Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous)

Revised Syllabus for B. Sc. I (physics) w.e.f. from 2021-22

Preamble:

This syllabus is framed to give sound knowledge with understanding of Physics to undergraduate students at first year of three years of B.Sc. degree course.

Students learn Physics as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Physics popular, interesting and encouraging to the students for higher studies including research.

The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

General Objectives of the Program:

1. To nurture academicians with focus and commitment to their subject.
2. To shape good and informed citizens from the students entering into the program.
3. To create a skilled workforce to match the requirements of the society.
4. To impart knowledge of Science is the basic objective of education.
5. To develop scientific attitude is the major objective to make the students open minded, critical, curious.
6. To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.

Program Outcomes:

1. The student will graduate with proficiency in the subject of his choice.
2. The student will be eligible to continue higher studies in his subject.
3. The student will be eligible to pursue higher studies abroad.

4. The student will be eligible to appear for the examinations for jobs in government organizations.
5. The student will be eligible to appear for jobs with minimum requirement of B. Sc. Program.

Program Specific Objectives:

1. The students are expected to understand the fundamentals, principles, concepts and recent developments in the Physics.
2. The practical course is framed in relevance with the theory courses to improve the understanding of the various concepts in Physics.
3. It is expected to inspire and boost interest of the students in Physics.
4. To develop the power of appreciations, the achievements in science and role in nature and society.
5. To enhance student sense of enthusiasm for science and to involve them in an intellectually stimulating experience of Course in a supportive environment.

Program Specific Outcomes:

1. Understand the basics of Physics.
2. Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
3. Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
4. Identify their area of interest in academic, research and development.
5. Perform job in various fields' like science, engineering, education, banking, business and public service, etc. or be an entrepreneur with precision, analytical mind, innovative thinking, clarity of thought , expression, and systematic approach.

1. **Title:** Physics
2. **Year of Implementation:** The syllabus will be implemented from June, 2021.
3. **Duration:** The course shall be a full time.
4. **Pattern: S**emester examination.
5. **Medium of Instruction:** English.

6. Structure of Course:

B.Sc.-I Semester-I

Sr. No.	Paper Title	Theory			Practical		
		Paper Code	Lectures per week	Credits	Paper Title	Lectures per week	Credits
1	Mechanics	BPT101	5	2	Practical Paper-I : BPP103	4	2
2	Electrostatics	BPT102		2			

B.Sc.-I Semester-II

Sr. No.	Paper Title	Theory			Practical		
		Paper Code	Lectures Per week	Credits	Paper Title	Lectures Per week	Credits
1	Gravitation and Properties of Matter	BPT201	5	2	Practical Paper – II : BPP203	4	2
2	Electricity and Magnetism	BPT202		2			

B: B.Sc. P: Physics T: Theory, P : Practical

3. Titles of papers of B.Sc. course:

B.Sc.-I Semester-I

Theory: 36 lectures, 30 hours (for each paper)

Paper – I: BPT101: **MECHANICS**

Paper – II: BPT102: **ELECTROSTATICS**

Practical: 40 lectures: 32 hours

Practical: BPP103: **MECHANICS and ELECTROSTATICS**

B.Sc. – I Semester – II

Theory: 36 lectures: 30 hours (for each paper)

Paper – III: BPT201: **GRAVITATION and PROPERTIES OF MATTER**

Paper – IV: BPT202: **ELECTRICITY and MAGNETISM**

Practical: 40 lectures: 32 hours

Practical: BPP203: **PROPERTIES OF MATTER and ELECTRICITY and MAGNETISM**

BPT101: Mechanics (Credits:02)

Learning Objectives: Students will be able to:

1. learn vectors, vector derivatives, scalars and ordinary & partial differential quations.
2. understand Newton's laws of motions.
3. understand conservation of energy, centre of mass, motion of rockets and examples.

4. understand concept of rotational motion and M. I. of various bodies.

Unit I: Vectors Algebra and Elementary Calculus (9)

Vector algebra, Scalar and vector products, Derivatives of a vector with respect to parameters (velocity and acceleration)

Unit II: Ordinary Differential Equations

Differential equations; degree, order, linearity and homogeneity of differential equation, ordinary and partial differential equations, 1^{st} order homogeneous differential equations, 2^{nd} order homogeneous differential equation with constant coefficients, problems.

Unit III: Dynamics of a system of particles: (9)

Frames of reference, Newton's Laws of motion, Conservation of linear and angular momentum, work and energy theorem, conservation of energy (Single Particle), Dynamics of a system of particles (linear momentum, angular momentum and energy), Centre of mass, Motion of rocket (qualitative treatments only), problems.

Unit IV: Rotational Motion: (9)

Angular velocity, angular momentum and Torque, Kinetic energy of rotation and moment of Inertia, Moment of Inertia of spherical shell; solid cylinder (only about the axis of symmetry), Motion of spherical shell and solid cylinder rolling down an inclined plane, problems.

REFERENCE BOOKS:

1. Principles of Physics: Walker, Halliday and Resnick , 10^{th} edn., 2017, Wiley

2. Mechanics: Berkeley Physics Course, Vol. 1, Charles Kittel, Tata McGraw Hill Publications

3. Mathematical Physics: Hobson MP. Bence S. J

Learning Outcomes:

Unit – I: **After completion of the unit**, **Student is able to:**

1. define scalar, vector and their products
2. understand derivative of a vector with respective to parameters.

Unit – II: **After completion of the unit**, **Student is able to:**

1. define order, degree of differential equation
2. define differential equation and able to distinguish ordinary and Partial differential equation.
3. define and understand 1^{st} and 2^{nd} order homogenous differential equation.

Unit – III: **After completion of the unit**, **student is able to:**

1. understand inertial and non-inertial frame of reference.
2. understand physical significance of Newton's laws of motion.
3. define linear momentum, angular momentum, work and energy.

4. understand work energy theorem and conservation of energy.
5. understand motion of particle and system of particles.
6. define centre of mass and centre of gravity.
7. understand concept of motion of rocket.

Unit – IV: **After completion of the unit**, **Student is able to:**

1. define angular velocity, torque, inertia and moment of inertia.
2. understand distinction between inertia and moment of inertia.
3. calculate the moment of inertia of a given body about axis of rotation.
4. understand the rolling motion of spherical shell and solid cylinder.

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B. Sc. Part-I Semester-I

BPT102: Electrostatics (Credits: 2)

Learning Objectives: Students will able to:

1. study gradient, divergence, curl and their physical significance.
2. study integrals of vector fields and corresponding various theorems.
3. study electrostatic field, electrostatic theorem.
4. study dielectric medium and three electric vectors.

Unit I: Vector Analysis I (9)

Concept of scalar and vector fields : Del operator, Gradients, divergence, curl and their physical significance, problems.

Unit II: Vector Analysis II (9)

Vector Integration: Line, surface and volume integrals of vector fields, Gauss- divergence theorem, Stoke's theorem and Green's theorem, problems.

Unit III: Electrostatics (9)

Electrostatic field, electric flux, polar and non-polar molecules, Gauss's theorem of electrostatics, Electric potential as line Integral of electric field, Potential due to point charge, Concept of electric dipole, physical examples (polar molecules), uniformly charged Spherical shell and solid sphere. Calculation of electric field from potential, energy density in electrostatic field, problems.

Unit IV: Dielectrics (9)

Dielectric medium, Polarization, displacement vector, Gauss's theorem in dielectrics, parallel plate capacitor completely filled with dielectrics. Relation between three electric vectors $\vec{E}$, $\vec{D}$ and $\vec{P}$.

Reference Books:

1. Electricity and Magnetism: D. C. Tayal, 1988, Himalaya Publishing House (Unit III, IV).
2. Electromagnetics : B. B. Laud (Unit III, IV).
3. Electricity &Magnetism: J. Yarwood & J. H. Fewkes, Vol. 1, 1991, Oxford Uni. Press. (Unit III & IV).
4. Introduction to Electrodynamics: David J. Griffith 3rd edn. (Unit I & II).
5. Mathematical Physics: B. D. Gupta (Unit I & II).
6. Electricity and Magnetism. By Khare, Shrivastav

Learning Outcomes:

Unit I: **After completion of the unit**, **Student is able to:**

1. define dell operator, gradient, divergence and curl.
2. understand significance of gradient, divergence and curl.

Unit II: **After completion of the unit**, **Student is able to:**

1. understand line, surface and volume integrals.
2. understand Gauss' divergence, Stoke's and Green's theorems.

Unit III: **After completion of the unit**, **Student is able to:**

1. understand basic concept of electrostatic field, electric flux and electric dipole.
2. understand concept of electric dipole and its examples.
3. understand energy per unit volume in electrostatic field.

Unit IV: **After completion of the unit**, **Student is able to:**

1. define dielectric medium, polarization and displacement vector.
2. understand relation between three electric vectors.

Practical: BPP103: **Mechanics and Electrostatics (Credits: 2)**

Course Objectives: Students should

1. learn measuring skills in practical.
2. determine M. I. and acceleration due to gravity.
3. understand the measurement of electrical quantities by using multimeter.
4. determine high resistance, capacitances and impedance.

Experiments:

1. Measurements of length (or diameter) using Vernier caliper, Screw gauge and Travelling Microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine Moment of inertia of a disc using auxiliary annular ring.
4. To determine 'g' by bar pendulum.

5. To determine ‘g’ by Kater’s pendulum.

6. To study the motion of a spring and calculate (a) spring constant (b) value of ‘g’.

7. To use a multimeter for measuring (a) Resistance, (b) AC and DC voltages, (c) DC current, and (d) checking electrical fuses.

8. To determine Constants of B.G.

9. To compare capacitances using De Sauty’s bridge.

10. Impedance of series LCR circuit.

REFERENCE BOOKS:

1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Asia Publ. House, 1971

2. Practical Physics, S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010

3. An Advanced Course in Practical Physics, D. Chattopadhyay and P. C. Rakshit, New Central Book Agency Pvt. Ltd., 7thedition, 2005

4. Experimental College Physics, White and manning, McGRAW-HILL Book Company. 3rd edition, 1954

Course Outcomes: After completion of the unit, **Students will be able to:**

1. learn measuring skills in practical.
2. understand theoretical concepts by performing experiments.
3. develop awareness of minimizing errors.
4. handle various instruments

B. Sc. Part-I Semester-II
BPT201: Gravitation And Properties of Matter (Credits:2)

Learning Objectives: Students will be able to:

1. understand motion of particle in central force field, Kepler’s laws and basic idea of GPS system.
2. learn tubes of flow and variation of viscosity of liquid with temperature and pressure.
3. study bending of beam and determination of Y, n and σ by Searle’s method.
4. understand angle of contact and wettability of the liquid. Experimental determination of surface tension and examples.

Unit I: Gravitation (9)

Newton’s Law of Gravitation, Motion of particle in central force field (motion in a plane, angular momentum is conserved, areal velocity is constant), Kepler’s laws (statements only), Satellite in circular orbit and its applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS), problems.

Unit II: Viscosity (9)

Introduction, rate of flow of liquid in a capillary tube, tubes of flow (streamline and turbulent), Poiseuille's formula (derivation)and determination of coefficient of viscosity of liquid by Poiseuille's method, variation of viscosity of liquid with temperature and pressure, problems.

Unit III: Elasticity (9)

Bending of beam, Bending moment, Cantilever (without considering weight of cantilever), Beam supported at both ends (without considering weight of beam), Tensional pendulum, Work done in twisting a wire, Twisting couple on a cylinder, Determination of modulus of rigidity, Determination of Y, n and σ by Searle's method, problems.

Unit IV: Surface Tension (9)

Surface tension (definition), Angle of contact and wettability, Relation between surface tension, excess pressure and radius of curvature, Experimental determination of surface tension by Jaeger's method, Applications of surface tension, problems.

Reference Books:

1. Physics: S. G. Sterling and Woodal, Longman's & Green Co. Ltd.
2. Principles of Physics: Walker, Halliday and Resnick , 10th edn., 2017, Wiley Eastern Ltd.
3. Elements of Properties of Matter: D. S. Mathur, Shamlal Charitable Trust, New Delhi.
4. Properties of Matter: Brijlal and Subrahmanyam , Eurasia Publication.

Learning Outcomes:

Unit I : **After completion of the unit**, **Student is able to:**

1. understand motion of particle in central force field.
2. understand concept of satellite in circular orbit, geosynchronous orbits.
3. study GPS.

Unit II: **After completion of the unit**, **Student is able to:**

1. understand streamline and turbulent flow.
2. understand Poiseuillie's formula and its application to calculate coefficient of viscosity.

Unit III: **After completion of the unit**, **Student is able to:**

1. understand concept of cantilever and torsional oscillations.
2. understand concept of torsional pendulum to determine rigidity modulus and moment of inertia
3. determine Y, n & σ

Unit IV: **After completion of the unit**, **Student is able to:**

1. understand concept of wettability.
2. determine surface tension by Jaeger's method.
3. understand applications of surface tension.

B. Sc. Part-I Semester-II
BPT202: Electricity & Magnetism (Credits : 2)

Learning Objectives: Students will be able to:

1. study LCR series circuit and AC bridge.
2. study magnetostatics and magnetic properties of materials.
3. learn electromagnetic induction laws.
4. study Maxwell's equations and electromagnetic wave propagation.

Unit I: AC Circuits (9)

Complex numbers and their application in solving AC series LCR circuit, Complex impedance, Reactance, Admittance and Susceptance, Resonance in LCR series circuit, Sharpness of resonance, (qualitative treatment only), Q-factor (definition only), AC Bridge- Owen's Bridge, problems.

Unit II: Magnetism (9)

Magnetostatics : Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Ampere's circuital law, properties of magnetic materials – Magnetic intensity, magnetic induction, permeability, susceptibility, brief introduction of dia, para, and ferro magnetic materials, problems.

Unit III: Electromagnetic Induction: (9)

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual induction, Ballistic Galvanometer, construction and working (Revision), expression for charge flowing through ballistic galvanometer, correction for damping in galvanometer, Constants of ballistic galvanometer.

Unit IV: Maxwell's equations and Electromagnetic Wave propagation (9)

Equation of continuity of current, displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation, through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

1. Electricity and Magnetism : D. C. Tayal, 1988, Himalaya Publishing House
2. Electromagnetics : B. B. Laud
3. Introduction to Electrodynamics: David J. Griffith 3rd edn.
4. Physics: S. G. Starling and A. J. Woodall, The Eng. Language Book Society Pub.
5. Electricity and Magnetism: J. H. Fewkes and John Yarhood , Vol I , Publication by Oxford University Press Vth Edition.
6 Electricity and Magnetism Brijlal Subramanyam, Ratan Prakashan
7 Elements of Electromagnetics, Matthew N.O. Sadiku, sixth Ed

Learning Outcomes:

Unit I: **After completion of the unit**, Student **is able to**

1. understand applications of complex numbers in solving AC series circuit.
2. define complex impedance, reactance, admittance and susceptance.
3. understand concept of Wein's bridge.

Unit II: **After completion of the unit**, **Student is able to**

1. learn applications of Biot-Sawart Law in straight conductor, circular coil & solenoid.
2. understand concept of divergence & curl of magnetic field.
3. study dia, para and ferro magnetic materials.

Unit III: **After completion of the unit**, **Student is able to**

1. understand concept of self and mutual inductance.
2. determine energy stored in magnetic field.
3. study the theory of ballistic galvanometer with different constants .

Unit IV: **After completion of the unit**, **Student is able to**

1. understand concept of conservation of charge.
2. learn divergence and curl of electric & magnetic fields in Maxwell's equations.
3. study the EM wave propagation through vacuum & isotropic dielectric medium.

Practical: BPP203: Properties of Matter and Electricity and Magnetism (Credits:2)

Course Objectives: Students should

1. develop practical skills.
2. determine Young's modulus, modulus of rigidity and Poisson's ratio.
3. determine viscosity and surface tension of the liquid.
4. study series and parallel LCR circuits.
5. determine frequency of AC mains and magnetic field of solenoid.

Experiments:

1. Young's modulus of material of bar by vibration.
2. Modulus of rigidity of material of wire by torsional oscillations.
3. Y and n of wire by Searle's method.
4. Poisson's ratio for rubber using rubber tube.
5. Coefficient of viscosity Poiseiulle's Method.
6. Surface Tension by Jaegar's method.
7. To study a series LCR circuit and determine its (a) resonant frequency (b) quality factor Q.
8. To study a parallel LCR circuit and determine its (a) anti-resonant frequency (b) quality factor Q.

9. Frequency of AC mains by sonometer.

10. Measurement of field strength B and its variation in a solenoid ($\frac{dB}{dx}$).

REFERENCE BOOKS:

1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Asia Publ. House, 1971
2. Practical Physics, S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010
3. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit, New Central Book Agency Pvt. Ltd. 7th edition, 2005
4. Experimental College Physics, White and Manning, McGraw-Hill Book Company. 3rd edition, 1954

Course Outcomes:

After completion of the unit, **Students are able to:**

1. handle electrical instruments
2. understand measuring skills in electrical instruments.
3. understand theoretical concepts by performing experiments.
4. develop awareness of minimizing errors.

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