Programme Structure for Bachelor of Science (Basic/Hons.) (Physics) Programme (Subjects with Practical)

Sem.	Discipline Core(DSC) (Credits)	Discipline Elective(DSE) /Open Elective (OE) (Credits)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	DSC A1(4+2) DSC B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: (2) (1+0+2)	Yoga (1) (0+0+2)	Health &Wellness (1) (0+0+2)	25
II	DSC A2(4+2) DSC B2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Certificate (48 credits)								
III	DSC A3(4+2) DSC B3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: (2)(1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
IV	DSC A4(4+2) DSC B4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Diploma in a particular Discipline (96 credits)								
V	DSC A5(3+2) DSC A6(3+2) DSC B5(3+2) DSC B6(3+2)				SEC-3: SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
VI	DSC A7(3+2) DSC A8(3+2) DSC B7(3+2) DSC B8(3+2)				SEC-4: Professional Communication (2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
Exit with Bachelor of Degree in a particular Discipline (140 credits)								
VII	DSC A/B9(3+2) DSC A/B10(3+2) DSC A/B11(3)	DSC A/B E-1 (3) DSC A/B E-2 (3) Res. Methodology (3)						22
VIII	DSC A/B12(3) DSC A/B13(3) DSC A/B14(3)	DSC A/B E-3 (3) DSC A/B E-4 (3) Research Project (6)*						21
Award of Bachelor of Degree with Honours, B.Sc (Hons.) 180 credits)								

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

Note: 1) Instruction hours per week: DSC-4 hrs; Practical-4 hrs; OE-3 hrs.

2) Max marks: DSC - 100 (IA 40+Exam 60); Practical – 50 (IA 25+Exam 25); OE – 100 (IA 40+Exam 60).

3) The theory IA will be based on (i) Average of 2 tests: 20 marks, (ii) activity/ seminars/ projects :20 marks.

4) The practical IA will be based on (i) Regular performance:15 marks, (ii) test/seminars: 10 marks.

5) Duration of Annual Examination: Theory-2hrs; Practical-4hrs.

Curriculum Structure-Physics

(Core and Electives)

Semesters- I to X

SEM	DSC	Core Papers
Sem-1	A1	Mechanics and Properties of Matter
Sem-2	A2	Electricity and Magnetism
Sem-3	A3	Wave Motion and Optics
Sem-4	A4	Thermal Physics and Electronics
Sem-5	A5 A6	1. Classical Mechanics and Quantum Mechanics- I 2. Elements of Atomic, Molecular Physics
Sem-6	A7 A8	1. Elements of Nuclear Physics and Nuclear Instruments 2. Elements of Condensed Matter Physics
Sem-7	A9 A10 A11	1. Mathematical Methods of Physics – I 2. Classical Electrodynamics. 3. Experimental methods of Physics 4. Research Methodology (Select Two DSE subjects from the Pool B-I shown below)
Sem-8	A12 A13 A14	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.
Sem-9	A15	1. Mathematical Methods of Physics – II (Select One DSE subjects from the Pool B-III shown below) 2. Research Project
Sem-10	A17	1. Quantum Mechanics – III (Select One DSE subjects from the Pool B-IV shown below) 2. Research Project

* The Courses of 3rd Semester and above need to be revisited.

Open Electives for 1st and 2nd Semester

Sem.	Courses
1.	Energy Sources
2.	Astronomy and Space Mission

Discipline Specific Electives for 7th to 10th 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 Semesters I & II

B.Sc., Physics

Detailed Syllabus for Semesters I & II

Semester – I

Mechanics and Properties of Matter

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) (UGC guidelines)	**1**	**2**	**3**	**4**	**5**	**6**
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	**x**	**x**				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	**x**	**x**				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	**x**					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	**x**			**x**	**x**	**x**
CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**
CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	**x**	**x**				
CO-7: Will get hands on experience of different equipment.	**x**	**x**	**x**		**x**	**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

Mechanics & Properties of Matter		Hrs
Credit : 4+2	**Unit – 1 Theory : 4 hours /Week**	
Chapter No. 1	**Units and measurements:** System of units (CGS and SI), dimensions of physical quantities, dimensional formulae. Minimum deviation, errors and error analysis **Vectors:** Instantaneous velocity and acceleration, Derivative of planar vector of constant magnitude but changing direction. Arbitrary planar motion, radial and transverse component of velocity and acceleration, deduction of the results of uniform circular motion.	(13)
Chapter No. 2	**Momentum and Energy**: Work and energy, Conservation of linear and angular momentum. Conservation of energy with examples. Motion of rockets. Problems	
Chapter No. 3	**Special Theory of Relativity:** Inertial and no-inertial frames of reference, Galelian transformation equation, Galelian principle of relativity. Search for absolute frame of reference, Ether concept, Null result of Michelson Morley experiment, Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Twin paradox, Relativistic addition of velocities, Einstein's mass energy relation-photon box experiment. Problems	
Topics for self study	**Self Study** **Units and measurements:** Measurement of length, mass and time. Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.	
	Suggested Activities	
Activity No. 1	i). Students can measure diameters of small balls of different size and estimate their volumes. ii). Students can measure lengths of nails of different size. iii). Students can measure volume of a liquid. iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement. v). students can estimate standard deviations wherever possible.	
Activity No. 2	Students can try and understand conservation of energy in every day examples. For example: i) What happens in solar conservation panels ii) Pushing an object on the table it moves iii) Moving car hits a parked car causes parked car to move. In these cases, energy is conserved. How? Understand and verify if possible. Students can try and understand conservation of momentum with help of coins and balls by referring to websites. Reference: https://www.youtube.com/	

Unit – 2		
Chapter No. 4.	**Laws of Motion:** Conservative and non-conservative forces. Deduction of conservation of energy in conservative force field. Centre of mass. Simple harmonic motion – vertical oscillations of the light loaded spring, expression for force constant and determination of acceleration due to gravity, Problems	(3)
Chapter No. 5.	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. Moment of inertia: Theorem of perpendicular axis and Theorem of parallel axes, Moment of Inertia of a rectangular Lamina, Circular disc and ring and solid cylinders. Flywheel, theory of compound pendulum and determination of 'g'. Problems	(7)
Chapter No. 6.	**Gravitation:** Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit. Problems	(3)
Topics for self study (If any) Chapter 7	Escape velocity, Geosynchronous orbits. Basic idea of global positioning system (GPS).	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by Referring to websites, students can construct and perform simple experiments to verify that MI α mr^2. Students can try to understand law of inertial with the help of coins and balloons by referring to websites.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn, https://www.youtube.com	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks related to moment of inertia, gravitation and planetary motion.	
Activity No. 5	(i) Rolling of different disc and cylinders on inclined plane to understand the moment of inertia. (ii) Listing and discussing the moment of inertia of bodies come across in daily life.	

Unit - 3		
Chapter No. 8	**Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method Bending moment of beams, Cantilever bending and uniform bending, I - section of girders. Problems.	(13)
	Suggested Activities	
Activity No. 6	Activity: Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale alongside. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.7	Activity: Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	
Activity No 8	Activity: Classifying different materials in to elastic and plastic materials. Studying the bending magnitudes of different shape and material rods.	

Unit - 4		
Chapter No. 9	**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact., Surface tension by drop weight method, Interfacial surface tension, Problems.	(13)
Chapter No. 10	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems.	
Topics for self study (If any)	Variation of surface tension with temperature, Surface tension by Capillarity rise, Application of viscosity.	

Suggested Activities		
Activity No.9	1. Measure surface tension of water and other common liquids and compare and learn i) Why water has high ST? think of reasons. ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST. iii) Plot ST versus T and learn how it behaves. Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.	
Activity No. 10	Activity: 2. Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons. ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration. iii) Do the above experiment by mixing sticky liquid to the non-sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. List the applications where concept of Viscosity plays a dominant role	

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	2013
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, et.al.	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.	S.Chand & Co	2014
5	Physics for Degree Students	CL Aurora & PS Hemne	S.Chand & Co	2010
6	Mechanics	J C Upadhyaya	Himalaya	2016

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Principles of Physics 9th Edn,	Resnick, Halliday & Walker,	Wiley	2013
2	Conceptual Physics, 10th Edn	Paul G Hewit	Pearson	2012
3	Introduction to Special Theory of Relativity	Robert Resnick	Wiley Student Edition	2014
4	Physics for Scientists and Engineers	Jewett & Serway	Cengage learning India Pvt Ltd, Delhi	2012
5	The Feynman Lectures on Physics – Vol 1	Richard P Feynman, Robert B Leighton, Mathew Sands	Narosa Publishing House	1986
6	Physics – (International Student Edition)	Marcelo Alonso & Edward J Finn	Addison – Wesley	1999
7	Concepts of Modern Physics	Arthur Beiser	Tata Mcggraw Hill	1998
8	Modern Physics	Kenneth Krane	Wiley	2012
9	Newtonian Mechanics	AP French	Viva Books	2017
10	Modern Physics	G Aruldhas & P Rajgopal	PHI Learning Pvt. Ltd.	2009

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (two hole method and L versus T graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stokes' method.
8.	Verification of Hooke's law by stretching and determination of Young's Modulus.
9.	Determination of surface tension of a liquid by drop weight method.
10	Study of motion of spring and to calculate the spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.
15	Determination of interfacial tension between two liquids using drop weight method.
16	Determination of viscosity of liquids by Poiseuille's method.

(Minimum EIGHT experiments have to be carried out).

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
5	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co	2007
6	An advanced course in practical physics	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd	2002

Semester – II

Electricity & Magnetism

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Will demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Will explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Will be able to apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Will describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Will be able to explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Will be in position to describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. Will be able to apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations	x	x			x	x

	of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.						
viii.	Will understand and able to apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	**x**	**x**			**x**	**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		**Hrs**
Unit – 1		
Chapter No. 1	**Topics to be covered:** Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy), Problems.	3
Chapter No. 2	**Topics to be Covered** Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole. Problems	7
Topics for self study(If any)	Constant potential surfaces - for self learning Work out problems listed in the reference	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	

	3. With the help of glass rod, plastic rod, silk, and fur demonstrate the generation of charge and electrostatic attraction and repulsion.	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		
Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law, Problems.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination, charging and discharging of capacitor. Force on a moving charge. Problems.	7
Topics for self study(If any)	Currents and voltage in combination of R, L and C circuits, Kirchoff's laws of voltage & Current	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field. Problems.	5
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits. Filters – High and Low and band pass filters (qualitative), Problems.	8
Topics for self study(If any)	Force acting on a moving charge in electric and magnetic fields – Lorentz force, Magnetic dipole moment – torque on a magnetic dipole.	
Suggested Activities		
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Scalar and vector fields, operator grad, the gradient of a scalar function, integration theorems – line integral, surface integral, volume integral, divergence and curl of a vector, Gauss and Stokes theorems (qualitative), Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, the field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	10
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	3
Topics for self study(If any)	B-H curves and its characteristics Ferrites	

Suggested Activities		
Activity No.7	1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	
Activity No 9	Identifying the magnetic meridian of the earth and measuring the magnetic dip at a place using the magnetic pointer. Discussion on magnetic equator	

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics for Degree Students Volume 1	CL Aurora & PS Hemne	S.Chand & Co	2010
2	Fundamentals of Magnetism and Electricity	DN Vasudeva	S Chand & Co	2011
3	Electricity and Magnetism	R Murugeshan	S Chand & Co	2019
4	Electricity and Magnetism	D C Tayal	Himalaya	1989

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008
3	The Feynman Lectures on Physics – Vol II	Richard P Feynman, Robert B Leighton, Mathew Sands	Narosa Publishing House	1986
4	Physics for Scientists and Engineers	Jewett & Serway	Cengage learning India Pvt Ltd, Delhi	2012
6	Physics – (International Student Edition)	Marcelo Alonso & Edward J Finn	Addison – Wesley	1999

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Verification of Maximum Power Transfer Theorem.
3.	Analysis of Phasor diagram.
4.	Determination of capacitance of a condenser using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.
13.	Low pass and high pass filters.
14.	Charge sensitiveness of BG.
15.	Field along the axis of a coil.
16.	Low resistance by potentiometer .

(Minimum EIGHT experiments have to be carried out).

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
5	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co	2007
6	An advanced course in practical physics	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd	2002

Question paper pattern for I and II Semester Examinations

Max. marks: 60

Part A

Answer any FOUR out of six questions. Each questions carry 2 marks. 4x2=8

1.
2.
3.
4.
5.
6.

Part B 4x10=40

Answer **All** questions.

7a) One question from Unit I for 4 marks.
b) One question from Unit I for 6 marks.

OR

8a) One question from Unit I for 4 marks.
b) One question from Unit I for 6 marks.

9a) One question from Unit II for 4 marks.
b) One question from Unit II for 6 marks.

OR

10a) One question from Unit II for 4 marks.
b) One question from Unit II for 6 marks.

11a) One question from Unit III for 4 marks.
b) One question from Unit III for 6 marks.

OR

12 a) One question from Unit III for 4 marks.
b) One question from Unit III for 6 marks.

13a) One question from Unit IV for 4 marks.
b) One question from Unit IV for 6 marks.

OR

14a) One question from Unit IV for 4 marks.
b) One question from Unit IV for 6 marks.

Part C

Answer any THREE out of four questions (one PROBLEM from each unit). Each questions carry 4 marks. 3x4=12

15 (a)
(b)
(c)
(d)

Total Marks = 60

Scheme of practical final examination (I and II semester)

Instructions:

i) Minimum 8 experiments should be done (otherwise student is not allowed to sit for semester examination)

ii) Knowledge of the experiment:-

- Student knowledge is judged based on the performance of the handling equipments & recognising suitable devices used in the experiment. Questions must be asked to test basic knowledge of concerned the experiment only.

Marks allotment for practical

Allotment of marks	I & II semesters
Record book	8
Formula	3
Diagram/circuit, Exptal set up	3
Observation & trails	6
Knowledge of the experiment	3
Result & accuracy	2
Total marks	25

OPEN ELECTIVES

(SEM I to II)

Open Elective 1

ENERGY SOURCES

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
CO - 1: Will be able to comprehend the varieties of energy sources and differentiate between the renewable and non-renewable sources of energy	**x**	**x**				
CO - 2: Will know the significance of solar energy and the different techniques to harness the solar energy	**x**	**x**				
CO - 3: Will gain the idea of the formation of waves and standing wave pattern, analysis of longitudinal and transverse waves.	**x**	**x**			**x**	
CO - 4: Will acquire the knowledge of wind energy and the methods to tap the energy from the blowing wind to generate electrical power.	**x**	x		x		
CO - 5: Will come to know about the conventional energy sources and its impact on the climate	**x**	x			**x**	

CO - 6: Will acquire the skill to set up a model to show the production of energy from different energy sources	**x**				**x**	**x**
CO - 7: Will be able to explain the different energy sources and how they are beneficial for the development of Technology.	**x**	**x**			**x**	**x**
CO - 8: Will be able to understand the problems of global warming and other climatic impact of the reckless usage of energy resources	**x**			**x**	**x**	**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

ENERGY SOURCES

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**

Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**07**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption.	**01**
	Total	**13**
	Activity 1. Demonstration of on Solar energy and wind energy using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet and Gadag. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Open Elective 2

Astronomy & Space Mission

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
CO – 1 : Will come to know the historical growth of Astronomy and the accumulation of knowledge.	**x**	**x**				
CO – 2 : Will be able to understand the basic principle of optical instruments such as telescope, binoculars.	**x**	**x**				
CO – 3 : Will acquire the skills to set up the telescope and recognize the star clusters and also the planets and satellites.	**x**	**x**			**x**	
CO- 4 : Will acquire the knowledge of wind energy and the methods to tap the energy from the blowing wind to generate electrical power.	**x**	x	x			
CO – 5 : Will come to know about the conventional energy sources and its impact on the climate	**x**	x			**x**	
CO-6 : Will be able to explain the stellar evolution and evolution of the universe.	**x**				**x**	**x**

CO- 7 : Will be able to explain the principle of Rocket launching and other space machines. .	x	x			x	x
CO-7 : Will know the Indian Space program and its contribution for the nation building.	x			x	x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Astronomy & Space Mission

Topic	Hours
Unit 1: History & Introduction	**13**
Ancient Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Greek, Sumerian, Mayan, Egyptian, Arabic and Chinese Observations	3
Medieval Astronomy: Geocentric Model, Heliocentric Model Observations by Tycho Brahe, Kepler, Galileo, Herschel and others.	3
Tools for Astronomy: Invention of Telescopes Pin Hole, Binoculars, Telescopes & Imaging.	3
Modern Astronomy Hubble's discovery, Stellar Evolution (Brief), Microwave, Radio Telescopes	2
Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors.	2
Unit 2: Observational Astronomy	**13**
The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Zero-shadow day Sunspots.	2
The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names.	2

Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearanc, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits. **Outer Planets: Mars, Jupiter & Saturn** Observational History, Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Galilean Moons, Saturn's Rings **Distant or Minute Objects: Uranus, Neptune & Asteroids** Observational History, Observational Windows, Asteroid Belt, Prominent Asteroids.	5
Comets & Meteors Origin, Orbital Nature, Historical Observations, Prominent Comets and Asteroids., Meteors, Origins and Showers	2
Occultations, Transits and Eclipses Definitions, Prominent Occultations and Transits, Eclipses – Types and prominent occurrences. Famous Eclipses in the past.	2
Unit 3: Space Missions	**13**
Introduction to Space Missions: Rockets, types and their applications, Different types of orbits, Artificial satellites – basic idea and their applications, Introduction to Space Missions, Beginning of Space Missions - World and India, Applications of Space Research, Space crafts, Launching Vehicles. **Topics for Self-study**: Major Space Centres in the World (at least 10) – brief idea about their location, establishment, capabilities and achievements. People behind space programs – at least 2 from India. Successful Missions (Any Five).	6
Indian Space Research Organisation (ISRO): About ISRO and its Goals, History of Creation. General Satellite Programmes: The IRS series, The INSAT series. Gagan Satellite Navigation System, Navigation with Indian Constellation (NavIC), Other satellites. Launch vehicles: Satellite Launch Vehicle (SLV), Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV). Experimental Satellites: Details and applications (Any Five) Earth Observation Satellites: Details and applications (Any Five) Communication satellites: Details and applications (Any Five) **Topics for Self study**: Chandrayaan 1: Details and applications. Mars Orbiter Mission: Details and applications.	7

References:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	The Amateur Astronomer	Sir Patrick Moore	Springer	2006
2	Handbook of Practical Astronomy	Gunter D. Routh	Springer	2009
3	Fundamental Astronomy	Hannu Karttunen	Springer	2007
4	Guide to Night Sky	P. Shankar	KRVP	2007
5	The Complete Idiot's Guide to Astronomy	Christopher De Pree and Alan Axelrod	Pearson	2001
6	The story of Astronomy In India	Chander mohan	Research Gate	2015
7	Trigonometry	-	Inc. BarCharts	
8.	Stargazing for Dummies	Steve Owens	John Wiley & Sons	2013
9.	A Skywatcher's Year	Jeff Kanipe	Cambridge University Press	1999
10.	The Casual Sky Observer's Guide	Rony De Laet	Springer	2012
11.	https://www.isro.gov.in/			

Question paper pattern for Open Elective for I and II Semester

Internal Assessment: 40 marks

Semester Examination: 60 marks

UNIT I, II & III Internal choice for each unit

Questions carrying 1 x 8 = 8

1 x 7 = 7

1 x 5 = 5

Total 20 x 3 = 60

Detailed 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 obtain the 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 stretched string 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 associated and measure the parameters like the 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 the optical activity of a medium.

Course Articulation Matrix													
Mapping of Course Outcomes (CO) Program Outcomes													
Course Outcomes / Program Outcomes		**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 obtain the 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	X	X	X	X	X	X					X	X

	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 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 affect the acoustics in a building, measure it and control it.	X	X	X	X	X	X					X	X
vii.	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
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). Brief account of Ripple and Gravity Waves. **(Text Book: 1-4) (5 Hours)**

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 Book: 1-4) (6 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 waves, longitudinal and transverse waves and give their characteristics.	L2	1	1-6, 11-12
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 Lissajous figures under different conditions of amplitude and frequency when they superimpose perpendicularly.	L2	3	1-6, 11-12
x.	Give some applications of Lissajous figures.	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 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 (2 Hours)	
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 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. **(Text Book: 1-4) (8 Hours)**
Acoustics: Absorption coefficient, Reverberation and Reverberation time, Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. **(Text Book: 1-4) (3 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's Reverberation formula and discuss what are the factors on which the Reverberation time depends 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 good acoustics of a building are 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 (2 Hours)	
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.
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**.** 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.
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 marble 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: To Determine wavelength of light, distances and shapes using Michelson interferometer. The corpuscular model of light-The wave model - Maxwells electromagnetic waves-Wave Particle Duality **(Text Book No 5; Sections 2.1 to 2.4 and 2.8) (2 Hours)**

Interference of light by division of wave front: Huygen's theory-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 (Text Book No 5; Sections 12.1 to 12.2, 14.1 to 14.5, 14.7 to 14.9) **(4 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- color of thin films—Newton's rings-(Reflected light)-Michelson Interferometer-Determination of wavelength of light* (Text Book No 5; Sections 15.1 to 15.2, 15.8 to 15.11) **(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.	Explain Maxwells 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 Huygen theory of wave-front.	**L1**	**7**	**1-6, 11-12**
vii.	Define Interference. 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 are 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 (2 Hours)

Activity No. 11

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

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**.**

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

Fraunhofer diffraction: Introduction- Fraunhofer diffraction- Single slit diffraction pattern-position of Maxima and Minima (Qualitative arguments)- Two slit diffraction pattern-position of Maxima and minima- Theory of plane diffraction Grating-Grating spectrum- normal and oblique incidence-Resolving power and dispersive power of a grating Single slit; Double Slit. Multiple slits & Diffraction grating. (Text Book No 5; Sections 18.1 to 18.2, 18.6,18.8 to 18.9) **(4 Hours) (few qualitative)**

Fresnel Diffraction- Fresnel half period zones-Diffraction by a circular aperture-diffraction by an opaque disc-The zone plate -comparison between zone plate and convex lens. (Text Book No 5; Sections 20.1 to 20.3) **(3 Hours) (Qualitative discussion)**

Polarisation: Introduction-Production of polarized light- The wire Grid polarizer and Polaroid-Superposition of two disturbances- Phenomenon of double refraction-Quarter wave plates and half wave plates- Analysis of polarized light-optical activity**.** (Text Book No 5; Sections 22.1, 22.3,22.4,22.6 to 22.8**) (4 Hours)**

Topic Learning Outcomes

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

SL No	TLO's	BL	CO	PO
i.	Define Fraunhofer 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 Fersnel 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 polaroids.	**L2**	**9**	**1-6, 11-12**
viii.	Give different types of polaroids.	**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 (2 Hours)	
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.
Activity No. 16	List out different types of zone plates and look for their applications in day-to-daylife. Make a report.
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.
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	Pragathi Prakashan, Meerut, Second Edition	2003
5.	Optics	Ajoy Ghatak	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	10
Activity	10
REU based Group Activity (Conduct, Report, Presentation)	10
Science Communication Seminar/Poster etc.)	10
Total	40

List of Experiments to be performed in the Laboratory *(Minimum 8 (Eight) experiments must be performed)	
1.	Velocity of sound through a wire using Sonometer.
2.	Frequency of AC using Sonometer.
3.	Study of Lissajous' Figures: Phase analysis at different phases.
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.	To determine refractive index of the Material of a prism using sodium source.
8.	To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
9.	To determine the wavelength of sodium source using Michelson's interferometer.
10.	To determine wavelength of sodium light using Fresnel Biprism.
11.	To determine wavelength of sodium light using Newton's Rings
12.	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
13.	To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. (Minimum deviation method)
14.	To determine resolving power of a plane diffraction grating.
15.	To determine dispersive power of a plane grating. (Normal incidence method)
16.	Determination of refractive index of a prism using Brewster's law.
17.	Determination of specific rotation of sugar solution using polarimeter.
18.	Diffraction at a straight wire in optic bench.

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

Detailed Syllabus of IV 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 – IV Thermal Physics and Electronics	
Course Title: Thermal Physics and Electronics	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.	Study of Pre-University

Course Learning Outcomes	
At the end of the course students will be able to:	
i.	Apply the laws of thermodynamics and analyze the thermal system.
ii.	Apply the laws of kinetic theory and radiation laws to the ideal and practical thermodynamics systems through derived thermodynamic relations.
iii.	Use the concepts of semiconductors to describe different Semiconductor devices such as diode transistors, BJT, FET etc. and explain their functioning.
iv.	Explain the functioning of OP-AMPS and use them as the building blocks of logic gates.
v.	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

Course Outcomes / Program Outcomes		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
i.	Apply the laws of thermodynamics and analyze the thermal system.	X	X	X	X	X	X					X	X
ii.	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
iii.	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
iv.	Explain the functioning of OP-AMPS and them as the building blocks of logic gates.	X	X	X	X	X	X					X	X
v.	Give the use of logic gates using different theorems of Boolean Algebra followed by logic circuits.	X	X	X	X	X	X					X	X

Thermal Physics and Electronics

Unit – 1

The Portion to be Covered

Laws of Thermodynamics:

Review of the concepts of Heat and Temperature. **(1 Hour)**

First Law of Thermodynamics: Differential form, Internal Energy. Equation of state for an adiabatic process, Work Done during Isothermal and Adiabatic Processes. **(3 Hours)**

Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Reversible and Irreversible processes with examples. Heat Engines: Carnot engine & efficiency (no derivation). Refrigeration & coefficient of performance, Applications of Carnot engine in locomotion, Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy **(5 Hours)**

Third Law of Thermodynamics: Statement, Significance and Unattainability of Absolute Zero. **(2 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 first law of thermodynamics.	L1	1	1-6,11-12
ii.	Give the differential form of the first law of thermodynamics and define what the internal energy is.	L2	1	1-6,11-12
iii.	Obtain an expression for work done in isothermal and adiabatic processes.	L2	1	1-6,11-12
iv.	Give two systems of units of temperature measurement and give their equivalence.	L2	1	1-6,11-12
v.	Describe and Discuss heat engine based on Carnot cycle.	L2	1	1-6,11-12
vi.	Explain how the efficiency of refrigeration is measured?	L2	1	1-6,11-12
vii.	Detail out the application of the Carnot engine to a locomotion system.	L1	1	1-6,11-12
viii.	Define entropy and write an expression for entropy using the second law of thermodynamics.	L2	1	1-6,11-12
ix.	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
x.	High Order Problems.	L3	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

Suggested Activities (2 Hours)

Activity No. 1	I feel cold because coldness enters my body. Discuss the statement in day-to-day life. Approximately give examples of **(i)** open system **(ii)** closed system and **(iii)** isolated system 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. Discuss why when a person works or does exercise, he sweats. Reason it with the laws of thermodynamics.
Activity No. 2	**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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** 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. **(i)** Plot a graph for the volume of the metal piece used v/s respective temperature change observed. **(ii)** Determine the heat capacity and specific heat of the metal used.

	All groups shall also do the following activity:
Activity No. 3	**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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take ice cubes of different size and immerse in water and measure the temperature change with time and repeat the experiment. Graph the observations.

Thermal Physics and Electronics

Unit – 2

The Portion to be Covered

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Properties and Applications. **(1 Hour)**

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations (1) First order Phase Transitions with examples, Clausius - Clapeyron Equation (2) Values of Cp-Cv (3) Joule-Thomson Effect and Joule-Thomson coefficient and Derive an equation for Vander Walls gas. Attainment of low temperature by liquefaction of gases and adiabatic demagnetization. **(3 Hours)**

Kinetic Theory of Gases: Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas: Mean, RMS and Most Probable Speeds. Degrees of Freedom, Law of Equipartition of Energy. Specific heats of Gases. **(2 Hours)**

Radiation: Blackbody radiation, spectral distribution, the concept of energy density and pressure of radiation, Wien's law, Wien's displacement law, Stefan-Boltzmann law, Rayleigh-Jeans law, Ultraviolet Radiation catastrophe and Planck's law of radiation. **(4 Hours)**

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

SL No	TLO's	BL	CO	PO
i.	State Maxwell relations.	**L1**	**2**	**1-6, 11-12**
ii.	Give examples where Maxwells relations are used.	**L1**	**2**	**1-6, 11-12**

iii.	Explain the phase transition. Which is called as first order phase transition? Give Examples	**L2**	**2**	**1-6, 11-12**
iv.	State Clausius - Clapeyron Equation.	**L1**	**2**	**1-6, 11-12**
v.	Obtain an equation for difference in C_P - C_V.	**L2**	**2**	**1-6, 11-12**
vi.	State Joule-Thomson effect and Joule-Thomson coefficient.	**L1**	**2**	**1-6, 11-12**
vii.	Obtain an expression, giving the relation between pressure, volume and temperature for a real gas (Vander Waals gas).	**L2**	**2**	**1-6, 11-12**
viii.	Explain adiabatic demagnetization and how it is used to obtain low temperature by the liquidation of gases?	**L2**	**2**	**1-6, 11-12**
ix.	State Maxwell-Boltzmann Law of Distribution of Velocities in Ideal gases.	**L1**	**2**	**1-6, 11-12**
x.	Explain the mean RMS and most probable speeds in ideal gases.	**L1**	**2**	**1-6, 11-12**
xi.	Explain degrees of freedom associated with particles in an ideal gas?	**L2**	**2**	**1-6, 11-12**
xii.	Define the specific heat of a gas.	**L1**	**2**	**1-6, 11-12**
xiii.	Explain black body radiation and its spectral distribution.	**L1**	**2**	**1-6, 11-12**
xiv.	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**
xv.	Define ultraviolet radiation catastrophe? Discuss its importance in the explanation of black body radiation.	**L2**	**2**	**1-6, 11-12**
xvi.	Define Planck's law of radiation and discuss how it could describe the whole black body radiation curve.	**L2**	**2**	**1-6, 11-12**
xvii.	High Order Problems.	**L3**	**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.

Suggested Activities (2 Hours)	
Activity No. 4	**(i)** Measuring the Solar Constant Materials: Simple flat sided Jar and Thermometer. Activity: Bottle containing water is exposed to solar radiation. The rise in temperature and time taken are noted. Calculate the heat absorbed by water and relate it to the output of the Sun. **(ii)** Thermo emf Materials: Suitable two dissimilar metal wires, voltage measuring device. Activity: In this experiment student will assemble the thermocouple and study the three effects namely, Seebeck, Peltier, and Thompson. **(iii)** Inverse square law of radiation Materials: A cardboard with a grid, cardboard with a hole, supporting clips, a ruler, candle. **(iv)** Activity: Students set the device. They count the lighted squares on the cardboard with the grid by varying the distance. And make necessary measurements and calculations to arrive at the inverse square law of radiation. Ref: Activity Based Physics Thinking Problems in Thermodynamics: Kinetic Theory http://www.physics.umd.edu/perg/abp/think/thermo/kt.htm
Activity No. 5	**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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** 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.
Activity No. 6	**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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study.

	Activity: Make 4 groups and give different-sized balloons to each group. Fit different-sized nozzles into the mouth of the large balloons. Measure the temperature or the EMF generated using a thermocouple placed at the mouth of the nozzle as the pressurised gas is released. Plot a graph of time v/s temperature. Vary the volume of the balloon and repeat the experiment. Plot the graph of volume v/s temperature difference created.

Thermal Physics and Electronics

Unit – 3

The Portion to be Covered

Semiconductor devices: Review of Intrinsic and Extrinsic semiconductors, p-n junction and its Characteristics (p-n, zener, LED and tunnel diode characteristics comparison) and Parameters, Diode approximations (applications of above diodes as per the respective graphs), Half-wave rectifier, Full-wave rectifier, Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator. **(5 hours)**

Junction Transistors: Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Emitter mode characteristics, [Common Base and Common Collector Characteristics (qualitative)]. Field Effect Transistor (FET) and its characteristics [J-FET only]. Transistor as an Amplifier [CE mode: voltage divider bias, DC load line, Q point, CE amplifier construction and frequency response] and Oscillator [RC phase shift oscillator (CE mode)]. **(6 hours)**

Topic Learning Outcomes

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

SL No	TLO's	BL	CO	PO
i.	Define Semiconductors and Band Gap. Explain on what basis they are classified as intrinsic and extrinsic.	**L2**	**3**	**1-6, 11-12**
ii.	Define PN junction. Explain it's functioning in forward and reverse bias.	**L1**	**3**	**1-6, 11-12**
iii.	Explain the approximation used in a real diode with respect to an ideal PN Junction?	**L2**	**3**	**1-6, 11-12**
iv.	With a schematic diagram, explain half wave and full wave rectifiers.	**L1**	**3**	**1-6, 11-12**
v.	Define a Zener diode and explain how it is different from an ordinary diode using V-I curves?	**L2**	**3**	**1-6, 11-12**
vi.	With the schematic diagram, explain the working of voltage regulators of different types using a Zener diode.	**L1**	**3**	**1-6, 11-12**

vii.	Give the basic concepts used in the instruction of bipolar junction transistor and its operation.	**L1**	**3**	**1-6, 11-12**

viii.	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**
ix.	Define FET? Give its characteristics.	**L1**	**3**	**1-6, 11-12**
x.	Explain how a transistor can be used as an amplifier and an oscillator using a circuit diagram.	**L2**	**3**	**1-6, 11-12**
xi.	High Order Problems.	**L3**	**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

Suggested Activities (2 Hours)

Activity No. 7	Wire a regulated DC power supply on a bread board or groove board to give a regulated output voltage of + 5 V; +15 V; Dual power output : ± 5 V; Dual power output : ± 15 V. Use: 3-pin voltage regulators. Components required: 1.Step down transformer- 1 No. (5 V tapping, 100 – 500 mA current rating), BY 127 semiconductor diodes – 4 Nos, Inductor -1, Capacitor - 1, 3 pin 5V regulator-1 Search for circuit diagram in books/net. **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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study.

	Activity: Form 3 groups and tell them to make a DC supply of low current of different voltages like 5V, 10V, and 15V on a breadboard
Activity No. 8	**(i)** Learn to identify the terminals of different types (packages) of BJTs. **(ii)** In the case of power transistors, learn how to fix a heat sink for the transistor. **(iii)** Learn the difference between BJT and FET in its operational characteristics.
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. **(i)** The first slide will explain the process of doing the experiment. **(ii)** In the second slide. Students will show the graph of measurement. **(iii)** In the third slide, they will list three observations from that study. **Activity:** Take any 3 diode and assign one to each group. Measure its resistance when dipped in ice and 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.

Thermal Physics and Electronics

Unit – 4

The Portion to be Covered

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)**

Digital: 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. **(3 hours)**

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. **(4 hours)**

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

SL No	TLO's	BL	CO	PO

i.	Define op-amps and give the characteristics of an ideal op-amp.	**L1**	**4**	**1-6, 11-12**
ii.	Explains an inverting and non-inverting configuration of typical op-amps, with a schematic diagram.	**L2**	**4**	**1-6, 11-12**
iii.	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**
iv.	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**
v.	Give different digital wave forms and explain how one can visualize the switching and logic levels.	**L1**	**5**	**1-6, 11-12**
vi.	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**
vii.	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**
viii.	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**
ix.	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**
x.	Why are X-NOR gates called Universal Gates?	**L2**	**5**	**1-6, 11-12**
xi.	High Order Problems.	**L3**	**4, 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

Suggested Activities (2 Hours)

Activity No. 10	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. 11	**Operational Amplifiers** **(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.
Activity No. 12	**(i)** 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 gates. **(ii)** A locker has been rented in the bank. Express the process of opening the locker in terms of digital operation. **(iii)** 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 and one of the switches irrespective of the state of the other switch. The logic of switching of the bulb resembles.

Textbooks

Sl No	Title of the Book
1.	Electronic Devices and Circuits, David A. Bell, 2004, PHI, New Delhi
2.	Integrated Electronics, Jacob Millman and CC Halkias
3.	Digital Fundamentals, Floyd, 2001, PHI, New Delhi

References Books

Sl No	Title of the Book
1.	Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2.	Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3.	A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
4.	Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5.	Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

6.	An Introduction to Thermal Physics, Daniel V Schroeder, 2020, Oxford University Press

Formative Assessment	
Assessment	**Marks**
Internal Assessment	10
Activity	10
REU based Group Activity (Conduction, Report, Presentation)	10
Science Communication (Seminar/Poster etc)	10
Total	40

List of Experiments to be performed in the Laboratory *(Minimum 8 (Eight) experiments must be performed)	
1.	Mechanical Equivalent of Heat by Callender and Barne's method.
2.	Coefficient of thermal conductivity of Copper by Searle's apparatus.
3.	Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
4.	Determination of Stefan's constant/ Verification of Stefan's law.
5.	Variation of thermo-emf across two junctions of a thermocouple with temperature.
6.	Verification of Clausius –Clapeyron equation and determination of specific enthalpy.
7.	V-I Characteristics of Silicon / Germanium p-n Junction diodes (FB & RB of p-n diode, FB of LED).
8.	Characteristics of BJT in Common Emitter Configuration(Input and Output characteristics).
9.	Half wave rectifier without & with filter (no filter C- filter, LC- filter and π- filter).
10.	Applications of Operational Amplifier [(Non-inverting, inverting and differential amplifier (DC)]
11.	Transfer characteristics of a TTL gate using CRO.
12.	V-I Characteristics of zener diode and zener voltage regulator (line & load regulation)
13.	Construction of CE amplifier and study the frequency response.
14.	Construction of CC amplifier and study the frequency response.
15.	Full wave rectifier without & with filter (no filter C- filter, LC- filter and π- filter).
16.	OPAMP applications: Adder, subtractor and voltage follower/differentiator/integrator
17.	Construction and verification of truth tables of OR, AND, NOT, NOR & NAND gates using discrete components.
18.	Construction and verification of truth tables of OR, AND, NOT, NOR & NAND gates using IC 7400.
19.	Verification of truth tables of De Morgan's theorems (for two input variables).

Reference Book for Laboratory Experiments	
Sl No	**Title of the Book**
1.	Basic Electronics Lab (P242) Manual 2015-16, National Institute of Science Education and Research, Bhubaneswar, 2015.
2.	**Suggested Readings:** 1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e. 2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e.

PHYSICS IN DIALY LIFE

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Outcomes (COs)	1	2	3	4	5	6
CO - 1: To understand the phenomenon taking place in nature and use physical reasoning to explain astronomical phenomena						
CO - 2: understand Newton's laws of motion and the role they play in predicting motion.						
CO - 3: To understand the concept and significance of physical phenomena in accoustics,optics ,heat and thermodynamics						
CO - 4: Will acquire the knowledge of regulator, chokes and electrical appliances						
CO - 5: Will understand the working principle of lightning arrestor,mixer,grinder						
CO - 6 Students shall be able to understand principles and applications associated with general physics as applied to a broad range of aspects of everyday life.						
CO - 7: To understand the concept of laser principles and applications						
CO - 8: Students shall be able to understand biological effects of radiations						

Unit I

PHYSICS IN NATURE

Introduction to environmental Physics-Our Environment, Constituents of Environment-Planetary motion atmospheric pressure, eclipses, 2 hours
Light-propagation-reflection-refraction-mirages-total internal reflection-optical fibres 2 hours
Newton's laws of motion : Illustrations for three laws, Inertia, gravity and conservation of angular momentum (Recoiling of gun, launching rockets),friction, working of lubricants, weightlessness, frame of reference: Relative motion 5 hours
Surface tension, viscosity, consequences capillarity: Applications
Energy: Kinetic and potential energy, conservation of energy examples
Sound: production and propagation, Resonance, Echo, ultrasonic, applications, basics of acoustics 4 hours

UNIT-II

PHYSICS IN APPLIANCES

Working of switches (1-way 2-way), Principle and working of regulator, principle and working of starter and chokes, Domestic wiring -Application of Fuses, ELCB (Earth Leakage Circuit Breaker) 4 hours

Principle and working of lightning arrester-precautions during lightning-, Principle and working of Iron box, induction coil- Principle and working of filament bulb, tube light, fluorescent bulb and LED bulbs, 5 hours

Working of ceiling & table fan, working of Mixer and Grinder, Working of Fridge/ AC/-washing machine. Smart electrical devices. Electricity saving techniques 4 hours

UNIT-III

RECENT TRENDS IN PHYSICS

-

Types of Radiations: Ionising and Non ionising radiations, Thermal radiations, Usage and impact. Radiation Hazards, Radiation Safety measures, Applications of radioactive elements Nuclear Reactors, applications 5 hours

Heat and thermodynamics: conduction, convection, working principle of pressure cooker, microwave ovens, effects of heat absorption-examples 4 hours

Superconductivity, Applications, Laser Principles and Applications, Nanotechnology: Medical and Military applications of Physics 4 hours

Activity

- Hands on training of electrical Equipments by experts
- Opening some electrical devices and understanding the construction and working
- Visiting nearby workshops / laboratories

Reference Books

1. Fundamentals of Environmental Physics by N K Mahapathra
2. Fundamental concepts in environmental studies by DD Mishra
3. Astronomy- the Evolving Universe III Edition (Harper and Row) by Felik M
4. Heat and thermodynamics: Brijlal N Subramanyam,P S Hemne
5. A text book of optics: N Subramanyam, Brijlal
4. Dawn of Universe by BimaNath
5. Sky watching by David H. Levy
6. Modern Physics by R. Murugeshan
7. Nuclear Physics by S. N. Ghoshal

ELECTRICAL /ELECTRONIC DEVICES

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
CO - 1: Will be able to understand working principle of electronic devices	**x**	**x**				
CO - 2: Will be able to understand working principle of electrical devices	**x**	**x**				
CO - 3: will understand mobile communication process	**x**	**x**	x			
CO - 4: Will acquire the knowledge of digital cameras and digital storage techniques	**x**		x			x
CO - 5: Will understand the working principle of lightning arrestor	**x**	x	x			
CO - 6: Will acquire the knowledge on measuring instruments	**x**		x	x	**x**	**x**
CO - 7: Will be able to explain the working principle of CRO	**x**	**x**		x		**x**
CO - 8: Will be able to understand the use of CRO for measuring	**x**					**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

Unit 1

Working Principle of Electronic devices

Electric current, Ohms law, emf, Electric Power, KWh, generator, reactance, impedance, capacitor, inductor, choke & transformer. Introduction to Current and voltage measuring instruments: AC & DC Ammeter, AC & DC Voltmeter, watt hour meter, Potentiometer, Multi meter, Basic working principle of Radio/TV /-Mobile phones-Chargers-remote controllers-Blue tooth-2G/3G/5G Concepts-GPRS-Digital devices –digital measuring instruments-digital display-Digital camera-Resolution–Pixels-advantages and limitations-Digital Zoom-Optical Zoom. Digital storage devices-CD/DVD/Pen drive. 13hrs

Unit 2

Working Principle of Electrical devices:

Working of switches (1-way 2-way), Principle and working of regulator, principle and working of starter and chokes, Domestic wiring -Application of Fuses, ELCB (Earth Leakage Circuit Breaker) Principle and working of lightning arrester-precautions during lightning-, Principle and working of Iron box, Mixer grinder-induction coil- Principle and working of filament bulb, tube light, fluorescent bulb and LED bulbs, Working of ceiling & table fan, working of Mixer and Grinder, Working of Fridge/ AC/-washing machine. Smart electrical devices 13 Hrs

Unit 3

Basics of Measurements: Instrument accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period) 13hrs

Activity

- Opening some electronic devices and understanding the construction and working
- Opening electrical devices and understanding the construction and working
- Studying all functions of multimeter
- Using multimeter for measurement of different electrical parameters
- Opening an old CRO and studying its construction
- Visiting nearby work shops /laboratories
- List out the least counts of different instruments
- Design a voltage regulator with out put 5 V

- List out different sensors used in electronic appliances

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer 8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson
8.Electrical Engineering, MV Rao, Subhas Stores Books Corner, 2013
9. Electrical Wiring, SL Uppal, GC Gang, Khanna, 1986
10.. Electrical Engineering, NL Anwani, Dhanpat Rai& Sons, 1978

Open Elective Syllabus (IV semester): For Science stream

Physics Open Elective-IV

Climate Science

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes

(POs) Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
CO-1: Will be able to provide a general framework for understanding climate change by addressing major components of Earth's climate system	✓	✓				
CO-2: Will come to know about the climate change differ from day-to-day weather, factors drive changes in Earth's climate	✓	✓				
CO-3: Will allows students to visualize the emission spectra associated with particular temperatures, to understand how Planck's Law can be used to plot blackbody curves of objects with different temperatures, and to learn the relationship between temperature and peak wavelengths in the electromagnetic spectrum.	✓	✓			✓	
CO-4: Will understand the effects of Hadley Circulation on global precipitation patterns, the geographical distribution of deserts, and trade winds.	✓	✓		✓		

CO-5: Will able to understand the Coriolis Force, and the effect of the Coriolis Force on weather and climate and able to apply the law of conservation of angular momentum and understand the concept of a thermally direct cell.	✓	✓			✓	
CO-6: Will understand the stability of different phases of matter (solid, liquid, and gas) under changing temperature and pressure.	✓				✓	✓
CO-7: Will able to explain the physical parts of the climate system temperature, precipitation, winds, and pressure, interaction with its organic parts (Earth's biosphere)	✓	✓			✓	✓
CO-8: Will be able to understand the effect of bio-sphere on the climate system and cause of recent warming and Green House Gases.	✓			✓	✓	✓

Unit.	Topics.	No. of Lectures.
Unit I	Chapter-1 Introduction: Climate, weather, Climate change.	
	Component of climate system: Internal interaction: Atmosphere, Vegetation, Ocean, Ice, Land surface. *Climate forcing and response*: External Forcing (CAUSES): Changes in plate tectonics, Changes in Earth's orbit, Changes in sun Strength. Anthropogenic Forcing.	3
	Chapter-II Climate Variation, Response.	
	Climate variations: Internal Response: Changes in atmosphere, changes in land surface, changes in ocean, changes in vegetation, and changes in ice. *Climate response Time*: Time scale of forcing verses response, Slow Response and Fast Response. *Feed back in climate system*: Positive and negative feedback.	3
	Chapter-III Heating Earth: Incoming solar Radiation	
	Planck's Law and Blackbody Radiation through Climate: Planck's Law, Wien's Law, Blackbody Radiation, Stefan-Boltzmann Law, Relationship between Temperature and Peak Wavelength of the Electromagnetic Spectrum, Planetary Temperatures as a function of solar energy received, Greenhouse Effect of Earth's Atmosphere, Planetary Climates, Planetary Energy Balance, The Greenhouse Effect.	7

Unit II	Heat Transfer in Atmosphere: Coriolis Effect, and the Impact of Coriolis Effect on Climate.	
	Chapter-I Heat Transfer in Earth's atmosphere.	2
	Water in the climate system: Heat capacity, specific heat, Latent Heat, Heat transformation. *Water Vapours*: Thermal inertia, sensible heat, convection, latent heat of melting/vaporisation,	
	Chapter-II *Heat Transport in the Atmosphere*, Hadley Circulation and Climate, Reason for geographical distribution of deserts on Earth (Global Precipitation Patterns and Distribution of Deserts) *Heat transfer in Earth's Ocean*: The Surface Ocean: Gyres. Deep ocean circulation: Thermo-haline Flow. Inter-tropical convergence zone (ITCZ), Monsoons (Summer and Winter monsoons).	6
	Chapter-III Coriolis Force, Coriolis Effect	
	Coriolis Force, Coriolis Effect, and the Impact of Coriolis Effect on Climate, Trade Winds, Upwelling, Climate and the Atmosphere, Climate and the Hydrosphere	5
Unit III	Phase Diagrams and Phase Equilibria. Earths Bio-sphere	
	Chapter-I Phase Diagram Of Water.	5
	Phase Equilibria, Phase Diagrams of Water, Triple and Critical Points in a Phase Diagram, Degrees of Freedom, Feedback Mechanisms, Vapour Pressure, Runaway Greenhouse Effect.	
	Chapter-II Response of bio-sphere to climate system	4
	Effect of Bio-sphere on the climate system. Anthropogenic Cause of Recent Warming. Green House Gases	
	Chapter-III Effect of Green House Gas on Climate system	4
	Effect of carbon dioxide, methane, chloroflurocarbons, sulphate aerosols, land clearance on global warming.	
	Reference Books/Materials:	
	1997. Climate Change: State of Knowledge. Washington, DC: Office of Science and Technology Policy. Imbrie, J. 1985. "A Theoretical Framework for the Ice Ages." Journal of the Geological Society 142:417–32. Barry, R. G., and Chorley, R. J. 2009. Atmosphere, Weather, and Climate. New York: Routledge. Thurman, H. V. 1997. Introductory Oceanography. New Jersey: Prentice Hall. Levitus, S., et al. 2000. "Warming of the World Ocean," Science 287:	

	285–93. Huang, S. H., N. Pollack, and P.-Y. Shen. 2000. "Temperature Trends over the Past Five Centuries Reconstructed from Borehole Temperatures." Nature 403: 756–8. World Climate Research Program (WCRP) Web site. http://www.wcrp-climate.org/. Last accessed March 17, 2013. National Climatic Data Center Web site. "Global Warming FAQs." http://www.ncdc.noaa.gov/oa/ climate/globalwarming.html. Last accessed March 17, 2013. Henson, R. 2006. "The Rough Guide to Climate Change." London, Rough Guides, Ltd World Climate Research Program (WCRP) Web site. http://www.wcrp-climate.org/. Last accessed March 17, 2013 Archer, D. 2011. *Global Warming: Understanding the Forecast*. Wiley. Introduction to Climate Science - 1st Edition Andreas Schmittner, Oregan State University. Understanding Climate Science - Stephen Schneider by R Wolfson Introduction to Weather and Climate Science, by Jonathan E. Martin	
	✓ **Additional Resources/Activities:**	
	1. A micro-lecture (video), "The Coriolis effect", from Khan Academy: https://www.khanacademy.org/partner-content/nova/clouds/v/hurricanes 2. A reading, "Coriolis effect", from National Geographic: https://www.nationalgeographic.org/encyclopedia/coriolis-effect/ 3. A reading, "Hadley Cells", from Harvard University: https://www.seas.harvard.edu/climate/eli/research/equable/hadley2.html 4. A reading and embedded videos, "Global circulation patterns", from the Met Office, UK: https://www.metoffice.gov.uk/learning/atmosphere/global-circulation-patterns 5. A reading, "Energy Balance and Planetary Temperatures", from the American Chemical Society (ACS): https://www.acs.org/content/acs/en/climatescience/energybalance.html 6. A visualization tool, "Planetary Energy Balance", from UCAR Center for Science Education: https://scied.ucar.edu/planetary-energy-balance 7. Classroom/Laboratory Activity (15 min) An interactive simulation from PhET, University of Colorado, to explore the phase transformations of water under changing temperature and pressure conditions. https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html 8. Video (~18 min)A video micro-lecture from Coursera that describes the current and past climatic conditions on Mars https://www.coursera.org/lecture/solar-system/lecture-1-15-was-early-mars-warmer-and-wetter-kNENP	

Open Elective Syllabus (IV semester): For Non-Science stream

Physics Open Elective-IV

Physics of Sports

Programme Outcomes

PO - 1 Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO - 2 Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO - 3 Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO - 4 Ethics: Apply the professional ethics and norms in respective discipline.

PO - 5 Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO - 6 Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes

(POs) Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
CO-1: Will be able to know the basic physics behind sports and games.	✓	✓				
CO-2: Will come to know about the laws that applicable in events.	✓	✓				
CO-3: Will allows students to apply the laws in sports equipment's.	✓	✓			✓	
CO-4: Will understand the effects of change in parameters.	✓	✓		✓		
CO-5: Will able to understand the principle behind the sports materials.	✓	✓			✓	
CO-6: Will understand the importance of the theory behind the preparation of equipment.	✓				✓	✓
CO-7: Will able to explain the fitness for particular event	✓	✓			✓	✓
CO-8: Will be able to understand balance of theory and application.	✓			✓	✓	✓

Syllabus- OEC: Physics of Sports	**Total Hrs: 39**

Unit-I	**13hrs.**
Concepts of Physics: Concept of Velocity, Momentum, Force, Action and Reaction, Damping, Friction. Rotation circular motion, gravitation, projectile -, Catch and Throws, thrust and pressure, Range conservation of angular momentum and torque, laws of floatation, Archimedes principle. Shooting.	
Unit-II	**13hrs.**
Physics of Instruments - Bats, Inflated Balls - Tennis, Table Tennis, Basketball, Football. Hard Balls - Cricket Ball, Bowling Ball, Soft (Woollen Ball), Javelin, discus, Carom and shot foot Physics of Instrument Sports: Impact sports - Cricket & Baseball Batting, Golf putting, Kicking Football, Badminton & Tennis Athletics - Paul Vault, Bowling, Curling-spinning, volley ball, throw ball Ice sports - Skating, Ice Hockey.	
Unit-III	**13hrs.**
Physics of Non-Instruments Sports: Throwing, Pulling Pushing and Sliding sports - Cricket Bowling, Baseball throw, Shot put throw. Discus throw and Javelin Throw, carrom game and Ice Skating, Kabaddi. Board games - Carrom, Billiards & Snooker Athletics - Physics of Running, Long jump, high jump, ballet dancer, gymnastics, diving and swimming, cycling track and Boating race, rowing, sailing, water polo, sport climbing and surfing	

Suggested Activities:

1. Assignment on size of courts used in volley ball, kabaddi and tennis and also nets.
2. Assignment on size of carom board and size carom pans
3. Assignment on size of cricket boundary and distance between wickets
4. Assignment size of Tracks, long and high jumps
5. Watching Videos on www.youtube.com

Reference:

1.The Physics of Sports A Textbook By David R. Heskett
2.Concepts in physics by H C Verma
3. https://en.wikipedia.org/wiki/Fundamentals_of_Physics
4.https://www.academia.edu/36062426/fundamentals_of_physics_textbook_pdf

OPEN ELECTIVE: PHYSICS

OPEN ELECTIVES TOPICS:

Semester	**Topic**	
	Science stream	**Non- Science stream**
First Semester	Energy Sources	Physics in time line
Second Semester	Astronomy	Space Mission
Third Semester	Electrical and Electronic Instruments	Physics in Daily life
Fourth Semester	Climate Science	Physics of Sports

Semester	**Instruction hour per week**	**Total No. of Lectures**	**Duration of Examination**	**I A marks**	**Semester Exam. Marks**
I, II, III & IV	**03**	**39**	**02 hours**	**40**	**60**

OPEN ELECTIVE (I semester): For Science stream

Physics Open elective - I

ENERGY SOURCES

Syllabus- OEC: Energy Sources	Total Hrs: 39
Unit-I	13 hrs
Introduction to Energy Sources: Energy concepts, sources in general, its significance and necessity. Classification of energy sources: primary and secondary sources. Energy consumption as a measure of prosperity. Need of renewable energy sources. Conventional (commercial) energy sources, non-conventional energy sources (Renewable energy). Advantages of renewable energy. Obstacles to the implementation of renewable energy systems. Prospects of renewable energy sources. Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges.	
Unit-II	13 hr
Solar-Energy and its Applications: Potential of solar energy, solar radiation and measurements, different types of solar energy collectors, advantages and disadvantages of different collectors, solar energy storage. Solar hot water supply systems. Solar air heating and cooling systems. Solar thermal electric power	

generation. Solar pumping, distillation, furnace and green houses. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems	
Unit-III	13 hr
Wind energy harvesting and Ocean Energy and energy from Biomass: Fundamental of wind energy, wind turbines and different electrical machines in wind turbines, power electronic interfaces and grid interconnection topologies. Ocean Energy: Ocean energy potential against wind and solar, wave characteristics and statics wave energy devices. Tide characteristics and statistics, tide energy technologies ocean thermal energy, osmotic power, ocean bio-mass Energy from Biomass: Biomass conversion technologies: wet process, dry process, photosynthesis. Biogas generation: Factors affecting bio-digestion. Classification of biogas plants: Floating drum plant, fixed dome plant, advantages and disadvantages of these plants.	

Suggested Activities:

1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs.
2. Conversion of vibration to voltage using piezoelectric materials.
3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules.
4. Project report on solar energy scenario in India
5. Project report on Hydro energy scenario in India
6. Project report on wind energy scenario in India
7. Field trip to nearby hydroelectric stations.
8. Field trip to wind energy stations
9. Field trip to solar energy parks
10. Videos on solar energy, hydro energy and wind energy.

Books recommended.

1. Non-conventional energy sources by G. D. Rai Khanna Publishers New Delhi.
2. Solar energy by M. P. Agarwal S. Chand and Co. Ltd.
3. Solar energy by Suhas P. Sukhative Tata McGraw-Hill publishing Company Ltd.
4. Dr. P. Jayakumar, solar Energy: Resources Assessment Handbook, 2009.

OPEN ELECTIVE (I semester): For Non-Science stream

Physics Open elective - I

PHYSICS IN TIME LINE

Syllabus- OEC: Physics in time line	Total Hrs: 39
Unit-I	**13hrs.**
EARLY MODERN WORLD: The ancient India describes the origin of the universe, Aristotle-geocentric Universe, Ptolemy - Geocentric model, Aryabhata ,Nicolaus Copernicus, Kepler Laws of Planetary Motion, Galileo Galilei Principle of Relativity, , Freely falling bodies, Isaac Newton Laws of motion , laws of gravitation John Dalton develops his atomic theory, Michael Faraday electromagnetism James Clerk Maxwell demonstrates that electric and magnetic field Henri Becquerel radioactivity Thomson discovers the electron.	
Unit-II	**13hrs.**
MODERN WORLD: Quantum theory, photoelectric effect $E=mc^2$ mass-energy relation, Special Theory of Relativity ,General Theory of Relativity, discovery of the proton, Pauli exclusion principle, Uncertainty principle, Schrödinger Equation, - Hubble's Law, discovers the neutron, "Chandrasekhar limit" nuclear fission, Integrated Circuit" Higgs Bosons, nuclear reactor, atom bomb, Blue LED, Laser, Optical fibre, MRI, CT scan, Ultrasound Super conductivity, Magnetic levitation-trains	
Unit-III	**13 hrs.**
Discoveries and Inventions- (mention only): X-rays ,Zeeman effect Radioactivity Work of Marie Curie, Rayleigh Scattering, Lenard - work on cathode rays, Thomson -conduction of electricity by gases" Michelson instruments and the spectroscopic, Colours photography, Wireless telegraphy, Equation of state for gases and liquids, Superconductivity Diffraction of X-rays by crystals Stark effect, Structure of atoms, Andrews Millikan- elementary charge ,Compton effect, Thermionic emission, - The wave nature of electrons, Raman - Effect, Diffraction of electrons by Crystals, Discovery of nuclear reactions ,Cyclotron, Transistor, Quantum electro dynamics.	

Suggested Activities:

1. Uses of LED, Transistor, diodes, and IC
2. Uses of LASER in Medicine, bar code reader, laser printer.

3. Uses of MRI, CT SCAN and X-RAYS.
4 uses and applications of physics in daily life

References:

1. Concepts in physics by H C Verma
2. https://www.pdfdrive.com/halliday-resnick-fundamentals-of-physics-e175337758.html
3. https://openstax.org/details/books/college-physics
4. https://www.nobelprize.org/prizes/lists/all-nobel-prizes-in-physics/
5. https://www.britannica.com

Open elective (II semester): For science stream

Physics Open elective-II

ASTRONOMY

Syllabus- OEC: ASTRONOMY	**Total Hrs: 39**
Unit-I	**13 hrs**
Ancient Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Greek, Sumerian, Mayan, Egyptian, Arabic and Chinese Observations Medieval Astronomy: Geocentric Model, Heliocentric Model Observations by Tycho Brahe, Kepler, Galileo, Herschel and others. 3 Tools for Astronomy: Invention of Telescopes Pin Hole, Binoculars, Telescopes & Imaging. Modern Astronomy Hubble's discovery, Stellar Evolution (Brief), Microwave, Radio Telescopes, Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors**.**	
Unit-II	**13hrs**
The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Zero-shadow day Sunspots. 2 The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names. Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits. Outer Planets: Mars, Jupiter & Saturn	
Unit-III	**13hrs**
Observational History, Observational Windows, Appearance, Frequency of Oppositions, Oppositions, Conjunctions, Galilean Moons, Saturn's Rings Distant or Minute Objects: Uranus, Neptune & Asteroids Observational History, Observational Windows, Asteroid Belt, Prominent Asteroids. 5 Comets & Meteors Origin, Orbital Nature, Historical Observations, Prominent Comets and Asteroids., Meteors, Origins and Showers 2 Occultations, Transits and Eclipses Definitions, Prominent Occultations and Transits, Eclipses – Types and prominent occurrences. Famous Eclipses in the past.	

Suggested Activities:

1. Assignments on Planets and Sun.
2. Project work on Comets.
3. Assignments of Bing Bang Theory.

4. Assignments of Types of Galaxies.
5. Assignments of Eclipses -Solar and Lunar.
6. Use of telescope to view sun spots.
7. Visiting Regional Science Centre.

Reference:

1 The Amateur Astronomer Sir Patrick Moore Springer 2006.

2 Handbook of Practical Astronomy Gunter D. Routh Springer 2009.

3 Fundamental Astronomy Hannu Karttunen Springer 2007.

4 Guide to Night Sky P. Shankar KRVP 2007.

5 The Complete Idiot's Guide to Astronomy Christopher De Pree and Alan Axelrod Pearson 2001.

6 The story of Astronomy In India Chander mohan Research Gate 2015

7 Trigonometry - Inc. Bar Charts.

8. Stargazing for Dummies Steve Owens John Wiley & Sons 2013.

9. A Sky watcher's Year Jeff Kanipe Cambridge University Press 1999.

10. The Casual Sky Observer's Guide Rony De Laet Springer 2012.

Open elective (II semester): For non-science stream

Physics Open elective-II

SPACE MISSION

Syllabus- OEC: SPACE MISSION	Total Hrs: 39
Unit-I	13 hrs
Introduction to Space Missions: Rockets, types and their applications, Different types of orbits, Artificial satellites – basic idea and their applications, Introduction to Space Missions, Beginning of Space Missions - World and India, Applications of Space Research, international space station, space telescopes -Hubble, Chandra and James web Telescopes	
Unit-II	13 hrs
Space crafts, Launching Vehicles. Topics for Self-study: Major Space Centres in the World (at least 10) – brief idea about their location, establishment, capabilities and achievements. People behind space programs – at least 2 from India. Successful Missions (Any Five). 6 Indian Space Research Organisation (ISRO): About ISRO and its Goals, History of Creation. General Satellite	

Unit-III	13 hrs
Programmes: The IRS series, The INSAT series. Gagan Satellite Navigation System, Navigation with Indian Constellation (NavIC), Other satellites. Launch vehicles: Satellite Launch Vehicle (SLV), Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV). Experimental Satellites: Details and applications (Any Five) Earth Observation Satellites: Details and applications (Any Five) Communication satellites: Details and applications	

Suggested Activities:

1. Assignments on rockets.
2. Project work Indian space programme.
3. Brief report ISRO AND NASA.
4. Telescopes and space station.
5. SLV.PSLV and GSLV.
6. Launching pad in India, master control facility and ISRO headquarters.
7. Father of Indian space program.

References:

1. India in Space Paper back by HarperCollins Publishers India.
2. international space station by Michel D Cole.
3. Developing space by John K.
4. Deep space craft's by Dave Doode.
5. Mission exploration space encyclopaedia.

First Semester B.Sc. Degree Examination, April/May 2022

(NEP-2020)

(2021-22 Batch Onwards)

PHYSICS (DSCC)

Mechanics and Properties of Matter

Time: 2 Hours Max. Marks : 60

***Instructions**: 1) Answer questions from **all** parts.*

*2) Scientific Calculators are **allowed**.*

PART- A

Answer **any 4** questions. (4×2=8)

1.

2.

3.

4.

5.

6.

PART-B

Answer the following. (4×10=40)

UNIT-I

7. a) 4

   b) 6

OR

8. a) 4

   b) 6

UNIT-II

9. a) 4

   b) 6

OR

10. a) 4

b) 6

UNIT-III

11. a) 4

b) 6

OR

12. a) 4

b) 6

UNIT-IV

13. a) 4

b) 6

OR

14. a) 4

b) 6

PART-C

15. Answer **any three** of the following. (3×4=12)

1.

2.

3.

4.

First Semester Open Elective Examination, April/May 2022

(NEP-2020) (2021-22 Batch Onwards)

PHYSICS

OPEN ELECTIVE TOPIC

Time: 2 Hours Max. Marks: 60

***Instructions**: 1) Answer questions from **all** Units.*

*2) Scientific Calculators are **allowed**.*

UNIT-1

1. a) 5

b) 7

c) 8

OR

2. a) 5

b) 7

c) 8

UNIT-2

3. a) 5

b) 7

c) 8

OR

4. a) 5

b) 7

c) 8

P.T.O.

UNIT-3

5. a)		5
b)		7
c)		8

OR

6. a)		5
b)		7
c)		8

Programme Name	BSC in Physics	Semester	V
Course Title	Classical Mechanics and Quantum Mechanics-I (Theory)		
Course Code	PHY C9-T	No. of Credits	04
Contact hours	52	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to

- **Identify the failure of classical physics at the microscopic level.**
- **Find the relationship between the normalization of a wave function and the ability to correctly calculate expectation values or probability densities.**
- **Explain the minimum uncertainty of measuring both observables on any quantum state.**
- **Describe the time-dependent and time-independent Schrödinger equation for simple potentials like for instance one-dimensional potential well and Harmonic oscillator.**
- **Apply Hermitian operators, their eigenvalues and eigenvectors to find various commutation and uncertainty relations.**

Contents	52 Hrs
Introduction to Newtonian Mechanics: Frames of references (Definition), Newton's laws of motion (statement), inertial and non-inertial frames (Statement). Mechanics of a particle: Conservation of linear momentum (Derivation), Angular momentum and torque, (Relation) conservation of angular momentum,(Derivation) work done by a force, conservative force and conservative energy.(Statement with equation) Lagrangian formulation: Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints (Statement, Differences and examples). Generalized coordinates (statement).Degrees of freedom (Statement).Principle of virtual work (Derivation).D'Alembert's principle,(Derivation). Lagrange equations (qualitative). Newton's equation of motion from Lagrange equations (Derivation). Examples i: simple pendulum (Derivation) ii: Atwood's machine (Derivation) and iii: linear harmonic oscillator (Derivation) ,problems.	13 Hrs
Variational principle: Hamilton's principle (Statement), Deduction of Hamilton's principle (Derivation), Lagrange's equation of motion from Hamilton's principle (Derivation), (Examples same as Lagrangian) Hamilton's principle for non-holonomic systems. (Qualitative). **Hamiltonian Mechanics:** The Hamiltonian of a system (statement), Hamilton's equations of motion,(Derivation) Hamilton's equations from variational principle, (derivation) Integrals of Hamilton's equations, energy integrals (Expression), Canonical Transformations (quantitative), Poison Brackets (Qualitative), fundamental properties and equations of motion in Poison Brackets (Derivation), Problems.	13 Hrs
Introduction to Quantum Mechanics	13 Hrs

Brief discussion about the failure of classical theory of physics in the experimental observations of black body radiation (Qualitative), Photoelectric effect (Quantitative), stability of atoms and spectra of atoms (quantitative),Compton Effect: Compton scattering: Expression for Compton shift (derivation). Matter waves: de Broglie hypothesis of matter waves,(Definition, relation), Experimental evidence for matter waves: Davisson-Germer experiment, (Quantitative) and its significance. Electron microscope(Qualitative), Wave description of particles by wave packets, Group velocity, Phase velocity, Particle velocity and relation between them(Definition, derivation),Heisenberg uncertainty principle: Elementary proof of Heisenberg's relation between momentum and position, energy and time, angular momentum and angular position. (Definition, relation, examples).Illustration of uncertainty principle by Gamma ray microscope thought experiment (Derivation), Consequences of the uncertainty relations: why electron cannot exist in nucleus? (Quantative). Diffraction of electrons at a single slit (Derivation), G.P Thomson's experiment Double slit experiment with photons and electrons,(Qualitative). Linear superposition principle as a consequence(Qualitative)	
Foundation of Quantum Mechanics Schrödinger equation: time-dependent and time-independent wave equations, (Derivation). Schrodinger wave equation for a free particle in one and three-dimension, (Derivation, problems).Probabilistic interpretation of the wave function: normalization and orthogonality of wave functions(Qualitative). Probability current density, equation of continuity and its physical significance(Definition, equation) Postulates of Quantum mechanics: First Postulate representation of states. Second postulates representation of dynamical variable as linear operators (Qualitative). Third postulate as representation of expectation values of operators (Qualitative). Ehrenfest theorem. (Statement and Significance). Eigen values and Eigen functions. (Qualitative) Particle in a one-dimensional infinite potential well (Derivation),. Particle in a finite potential well (Qualitative), Transmission across a potential barrier (Qualitative), the tunnel effect (Qualitative), scanning tunnelling microscope, One-dimensional simple harmonic oscillator (Qualitative) - concept of zero - point energy (Qualitative).	**13 Hrs**

Pedagogy: 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 for Theory Assessment Occasion/ type Marks Total 40 Marks Formative Assessment as per UNIVERSITY guidelines are compulsory.

Formative Assessment for Theory	
Assessment Occasion Type	Marks
Total	40 marks

References	
1	Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2	Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer
3	Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4	Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
5	Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009
6	Physics for Scientists and Engineers with Modern Physics, Serway and Jewett, 9th edition, Cengage Learning, 2014.
7	Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008.
8	Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, McGraw Hill, 2003.
9	P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN: 9780070146174.
10	Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication,ISBN 978-1-4020-2130-5.
11	Modern Physics; R.Murugeshan & K.Sivaprasath; S. Chand Publishing.
12	G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN: 97881203363.
13	Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications.
14	Physics for Degree Students B.Sc., Third Year, C.L.Arora and P.S.Hemne, 1st edition, S.Chand & Company Pvt. Ltd., 2014.

Course Title	Classical Mechanics and Quantum Mechanics-I Lab **(Practical)**		No of Credits 02
Course Code	PHY C10-P	**Contact Hours : 04 Hours**	
Formative Assessment	25 Marks	**Summative Assessment**	**25 Marks**
Practical Content			

Lab experiments: (Minimum 8 experiments must be completed by the students)

1) To determine 'g', the acceleration due to gravity, at a given place, from the L – T 2 graph, for a simple pendulum.
2) Studying the effect of mass of the bob on the time period of the simple pendulum.
3) Studying the effect of amplitude of oscillation on the time period of the simple pendulum.
4) Determine the acceleration of gravity is to use an Atwood's machine.
5) Study the conservation of energy and momentum using projectile motion.
6) Verification of the Principle of Conservation of Linear Momentum
7) Determination of Planck constant and work function of the material of the cathode using Photo-electric cell.
8) To study the spectral characteristics of a photo-voltaic cell (Solar cell).
9) Determination of electron charge 'e' by Millikan's Oil drop experiment.
10) To study the characteristics of solar cell.
11) To find the value of e/m for an electron by Thomson's method using bar magnets.
12) To determine the value of e/m for an electron by magnetron method.
13) To study the tunnelling in Tunnel Diode using I-V characteristics.
14) Determination of quantum efficiency of Photodiode.
15) A code in C/C++/Scilab to find the first seven eigen states and eigen functions of Linear Harmonic Oscillator by solving the Schrödinger equation.
16) A code in C/C++/Scilab to plot and analyse the wavefunctions for particle in an infinite potential well.
17) Damped oscillations
18) q by stretching.
19) Monte-Carlo experiment
20) Study of tunnel diode as oscillator
21) Fourier analysis of square wave

Formative Assessment for Theory	
Assessment Occasion Type	Marks
Total	25 marks

References

1 B.Sc Practical Physics by C.L Arora.
2 B.Sc Practical Physics by Harnam Singh and P.S Hemne.
3 Practical Physics by G.S Squires.
4 Scilab Manual for CC-XI: Quantum Mechanics &Applications (32221501) by Dr Neetu Agrawal, Daulat Ram College, of Delhi.
5 Scilab Textbook Companion for Quantum Mechanics by M. C. Jain.
6 Computational Quantum Mechanics using Scilab, BIT Mesra.
7 Advanced Practical Physics for Students by Worsnop B L and Flint H T.

For Lab Activity refer the KSHEC web Site.

Programme Name	BSC in Physics	Semester	V
Course Title	Elements of Atomic, Molecular & Laser Physics (Theory)		
Course Code	PHY C11-T	No. of Credits	04
Contact hours	52	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s): PUC Science Knowledge

Course Outcomes (COs): After the successful completion of the course, the student will be able to

- Describe atomic properties using basic atomic models.
- Interpret atomic spectra of elements using vector atom model.
- Interpret molecular spectra of compounds using basics of molecular physics.
- Explain laser systems and their applications in various fields.

Contents	52 Hrs
Unit 1: Basic Atomic models: Thomson's atomic model; Rutherford atomic model Theory of alpha particle scattering,(Idea of Distance of closest approach, impact parameter and scattering cross section), Rutherford scattering formula;(Mention) Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom; Effect of nuclear motion on atomic spectra - derivation; Ritz combination principle; Correspondence principle; Critical potentials-excitation potential and ionisation potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits.(Qualitative) **11Hours** **Activities: 02 Hours** 1. Students to estimate radii of orbits and energies of electron in case of hydrogen atom in different orbits and plot the graph of radii / energy versus principal quantum number 'n'. Analyse the nature of the graph and draw the inferences. 2. Students to search critical, excitation and ionisation potentials of different elements and plot the graph of critical /excitation / ionisation potentials versus atomic number/mass number/neutron number of element. Analyse the nature of the graph and draw the inferences.	**13 Hrs**
Unit 2: Vector atomic model and optical spectra: Concept of spin, Stern-Gerlach experiment – Experimental arrangement, principles and results. Vector atom model – model fundamentals, spatial quantisation, spinning electron; Quantum numbers associated with vector atomic model; Coupling schemes – L-S and j-j schemes; Spin-orbit coupling/Spin-Orbit Interaction – qualitative; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Lande g-factor and its calculation for different states;(Singlet and Doublet); Fine structure of spectral lines with examples; Optical spectra – spectral terms, spectral notations, selection rules, intensity rules; Fine structure	**13 Hrs**

of the sodium D-line; Zeeman effect: Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation), examples; Stark effect: Experimental study, Types and examples.(Qualitative). **11 Hours** **Activities: 02 Hours** 1. Students to couple a p-state and s-state electron via L-S and j-j coupling schemes for a system with two electrons and construct vector diagrams for each resultant. Analyse the coupling results and draw the inferences. 2. Students to estimate magnetic dipole moment due to orbital motion of electron for different states 2P1/2, 2P3/2, 2P5/2, 2P7/2, 2P9/2 and 2P11/2 and plot the graph of dipole moment versus total orbital angular momentum "J'. Analyse the nature of the graph and draw the inferences.	
Unit 3: Molecular Physics; Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non- rigid rotator. Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence; Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum approaches, Experimental study of Raman effect; Applications of Raman effect. **11 Hours** **Activities: 02 Hours** 1. Students to estimate energy of rigid diatomic molecules CO, HCl and plot the graph of rotational energy versus rotational quantum number 'J'. Analyse the nature of the graph and draw the inferences. Also students study the effect of isotopes on rotational energies. 2. Students to estimate energy of harmonic vibrating molecules CO, HCl and plot the graph of vibrational energy versus vibrational quantum number 'v'. Analyse the nature of the graph and draw the inferences.	**13 Hrs**
Unit 4: Laser Physics: Ordinary light versus laser light; Characteristics of laser light; Interaction of radiation with matter - Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Assuming the Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion, medicine, industry, and space. **11 Hours** **Activities: 02 Hours** 1. Students to search different lasers used in medical field (ex: eye surgery, endoscopy, dentistry etc.), list their parameters and analyse the need of these	**13 Hrs.**

parameters for specific application, and draw the inferences. Students also make the presentation of the study. 2. Students to search different lasers used in defence field (ex: range finding, laser weapon, etc.), list their parameters and analyse the need of these parameters for specific application, and draw the inferences. Students also make the presentation of the study.	

Pedagogy: 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 for Theory	
Assessment Occasion Type	Marks
Total	40 marks

References	
1	Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2	Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut
3	Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
4	Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
5	Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.
6	Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, Fourth Edition, 2008, Tata McGraw-Hill Publishers.
7	Elements of Spectroscopy – Atomic, Molecular and Laser Physics, Gupta, Kumar and Sharma, 2016, Pragati Publications.

Course Title	Elements of Atomic, Molecular& Laser Physics Lab Practicals		**Practical Credits 02**
Course Code	PHY C12-P	Contact Hours	04 Hours
Formative Assessment	25 Marks	Summative Assessment	25 marks

Practical Content

LIST OF EXPERIMENTS

1. To determine Planck's constant using Photocell-.
2. To determine Planck's constant using LED.
3. To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube/solar radiation.
4. To determine the wavelength of H-alpha emission line of Hydrogen atom.
5. To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapor.
8. To determine the force constant and vibrational constant for the iodine molecule from its absorption spectrum.
9. To determine the wavelength of laser using diffraction by single slit/double slits.
10. To determine wavelength of He-Ne laser/Semiconductor laser using plane diffraction grating.
11. To determine angular spread of He-Ne laser/Semiconductor laser using plane diffraction grating.
12. Study of Raman scattering by CCl_4 using laser and spectrometer/CDS.
13. M and C by Carey-Foster method
14. ECE of copper
15. Earth inductor
16. Intensity of spectral lines
17. L and C by Anderson's bridge.
18. Spectral response of LDR

NOTE: Students have to perform at-least EIGHT Experiments from the above list.

References

1 Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.

2 B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand & Comp.Ltd.

3 An Advanced Course in Practical Physics, D. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.

4 Physics through experiments, B. Saraf, 2013, Vikas Publications.

Formative Assessment for Theory	
Assessment Occasion Type	Marks
Total	25 marks

Program Name	**B Sc Physics**	Semester	VI
Course Title	Elements of Condensed Matter & Nuclear Physics		
Course Code:	PHY C14 - T	No. of Credits	**4**
Contact hours	**52 Hours**	Duration of SEA/Exam	**3 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- Explain the basic properties of nucleus and get the idea of its inner information.
- Understand the concepts of binding energy and binding energy per nucleon v/s mass number graph.
- Describe the processes of alpha, beta and gamma decays based on well-established theories.
- Explain the basic aspects of interaction of gamma radiation with matter by photoelectric effect, Compton scattering and pair production.
- Explain the different nuclear radiation detectors such as ionization chamber, Geiger-Mueller counter etc.
- Explain the basic concept of scintillation detectors, photo-multiplier tube and semiconductor detectors

Contents	52 Hrs
Crystal systems and X-rays: Crystal structure: Space Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, primitive, non-primitive cells. Seven crystal system, Coordination numbers, Miller Indices, Expression for inter planner spacing. **X Rays**: Production and properties of X rays, Coolidge tube, Continuous and characteristic X-ray spectra; Moseley's law. **X-Ray diffraction**, Scattering of X-rays, Bragg's law. **Crystal diffraction:** Bragg's X-ray spectrometer- powder diffraction method, Intensity vs 2θ plot (qualitative). **Free electron theory of metals:** Classical free electron model (Drude-Lorentz model), expression for electrical and thermal conductivity, Weidman-Franz law, Failure of classical free electron theory; Quantum free electron theory, Fermi level and Fermi energy, Fermi-Dirac distribution function (expression for probability distribution F(E), statement only); Fermi Dirac distribution at T=0 and $E<E_f$, at $T\neq 0$ and $E>E_f$, F(E) vs E plot at $T = 0$ and $T\neq 0$. Density of states for free electrons (statement only, no derivation). Qualitative discussion of lattice vibration and concept of Phonons.; Specific heats of solids: Classical theory, Einstein's and Debye's theory of specific heats. Hall Effect in metals.	13 Hrs
Magnetic Properties of Matter, Dielectrics and Superconductivity **Magnetic Properties of Matter**	13 Hrs

Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia, Para, and ferro magnetic materials; Langevin Classical Theory of dia – and Paramagnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains (qualitative). Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials **Dielectrics**: Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric loss. Piezo electric effect, cause, examples and applications. **Superconductivity:** Definition, Experimental results – Zero resistivity and Critical temperature– The critical magnetic field – Meissner effect, Type I and type II superconductors.	
General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy ,main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments **Radioactivity decay:** Radioactivity: definition of radioactivity, half life, mean life, radioactivity equilibrium (a) Alpha decay: basics of α-decay processes, theory of α emission (brief), Gamow factor, Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion (Definition)	13 Hrs
Interaction of Nuclear Radiation with matter: Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe Block formula), energy loss of electrons, introduction of Cerenkov radiation **Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility) qualitative only, Accelerators: Cyclotrons and Synchrotrons	13 Hrs
Suggested Activities:	
1) Students to construct seven crystal systems with bamboo sticks and rubber bands. Use foam ball as atoms and study the BCC and FCC systems. 2)Students to search the characteristic X ray wavelength of different atoms/elements and plot characteristic wavelength vs atomic number and analyse the result and draw the inference. 3)Magnetic field lines are invisible. Students to trace the magnetic field lines using bar magnet and needle compass. https://nationalmaglab.org/magnet-academy/try-this-at-home/drawing-magnetic-field-lines/ , 4)Using vegetable oil and iron fillings students to make ferrofluids and see how it behaves in the presence of magnetic field. https://nationalmaglab.org/magnet-academy/try-this-at-home/making-ferrofluids/ 1) Study the decay scheme of selected alpha, beta & gamma radioactive sources with the help of standard nuclear data book. 2) Calculate binding energy of some selected light, medium and heavy nuclei. Plot the graph of binding energy versus mass number A 3) Study the decay scheme of standard alpha, beta and gamma sources using nuclear data book. 4) Make the list of alpha emitters from Uranium series and Thorium series. Search the kinetic energy of alpha particle emitted by these alpha emitters. Collect the required data such as half life or decay constant. Verify Geiger-Nuttal in each series. 5) Study the Z dependence of photoelectric effect cross section. 6) Study the Z dependence of common cross section for selected gamma energies and	

selected elements through theoretical calculation. 7) List the materials and their properties which are used for photocathode of PMT. 8) Study any two types of PMT and their advantages and disadvantages.	

Pedagogy: 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 for Theory	
Assessment Occasion/ type	**Marks**
Total	**40 Marks**
Formative Assessment as per UNIVERSITY guidelines are compulsory	

References

Text Books

1. Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
2. Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut(2017).
3. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclear Physics, Irving Kaplan, Narosa Publishing House

Reference Books

1. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
5. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
6. Essential of crystallography, **M A Wahab**, Narosa Publications (**2009**)
7. Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**).
8. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
9. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
10. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
11. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
12. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
13. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

Course Title	Elements of Condensed Matter & Nuclear Physics Lab (Practical)	Practical Credits	02
Course Code	A15	Contact Hours	04 Hours
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Practical Content

List of experiments: (Minimum 8 experiments must be completed by the students.)

1. Determination of Plank's constant by Photo Cell
2. Hall Effect in semiconductor: determination of mobility, hall coefficient.
3. Energy gap of semiconductor (diode/transistor) by reverse saturation method
4. Thermistor energy gap
5. Fermi Energy of Copper
6. Analysis of X-ray diffraction spectra and calculation of lattice parameter.
7. Specific Heat of Solid by Electrical Method
8. Determination of Dielectric Constant of polar liquid.
9. Determination of dipole moment of organic liquid
10. B-H Curve Using CRO/By conventional method.
11. Spectral Response of Photo Diode and its I-V Characteristics.
12. Determination of particle size from XRD pattern using Debye-Scherrer formula.
13. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method).
14. Measurement of susceptibility of paramagnetic solid (Gouy's Method)
15. Energy gap of photodiode
16. B_H by Tangent galvanometer
17. Specific heat by cooling.
18. Thermocouple – Determination of Thermo emf
19. Refractive index of material of convex lens and focal length
20. Study the characteristics of Geiger-Mùller Tube. Determine the threshold voltage, plateau region and operating voltage.
21. Study the absorption of beta particles in aluminium foils using GM counter. Determine mass attenuation coefficient of Aluminium foils.
22. Study the absorption of beta particles in thin copper foils using G M counter and determine mass attenuation coefficient.
23. Study the attenuation of gamma rays in lead foils using Cs-137 source and G M counter. Calculate mass attenuation coefficient of Lead for Gamma.
24. Determine the end point energy of Tl-204 source by studying the absorption of beta particles in aluminium foils.
25. Study the attenuation of absorption of gamma rays in polymeric materials using Cs-137 source and G M counter.

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Total	**25 Marks**

Program Name	**BSc in Physics**		Semester	**VI**
Course Title	Electronic Instrumentation & Sensors **(Theory)**			
Course Code:	PHY C16 - T		No. of Credits	**04**
Contact hours	**52 Hours**		Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- Identify different types of tests and measuring instruments used in practice and understand their basic working principles.
- Get hands on training in wiring a circuit, soldering, making a measurement using an electronic circuit used in instrumentation.
- Have an understanding of the basic electronic components viz., resistors, capacitors, inductors, discrete and integrated circuits, colour codes, values and pin diagram, their practical use.
- Understanding of the measurement of voltage, current, resistance value, identification of the terminals of a transistor and ICs.
- Identify and understand the different types of transducers and sensors used in robust and hand-held instruments.
- Understand and give a mathematical treatment of the working of rectifiers, filter, data converters and different types of transducers.
- Connect the concepts learnt in the course to their practical use in daily life.
- Develop basic hands-on skills in the usage of oscilloscopes, multimeters, rectifiers, amplifiers, oscillators and high voltage probes, generators and digital meters.
- Servicing of simple faults of domestic appliances: Iron box, immersion heater, fan, hot plate, battery charger, emergency lamp and the like.

Contents	**52 Hrs**
Power supply AC power and its characteristics, Single phase and three phase, Need for DC power supply and its characteristics, line voltage and frequency, Rectifier bridge, Filters: Capacitor and inductor filers, L-section and π-section filters, ripple factor, electronic voltage regulators, stabilization factor, voltage regulation using ICs. (5 hours) **Basic electrical measuring instruments** Cathode ray oscilloscope- Block diagram, basic principle, electron beam, CRT features, signal display. Basic elements of digital storage oscilloscopes. Basic DC voltmeter for measuring potential difference, Extending Voltmeter range, AC voltmeter	13 Hrs

using rectifiers Basic DC ammeter, requirement of a shunt, Extending of ammeter ranges. (5 hours) *Topics for self-study:* *Average value and RMS value of current, Ripple factor, Average AC input power and DC output power, efficiency of a DC power supply. Multirange voltmeter and ammeter.* **Activities (3 hours)** 1. Design and wire your own DC regulated power supply. Power output: 5 V, 10 V, ± 5 V. Components required: A step down transformer, semiconductor diodes (BY126/127), Inductor, Capacitor, Zener diode or 3-pin voltage regulator or IC. Measure the ripple factor and efficiency at each stage. Tabulate the result. 2. Extend the range of measurement of voltage of a voltmeter (analog or digital) using external component and circuitry. Design your own circuit and report. 3. Measure the characteristics of the signal waveform using a CRO and function generator. Tabulate the frequency and time period. Learn the function of Trigger input in an CRO. 4. Learn to use a Storage Oscilloscope for measuring the characteristics of a repetitive input signal. Convince yourself how signal averaging using Storage CRO improves S/N ratio.	
Unit-II: Wave form generators and Filters Basic principle of standard AF signal generator: Fixed frequency and variable frequency, AF sine and square wave generator, basic Wein-bridge network and oscillator configuration, Triangular and saw tooth wave generators, circuitry and waveforms. (5 hours) Passive and active filters. Fundamental theorem of filters, Proof of the theorem by considering a symmetrical T-network. Types of filters, Circuitry and Cut-off frequency and frequency response of Passive (RC) and Active (op-amp based) filters: Low pass, high pass and band pass. (5 hours) **Activities (3 hours)** 1. Measure the amplitude and frequency of the different waveforms and tabulate the results. Required instruments: A 10 MHz oscilloscope, Function generators (sine wave and square wave). 2. Explore where signal filtering network is used in real life. Visit a nearby telephone exchange and discuss with the Engineers and technicians. Prepare a report. 3. Explore op-amp which works from a single supply biasing voltage (+15V). Construct an inverting/non-inverting amplifier powered by a single supply voltage instead of dual or bipolar supply voltage. 4. Op-amp is a linear (analog) IC. Can it be used to function as logic gates? Explore, construct and implement AND, OR NAND and NOR gate functions using op-amps. Verify the truth table. Hint: LM3900 op-amp may be used. The status of the output may be checked by LED.	13 Hrs
Unit-III: Data Conversion and display Digital to Analog (D/A) and Analog to Digital (A/D) converters – A/D converter with pre-amplification and filtering. D/A converter - Variable resistor network, Ladder type (R-2R) D/A converter, Op-amp based D/A converter. (4 hours) Digital display systems and Indicators- Classification of displays, Light Emitting Diodes (LED) and Liquid Crystal Display (LCD) – Structure and working. (3 hours) Data Transmission systems – Advantages and disadvantages of digital transmission over analog transmission, Pulse amplitude modulation (PAM), Pulse time modulation (PTM) and Pulse width	13Hrs

modulation (PWM)- General principles. Principle of Phase Sensitive Detection (PSD). *Topic for self-study: Lock-in amplifier and its application, phase locked loop.* (3 hours) **Activities (3 hours)** 1. Explore where modulation and demodulation technique is employed in real life. Visit a Radio broadcasting station. (Aakashavani or Private). Prepare a report on different AM and FM stations. 2. Explore and find out the difference between a standard op-amp and an instrumentation op-amp. Compare the two and prepare a report.	
Unit-IV: Transducers and sensors Definition and types of transducers. Basic characteristics of an electrical transducer, factors governing the selection of a transducer, Resistive transducer-potentiometer, Strain gauge and types (general description), Resistance thermometer-platinum resistance thermometer. Thermistor. Inductive Transducer-general principles, Linear Variable Differential Transducer (LDVT)- principle and construction, Capacitive Transducer, Piezo-electric transducer, Photoelectric transducer, Photovoltaic cell, photo diode and phototransistor – principle and working. **Activities (3 hours)** (10 hours) 1. Construct your own thermocouple for the measurement of temperature with copper and constantan wires. Use the thermocouple and a Digital multimeter (DMM). Record the emf (voltage induced) by maintaining one of the junctions at a constant temperature (say at 0° C, melting ice) and another junction at variable temperature bath. Tabulate the voltages induced and temperatures read out using standard chart (Chart can be downloaded from the internet). 2. Observe a solar water heater. Some solar water heaters are fitted with an anode rod (alloy of aluminium). Study why it is required. Describe the principle behind solar water heater.	13Hrs

Pedagogy: 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 for Theory	
Assessment Occasion/ type	**Marks**
Total	**40 Marks**
Formative Assessment as per UNIVERSITY guidelines are compulsory	

References

1. Physics for Degree students (Third Year) – C.L. Arora and P.S. Hemne, S, Chand and Co. Pvt. Ltd. 2014 (For Unit-1, Power supplies)
2. Electronic Instrumentation, 3rd Edition, H.S. Kalsi, McGraw Hill Education India Pvt. Ltd. 2011 (For rest of the syllabus)
3. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd. (Especially for circuitry and analysis of signal generators and filters)

Course Title	Electronic Instrumentation & Sensors Lab **(Practical)**	Practical Credits	**02**
Course Code	**PHY C17 - P**	Contact Hours	**04 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

List of experiments (At least 8 experiments to be performed)

1. **Construct a DC power supply using a bridge rectifier and a capacitor filter. Use a Zener diode or a 3-pin voltage regulator and study the load and line regulation characteristics. Measure ripple factor with and without filter and compare with theoretical values.**
2. **Calibration of a low range voltmeter using a potentiometer**
3. **Calibration of an ammeter using a potentiometer**
4. Design and construct a Wien bridge oscillator (sine wave oscillator) using µA 741 op-amp. Choose the values of R and C for a sine wave frequency of 1 KHz. Vary the value of R and C to change the oscillation frequency.
5. Design and construct a square wave generator using *µA* 741 op-amp. Determine its frequency and compare with the theoretical value. Also measure the slew rate of the op-amp. If the 741 is replace by LM318, study how does the waveform compare with the previous one.
6. Study the frequency response of a first order op-amp low pass filter
7. Study the frequency response of a first order op-amp high pass filter
8. Study the frequency response of a first order op-amp band pass and band stop filters
9. Study the characteristics of *pn*-junction of a solar cell and determine its efficiency.
10. Study the illumination intensity of a solar cell using a standard photo detector (e.g., lux meter).
11. Study the characteristics of a LED (variation of intensity of emitted light).
12. Study the characteristics of a thermistor (temperature coefficient of resistance)
13. Determine the coupling coefficient of a piezo-electric crystal.
14. Study the amplitude modulation using a transistor.
15. Performance analysis of A/D and D/A converter using resistor ladder network and op-amp.
16. Clipping and clamping circuits
17. Study of OPAMP as integrator
18. Study of OPAMP as differentiator

20. frequency of AC by AC and DC meters
21. Measurement of frequency, voltage, types of waves and testing components using CRO

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Total	**25 Marks**

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