1. **Title:** Physics

2. **Year of Implementation:** The syllabus will be implemented from June, 2018 onwards.

3. **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.

4. **General Objectives of the Course:**

1. The students are expected to understand the fundamentals, principles, physical concepts and recent developments in the subject area.

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 towards Physics as the main subject.

4. To develop the power of appreciations, the achievements in Physics and role in nature and society.

5. To enhance student sense of enthusiasm for Physics and to involve them in an intellectually stimulating experience of learning in a supportive environment.

5. Duration: The course shall be a full time.

6. Pattern: Semester examination.

7. Medium of Instruction: English.

8. Structure of Course:

B.Sc. – I
Semester –I

Sr. No.	Course Title	Theory			Practical		
		Paper No. & Paper Code	No. of lectures per week	Credits	Course Title	No. of lectures per week	Credits
1	Physics	Paper-I: BPT101	5	2	Practical Paper – I : BPP103	4	2
		Paper-II: BPT102		2			

B.Sc. – I
Semester –II

Sr. No.	Course Title	Theory			Practical		
		Paper No. & Paper Code	No. of lectures Per week	Credits	Course Title	No. of lectures Per week	Credits
1	Physics	Paper-III: BPT201	5	2	Practical Paper – II : BPP203	4	2
		Paper-IV: BPT202		2			

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 & 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 & MAGNETISM

Practical : 40 lectures, 32 hours
Practical : BPP203 : PROPERTIES OF MATTER and ELECTRICITY & MAGNETISM

4. Other Features:
A. Library: Reference and Text books, Journals and Periodicals, reference books for advance studies.

B. Specific Equipments:

Necessary to run the course: Computers, LCD projectors, Visualizers, Smart board.

C. Laboratory Equipments:
1. Vernier calipers, Micrometer screw gauge, Meter scale and Travelling microscope.
2. AC and DC Voltmeters and Current meters.
3. Poiseuille's apparatus, Jaeger's apparatus and sonometer.
4. Multimeter (Analog and Digital).
5. Fly wheel and Auxiliary annular ring.
6. LCR Electronic kit, Thevenin's and Norton's electronic kits.
7. Ballistic galvanometer, Spot galvanometer and Gauss meter.
8. Audio frequency generators.
9. AC and DC power supply.

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Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE , SATARA

(AUTONOMOUS)

Syllabus introduced from June, 2018

Subject: Physics

B. Sc. Part – I

Semester – I

Paper – I : BPT101 : **MECHANICS   (Credits : 02)**
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Learning Objectives:

Students will able to:

1. learn vectors, vector derivatives, scalars and ordinary & partial differential equations.
2. study Newton's laws of motions and applications.
3. study conservation of energy, centre of mass, motion of rockets and examples.
4. study rotational motion and M. I. of various bodies.

Unit I: Vectors and ordinary differential equations   **(9)**

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

Differential equations; ordinary and partial differential equations, 1st order homogeneous differential equations, 2nd order homogeneous differential equation with constant coefficients, problems.

Unit II: Laws of Motion: (9)

Frames of reference, Newton's Laws of motion, applications, problems.

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

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 , 10th edn., 2017, Wiley (Units I: pp 34, II: pp. 80 - 105, III: pp. 34 -51 to IV: pp. 265 - 275).
2. Mechanics: Berkeley Physics Course, Vol. 1, Charles Kittel, Tata McGraw Hill Publications (Unit III: pp. 54 - 164).
3. Mathematical Physics: Hobson M.P. Bence S. J (Unit I: pp. 212 -240, pp. 468 - 553).

Learning Outcomes:

Unit – I :

Student is able to:

 1. define scalar, vector and their products
 2. understand derivative of a vector with respective to parameters.
3. define differential equation and able to distinguish ordinary and Partial differential equation.
4. define and understand 1st and 2nd order homogenous differential equation.

Unit – II :

Student is able to:

1. understand inertial and non-inertial frame of reference.

2. understand physical significance of Newton's laws of motion.

3. apply Newton's laws of motion to the given problems.

Unit – III :

Student is able to:

1. define linear momentum, angular momentum, work and energy.

2. understand work energy theorem and conservation of energy.

3. understand motion of particle and system of particles.

4. define centre of mass and centre of gravity.

5. understand concept of motion of rocket.

Unit – IV :

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. – I
Semester I
BPT102 : **ELECTROSTATICS (Credits: 2)**

Learning Objectives:
Students will able to:
1. study Gradients, divergence, curl and their physical significance.
2. study integrals of vector fields and corresponding various thermos.
3. study electrostatic field, electrostatic theorem and electrolytic capacitors.
4. study dielectric medium and three electric vectors.

Unit I: Vector Analysis I (9)

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, Gauss's theorem of electrostatics, Electric potential as line Integral of electric field, Potential due to point charge, electric dipole, uniformly charged Spherical shell and solid sphere. Calculation of electric field from potential, capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, 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:pp. 29 - 152 & IV:pp. 153 - 216).
2. Electromagnetics :   B. B. Laud (Unit III: pp. 1 - 34 & IV: pp. 35 - 62).
3. Electricity &Magnetism: J. Yarwood & J. H. Fewkes, Vol. 1, 1991, Oxford Uni. Press. (Unit III: pp. 214 - 243 & IV: pp. 275 - 304).
4. Introduction to Electrodynamics: David J. Griffith 3rd edn. (Unit I: pp. 1 - 22, & II: pp. 24 - 37, 56, 552 - 560).
5. Mathematical Physics: B. D. Gupta (Unit I & II: pp. 1 - 179).

Learning Outcomes:
Unit I :
Student is able to:
1. define gradient, divergence and curl.
2. understand significance of gradient, divergence and curl.
Unit II :
Student is able to:
1. understand line, surface and volume integrals.
2. understand Gauss' divergence, Stoke's and Green's theorems.
Unit III :
Student is able to:
1. understand basic concept of electrostatic field, electric flux and electric dipole.
2. understand concept of parallel plate, cylindrical and spherical condenser.
3. understand energy per unit volume in electrostatic field.
Unit IV :
Student is able to:
1. define dielectric medium, polarization and displacement vector.
2. understand relation between three electric vectors

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B.Sc. – I
Semester II
BPT201 : **GRAVITATION and PROPERTIES OF MATTER** (Credits : 2)

Learning Objectives:
Students will 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), Torsional oscillations, Work done in twisting a wire, Twisting couple on a cylinder, Torsional pendulum-Determination of Rigidity modulus and moment of inertia, 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. (Unit I: pp 47 to 66, II: P 85 to 104, III: P 67 to 84, IV: 104 to 121).
2. Principles of Physics: Walker, Halliday and Resnick , 10th edn., 2017, Wiley Eastern Ltd. (Unit I: P 308 to 331).
4. Elements of Properties of Matter: D. S. Mathur, Shamlal Charitable Trust, New Delhi. (Unit I: 230 to 283, II: 428 to 464, III: 284 to 360, IV: 486 to 542).
6. Properties of Matter: Brijlal and Subrahmanyam , Eurasia Publication (Unit I: P 122 to 170, II: P224 to 270, III: P 173 to 218, IV: P 273 to 313).

Learning Outcomes:
Unit I :
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 :

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 :

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 :

Student is able to:

1. understand concept of wettability.

2. determine surface tension by Jaeger's method.

3. understand applications of surface tension.

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B.Sc. – I
Semester II
BPT202 : **ELECTRICITY & MAGNETISM (Credits : 2)**

Learning Objectives:
Students will 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, Magnetic vector potential, 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, L of single coil and M of two coils, energy stored in magnetic field, problems.

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
     (Unit I: pp. 529 - 601, II: pp. 293 - 364, III: pp. 365 - 438, IV: pp. 439 - 465).
2. Electromagnetics : B. B. Laud (Unit II: pp. 110 - 143, III: pp. 144 - 165).
3. Introduction to Electrodynamics: David J. Griffith 3rd edn. (Unit II: pp. 202 - 235,
     IV: pp. 321- 331).
4. Physics: S. G. Starling and A. J. Woodall . The English Language Book Society Publication.
     (Unit I: pp. 1073 - 1089)
5. Electricity and Magnetism: J. H. Fewkes and John Yarhood , Vol I , Publication by Oxford
     University Press Vth Edition. (Unit: I: pp. 152 - 196)

Learning Outcomes:
Unit I :
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 :
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 :

Student is able to:

1. understand concept of self and mutual inductance.
2. determine energy stored in magnetic field.

Unit IV :

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.

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B. Sc. – I
Semester – I
PRACTICAL
BPP103: **MECHANICS & ELECTROSTATICS (Credits : 2)**

Learning Objectives:
Students will able to:
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 & DC voltages, (c) DC current, & (d) checking electrical fuses.
8. Determination of high resistance by Leakage method.
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 , 1971 Asia Publ. House.
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, 7th edition, 2005,New Central Book Agency Pvt. Ltd.
4. Experimental College Physics: White and manning, McGRAW-HILL Book Company. 3rd edition.

Learning Outcomes:
Students is 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.

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BPP203 : **PROPERTIES OF MATTER and ELECTRICITY & MAGNETISM (Credits : 2)**

Learning Objectives:
Students will able to:
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 & 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 , 1971 Asia Publ. House.
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, 7th edition,
   2005,New Central Book Agency Pvt. Ltd.
4. Experimental College Physics: White and Manning, McGRAW-HILL Book Company. 3rd edition.

Learning Outcomes:
Students is 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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B.Sc. – II
Semester – III

Theory: 45 lectures, 36 hours (for each paper)
Paper : BPT 301 : **WAVES , OSCILLATIONS AND SOUND**
Paper : BPT 302 : **THERMAL PHYSICS**

Practical: 64 lectures, 51 hours
Practical : BPP 303 : **WAVES , OSCILLATIONS, SOUND AND THERMAL PHYSICS**

B.Sc. – II Semester – IV
Theory: 45 lectures, 36 hours (for each paper)
Paper : BPT 401 : **MODERN PHYSICS**
Paper : BPT 402 : **OPTICS AND LASERS**

Practical: 64 lectures, 51 hours
Practical : BPP 403 : **MODERN PHYSICS, OPTICS AND LASERS**
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Astrophysics
B.Sc. – II Semester – III

Theory: 45 lectures, 36 hours (for each paper)
Paper : BAT 301 : **FUNDAMENTALS OF ASTRONOMY**
Paper : BAT 302 : **FUNDAMENTALS OF ASTROPHYSICS**

Practical: 64 lectures, 51 hours
Practical : BAP 303 : **NUMERICAL CALCULATIONS, PARALLAX , PHOTOMETRY AND SOUND**

B.Sc. – II Semester – IV
Theory: 45 lectures, 36 hours (for each paper)
Paper : BAT 401 : **GALAXIES AND UNIVERSE**
Paper : BAT 402 : **COSMIC ELECTRODYNAMICS**

Practical: 64 lectures, 51 hours
Practical : BAP 403 : **SPECTROSCOPY, MAGNETISM AND ELECTRONICS**

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Theory: 45 lectures, 36 hours (for each paper)
Paper : BPT 501 : MATHEMATICAL PHYSICS
Paper : BPT 502 : CLASSICAL MECHANICS
Paper : BPT 503 : QUANTUM MECHANICS
Paper : BPT 504 : NUCLEAR AND PARTICLE PHYSICS

Practical: 120 lectures, 96 hours
Practical : BPP 505 :

B.Sc. – III Semester – VI
Theory: 45 lectures, 36 hours (for each paper)
Paper : BPT 601 : STATISTICAL PHYSICS
Paper : BPT 602 : ELECTRODYNAMICS
Paper : BPT 603 : SOLID STATE PHYSICS
Paper : BPT 604 : MATERIAL SCIENCE

Practical: 120 lectures, 96 hours
Practical : BPP 605

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