
Bangalore University
Bangalore - 560056

Course Structure
(Major Discipline: Physics)
Semester 1 - 10

SEMESTER	Discipline Core Theory (DSCT)	Core Papers
SEMESTER -1	Phy.DSCT1	Mechanics & Properties of Matter
SEMESTER -2	Phy.DSCT2	Electricity and Magnetism
SEMESTER -3	**Phy.DSCT3**	**Wave motion and optics**
SEMESTER -4	**Phy.DSCT4**	**Thermal Physics & Electronics**
SEMESTER -5	Phy.DSCT5 Phy.DSCT6	1. Classical Mechanics and Quantum Mechanics- I 2. Elements of Atomic, Molecular Physics
SEMESTER -6	Phy.DSCT7 Phy.DSCT8	1. Elements of Nuclear Physics and Nuclear Instruments 2. Elements of Condensed Matter Physics
SEMESTER -7	Phy.DSCT9 Phy.DSCT10 Phy.DSCT11	1. Mathematical Methods of Physics – I 2. Classical Electrodynamics. 3. Experimental methods of Physics 4. Research Methodology
SEMESTER -8	Phy.DSCT12 Phy.DSCT13 Phy.DSCT14	1. Classical Mechanics and Quantum Mechanics-II 2. Statistical Mechanics 3. Astrophysics & Astronomy 4. Research Project* (Select Two DSE subjects from the Pool B-II shown below) *In lieu of the research Project, two additional elective papers/ Internship may be offered.
SEMESTER -9	Phy.DSCT15	1. Mathematical Methods of Physics – II (Select One DSE subjects from the Pool B-III shown below) 2. Research Project
SEMESTER -10	Phy.DSCT17	1. Quantum Mechanics – III (Select One DSE subjects from the Pool B-IV shown below) 2. Research Project

Open Electives

1st Semester	
1.	Phy-OE1: Energy Sources
2.	*Phy-OE2: Physics for All.
2nd Semester	
3.	Phy-OE3: Atmospheric Science
4.	Phy-OE4: Sports Science
3rd Semester	
5.	**Phy-OE5: Optical Instruments**
6.	**Phy-OE6: Elements of Astronomy and Astrophysics**
4th Semester	
7.	**Phy-OE7: Medical Physics**
8.	**Phy-OE9: Electrical Instruments**

***Students who have chosen Phy-DST1 are not eligible to take Open Elective paper Phy-OE2.**

Discipline Specific Electives for 7 to 10 Semesters

7th Sem Electives **Pool B-I (Select any two)**		**8th Sem Electives** **Pool B-II (Select any two)**	
A.	Condensed Matter Physics-1	A.	Atomic & Molecular Physics-1
B.	Nuclear and Particle Physics	B.	Materials Physics & Nano materials
C.	Theoretical and Computational Physics-I	C.	Lasers and non-linear optics
D.	Biophysics	D.	Plasma Physics
E.	Astronomy and Astrophysics	E.	Physics of Semiconductor devices

9th Sem Electives (Specialization papers) **Pool B-III**		**10th Sem Electives (Specialization papers)** **Pool B-IV**	
A.	Condensed Matter Physics-2	A.	Condensed Matter Physics-3
B.	Nuclear and Particle Physics-2	B.	Nuclear and Particle Physics-3
C.	Atomic & Molecular spectroscopy-1	C.	Atomic & Molecular spectroscopy-2
D.	Materials Physics & Nanophysics –1	D.	Materials Physics & Nanophysics -2
E.	Theoretical and Computational Physics-I	E.	Theoretical and Computational Physics-2
F.	Astronomy and Astrophysics-1	F.	Astronomy and Astrophysics-2

Detailed Syllabus
for 3rd & 4th Semester Physics Papers
Under-Graduate(UG) B.Sc/B.Sc (Hon) Program
Framed according to the National Education Policy (NEP)

3rd Semester B.Sc

Phy-DSCT3: Wave Motion and Optics	**Course Credits (L+T+P) : 4+0+0**
Total Contact Hours: 52	**Duration of ESA: 4 hours**

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

Prerequisites

Fundamentals of waves

Course Learning Outcomes

At the end of the course it should be ensured that students understand the following concepts:

1. Identify different types of waves by looking into their characteristics.
2. Formulate a wave equation and obtain the expression for different parameters associated with waves.
3. 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.
4. 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.
5. Give an analytical treatment of resonance in the case of open and closed pipes in general and Helmholtz resonators in particular.
6. Describe the different parameters that affect the acoustics in a building, measure it and control it.
7. Give the different models of light propagation and phenomenon associated and measure the parameters like the wavelength of light using experiments like Michelson interferometer, interference and thin films.
8. 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.
9. 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.

Course Articulation Matrix													
Mapping of Course Outcomes (CO) & Program Outcomes (PO)													
Course Outcomes / Program Outcomes		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	Identify different types of waves by looking into their characteristics.	X	X	X	X	X	X					X	X
2.	Formulate a wave equation and obtain the expression for different parameters associated with waves.	X	X	X	X	X	X					X	X
3.	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
4.	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
5.	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
6.	Describe the different parameters that affect the acoustics in a building, measure it and control it.	X	X	X	X	X	X					X	X
7.	Give the different models of light propagation and phenomenon associated and measure the parameters like the wavelength of light using experiments like Michelson interferometer, interference and thin films.	X	X	X	X	X	X					X	X
8.	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
9.	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

Course Content Phy.DSCT3: Wave Motion and Optics		Hrs
Unit – 1: Waves and Superposition of Harmonic Waves (11 hours of teaching plus 2 hours of activities)		
Chapter No. 1	**Waves:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation (derivation), 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). Brief account of Ripple and Gravity Waves. **(Text Books : 1-4)**	**5 hours**
Chapter No. 2	**Superposition of Harmonic Waves** : Linearity and superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular harmonic oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. **(Text Books : 1-4)**	**6 hours**
Topics for Self-study	Study of coupled pendulum. Explain the impact on the motion of one pendulum due to that of the other pendulum by varying the length, and mass of pendulum. Prepare a report.	
Suggested Activities (Any two activities to be conducted compulsorily)		
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 equipments 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. 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	Take a stretched spring. Stretch it across two edges. Put a weight on the string, pluck it and measure the amplitude of the vibration. Students should measure the total damping time of oscillating spring. (Using mobile or scale) And plot graphs by 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. **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. On the specific day, each group has to make a ppt presentation of the following three slides. On 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.

Topic Learning Outcomes

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

SL No	TLO's	CO	PO
1.	Explain the difference between plane and spherical waves, longitudinal and transverse waves and give their characteristics.	**1**	**1-6, 11-12**
2.	Write down an equation for the progressive wave in its differential form.	**1**	**1-6, 11-12**
3.	Obtain the relation between particle and wave velocity.	**1**	**1-6, 11-12**
4.	Obtain an expression for intensity of progressive waves.	**1**	**1-6, 11-12**
5.	Obtain Newton's formula for the velocity of sound and discuss the factors for which sound velocity is dependent.	**2**	**1-6, 11-12**
6.	Apply the Laplace's correction to the equation of motion of a progressive wave.	**2**	**1-6, 11-12**
7.	With examples explain ripple and gravity waves.	**2**	**1-6, 11-12**
8.	Give the theory of superposition of two linear waves having equal frequencies and different frequencies.	**3**	**1-6, 11-12**
9.	Discuss the formation of different Lissajous figures under different conditions of amplitude and frequency when they superimpose perpendicularly.	**3**	**1-6, 11-12**
10.	Give some applications of an Lissajous figures.	**3**	**1-6, 11-12**

Unit – 2 - Standing Waves and Acoustics
(11 hours of teaching plus 2 hours of activities)

Chapter No. 3	**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	**8 hours**

	Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. **(Text Books: 1-4)**	
Chapter No. 4	**Acoustics**: Absorption coefficient, Reverberation time - Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. **(Text Books : 1-4)**	**3 hours**
Topics for Self-study	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**.**	
Suggested Activities (Any two activities to be conducted compulsorily)		
Activity No. 6	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 acoustic arrangements 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. 7	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 **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. On the specific day, each group has to make a ppt presentation of the following three slides. On 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 No. 8	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 **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. On the specific day, each group has to make a ppt presentation of the following three slides. On 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.	

Topic Learning Outcomes At the end of the topic, students should be able to understand the following concepts				
SL No	**TLO's**	**BL**	**CO**	**PO**
1.	Discuss the Transverse waves produced in stretched string and obtain the expression for the same.	**L2**	**3**	**1-6, 11-12**
2.	Give a qualitative treatment of vibration of a string when it's both ends are fixed and free.	**L2**	**3**	**1-6, 11-12**
3.	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**
4.	Quantitatively bring about the mode of vibrations created in a rod.	**L2**	**4**	**1-6, 11-12**
5.	Explain types of waves that are produced in gas. Obtain an expression for the same.	**L2**	**4**	**1-6, 11-12**
6.	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**
7.	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**
8.	Define Reverberation, Reverberation time and absorption coefficient of a material.	**L1**	**5**	**1-6, 11-12**
9.	Obtain Sabine's Reverberation formula and discuss what are the factors on which the Reverberation time depends on.	**L2**	**5**	**1-6, 11-12**
10.	List out which are different parameters within a building which effects the acoustics.	**L1**	**6**	**1-6, 11-12**
11.	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**
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

<table>
<tr><td colspan="3">Unit – 3: Nature of light and Interference
(11 hours of teaching plus 2 hours of activities)</td></tr>
<tr><td>Chapter No. 5</td><td>Nature of light : Corpuscular theory- laws of reflections and refraction; The Wave model, Group velocity & wave velocity - relation between them, Maxwell’s electromagnetic waves. (Text Book No 5)</td><td>2 hours</td></tr>
<tr><td>Chapter No. 6</td><td>Interference of light by division of wave front: Coherent source-Interference of light waves by division of wave-front, Young’s double slit interference- theory and experiment, Fresnel Biprism- theory and experiment (determination of wavelength) (Text Book No 5)</td><td>4 hours</td></tr>
<tr><td>Chapter No. 7</td><td>Interference of light by division of amplitude: Interference at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Reflection). Determination of Refractive index of a liquid, Michelson Interferometer-Determination of wavelength of light (Text Book No 5)</td><td>5 hours</td></tr>
<tr><td>Topics for Self-study</td><td colspan="2">Why colour strips are seen in paddles on roads in rainy seasons? Give reasons. Make a report of it.</td></tr>
<tr><td colspan="3">Suggested Activities (Any two activities need to be conducted compulsorily)</td></tr>
<tr><td>Activity No. 9</td><td colspan="2">In the table given below explore which phenomenon can be explained by what and prepare report explaining it.
<table>
<tr><th>Sl No</th><th>Phenomenon</th><th>Corpuscular Nature</th><th>Wave Nature</th></tr>
<tr><td>1.</td><td>Formation of images on lenses</td><td></td><td></td></tr>
<tr><td>2.</td><td>Formation of images on mirror</td><td></td><td></td></tr>
<tr><td>3.</td><td>Interference</td><td></td><td></td></tr>
<tr><td>4.</td><td>Polarization</td><td></td><td></td></tr>
<tr><td>5.</td><td>Diffraction due to single slit</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Activity No. 10</td><td colspan="2">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. Analyze the wavefronts and draw pictures of different observations.

Note to 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. On the specific day, each group has to make a ppt presentation of the following three slides. On 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.</td></tr>
<tr><td>Activity No. 11</td><td colspan="2">Teachers should demonstrate the formation of Lissajous Figure using a CRO. Give different shapes of Lissajous Figure with varying frequency and amplitude. Then ask the students to comment on the observations and prepare a report.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Topic Learning Outcomes **At the end of the topic, students should be able to understand the following concepts**				
SL No	**TLO's**	**BL**	**CO**	**PO**
1.	Discuss the wave model and the Corpuscular model of light.	**L2**	**7**	**1-6, 11-12**
2.	Give the Huygen theory of wave-front.	**L1**	**7**	**1-6, 11-12**
3.	Define Interference. Give some examples of Interference.	**L1**	**7**	**1-6, 11-12**
4.	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**
5.	Explain how using personal biprism, a monochromatic coherent source of light are obtained. Using this experimental setup explain how the wavelength of monochromatic sources of light is determined.	**L2**	**7**	**1-6, 11-12**
6.	Give the theory of interference due to division of amplitude by parallel and non-parallel plates.	**L1**	**7**	**1-6, 11-12**
7.	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**
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				

Unit – 4 - Diffraction and Polarisation

Chapter No. 8	**Fraunhofer diffraction**: Introduction- Fraunhofer diffraction- Theory of single slit diffraction, Two slit diffraction pattern, Theory of diffraction Grating, Normal and oblique incidence – experimental determination of wavelength, Resolving power – Rayleigh criterion, Expression for resolving power of grating and telescope (Text Book No 5)	**4 hours**
Chapter No. 9	**Fresnel Diffraction**- Concept of Fresnel half period zones, Comparison of Zone plate with lens, Theory of diffraction at a straight edge, Qualitative discussion on diffraction by a circular aperture and diffraction by an opaque disc (Text Book No 5)	**3 hours**
Chapter No. 10	**Polarisation:** Production of polarized light, Malus' law, Phenomenon of double refraction in crystals, Quarter wave plate and half wave plate, Optical activity, Laurent's half shade polarimeter (Text Book No 5)	**4 hours**
Using CDs and DVDs as diffraction Grating Ref:https://www.nnin.org/sites/default/files/files/Karen_Rama_USING_CDs_AND_DVDs_AS_DIFFRACTION_GRATINGS_0.pdf Obtain the diffraction pattern 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)		

Explain polarization of light with the help of a chart. List out the surfaces that reflect polarized light. Learn how polarization of light can be learnt by both transmission and reflection.
What is the physics behind making 3D movies? Group Discussion (https://www.slideserve.com/rae/physics-behind-3d-movies-powerpoint-ppt-presentation)
List out different types of zone plates and look for their applications in day-to-day life. Prepare a report.
Collect information and study how optically polarizing lenses are made. Visit a nearby lens making facility. Learn the principle behind sunglasses. Prepare a report.

TLO's	BL	CO	PO
Define Fraunhofer diffraction.	**L2**	**8**	**1-6, 11-12**
Give a qualitative treatment of single slit/diffraction double slit diffraction.	**L2**	**8**	**1-6, 11-12**
Explain the theory of diffraction due to grating and the normal and oblique incidence.	**L2**	**8**	**1-6, 11-12**
Explain how the resolving power of a grating depends of the number of slits used.	**L2**	**8**	**1-6, 11-12**
Give the theory of Fersnel half period zones.	**L2**	**8**	**1-6, 11-12**
Discuss zone plates with respect to convex lenses.	**L2**	**8**	**1-6, 11-12**
Explain optical polarization and polaroids.	**L2**	**9**	**1-6, 11-12**
Give different types of polaroids.	**L2**	**9**	**1-6, 11-12**
Give the theory of phenomenon of double refraction and explain what are ordinary and extraordinary rays.	**L2**	**9**	**1-6, 11-12**
Give the theory of quarter wave plates and half wave plates.	**L2**	**9**	**1-6, 11-12**
Explain optical activity with theory. Give an experimental method to measure the optical activity of a material.	**L2**	**9**	**1-6, 11-12**

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	Pragathi Prakashan, Meerut, Second Edition	2003
5	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	Optics	Ajoy Ghatak	McGraw Hill Education (India) Pvt Ltd	2017

2	Berkeley Physics Course – Waves,	Frank S Crawford Jr.	Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition,.	2011
3	Optics	E. Hecht	Pearson Paperback	2019
4	Introduction To Optics	F. L. Pedrotti, L.M. Pedrotti & L.S. Pedrotti	Pearson India	2008
5	Fundamentals of Optics	F. Jenkins & H. White	McGraw Hill Education	2017

Paper Code: Phy-DSCP3 - Lab III

List of Experiments to be performed in Lab III	
1.	Velocity of sound through a wire using Sonometer.
2.	Frequency of AC using Sonometer.
3.	Study of Lissajous' Figures
4.	To verify the laws of transverse vibration using Melde's apparatus.
5.	Helmholtz resonator using tuning fork.
6.	Helmholtz resonator using electrical signal generator.
7.	Study of Lissajous figures using CRO
8.	To determine refractive index of the material of a prism using sodium source.
9.	To determine refractive index of a liquid by parallax method.
10.	To determine the dispersive power and Cauchy constants of the material of a prism using Hg source.
11.	To determine wavelength of sodium light using Fresnel Biprism.
12.	Determination of radius of curvature of a lens using Newton's rings.
13.	To determine the thickness of a paper using air-wedge.
14.	Study of Fraunhofer diffraction at single slit
15.	Study of Diffraction at a straight edge.
16.	To determine wavelength of spectral lines of Hg source using plane diffraction grating.
17.	To determine dispersive power and resolving power of a plane diffraction grating.
18.	To verify Brewster's law.
19.	To determine specific rotation of a solution using Polarimeter.

Note: A minimum of EIGHT experiments must be performed

One hour of Laboratory time every week has to be dedicated for suggested activities in the theory paper DSCT3: Wave Motion and Optics. Note that this is in addition to a total of 8 hour of time allotted during theory teaching during the entire semester (2 hours each for every Unit of the theory paper).

Reference Books 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

4th Semester B.Sc

Phy-DSCT4: Thermal Physics & Electronics	**Course Credits (L+T+P) : 4+0+0**
Total Contact Hours: 52	**Duration of ESA: 4 hours**

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

Prerequisites
Exposure of the topic in Pre-University

Course Learning Outcomes	
At the end of the course students will be able to understand the following concepts.	
1.	Apply the laws of thermodynamics and analyze the thermal system.
2.	Apply the laws of kinetic theory and radiation laws to the ideal and practical thermodynamics systems through derived thermodynamic relations.
3.	Use the concepts of semiconductors to describe different Semiconductor devices such as diode transistors, BJT, FET etc and explain their functioning.
4.	Explain the functioning of OP-AMPS and use them as the building blocks of logic gates.
5.	Give the use of logic gates using different theorems of Boolean Algebra followed by logic circuits.

Course Articulation Matrix													
Mapping of Course Outcomes (CO) - Program Outcomes (PO)													
Course Outcomes / Program Outcomes		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	Apply the laws of thermodynamics and analyze the thermal system.	X	X	X	X	X	X					X	X
2.	Apply the laws of kinetic theory and radiation laws to the ideal and practical thermodynamics systems through derived thermodynamic relations.	X	X	X	X	X	X					X	X
3.	Use the concepts of semiconductors to describe different Semiconductor devices like diode transistors, BJT, FET etc and explain their functioning.	X	X	X	X	X	X					X	X
4.	Explain the functioning of OP-AMPS and them as the building blocks of logic gates.	X	X	X	X	X	X					X	X
5.	Give the use of logic gates using different theorems of Boolean Algebra followed by logic circuits.	X	X	X	X	X	X					X	X

Course Content **Phy.DSCT4: Thermal Physics & Electronics**		**Hrs**
Unit – 1: Thermodynamics **(11 hours of teaching plus 2 hours of activities)**		
Chapter No. 1	**Laws of Thermodynamics**: Review of the concepts of Heat and Temperature – the zeroth law of thermodynamics, Thermodynamic variables - extensive and intensive, Equations of state, PV diagrams.	**2 hours**
Chapter No. 2	**First Law of Thermodynamics:** Differential form of the First Law of Thermodynamics, Work done in an isothermal and adiabatic process for an ideal gas, Internal Energy as a state function, Equation of state for an adiabatic process Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process.	**3 hours**
Chapter No. 3	**Second Law of Thermodynamics:** Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence); Reversible and irreversible processes with examples; Heat engines: Carnot Engine; Carnot Cycle and its efficiency, Practical internal combustion engines - Otto and Diesel Cycles (qualitative treatment); Carnot theorem, Refrigerator- Coefficient of performance. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy, Entropy in reversible process, Entropy in irreversible process, Principle of increase of entropy, Entropy change in (i)	**6 hours**

	adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process **Third Law of Thermodynamics(Nernst Heat theorem):** Statement, Significance and Unattainability of Absolute Zero	
Topics for Self-study	(1) Discuss when the temperature of the body is locked until what time you hold the thermometer in contact with a body. Discuss it in contact with laws of thermodynamics. (2) Discuss why when a person works or does exercise, he sweats. Reason it with the laws of thermodynamics.	

Suggested Activities (Any two activities to be conducted compulsorily)

Activity No. 1	We feel cold because coldness enters our body. Discuss the statement in day-to-day life. Approximately give examples of a) open system b) closed system and c) isolated system
Activity No. 2	Take four different sizes of same metal, preferable of same shape and give one piece to each group. Heat it uniformly on a hot plate. Keep a beaker of water with a thermometer immersed in it. Drop one hot metal into the water and record the temperature with time. Repeat the experiment for the other heated metal pieces of different sizes. 1. Plot a graph for the volume of the metal piece used v/s respective temperature change observed. 2. Determine the heat capacity and specific heat of the metal used. All groups shall also do the following activity: **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. On the specific day, each group has to make a ppt presentation of the following three slides. On 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 No. 3	Take ice cubes of different size and immerse in water and measure the temperature change with time and repeat the experiment. Graph the observations. **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.

Topic Learning Outcomes

At the end of the topic, students should be able to understand the following concepts.

SL No	TLO's	BL	CO	PO
1.	Explain the first law of thermodynamics.	**L1**	**1**	**1-6, 11-12**
2.	Give the differential form of the first law of thermodynamics and define what is the internal energy.	**L2**	**1**	**1-6, 11-12**
3.	Obtain an expression for work done in isothermal and adiabatic processes.	**L2**	**1**	**1-6, 11-12**

4.	Give two systems of units of temperature measurement and give their equivalence.	**L2**	**1**	**1-6, 11-12**
5.	Describe and Discuss heat engine based on Carnot cycle.	**L2**	**1**	**1-6, 11-12**
6.	Explain how the efficiency of refrigeration is measured?	**L2**	**1**	**1-6, 11-12**
7.	Detail out the application of the Carnot engine to a locomotion system.	**L1**	**1**	**1-6, 11-12**
8.	State the third law of thermodynamics and give its significance using the third law of thermodynamics describing why absolute zero temperature is not unattainable.	**L2**	**1**	**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

Unit – 2

(11 hours of teaching plus 2 hours of activities)

Chapter No. 4	**Thermodynamic Potentials**: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, properties and applications **Maxwell's Thermodynamic Relations**: Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell's thermodynamic relations (using Thermodynamic potentials), Applications of Maxwell's Relations (1) Gibbs potential, First order Phase Transitions with examples, Clausius - Clapeyron Equation (2) Liquifaction of gases, regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)	**5 hours**
Chapter No. 5	**Kinetic Theory of Gases**: Maxwell's law of distribution of velocity (without derivation), Deduction of most probable velocity, mean velocity and root mean square velocity, Degrees of Freedom, Law of Equipartition of Energy. Dearivation of Specific heats of ideal gas.	**3 hours**
Chapter No. 6	**Black body radiation** and its spectral energy distribution; Kirchhoff's law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law (Statements), Planck's law – deduction of Wien's Law & Rayleigh – Jeans Law.	**3 hours**
Topics for Self-study	(1) Equilibrium between phases - triple point of water. (2) Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment.	

Suggested Activities (Any two activities to be conducted compulsorily)

Activity No. 4	1. Watch the you tube video: https://www.youtube.com/watch?v=bODiX2PjCPE and write a report on the difference between heat and temperature. 2. Watch the you tube video https://www.youtube.com/watch?v=v5zAiWSi7rs "A simple animation showing the thermoelectric effect"(Seebeck effect) and explain it in your own words.
Activity No. 5	Take two containers (cylindrical jars) A and B of identical size (volume 500 ml). Connect them to a reservoir (huge bottle containing water) though pipes of equal length, but of different radii of cross-section. Let container A be connected using a pipe of inner radius of 5 mm and container B be connected using a pipe of inner radius 1.5 mm. Sketch the graphs for the rise of water levels in containers A and B as a function of time when water was allowed to flow from the reservoir to the containers. Explain the results. What happens if the diameter of the containers A is larger than that of B, but pipes of equal length connecting the containers with the reservoir have same inner radii.
Activity No. 6	A hot object at a temperature T_1 is placed in an environment at a temperature T_0. The temperature of the object will be some function of time, T(t). This function will satisfy the equation: $\frac{dT}{dt} = -A(T - T_0)$ (a) Explain "what this equation explains" in your own words. (b) Show that the function $T(t) = T_0 + ce^{-At}$ satisfies the above equation. (c) Plot T(t) as a function of time t.
Activity No. 7	Take two dissimilar metal wires. Spot weld them forming two junctions. Dip one junction in ice and heat the other junction with a burner. Plot a graph of time of heating v/s Thermo EFM generated in the voltmeter. **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.

Topic Learning Outcomes

At the end of the topic, students should be able to understand the following concepts.

SL No	TLO's	BL	CO	PO
1.	State Maxwell relations.	**L1**	**2**	**1-6, 11-12**
2.	Give examples where Maxwells relations are used.	**L1**	**2**	**1-6, 11-12**
3.	Explain the phase transition. Which is called as first order phase transition? Give Examples	**L2**	**2**	**1-6, 11-12**
4.	State Clausius - Clapeyron Equation.	**L1**	**2**	**1-6, 11-12**
5.	Obtain an equation for difference in C_P - C_V.	**L2**	**2**	**1-6, 11-12**
6.	State Joule-Thomson effect and Joule-Thomson coefficient.	**L1**	**2**	**1-6, 11-12**

7.	Obtain an expression, giving the relation between pressure, volume and temperature for a real gas (Vander Waals gas).	**L2**	**2**	**1-6, 11-12**
8.	Explain how low temperature is achieved by the liquefaction of gases?	**L2**	**2**	**1-6, 11-12**
9.	State Maxwell-Boltzmann Law of Distribution of velocities in Ideal gases.	**L1**	**2**	**1-6, 11-12**
10.	Explain the mean RMS and most probable speeds in ideal gases.	**L1**	**2**	**1-6, 11-12**
11.	Explain degrees of freedom associated with particles in an ideal gas.	**L2**	**2**	**1-6, 11-12**
12.	Define the specific heat of a gas.	**L1**	**2**	**1-6, 11-12**
13.	Explain black body radiation and its spectral distribution.	**L1**	**2**	**1-6, 11-12**
14.	Explain the different laws used to describe different parts of the curves of a spectral distribution of black body radiation.	**L2**	**2**	**1-6, 11-12**
15.	Define ultraviolet radiation catastrophe? Discuss its importance in the explanation of black body radiation.	**L2**	**2**	**1-6, 11-12**
16.	Define Planck's law of radiation and discuss how it could describe the whole black body radiation curve.	**L2**	**2**	**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				

Unit – 3: Semiconductor devices **(11 hours of teaching plus 2 hours of activities)**		
Chapter No. 8	**Semiconductor devices**: Intrinsic semiconductors, concept of holes , effective mass expression for carrier concentration Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration and electrical conductivity – extrinsic semiconductors and electrical conductivity p-n junction and its characteristics and parameters, diode current, P-N Junction as a rectifier ,Half wave rectifier, full wave rectifier, Zener diode as voltage regulator, regulator circuit with no load & loaded regulator.	**5 hours**
Chapter No. 9	**Junction Transistors**: Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Base, Common Emitter and Common Collector Characteristics. Field Effect Transistor (FET) and its characteristics. Transistor as an Amplifier and Oscillator.	**6 hours**
Topic for Self-study	Diode approximations	
Suggested Activities (Any two activities need to be conducted compulsorily)		

Activity No. 8	a. Learn to identify the terminals of different types (packages) of BJTs. b. In the case of power transistors, learn how to fix a heat sink for the transistor. c. Learn the difference between BJT and FET from operational characteristics.
Activity No. 9	Take any 3 diodes and assign one each to three groups of students. Ask them to measure diode resistance when dipped in ice and while heating the ice till it boils. Using this data, plot calibration curve of temperature v/s resistance and also the cooling curve of temperature v/s time for the diode by each group. **Note for the teachers for the activity:** Form 3 groups. Assign each group the activity of drawing one of the graphs. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. 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 No. 10	Prepare a table consisting of (i) name of the semiconductor diode (Zener diode, Light Emitting Diode, Rectifier Diode, Schottky diode) (ii) its application/s (3) attach a sample photo for each type of semiconductor diode (4) give a link for the website where you got the sample photo of the diode.

Topic Learning Outcomes

At the end of the topic, students should be able to understand the following concepts.

SL No	TLO's	BL	CO	PO
1.	Define Semiconductors and Band Gap. Explain on what basis they are classified as intrinsic and extrinsic.	**L2**	**3**	**1-6, 11-12**
2.	Define PN junction. Explain its functioning in forward and reverse bias.	**L1**	**3**	**1-6, 11-12**
3.	Explain the approximation used in a real diode with respect to an ideal PN Junction?	**L2**	**3**	**1-6, 11-12**
4.	With a schematic diagram, explain half wave and full wave rectifiers.	**L1**	**3**	**1-6, 11-12**
5.	Define a Zener diode and explain how it is different from an ordinary diode using V-I curves?	**L2**	**3**	**1-6, 11-12**
6.	With the schematic diagram, explain the working of voltage regulators of different types using a Zener diode.	**L1**	**3**	**1-6, 11-12**
7.	Give the basic concepts used in the instruction of bipolar junction transistor and its operation.	**L1**	**3**	**1-6, 11-12**
8.	Compare the V-I curve of common base common emitter and common collector BJT curves while explaining their working principles.	**L2**	**3**	**1-6, 11-12**
9.	Define FET. Give its characteristics.	**L1**	**3**	**1-6, 11-12**
10.	Explain how a transistor can be used as an amplifier and an oscillator using a circuit diagram.	**L2**	**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 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		
Unit – 4: Electronics		
Chapter No. 10	**Electronics**: Integrated Circuits (Analog and Digital), Operational Amplifier, Ideal characteristics of Op-Amp, Inverting and Non-Inverting Configurations. Applications- Voltage Follower, Addition and Subtraction.	**4 hours**
Chapter No. 11	**Digital Electronics:** Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. **Boolean Algebra Theorems:** De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, Algebraic Simplification, Implementation of NAND and NOR functions.	**7 hours**
Topics for Self-study	(i)Understand the concept of virtual ground of an OP-AMP. (ii)Learn the different types of op-amps used for different applications. (iii)What is a buffer? Prepare a report on buffers and its application in instrumentation electronics.	
Suggested Activities (Any two activities need to be conducted compulsorily)		
Activity No. 12	Learn how to implement logic functions (AND, OR, NOT) using just diodes and resistors. With a circuit diagram show how different types of gates can be built by X-NOR gates.	
Activity No. 13	A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by one of the switches irrespective of the state of the other switch. Explain switching of the bulb in terms of logic gate operation.	
Activity No. 14	A man has to take a wolf, a goat, and some cabbage across a river. His rowboat has enough room for the man plus either the wolf or the goat or the cabbage. If he takes the cabbage with him, the wolf will eat the goat. If he takes the wolf, the goat will eat the cabbage. Only when the man is present are the goat and the cabbage safe from their enemies. All the same, the man carries wolf, goat, and cabbage across the river. How? Write the truth table for the above story and implement using digital gates.	
Activity No. 15	A locker has been rented in the bank. Express the process of opening the locker in terms of digital operation.	

Topic Learning Outcomes

At the end of the topic, students should be able to understand the following concepts.

SL No	TLO's	BL	CO	PO
1.	Define op-amps and give the characteristics of an ideal op-amp.	L1	4	1-6, 11-12
2.	Explains an inverting and non-inverting configuration of typical op-amps, with a schematic diagram.	L2	4	1-6, 11-12

3.	Explain how op-amps can be used as a voltage follower, with a schematic diagram and with relevant expressions.	**L2**	**4**	**1-6, 11-12**
4.	Explain how op-amps can be used as a voltage follower, adder and subtractor, with a schematic diagram and with relevant expressions.	**L2**	**4**	**1-6, 11-12**
5.	Give different digital wave forms and explain how one can visualize the switching and logic levels.	**L1**	**5**	**1-6, 11-12**
6.	Write any four-digit numbers other than zero in the decimal number system and convert that into binary and hexadecimal.	**L2**	**5**	**1-6, 11-12**
7.	Write any number in a Binary System of 8 digits other than zero and convert it into decimal and hexadecimal.	**L2**	**5**	**1-6, 11-12**
8.	Write any number in the hexadecimal system of 4 digits other than zero and converted it into a binary and decimal number.	**L2**	**5**	**1-6, 11-12**
9.	Give simplified diagram for a given Boolean circuit diagram of logic gates, and verify using the De-Morgans theorem.	**L2**	**5**	**1-6, 11-12**
10.	Why are X-NOR gates called Universal Gates?	**L2**	**5**	**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

Textbooks

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1.	Heat and Thermodynamics	Brij lal, N. Subrahmanyam and P.S.Hemne	S. Chand Publishing	2001
2.	Heat and Thermodynamics	D. S. Mathur	S. Chand Publishing	2008
3.	Heat and Thermodynamics	M.W. Zemansky and Richard Dittman	McGraw-Hill Education	2017
4.	Thermal Physics	S C Garg, R M Bansal & C K Ghosh	McGrawHill Education (India)	2013
5.	Fundamentals of Classical Thermodynamics	G. J. V. Wylen, R. E. Sonntag, C. Borgnakke	John Wiley	1994
6.	Integrated Electronics	J. Millman, C. Halkias & C. Parikh	McGraw Hill Education	2017
7.	Digital Fundamentals	T. L. Floyd	Pearson Education	2005
8.	Principals of Electronics	V.K Mehta and Rohit Mehta	S. Chand Publishing	2020

References Books				
Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	A Treatise on Heat	M. Saha & B.N.Srivastava	Hafner Publishing Company, Indian Press	1958
2	Thermodynamics, Kinetic theory & Statistical Thermodynamics	F. W. Sears & G. L. Sailinger	Pearson Education	1975
3	Electronic Principles	A Malvino and D J Bates	McGraw Hill Education	2017
4	Electronic Devices and Circuits	David A. Bell	PHI, New Delhi	2004

Paper Code: Phy-DSCP4 - Lab IV

List of Experiments to be performed in Lab IV **Note: A minimum of EIGHT experiments must be performed in Lab IV of which FOUR experiments should be chosen from 1-13 and FOUR experiments should be chosen from 14-24.**	
1.	Specific heat by Newton's law of cooling
2.	Verification of Newton's law of cooling
3.	Calibration of thermocouple for Temperature measurement
4.	Thermal conductivity of a bad conductor by Lee's and Charlton's method
5.	Thermal conductivity of rubber
6.	Mechanical Equivalent of Heat by Callender and Barne's method
7.	Coefficient of thermal conductivity of Copper by Searle's method
8.	Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
9.	Determination of Stefan's constant/ Verification of Stefan's law
10.	Variation of thermo-emf across two junctions of a thermocouple with temperature
11.	Verification of Clausius-Clapeyron equation
12	Study of Gaussian distribution using Monte Carlo method.
13	Determination of Planck's constant.
Any FOUR of the above listed experiments 1-13 must be conducted in Lab IV	
14.	V-I Characteristics of Silicon & Germanium PN Junction diodes (FB & RB)
15.	(i) V-I Characteristics of Zener Diode (ii) Regulated power supply (using zener diode).
16.	Characteristics of BJT in Common Emitter Configuration
17.	Half Wave and Full Wave Rectifier without Filter
18.	Half Wave and Full Wave Rectifier with Filter
	Determination of transistor h-parameters.
19.	Frequency response of a CE amplifier.
20.	Frequency response of CC Amplifier (Emitter Follower).
21.	Applications of Operational Amplifier: (i) Non-inverting and Inverting op-amp circuits (ii) Voltage follower, Adder and Subtractor circuits
22.	Truth table verification of logic gates using TTL 74 series ICs.
23.	Logic Gates; Combinational Circuits; Sequential Circuits
24.	Transfer characteristics of a TTL gate using CRO.
Any FOUR of the above listed experiments 14-24 must be conducted in Lab IV	
One hour of Laboratory time every week has to be dedicated for suggested activities in the theory paper DSCT3: Thermal Physics & Electronics. Note that this is in addition to a total of 8 hour during theory teaching during the entire semester (2 hours each for every Unit of the theory paper).	

Reference Books 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	Basic Electronics Lab Manual 2015-16,	National Institute of Science Education and Research, Bhubaneswar, 2015.	NISER, Bhubaneswar	**2015**
3	Engineering Practical Physics	S. Panigrahi, B. Mallick	Cengage Learning India Pvt. Ltd	**2015**

OPEN ELECTIVE PAPERS

Phy-OE5: Optical Instruments (Credits:3)
3 hours of teaching per week

Unit-I	Hrs.
Basics of Optics: Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (No derivations; concepts to be discussed qualitatively).	**13**
Unit-II	
Camera and microscopes: Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of (i) Simple microscopes (ii) Compound microscope (iii) Electron microscopes (iv) Binocular microscopes **Self study:** Experimental determination of magnifying power of a microscope.	**13**
Unit-III	
Telescopes and Spectrometer: Construction, working and utilities of (i) Astronomical telescopes (ii) Terrestrial telescopes (iii) Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer – Construction, working and utilities, measurement of refractive index.	**13**
Self study — Telescopes used at different observatories in and outside India.	

Suggested Activities

1. Find position and size of the image in a magnifying glass and magnification.
2. Observe rain bows and understand optics. Create a rainbow.
3. Find out what makes a camera to be of good quality.
4. Observe the dispersion of light through prism.
5. Make a simple telescope using magnifying glass and lenses.
6. Learn principle of refraction using prisms.
7. Check bending of light in different substances and find out what matters here.
8. Learn about different telescopes used to see galaxies and their ranges.

Weblinks: **https://spark.iop.org, http://www.yenka.com, https://publiclab.org** etc

Reference Books

1. Galen Duree. Optics for Dummies. Wiley. 2011.
2. Blaker J W. Optics: An Introduction for Students of Engineering. Pearson, 2015.
3. Hecht E. Optics. Pearson. 5th Edition, 2019.
4. Khurana A K. Theory And Practice Of Optics & Refraction. Elsevier India. 2016.
5. FlexBooks® 2.0 https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/19.9/primary/lesson/optical-instruments-ms-ps/

Phy-OE6: Elements of Astronomy & Astrophysics (Credits:3)
3 hours of teaching per week

Unit-I : History and Introduction	Hrs.
Ancient Astronomy: Greek Observations, Sumerian Observations, Mayan Observations, Arabic Observations ,Chinese Observations (2 hours) **Indian Astronomy:** Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara, Astronomy in Indian Scriptures, Precession of the Equinox, Celebrations of Equinox (2 hours) **Medieval & Modern Astronomy:** Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other, Modern Astronomy (3 hours) **Optical Tools for Astronomy:** Pin Hole, Binoculars, Telescopes & Imaging (1 hour) **Mathematical Methods of Observations:** Angular Measurement, Trigonometric functions, Stellar Parallax (2 hour) **Observational Terminologies:** Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc. (3 hours)	**13**
Unit-II: Observations of the Solar System	
The Sun: Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots (3 hours) **The Moon:** Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names (3 hours) **Inner Planets: Mercury & Venus** - Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits. (4 hours) **Outer Planets: Mars, Jupiter & Saturn** - Observational History. Observational Windows, Appearance, Frequency of Oppositions, Conjunctions, Moons Eclipses. Galilean Moons, Saturn's Rings (3 hours)	**13**
Unit-III: Major Astronomy Observations	
March to June: Prominent Stars and Constellations Visible during this period, Methods of Spotting. (4 hours) **June to September:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. (3 hours) **September to December:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. (3 hours) **December to March**: Prominent Stars and Constellations Visible during this period, Methods of Spotting. (3 hours)	**13**

Suggested Activities

1. Measuring Seasons using Sun's Position.
2. Measuring Distance using Parallax
3. Estimation of the Stellar Diameter using Pin Hole
4. Measuring Height of an Object Using Clinometer.
5. Star spotting using constellation maps
6. Constellation spotting using Skymaps
7. Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8. Estimation of the Size of the Solar System in using Light Years.
9. Identification of Lunar Phases across a year.
10. Measuring Constellation of the Sun using Night Sky maps or Planispheres

Reference Books

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelro

Phy-OE7: Medical Physics (Credits:3)
3 hours of teaching per week

Unit-I: Human Anatomy and Physiology	
Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit-II: Physics of Medical Diagnostics	
Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit-III: Physics of Radiotherapy	
Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)

Suggested Activities

Unit I: Students may demonstrate the shape, size, positions and functions of different organs in the body with the help of models.

Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes.

Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers.

(ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines.

Other related activities/projects

1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines.
2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis.
3. Project on principle and use of X-ray films in imaging.
4. Visit to radiotherapy centers to study the modalities of radiotherapy.

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.
2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.
3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.
4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.
5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.
6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.
2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.
3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.
4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.
5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.
6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.
7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.
8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.
9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.
10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.
11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.
12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.
13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.
14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.
15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.
16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.
17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002.
18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005.
19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.

Phy-OE8: Electrical Instruments (Credits:3)
3 hours of teaching per week

Content		Hrs
Unit - 1		
Chapter No. 1	Voltage and current sources, Kirchoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Ammeters,voltmeters: (DC/AC)	03
Chapter No. 2	Representation of sinusoidal waveforms, peak and rms values, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. Wattmeters: Induction type, single phase and three phase wattmeter, Energy meters: AC. Induction type single phase and three phase energy meter	05
Chapter No. 3	Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications.	05
Topics for self study (If any)	Types of switches and Circuits, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED	
	Suggested Activities	
Activity No. 1	Identify variety of electrical switches and note down their applications/utility. Reference: Weblink/Youtube/Book	
Activity No. 2	Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks. Reference : Weblink/Youtube/Book	
Unit - 2		
Chapter No. 4.	Galvanometers: General principle and performance equations of D'ArsonvalGalvanometers, Vibration Galva nometer and Ballistic Galvanometer.	03
Chapter No. 5.	Potentiometers: DCPotentiometer, Crompton potentio meter, construction, standardization, application. AC Potentio meter, Drysdalepolar potentio meter; standardization, application.	03
Chapter No. 6.	DC/AC Bridges: General equations for bridge balance, measurement of self inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device, Kelvin's double bridge.	07
Topics for self study	Importance of grounding and Earthing, Methods for Earthing,	

Suggested Activities		
Activity No. 3	Make a study of importance of grounding in electrical circuits. Reference : Weblink/Youtube/Book	
Activity No. 4	Prepare a detailed account of various methods of earthing and their utility/applications Reference : Weblink/Youtube/Book	
Unit - 3		
Chapter No.7	Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Hall Effect Transducer	06
Chapter No. 8	CRO: Block diagram, Sweep generation, vertical amplifiers, use of CRO in measurement of frequency,phase, Amplitude and rise time of a pulse. Digital Multi-meter: Block diagram, principle of operation	03
Chapter No. 9	Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing.	04
Topics for self study (If any)	Basic study of Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED	
Suggested Activities		
Activity No. 5	Prepare a document on evolution of incandescent bulbs to the present-day LED lights Reference : Weblink/Youtube/Book	
Activity No.6	Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications Reference : Weblink/Youtube/Book	

Text Books

1. A. K.Sawhney, A Course in Electrical.and Electronic Measurements & Instrumentation **, Dhanpat Rai & Sons, 1978**
2. A.D. Helfrick, W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, **Prentice Hall India, 1992.**

References Books

1. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,**2019**
2. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005
3. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India, **2009**

COURSE PATTERN & SCHEME OF EXAMINATION for B.Sc. / B.Sc. (Hons.) as per NEP-2020

Semester	Title of the Paper	Total No of hours	Hours per week	Marks		Duration of Examination (hours)	Total Marks	Credits
				Theory/ Practicals	Internal Assessment (IA)			
				Max	Max			
3rd Sem.	Phy-DSCT3: Wave motion and Optics	52	4	60	40	$2\frac{1}{2}$	100	4
	Phy-DSCP3-Lab III	40	4	25	25	3	50	2
	Phy-OE5 : Optical Instruments OR Phy-OE6: Elements of Astronomy and Astrophysics	39	3	60	40	$2\frac{1}{2}$	100	3
4th Sem.	Phy-DSCT4: Thermal Physics & Electronics	52	4	60	40	$2\frac{1}{2}$	100	4
	Phy-DSCP4-Lab II	40	4	25	25	3	50	2
	Phy-OE7: Medical Physics OR Phy-OE8: Electrical Instruments	39	3	60	40	$2\frac{1}{2}$	100	3

Formative/Internal Assessment for Theory Papers	
Assessment Occasion	Marks
Test-1 (Attendance+Activity + Self-study related)	20
Test-2 (Theory based)	20
Total	40

***Questions should not be set on activity and self-study topics during end semester examinations.**

Distribution of Marks for the Practical Examination (Phy-DSCP1 & Phy-DSCP2)		
Sl No	Particulars	Marks
1	Writing Principle/Statement/Formulae with symbols, units and explanations.	03
2	Drawing illustrative diagrams and expected graphs	03
3	Setting up of the experiment & taking readings	06
4	Calculations and graphs drawn based on experimental data.	05
5	Accuracy of results with units	03
6	Valuation of Practical Record	05
Total Marks		25

3rd/4th Semester B.Sc Examination, April/May (September/October) 2023

CBCS - 2021 ONWARDS

Subject: Physics

Phy-DSCT3/Phy-DSCT4: …….

Time: 2 $\frac{1}{2}$ hours **Max. Marks: 60**

Instruction: Answer *any* FOUR questions from *each* part

PART- A

Each question carries 2 marks (concept based)

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 1,2,3,4,5,6)

PART-B (20 marks)

Each question carries 5 marks (numerical problems)**

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 7,8,9,10,11,12)***

PART-C (32 marks)

Each question carries 8 marks

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 13,14,15,16,17,18)**

*In each part of the question paper first three questions should be set from the first TWO units of the syllabus and next three questions should be set from second half (last TWO units) of the syllabus.

**Questions in Part-B should contain numerical problems in the specific cases of discipline core subjects, where problem solving is an essential component of learning.

*** Questions of Part B and Part C may contain subdivisions i.e., (i) questions 7 to 12 of Part B may be split into a, b & division of marks in such cases should be clearly indicated – for example 2 + 3=5 marks or 1+4=5

marks. Similarly (ii) question 13 to 18 of Part C may be split into a, b, c with division of marks clearly indicated – for example 3+5=8 marks or 2+6=8 marks or 2+3+3=8 marks and so on).

3rd/4th Semester B.Sc Examination, April/May (September/October) 2023

CBCS - 2021 ONWARDS

Subject: Physics

Phy-OE5/OE6/OE7/OE8 : ……..(Open Elective)

Time: 2 $\frac{1}{2}$ hours **Max. Marks: 60**

Instruction: Answer *any* FOUR questions from *each* part

PART- A

Each question carries 2 marks (concept based)

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 1,2,3,4,5,6)

PART-B (20 marks)

Each question carries 5 marks **

6 QUESTIONS TO BE SET*

(Question Numbers: 7,8,9,10,11,12)***

PART-C (32 marks)

Each question carries 8 marks

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 13,14,15,16,17,18)**

* All parts should have TWO questions each from 3 units of the open elective syllabus.
** Questions of Part B and Part C may contain subdivisions i.e., (i) questions 7 to 12 of Part B may be split into a, b & division of marks in such cases should be clearly indicated – for example 2 + 3=5 marks or 1+4=5 marks. Similarly (ii) question 13 to 18 of Part C may be split into a, b, c with division of marks clearly indicated – for example 3+5=8 marks or 2+6=8 marks or 2+3+3=8 marks and so on).