Bangalore University
Department of Physics

Jnanabharathi Campus
Bengaluru – 560 056

Syllabus for
1st & 2nd Semester Physics Papers
Under-Graduate(UG) Program

Framed according to the National Education Policy (NEP 2020)

(Effective from the Academic Year 2021-22)

Board of Studies in Physics (UG) Members

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Date: 18 September 2021
Place: Bengaluru

Names	Members	Signature
Dr. A R Ushadevi, Professor & Chairman Department of Physics, Bangalore University, Bengaluru-560056.	Chairperson	18/9/2024
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Dr. B N Meera, Associate Professor (Invited) Department of Physics, Bangalore University Jnanabharthi Campus, Bengaluru-560056.	Member	B. N. Meera
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Dr. Seeta Vasudevrao, Assistant Professor, (Invited) Government First Grade College, Kengeri, Bengalore-560002.	Member	Seeta V

Introduction

The NEP-2020 offers an opportunity to effect a paradigm shift from a teacher-centric to a student-centric higher education system in India. It is based on Outcome Based Education, where the Graduate Attributes are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Physics is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Physics, as well as to develop scientific orientation, spirit of enquiry problem solving skills and human and professional values which foster rational and critical thinking in students.

Graduate attributes in Physics

Some of the characteristic attributes a graduate in Physics should possess are:

- Disciplinary knowledge and skills:
- Skilled communication:
- Critical thinking and problem solving capacity:
- Sense of inquiry:
- Team player/worker:
- Project Management Skills:
- Digital and ICT efficiency:
- Ethical awareness / reasoning:
- National and international perspective:
- Lifelong learning

Flexibility

- The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.
- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.
- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities
- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3.i and 3.ii)
- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.
- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

EXIT OPTIONS	Credits required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	44 - 48
Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	88 - 96
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-year Integrated Master's Degree Programme	132 - 144
Bachelor Degree with Honours in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	176 - 192
Master's Degree in a Discipline at the Successful Completion of the Fifth Year (Ten Semesters) of the Five- year Integrated Master's Degree Programme	224- 240

Aims of UG program in Physics

The aims and objectives of our UG educational programs in sciences in general and Physics in particular should be structured to

- Create the facilities and environment in all the educational institutions to consolidate the knowledge acquired at +2 level and to motivate and inspire the students to create deep interest in Physics, to develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
- Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
- Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
- Expose the student to the vast scope of Physics as a theoretical and experimental science with applications in solving most of the problems in nature spanning from 10^{-15} m to 10^{26}m in space and 10^{-10} eV to 10^{25}eV in energy dimensions.
- Emphasize the discipline of Physics to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.
- To emphasize the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

The progressive curriculum shall position knowledge and skills required on the transformation of novice problem solvers (at entry level of the program) to expert problem solvers (by the time of graduation) as given below:

- At the end of first year – Ability to solve well defined problems
- At the end of second year – Ability to solve broadly defined problems
- At the end of third year – Ability to solve complex problems that are ill-structure that require multi-disciplinary skills to solve them
- During fourth year – Experience of workplace problem solving in the form of internship or Research Experience preparing for higher education or Entrepreneurship and employment.

Curriculum Framework for Multidisciplinary Four- year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

Year	Objectives	Nature of Courses	Outcome	No. of courses
1st year – (1st & 2nd Semesters)	Understanding and Exploration	1. Discipline based Core Courses 2. Open Elective 3. Languages, 4. Ability Enhancement Compulsory Courses 5. Skill Enhancement/ Development Courses	Understanding of Disciplines Language Competency Gaining perspective of context/Generic skills Basic skills sets to pursue any vocation	2+2 1+1 2+2 1+1 1+1
Exit option with Certification				
2nd Year - (3rd & 4th Semesters)	Focus and Immersion	1. Discipline based Core Courses 2. Open Elective 3. Ability Enhancement 4. Skill based/Vocational 5. Extra Curricular Activities	Understanding of disciplines Gaining perspective of context Skill sets to pursue vocation Development of various domains of mind & Personality	2+2 1+1 1+1 1+1 1+1
Exit Option with Diploma				
3rd Year - (5th & 6th Semesters)	Real time Learning	1. Major Discipline Core and Elective Courses 2. Minor Discipline/ Generic or Vocational Electives/Field based Learning/ Research Project	In depth learning of major and minor disciplines, Skill sets for employability. Exposure to discipline beyond the chosen Subject Experiential learning/ Research.	2+2 1+1 1+1
Exit option with Bachelor Degree				
4th Year - (7th&8th Semesters)	Deeper Concentration	Major Discipline Core and Elective courses Research/ Project Work with Dissertation	Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies	4+4
Bachelor Degree with Honours				
5th Year - (9th & 10th Semesters)	Master of the subject	Major Discipline Core and Elective courses/ Research/ Project Work with Dissertation	Deeper and Advanced Learning of the Major Discipline towards gaining proficiency	4+4/6+6

			over the subject	
Master's Degree				

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

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

Open Electives

1st Semester	
1.	Phy-OE1: Energy Sources
2.	*Phy-OE2: Physics for All.
2nd Semester	
3.	Phy-OE3: Atmospheric Science
4.	Phy-OE4: Sports Science
3rd Semester	
5.	Phy-OE5: Optical Instruments
6.	Phy-OE6: Elements of Astronomy and Astrophysics
4th Semester	
7.	Phy-OE7: Medical Physics
8.	Phy-OE8: Nanotechnology
9.	Phy-OE9: Electrical Instruments

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

Discipline Specific Electives for 7 to 10 Semesters

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

9th Sem Electives (Specialization papers) **Pool B-III**		**10th Sem Electives (Specialization papers)** **Pool B-IV**	
A.	Condensed Matter Physics-2	A.	Condensed Matter Physics-3
B.	Nuclear and Particle Physics-2	B.	Nuclear and Particle Physics-3
C.	Atomic & Molecular spectroscopy-1	C.	Atomic & Molecular spectroscopy-2

D.	Materials Physics & Nanophysics –1	D.	Materials Physics & Nanophysics -2
E.	Theoretical and Computational Physics-I	E.	Theoretical and Computational Physics-2
F.	Astronomy and Astrophysics-1	F.	Astronomy and Astrophysics-2

Detailed Syllabus for 1st & 2nd Semesters

1st Semester

Phy-DSCT1: Mechanics and Properties of Matter	Course Credits (L+T+P) : 4+0+0
Total Contact Hours: 52	Duration of ESA: 3 hours

Course Outcomes (COs):

1. Fixing units, tabulation of observations, analysis of data (graphical/analytical).
2. Accuracy of measurement and sources of errors, importance of significant figures.
3. Knowledge of how g can be determined experimentally and derive satisfaction.
4. Understanding the difference between simple and torsional pendulum and their use in the determination of various physical parameters.
5. Knowledge of how various elastic moduli can be determined.
6. Measuring surface tension and viscosity and appreciate the methods adopted.
7. Hands on experience of different equipments.

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

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Fixing units, tabulation of observations, analysis of data (graphical/analytical)	x					
Accuracy of measurement and sources of errors, importance of significant figures		x				
Knowledge of how g can be determined experimentally and derive satisfaction.	x					
Understanding the difference between simple and torsional pendulum and their use in the determination of various physical parameters					x	
Knowledge of how various elastic moduli can be determined	x					
Measuring surface tension and viscosity and appreciate the methods adopted	x					
Hands on experience of different equipments.	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.

Course Content Phy.DSCT1: Mechanics & Properties of Matter		Hrs
Unit – 1 **(13 hours of teaching includes 3 hours of activities)**		
Chapter No. 1	**Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.	4
Chapter No. 2	**Momentum and Energy**: Work and energy, Conservation of linear momentum, Conservation of energy with examples, Motion of rockets	4
Chapter No. 3	**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	5
Topics for Self-study	Variable mass problem & Rocket motion Twin paradox	
	Suggested Activities	
Activity No. 1	i). Measure diameters of small balls of different size and estimate their volumes. ii). Measure lengths of nails of different size. iii). Measure volume of a liquid. iv). Measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Mention the precision of the measurement. v). Estimate standard deviations wherever possible.	
Activity No. 2	Understand conservation of energy in every day examples like i) What happens in solar energy conversion panels ii) Pushing an object on the table iii) Moving car hits a parked car causes parked car to move. In these cases, it is known that energy is conserved. How? Understand and verify if possible.	
Unit – 2 **(13 hours of teaching includes 3 hours of activities)**		
Chapter No. 4.	**Laws of Motion:** Newton's Laws of motion, Dynamics of single particle and a system of particles, Centre of mass.	3

Chapter No. 5.	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy, Moment of inertia (M.I): M.I of a rectangular lamina and solid cylinders, Flywheel, Theory of compound pendulum and determination of g.	6
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.	4
Topics for self study	Geosynchronous orbits Basic idea of global positioning system (GPS).	
	Suggested Activities	
Activity No. 3	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. Refer to different websites to construct and perform simple experiments to verify that M.I.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Prepare suitable charts and give seminar talks in the class.	
	Reference : Weblink/Youtube/Book	
Unit – 3 **(13 hours of teaching includes 3 hours of activities)**		
Chapter No. 7	**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. Beams, bending of beams, expression for bending moment, theory of single cantilever. Torsional pendulum, expression for time-period of torsional oscillations, determination of rigidity modulus (static and dynamic methods) and moment of inertia, determination of q, η and σ by Searle's double bar with necessary theory.	13
Topics for self study	Time period of oscillations of a spring-mass system with non-negligible mass of the spring.	

	Suggested Activities	
Activity No. 5	Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. 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.	
	Reference : Weblink/Youtube/Book	
Activity No.6	Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	
	Reference : Weblink/Youtube/Book	
Unit – 4 **(13 hours of teaching includes 3 hours of activities)**		
Chapter No. 8	**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.	7
	Text Book : Units/sections to be Referred:	
Chapter No. 9	Topics to be covered: **Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems	6
	Text Book : Units/sections to be Referred:	
Topics for self study	Capillarity determination of surface tension by drop weight method.	
	Suggested Activities	
Activity No.7	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. Think of reasons.	
	Reference : Weblink/Youtube/Book	
Activity No. 8	Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non sticky liquids are most viscous. Think of 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. Think why anyone should know viscosity of a liquid.	
	Reference : Weblink/Youtube/Book	

Text Books

Sl No	Title of the Book	Author(s)	Publisher	Year of Publication
1	Mechanics	D. S. Mathur	S.Chand &Co.	2000
2	Mechancis and Relativity (3rd Edition)	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	2013
3	Mechanics (In SI Units): Berkeley Physics Course Vol 1	Charles Kittel, Walter Knight, et al	Tata McGraw-Hill	2007
4	Properties of Matter	Brij Lal & Subrahmanyam	S.Chand &Co.	2002

References Books

Sl No	Title of the Book	Author(s)	Publisher	Year of Publication
1	Principles of Physics	David Halliday, Jearl Walker & Robert Resnick	Wiley India Pvt. Ltd	2010
2	Physics (8^{th} Edition)	David Halliday & Robert Resnick	Wiley India Pvt Ltd	2008

Paper Code: Phy-DSCP1 - Lab I (2 credits, 4 hours per week)
List of Experiments to be performed in Lab I

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

Note: A minimum of EIGHT experiments to be carried out

Reference Books for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B. Saraf	Vikas Publications	2013
2	A laboratory manual of Physics for undergraduate classes, 1st Edition,	D P Khandelwal	Vikas Publications.	1985
3	B.Sc. Practical Physics (Revised Edition)	C. L Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B. Saha	New Central Book Agency Pvt Ltd.	2002

Course Content: 2nd Semester

Phy-DSCT2: Electricity and Magnetism	Course Credits (L+T+P) : 4+0+0=4
Total Contact Hours: 52	Duration of ESA: 3 hours

Course Outcomes (COs):

1. 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.
2. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
3. Apply Gauss's law of electrostatics to solve a variety of problems.
4. Describe the magnetic field produced by magnetic dipoles and electric currents.
5. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
6. Describe how magnetism is produced and list examples where its effects are observed.
7. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
8. 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.

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

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point, line, surface, and volume distributions of charges.	x	x				
Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	x	x			x	x
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.

Course Content Phy-DSCT2:Electricity and Magnetism		Hrs
Unit – 1 **(13 hours of teaching includes 3 hours of activities)**		
Chapter No. 1	**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)	3
Chapter No. 2	**Gauss law:** 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	**Electrostatic potential** 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.	7
Topics for self study	Concept of Voltage and Current Sources, Kirchhoff's Laws	
	Suggested Activities	
Activity No. 1	(i) Learn the difference between and DC and AC electricity and their characteristics. (ii) Voltage and line frequency standards in different countries. (iii) A small project report on production of electricity as a source of energy: Different methods	
	Reference : Weblink/Youtube/Book	
Activity No. 2	(i) Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. (ii) Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
	Reference : Weblink/Youtube/Book	

Unit – 2 (13 hours of teaching includes 3 hours of activities)		
Chapter No. 4.	**Conductors in electrostatic field:** Conductors and insulators, conductors in electric field. Capacitance and capacitors, expression for capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, Dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Gauss's law.	6
Chapter No. 5.	**DC currents:** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuit elements and circuits: Transient currents in RC, LR and LCR circuits. Force on a moving charge.	7
Topics for self study	Currents and voltage in combination of R, L and C circuits	
	Suggested Activities	
Activity No. 3	(i) Learn about electrical appliances which work with AC and DC supply. (ii) Learn about types of resistors and their colour codes and types of capacitors (electrolytic and non-electrolytic)	
	Reference : Weblink/Youtube/Book	
Activity No. 4	(i) Learn about power transmission: 3-phase electricity, voltage and phase (ii) Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? (iii) Prepare a small project report on street lighting and types of electrical bulbs.	
	Reference : Weblink/Youtube/Book	

Unit – 3 (13 hours of teaching includes 3 hours of activities)		
Chapter No.6	**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 in a conductor. Electromagnetic induction, conducting rod moving in a magnetic field, Faraday's laws of induction, Lenz's Law, expression for self-inductance and energy stored in a magnetic field. Mutual inductance.	7
Chapter No. 7	**AC circuits:** RMS and average value of AC, Response of series RL, RC, LC, LCR circuits using j-operator method, quality factor, admittance and impedance, power and energy in AC circuits.	6
Topics for self study	Response of parallel RL, RC, LC, LCR circuits using j-operator method	
	Suggested Activities	
Activity No. 5	(i) Prepare a small project report on street lighting and types of electrical bulbs. (ii) Learn the measurement of electric current using tangent galvanometer.	
	Reference : Weblink/Youtube/Book	
Activity No.6	Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
	Reference : Weblink/Youtube/Book	
Unit – 4		
Chapter No. 8	**Electromagnetic waves:** Equation of continuity, Maxwell's equations, displacement current, equation for propagation of electromagnetic wave, transverse nature of electromagnetic wave, energy transported by electromagnetic waves. Poynting vector, magnetic moment of a point charge moving in a circular loop, electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8

Chapter No. 9	**Magnetic materials:** Magnetic intensity and magnetic induction, Intensity of magnetization, Susceptibility, Permeability, Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. Classical Langevin's theory of diamagnetism, B-H hysteresis curves, Hard and soft magnetic materials.	5
Topics for self study	1. Super conductivity 2. At least two Applications of magnetic materials	
	Suggested Activities	
Activity No.7	(i) Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. (ii) Learn the principle of working of a Gauss meter to measure magnetic field	
	Reference : Weblink/Youtube/Book	
Activity No. 8	(i) Model the earth's magnetic field with a diagram. (ii) 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.	
	Reference : Weblink/Youtube/Book	

Text Books

Sl No	**Title of the Book**	**Author(s)**	**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

Paper Code: Phy-DSCP1-Lab II

List of Experiments to be performed in Lab II

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage 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.	Frequency response of LCR Series resonance circuit.
8.	Frequency response of LCR Parallel resonance circuit.
9.	Impedance of series RC circuits - determination of frequency of AC.
10.	Study the i-v characteristics of a series RC and RL Circuit.
11.	Determination of self-inductance of a coil.
12.	Verification of laws of combination of capacitances and determination of unknown capacitance using de-Sauty bridge.
13.	Maxwell's impedance bridge to determine L.
14.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

Note: A minimum of EIGHT experiments to be performed.

Reference Books for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B. Saraf	Vikas Publications	2013
2	A laboratory manual of Physics for undergraduate classes, 1st Edition,	D P Khandelwal	Vikas Publications.	1985
3	B.Sc. Practical Physics (Revised Edition)	C. L Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B. Saha	New Central Book Agency Pvt Ltd.	2002

Open Elective Papers
Phy-OE1: Energy Sources (Credits:3)
3 hours of teaching per week

Unit-I: Non-Renewable energy sources	**Hrs.**
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 (5 hours) **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. (8 hours)	**13**
Unit-II: Renewable energy sources	
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 hours) **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. (8 hours)	**13**
Unit-III	
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. (8 hours) **Geothermal and hydro energy:** Geothermal Resources, Geothermal Technologies (2 hours), Hydropower resources, hydropower technologies, environmental impact of hydro power sources, Carbon captured technologies, cell, batteries, power consumption (3 hour)	**13**

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 nearby to wind energy stations.
9. Field trip to nearby to solar energy parks.
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

Phy-OE2: Physics for all (Credits:3)
3 hours of teaching per week

Unit-I	Hrs.
Energy and Power: Explosions and energy; Energy, heat and its units; Energy table and discussions; Discussion of cost of energy; Measuring energy; Power; Different power sources; Kinetic energy.	**13**
Unit-II	
Gravity, Force and Space: The force of Gravity; Newton's third law; Weightlessness; Low earth orbit; Geosynchronous satellites; Spy satellites; Medium Earth Orbit satellite; Circular Acceleration; momentum; Rockets; Airplanes, helicopters and fans; Hot air and helium balloons; angular momentum and torque..	**13**
Unit-III	
Nuclei and radioactivity: Radioactivity; Elements and isotopes; Radiation and rays; Seeing radiation; The REM – The radiation poisoning; Radiation and cancer; The linear hypothesis; Different types of radiation; The half-life rule; Smoke detectors; measuring age from radioactivity; Environmental radioactivity; Glow of radioactivity; Nuclear fusion.	**13**

References Book

This course is extracted from the book titled "Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know" by Richard A Muller, WW Norton and Company, 2007. (Units 1 to 3 are from chapters 1, 3, 4 respectively).

Phy-OE3: Atmospheric Science (Credits:3)
3 hours of teaching per week

Unit-I	Hrs.
Atmosphere: Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	**13**
Unit-II	
Climate Science: Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models(GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more.	**13**
Unit-III	
Global Climate Change: Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming, Schemes of geo-engineering.	**13**

Suggested Activities

1. Try to find answer to the following questions:
   (a) Imagine you are going in a aircraft at an altitude greater than 100 km. The air temperature at that altitude will be greater than 200^{o}C. If you put your hands out of the window of the aircraft, you will not feel hot.
   (b) What would have happened if ozone is not present in the stratosphere.
2. Visit a nearby weather Station and learn about their activities.
3. Design your own rain gauge for rainfall measurement at your place.
4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers.
5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction.
6. Learn about ozone layer and its depletion and ozone hole.
7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades.
8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).

Reference Books

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

Phy-OE4: Sports Science (Credits:3)
3 hours of teaching per week

Unit-I	Hrs.
Measurement: Physical quantities, Standards and Units, International system of Units, Standards of time, length and mass, Precision and significant figures (4 hours) **Newton's laws of motion**: Newton's first law. Force, mass. Newton's second law. Newton's third law, Mass and weight. Applications of Newton's laws. (5 hours) **Projectile motion**: Shooting a falling target, Physics behind Shooting, Javelin throw and Discus throw. (4 hours) **Topics for self study:** https://www.real-world-physics-problems.com/physics-of_sports.html	**13**
Unit-II	
Conservation laws: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing) (4 hours) **Centre of mass**: Physics behind Cycling, Rock climbing, Skating (5 hours) **Gravitation**: Origin, Newton's law of gravitation, Archimedes's principle, Buoyancy & Physics behind swimming (4 hours) **Topic for self-study:** Archimedes' Principle: Made EASY | Physics in You tube	**13**
Unit-III	
Food and Nutrition: Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins. (4 hours) **Energy:** Different forms of Energy, Conservation of mass-energy (3 hours) **Physical exercises:** Walking, Jogging and Running, Weight management. (3 hours) **Topic for self-study:** 10 Best Exercises for Everyone – Healthline	**13**

Suggested Activities

1. Identify the methods of measurement of time, length and mass from ancient time and build models for them. **(**Reference : History of measurement - Wikipedia *https://en.wikipedia.org › wiki › History_of_measurement*)
2. Identify Physics principles behind various Sports activities. **https://www.real-world-physics-problems.com/physics-of-sports.html**
3. List the difficulties experienced in Gymnastics, Cycling and Weight lifting.
4. List the difficulties experienced in swimming.
5. Learn breathing exercises.
6. Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health.

Text Books

1. Yakov Perelman. Physics for Entertainment. Createspace Independent Pub, 2010.
2. Yakov Perelman. Physics Everywhere. Prodinnova Publishers, 2014.
3. Yakov Perelman. Mechanics for Entertainment. Prodinnova Publishers, 2014.
4. Vassilios McInnes Spathopoulos. An Introduction to the Physics of Sports. Createspace Independent Publishing Platform, 2013.
5. Walter Lewin. For the Love of Physics. Taxmann Publications Pvt. Ltd., 2012.
6. Swaminathan M. Handbook of Food and Nutrition. Bangalore Press. 2012.
7. Srilakshmi B. Food Science. New Age International Pub. 2015.

Internet Resources for Reference: Internet resources

https://www.topendsports.com/biomechanics/physics.htm
https://www.real-world-physics-problems.com/physics-of-sports.html
https://www.healthline.com/
https://www.mayoclinic.org/
https://www.who.int/news-room/

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

Semester	Title of the Paper	Total No of hours	Hours per week	Marks		Duration of Examination (hours)	Total Marks	Credits
				Theory/Practicals	Internal Assessment (IA)			
				Max	Max			
1st Semester	Phy-DSCT1: Mechanics and Properties of Matter	52	4	60	40	3	100	4
	Phy-DSCP1-Lab I	40	4	25	25	3	50	2
	Phy-OE1 : Energy Sources OR Phy-OE2: Physics for All	39	3	60	40	3	100	3
2nd Semester	Phy-DSCT2: Electricity and Magnetism	52	4	60	40	3	100	4
	Phy-DSCP2-Lab II	40	4	25	25	3	50	2
	Phy-OE3:Atmospheric Science OR Phy-OE4: Sports Science	39	3	60	40	3	100	3

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

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

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

QUESTION PAPER PATTERN (INDICATIVE TEMPLATE)

I Semester B.Sc Examination, April/May (September/October) 2022

CBCS - 2021 ONWARDS

Subject: Physics

Phy-DSCT1: Mechanics and Properties of Matter

Time: 2 hours **Max. Marks: 60**

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

PART- A

Each question carries 2 marks (concept based)

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

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

PART-B (20 marks)

Each question carries 5 marks (numerical problems)**

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

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

PART-C (32 marks)

Each question carries 8 marks

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

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

*In each part of the question paper first three questions should be set from the first TWO units of the syllabus and next three questions should be set from second half (last TWO units) of the syllabus.
**Questions in Part-B should contain numerical problems in the specific cases of discipline core subjects, where problem solving is an essential component of learning.
*** Questions of Part B and Part C may contain subdivisions i.e., (i) questions 7 to 12 of Part B may be split into a, b & division of marks in such cases should be clearly indicated – for example 2 + 3=5 marks or 1+4=5 marks. Similarly (ii) question 13 to 18 of Part C may be split into a, b, c with division of marks clearly indicated – for example 3+5=8 marks or 2+6=8 marks or 2+3+3=8 marks and so on).

I Semester B.Sc Examination, April/May (September/October) 2022

CBCS - 2021 ONWARDS

Subject: Physics

Phy-OE1 : Energy Sources (Open Elective)

Time: 2 hours **Max. Marks: 60**

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

PART- A

Each question carries 2 marks (concept based)

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

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

PART-B (20 marks)

Each question carries 5 marks (numerical problems)**

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

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

PART-C (32 marks)

Each question carries 8 marks

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

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

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