Course Structure for Under-Graduate Programme in PHYSICS,2024

Semester	Course Type	Course	Course Code	Credits	Marks	Internal Assessment	End Semester	
							Theory	Practical
First Semester	DSC-A1	Mechanics	DSC-PHYT-111(a) DSC-PHYP-111(b)	3 1	75 25	25 05	50 ----	--- 20
	DSC-B1*	Second core Discipline (To be chosen from discipline i.e. Chemistry/Math/Computer Science)		4	100	30	70	---
	MC-1*	Second core Discipline (To be chosen from discipline i.e. Chemistry/Math/Computer Science)		4	100	30	70	---
	MDC-1#	From pool of MDCs		3	75	25	50	----
	SEC-1	Physical Gadgets and their applications	SEC-PHYP-111	3	75	25	50	----
	AEC-1	Ability enhancement (from pool of AECs)		2	50	15	35	----
Second Semester	DSC-A2	Electricity and magnetism	DSC-PHYT-121(a) DSC-PHYP-121(b)	3 1	75 25	25 05	50 ----	---- 20
	DSC-B2*	Second core Discipline (To be chosen from discipline i.e. Chemistry/Math/Computer Science)		4	100	30	70	---
	MC-2*	Second core Discipline (To be chosen from discipline i.e. Chemistry/Math/Computer Science)		4	100	30	70	---
	MDC-2#	From pool of MDCs		3	75	25	50	----
	SEC-2	Skill enhancement course (To be chosen from SEC of Maths/ Chemistry/ Computer)		3	75	25	50	----
	I/A/P/C**	Has to be proposed as per guideline circulated on 13th May 2024		2	50			
	VAC	From pool of VACs		2	50	15	35	---

Note: ***(a)** If any one chooses **DSC B1** as Chemistry / Computer Science, then he / she has to choose **MC1** as Math.
(b) If any one chooses DSC **B1** as Math, then he / she has to choose any one of Chemistry/Computer Science.

**** Students have to go for one month social responsibility training i.e. in school/ hospital/ police/NGOs. Further, he/she has to produce a certificate with attendance record after the completion of training.

MDC must be selected from a broad discipline/pool of MDCs other than Major and Minor subjects.

B.Sc. Multidisciplinary with Physics

1st Semester

Physics DSC-PHYT-111(a)**: MECHANICS**

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering whole syllabus from all the units), Section B from Unit 1, Section C from Unit II, Section D from Unit III and Section E from Unit IV. Examiner will set nine questions in all, question number 1 will be compulsory and two questions from each Unit, i.e., I, II, III and IV, respectively. Each question will carry 10 marks. Question Number 1 (Section A) will consist of seven sub-short answer type questions carrying 02 (two) marks each and candidate has to attempt any five (5) questions. Each Question must include at least 20% numerical problems.*
2. *Candidate will have to attempt five questions in all, i.e., selecting one question from each sections B, C, D & E.* From the *Compulsory section A candidate has to attempt any five (5) out of seven (7) questions. The duration of the examination will be 3 hours.*

Pre-requisite: Brief introduction to Newtons's Laws of motion and Newtons law of gravitation, Motion of a particle in uniform gravitational field; G (Gravitational constant) as a natural constant; Need of differntial equations; Differential equations in mechanics: Projectile motion, spring mass system (simple harmonic oscillator), simple pendulum, Newtons's second law of motion; First order homogeneous differential equations: Example (Cooling coffee problem); Second order differential equations with constant coefficients: Example (spring mass system (simple harmonic oscillator)).

Unit-I

Coordinate systems, Symmetries and conservation laws: Need of Coordinate system, Types of Coordinate systems: **Orthogonal coordinate systems** (Cartesian coordinate system (left handed and right handed system), plane polar coordinate system, spherical polar coordinate system and cylindrical coordinates) and **non-orthogonal coordinate system** (brief introduction with examples), Relation between cartesian and spherical polar coordinates in terms of position, velocity and acceleration, Area and volume elements in spherical polar coordinates, Concept of plane angle and solid angle. Symmetries and conservation laws: homogeneity of space and conservation of momentum, isotropy of space and conservation of angular momentum, homogeneity of time and conservation of energy **(7 Lectures)**

Frames of Reference: Inertial and accelerated (non-inertial) frames of reference: Earth and stars as a reference frame and other examples, Galilean transformations, Galilean invariance: distance, velocity, acceleration, Newton's second law, momentum and energy; Fictitious or pseudo force, Fictitious force in a rotating frame: Coriolis force and centrifugal force; Applications of Coriolis force & centrifugal force. Foucault's pendulum and its applications (Qualitative idea). (5) **Lectures)**

Unit-II

Inverse square law force: Classification of forces: central and non-central forces (examples), Inverse Square Law, Concept of centre of mass and reduced mass and their importance in central force problems,reduction of two body central force problem to equivalent one body problem. reduced mass of electron proton system and electron positron system. **(5 Lectures)**

Motion under a central force: Features of central force motion,Central force motion as a one body problem, Motion confined to a plane, conservation of angular momentum, conservation of energy; Energy equation and

energy diagrams; Equation of conic (ellipse, hyperbola and parabola), Keplers laws of planatery motion. **(6 Lectures)**

Unit-III

Fundamentals of Collisions: Basic Concepts of Collision, Reference Frames: Laboratory frame (Lab frame) and Center of Mass (CM) frame; Elastic Collisions in the Lab Frame: Kinematics of elastic collisions in one dimension (1D), Elastic Collisions in the CM Frame, Relationship between Lab and CM frame quantities, Relation between Kinetic Energies and Scattering Angle in Lab and CM frames **(7 Lectures)**

Applications of Collisions: Rutherford Scattering, Scattering: Angle and Impact Parameter, Collision Cross Section, Differential Scattering Cross Section. **(3 Lectures)**

Unit-IV

Special Theory of Relativity and Lorentz transformations: Ether Hypothesis, Michelson-Morley Experiment, Postulates of Special Theory of Relativity, Lorentz Transformation, Consequences of Lorentz Transformations: Length Contraction, Simultaneity of Events, Time dilation; Experimental Evidences for Time Dilation and Length Contraction, Twin paradox, Relativistic Addition of Velocities, Relativistic Doppler Effect. (**8Lectures)**

Relativistic Mechanics: Introduction,Variation of mass with velocity. mass-energy equivalence, relativistic momentum and energy, Lorentz transformation of momentum and energy. Lorentz transformation of forces, Minkowski space. **(4 Lectures)**

Reference Books:

1. Classical Mechanics by John R Taylor, University Science book ,U.S.
2. An Introduction to Mechanics, D. Kleppner, and R. Kolenkow, Tata McGraw Hill.
3. Mechanics: Berkeley Physics Course Vol 1, by Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz and Burton Moyer
4. Mechanics, D.S. Mathur, S. Chand and Company Ltd.
5. Classical Mechanics, J.C. Upadhyaya Himalaya Publishing House.
6. Concepts of Modern Physics: Special Indian Edition by Arthur Beiser
7. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
8. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
9. Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
10. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
11. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
12. Modern Physics, K. Krane, John Wiley and Sons.

Course Outcomes: B.Sc. (Discipline-Physics)		
Course Name	**Course Outcomes**	**Methodology**
Semester I		
Mechanics DSC-PHYT-111(a)/ MC-PHYT-111(a)	**CO1:** Grasp the fundamental principles of mechanics, role of coordinate systems, and symmetry and conservation laws of motion. **CO2:** Understand the concept of Inertial and non-inertial frames of references and analyze motion in different frames. **CO3:** Understand the description of Central Motion **CO4:** Learn the concept of particle collision (elastic and inelastic) in lab and CM frames **CO5:** Understand and apply the principles of special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.	

1st Semester

DSC-PHYP-111(b): **Mechanics Laboratory**

Note:

1. ***Teacher should give a lecture on error analysis before practical classes.***
2. ***A student has to perform minimum ten (10) experiments.***
3. ***Error analysis should be done in each experiment.***
4. ***External examiner for the end semester practical exam should be deputed by the H. P. University and should not be from the same college. University has to depute from any other college affiliated to the University.***

List of Experiments:

1. Measurements of length/diameter using Vernier Caliper, Screw Gauge and Travelling Microscope.
2. To measure the density and identify the material of a given wire using Screw Gauge.
3. To find the radius of curvature of spherical surfaces using spherometer.
4. To determine the Height of anaccessible and inaccessible object using a Sextant.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's Needle.
8. To determine the Elastic Constants of a Wire by Searle's method.
9. To determine acceleration due to gravity by Bar Pendulum.
10. To determine acceleration due to gravity by Kater's Pendulum.
11. To determine acceleration due to gravity and velocity for a freely falling body using Digital Timing Technique.
12. To study the Motion of a Spring and calculate (a) Spring Constant and (b) Value of acceleration due to gravity.
13. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
14. To compare the moment of inertia of a solid sphere and hollow sphere or solid disc of same mass with the torsional pendulum.
15. To verify (a) the law of conservation of linear momentum and (b) law conservation of kinetic energy in case of one and two dimension elastic collision,.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick 2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
5. B.Sc. Practical Physics C.L. Arora, S. Chand and Company Ltd.

B.Sc. Multidisciplinary with Physics

2nd Semester

Physics DSC-121(a)**: Electricity and Magnetism**

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering whole syllabus from all the units), Section B from Unit 1, Section C from Unit II, Section D from Unit III and Section E from Unit IV. Examiner will set nine questions in all, question number 1 will be compulsory and two questions from each Unit, i.e., I, II, III and IV, respectively. Each question will carry 10 marks. Question Number 1 (Section A) will consist of seven sub-short answer type questions carrying 02 (two) marks each and candidate has to attempt any five (5) questions. Each Question must include at least 20% numerical problems.*
2. *Candidate will have to attempt five questions in all, i.e., selecting one question from each sections B, C, D &E.* From the *Compulsory section A candidate has to attempt any five(5) out of seven (7) questions. The duration of the examination will be 3 hours.*

Unit-I

Vector Analysis: Review of vector algebra (properties of vectors, scalar product, vector product, scalar triple product and vector triple product), Field and its classification (Scalar and Vector field), Differentiation of a vector, Partial Differentiation of Vector and Scalar, Differential (Del operator) and Laplace's operator, Gradient of scalar field (Physical Meaning), Integration of Vectors, Flux of a vector, Divergence of vector field and its physical interpretation, Gauss Divergence theorem, Curl of vector field and its physical significance, Stoke's Theorem, Green's theorem. **(7 Lectures)**

Electrostatics: Differential form of Gauss's law, Applications of Gauss's Law (i) electric field due to point charge, (ii) infinite line of charge, (iii) uniformly charged spherical shell and (iv) solid sphere, (v) plane charged sheet, Electrostatic potential and electrostatic potential energy. Equipotential surface, Potential Gradient, Electric potential due to a dipole and quadrupole, Electric field as a gradient of a scalar potential, Poisson and Laplace equations. **(5 Lectures)**

Unit-II

Electrostatic Fields in Dielectrics: Dielectrics, Classification of Dielectrics, Response of Dielectric to external electric field, Polarization vector and Susceptibility, Atomic polarizability, Dielectric constant, Dielectric Strength, Electric susceptibility, Relation between dielectric constant and electric susceptibility, Gauss's law in dielectric, Integral form of Gauss's law for dielectrics, Differential form of Gauss's law for dielectrics, Displacement vector, Energy stored in a dielectric medium. Claussius - Mossotti relation. Difference between piezoelectric, pyroelectric, ferroelectric materials and electrets (Qualitative idea). **(6Lectures)**

Magnetism: Magnetic field Biot-savarot's law, Magnetic flux, Divergence and curl of magnetic field, Magnetic field of a moving point charge, Ampere circuital law and its applications: (i) current carrying wire (ii) long solenoid, (iii) toroid. Differential form of Ampere's Law, Magnetic vector potential and its divergence. **(5 Lectures)**

Unit-III

Magnetic Fields in Matter: Classification of Magnetic Materials, Magnetization, magnetic induction (self induction and mutual induction, Magnetic permeability and susceptibility and their interrelation. Diamagnetism and Langevin's theory of diamagnetism. Paramagnetism and origin of atomic magnetic moment. Domain theory of ferromagnetism, magnetization curve, Hysteresis loss and its applications. **(5 Lectures)**

Electric current and Field of Moving Charges:
Electric current and current density, Equation of continuity and conservation of charge, Atomic theory of conductivity (Microscopic form of Ohm's Law), Moving charge particle in (i) uniform electric, (ii) uniform magnetic field, (iii) crossed uniform electric and magnetic field. **(5 Lectures)**

Unit-IV

Maxwell`s equations & electromagnetic waves: Displacement current, Maxwell's equations and their derivation, Electromagnetic waves equation, Transverse nature of EM waves, Poynting vector, Poynting theorem, relation between electric and magnetic field vectors in EM waves. **(5 Lectures)**
Electromagnetic wave propagation: Propagation of EM waves in vacuum, isotropic and dielectric medium EM waves in conducting medium, skin depth, normal and anomalous dispersion. Reflection and Transmission of EM waves at a boundary of two dielectric media for normal and oblique incidence. **(7 Lectures)**

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Un. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Introduction to Electrodynamics, D.J. Griffth,.
6. Electricity and Magnetism, Brij Lal and Subramanium, S. Chand. Edition, Prentice Hall of India.
7. Electricity and Magnetism, A S Mahajan and A A Rangwala, Tata McGraw Hill Company. Co. Ltd.

Physics DSC-121(a)**: Electricity and Magnetism**

Course Outcomes:

Upon successful completion of this course, students will be able to:

- **Understand the fundamental concepts of vector algebra,** including scalar and vector products, and apply these concepts to solve physical problems.
- **Derive and apply Gauss's Law** in both its differential and integral forms to determine electric fields from various charge distributions.
- Develop a deep understanding of electrostatic potential and electrostatic potential energy, and will be able to compute the electric potential due to dipoles and quadrupoles.
- **Classify and analyze dielectric materials**, understand their polarization behavior under the influence of external electric fields.
- Apply Gauss's law in the context of dielectrics, with a focus on the displacement vector and energy stored within dielectric materials.
- **Understand and apply fundamental laws of magnetism**, including Biot-Savart's Law and Ampere's Circuital Law.
- **Gain a comprehensive understanding of magnetization and magnetic properties of materials**, including the analysis of diamagnetism, paramagnetism, and ferromagnetism.
- Develop an understanding of Maxwell's equations and their role in the description of electromagnetic phenomena.
- Analyze and solve problems involving electromagnetic wave propagation, ensuring a strong grasp of the theoretical foundation of modern electromagnetism.

2nd Semester
DSC-PHYP- 121(b): Electricity and Magnetism Laboratory

Note:

1. ***Teacher should give a lecture on error analysis before practical classes.***
2. ***A student has to perform minimum ten (10) experiments.***
3. ***Error analysis should be done in each experiment.***
4. ***External examiner for the end semester practical exam should be deputed by the H. P. University and should not be from the same college. University has to depute from any other college affiliated to the University.***

List of Experiments:

1. Use a Multi-meter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity,
   (ii) Measurement of Critical Damping Resistance (CDR)
3. Determine high resistance by Leakage Method
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
6. To study a series LCR circuit and determine its (a) Resonant Frequency and Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and
   (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To determine unknown capacitance by flashing and quenching method
10. To find frequency of ac supply using an electrical vibrator.
11. To study the induced EMF as a function of the velocity of the magnet.
12. To measure the resistance using wheatstone bridge.
13. To measure the capacitance using AC bridge.
14. To draw the magnetic lines of force of bar magnet and find magnetic length.
15. To determine the low resistance by Kelvin double Bridge.
16. CRO and its applications.

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
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