Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. I (Physics)

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2026-2027

Syllabus for B.Sc. I (Physics)

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 will learn Physics as a separate subject from B.Sc. I. The aim of the syllabus is to make the study of physics interesting, encouraging and popular 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.

A. GENERAL OBJECTIVES OF THE PROGRAMME:

The Bachelor of Science (B.Sc.) Programme in Physics aims to:

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 work force 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 equipment along with the collection and interpretation of scientific data to contribute the science.

B. PROGRAMME OBJECTIVES (POs):

Within a few years after graduation, the graduates of the B.Sc. Physics Programme will be able to:

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 the intellectually stimulating experience of course in a supportive environment.

C. PROGRAMME OUTCOMES (POs)

After successful completion of the B.Sc. Physics Programme, students will be able to:

1. The student will graduate with proficiency in the subject.
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 eligibility as science graduate.
6. The student will be eligible to appear for industrial jobs with minimum eligibility as physics graduate.

D. Programme Specific Outcomes (PSOs):

After successful completion of the Bachelor of Science (B.Sc.) Programme in Physics, students will be able to:

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, 2024 onwards.
3. **Duration:** The course shall be a full time.
4. **Pattern:** Semester examination
5. **Eligibility of Students:** 12th Pass with Science, or equivalent
   Any other eligibility prescribed by UGC, Government of Maharashtra, Karmaveer Bhaurao Patil University, Satara
6. **Medium of Instruction:** The medium of instructions shall be in English.
   Batch Size:
   B.Sc. I -20 students per batch
   B.Sc. II -16 students per batch
   B.Sc. III-12 students per batch
   B.Sc. IV Honors -20 students per batch
   B.Sc. IV Honors with Research - 5 students per guide
7. **Eligibility of the Core Faculty:**
   • Assistant Professor: Master of Science with specialization in Physics and NET/ SET/ Ph.D.
   • Associate Professor: Master of Science in Physics with NET/ SET/Ph.D.
   • Professor: Master of Science in Physics with NET/ SET/Ph.D.
   Eligibility for Professor of Practice or Professional Trainer:
   Any other eligibility as per the Guidelines and Regulations Passed by the Board of Concerned Studies, Academic Council of the College / University and Rules and Regulations of Karmaveer Bhaurao Patil University, Satara, Government of Maharashtra, and UGC norms.
   Eligibility for Adjunct Professor of Practice or Professional Trainer:
   As per eligibility prescribed by UGC

8. **Course Structure: (NEP2.0)**

Sem (Level)	**Course I**	**Course II**	**Course III**	**OE**	**VSC/ SEC**	**AEC/ VEC/ IKS**	**OJT/ FP/ CEP/ CC/ RP**	**Total Credits**	**Degree/ Cum. Cr. MEME**
Sem I (4.5)	DSC I (2)	DSC I (2)	DSC I (2)	OE I (2) (P)	-	IKS I (2) (Generic)	-	22	UG Certificate: 44
	DSC II (2)	DSC II (2)	DSC II (2)						
	DSC P I (2)	DSC P I (2)	DSC P I (2)						
Sem II (4.5)	DSC III (2)	DSC III (2)	DSC III (2)	OE II (2) (P)	-	VEC I (2) DEGG and IIC	-	22	
	DSC IV (2)	DSC IV (2)	DSC IV (2)						
	DSC P II (2)	DSC P II (2)	DSC P II (2)						
Credits	12	12	12	4	-	4	-	44	Exit option: 4 Cr. NSQF/Internship/Skill Courses

Level 4.5, Semester I

Course Title	**Theory**			**Practical**		
	Course Code	Credits	Lectures Per Week	Course Code	Credits	Lectures Per Week
Mechanics	BPT 111	2	4	Physics Practical Course –I BPP 113	2	4
Electrostatics and Electronics	BPT 112	2				
Open Elective Course	--	--	--	BPPOE1	2	4
Introduction to Indian Knowledge System (IKS)	BPTIKS1 (Generic)	2	2			

Level 4.5, Semester II

Course Title	**Theory**			**Practical**		
	Course Code	Credits	Lectures Per Week	Course Code	Credits	Lectures Per Week
Gravitation and Properties of matter	BPT 121	2	4	Physics Practical Course –II BPP 123	2	4
Electricity and Magnetism	BPT 122	2				
Open Elective Course	--	--	-	BPPOE2	2	4
Democracy, Election and Indian Constitution (VEC)	BPTVEC1	2	2	--	--	--

OE= Open Elective, SEC: Skill Enhancement Course, IKS: Indian Knowledge System, VEC: Value Education Course

Evaluation Structure

Semester - I

Course Name	Course Code	Internal Evaluation			ESE	Total Marks	Credits
		CCE-I	CCE-II	CCE-III			
Mechanics	BPT 111	10	10	10	30	50	2
Electrostatics and Electronics	BPT 112	10	10	10	30	50	2
Physics Practical Course – I	BPP 113	20			30	50	2

Semester – II

Course Name	Course	Internal Evaluation			ESE	Total Marks	Credits
		CCE-I	CCE-II	CCE-III			
Gravitation and Properties of matter	BPT 121	10	10	10	30	50	2
Electricity and Magnetism	BPT 122	10	10	10	30	50	2
Physics Practical Course – II	BPP 123	20			30	50	2

CCE*- Out of three CCE marks best of two CCE marks consider

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc. I	**Semester** – I
Type : DSC I	**Marks:** 50
Credits : 02 (30 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPT 111: Mechanics

Course Objectives: Students should be able to,

1) learn the vector algebra and basic vector calculus and difference between scalars and vectors.
2) study different types of differential equations.
3) explain Newton's laws of motion, conservation laws for single and system of particles and their applications and corelate linear and angular motions.
4) know the concept of rotational motion and moment of inertia of various bodies.

Course Outcomes: Students will be able to,

1) define scalar, vector and their products and perform the basic algebra operations of scalars and vectors.
2) examine the order, degree, linearity of differential equation, solve 1st and 2nd order homogenous differential equation and distinguish between ordinary and partial differential equations as well as exact and inexact differential equations.
3) state Newton's laws of motion, law of conservation of linear momentum, angular momentum and energy for single and system of particles, describe physical significance of them and describe the concept of center of mass and use it extend conservation laws from single particle to system of particles.
4) describe rotational kinematical variables, relate them to their linear counterparts and calculate the moment of inertia of a spherical shell and solid cylinder about axis of rotation and analyze their rolling motion.

Module		Title and Contents	Hrs
Module -1	**Vectors Algebra and Elementary Calculus**		07
	1.1	Vector algebra	
	1.2	Scalar and vector products	
	1.3	Derivatives of a vector with respect to parameters (velocity and acceleration)	
Module -2	**Ordinary Differential Equations**		07
	2.1	Differential equations, Degree, Order, Linearity and homogeneity of differential equation	
	2.2	Ordinary and partial differential equations	
	2.3	1st order homogeneous differential equations (method of solving)	
	2.4	2nd order homogeneous differential equation with constant coefficients, Problems	
	2.5	Applications: 1st order ODE: Newton's Law of Cooling (why tea gets cold), radioactive decay, population growth models; 2nd order ODE: Simple harmonic motion (pendulum, spring), RLC circuit oscillations, damped vibrations in vehicles	
Module -3	**Dynamics of a system of particles**		08
	3.1	Frames of reference, Apparent weight of body in a lift	
	3.2	Newton's Laws of motion, Conservation of linear and angular momentum, Work and energy theorem, Conservation of energy (Single Particle)	

	3.3	Dynamics of a system of particles: linear momentum, angular momentum and energy (statement and physical significance)	
	3.4	Centre of mass (formula and physical significance), Motion of rocket (qualitative treatments only), Problems	
	3.5	Applications: Momentum conservation: rocket propulsion, recoil of a gun, collision analysis in road safety; Angular momentum conservation: spin stories of ball-cord, diver, ballet dancer; Energy conservation: roller coaster design, hydroelectric power generation; Centre of mass: stability of vehicles, balance in gymnastics, design of satellites; Rocket motion: space missions (ISRO, NASA launch mechanics)	
Module -4	**Rotational Motion**		
	4.1	Angular velocity and angular momentum, Torque, Analogy between translational and rotational motion	
	4.2	Relation between torque and angular momentum, Kinetic energy of rotation and moment of inertia	
	4.3	Moment of Inertia (physical significance and factors affecting it), Moment of Inertia of ring, disc, solid sphere, spherical shell and solid cylinder (formula and physical significance)	08
	4.4	Motion of spherical shell and solid cylinder rolling down an inclined plane (formula and physical significance), Problems	
	4.5	Application: Torque: opening doors, tightening bolts, steering of vehicles; Angular momentum conservation : gyroscope in aircraft navigation, spinning tops; Moment of Inertia: flywheel in engines (energy storage), figure skater spinning faster by pulling arms in; Rolling motion : design of wheels, tyres, and ball bearings	

Reference Books:-

1. Walker, Halliday and Resnick, *Fundamentals of Physics* (Hoboken, New Jersey: John Wiley & Sons,11th Edition, 2018).
2. H. C. Verma, *Concepts of Physics –Part–I, (*Bharati Bhawan Publishers, Revised Edition, 2018).
3. Charles Kittel, Knight, Ruderman et al., *Mechanics,* (New York: Berkeley Physics Course, Vol.1, Tata McGraw Hill Publications, 2nd Edition, 2017).
4. H. K. Das, Dr. Rama Verma, *Mathematical Physics,* (New Delhi: S. Chand Publication,7th Edition,2014).
5. B. D. Gupta, *Mathematical Physics* (Mumbai: Vikas Publication House,4th Edition,2010).
6. D.S. Mathur, *Mechanics*, (New Delhi: S. Chand and Company Ltd.,2007).
7. K. F. Riley, M. P. Hobson, S.J. Bence, *Mathematical Methods for Physics and Engineering*, (Cambridge: Cambridge University Press,3rd Edition, 2006).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 20 Marks	**End Semester Examination: Total- 50 Marks**
CCE- I: 10 Marks	Question -1 – Attempt any five (5 x 2 Marks – 10 Marks)
CCE- II: 10 Marks	Question -2 – Solve any two (2 x 10 Marks – 20 Marks)
CCE- III: 10 Marks	Question -3 – Solve any four (4 x 5 Marks – 20 Marks)
(Best of two CCE)	(50 Marks converted to 30 Marks)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc. I	**Semester** – I
Type : DSC II	**Marks:** 50
Credits : 02 (30 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPT 112: Electrostatics and Electronics

Course Objectives: Students should be able to,

1. learn the gradient, divergence and curl of vector fields and various integral calculus.
2. study Gauss's theorem of electrostatics and use it to calculate electric field, electric potential, electric energy density.
3. describe electric polarization of dielectric medium and interrelate different polarization parameters.
4. understand to simplify complex electric circuits using network theorems and study characteristics and different configurations of transistors.

Course Outcomes: Students will be able to,

1. compute gradient, divergence, curl to interpret their physical significances and solve practical problems using integral theorems of vector fields, Gauss divergence theorem, Stokes' theorem.
2. state Gauss's law and apply it to calculate electric field for a point charge, uniformly charged spherical shell and solid sphere, interrelate electric field, electric potential, electric potential energy and electric potential difference.
3. describe Gauss law for dielectrics and interrelate three electric vectors E, P, D as well as dielectric constant and electric susceptibility, distinguish between polar and non-polar dielectrics and compute the expression for capacitance of parallel plate capacitor filled with dielectric medium.
4. use Thevenin's and Norton's theorem to simplify an electric circuit, draw and discuss NPN structure, PNP structure, transistor characteristics in CB, CE and CC mode.

Module		Title and Contents	Hrs
Module -1	**Vector Analysis**		
	1.1	Differentiation of vector, Del operator, Scalar and vector fields	07
	1.2	Gradient, divergence, curl operations and their physical significance	
	1.3	Idea of line, surface and volume integrals	
	1.4	Gauss divergence theorem, Stokes' theorem (statements and physical significance)	
Module -2	**Electrostatics**		
	2.1	Electrostatic field, Electric flux	08
	2.2	Gauss's theorem of electrostatics, Applications of Gauss theorem –Electric field due to a point charge, infinite line of charge, infinite plane sheet of charge, two infinite parallel sheets of charge, just outside charged conductor, uniformly charged spherical shell and solid sphere (Formulae with physical significance)	
	2.3	Electric potential — concept and relation to electric field, Poisson and Laplace equations (formulae & physical interpretation), Energy density in electrostatic field (concept), Problems	

	2.4	Applications: Gauss's law: design of capacitors, shielding in electronic devices; Faraday cage: MRI scanning rooms, microwave ovens); Protection from lightning, Coaxial cable, Lineman suit; Electric potential: electrocardiogram (ECG), lightning rod working principle; Energy density: energy storage in capacitors used in camera flash, defibrillators; Laplace equation: electrostatic lens design in electron microscopes	
Module -3	**Dielectrics**		
	3.1	Dielectric medium, Concept of electric dipole, Polar and non-polar molecules, Polarization, Displacement vector	08
	3.2	Gauss's theorem in dielectrics (statement and physical meaning), Parallel plate capacitor completely filled with dielectrics (formula and physical interpretation)	
	3.3	Relation between three electric vectors D, E and P (formula with physical interpretation), Relation between dielectric constant and electric susceptibility (Formulae & physical interpretation), Problems	
	3.4	Applications: Dielectrics: capacitors in smartphones, computers, and power supplies; Polar molecules: microwave oven working (water molecules rotate in alternating field); Polarization: LCD screen technology, optical waveguides; Dielectric constant: selection of insulating materials in high-voltage equipment	
Module -4	**Network Theorems and Transistors (BJT)**		
	4.1	Review of Ohm's and Kirchhoff's laws	07
	4.2	Thevenin's theorem, Norton's theorem, Application of simple networks with D.C. sources	
	4.3	PNP and NPN structure, Transistor characteristics in CB, CE and CC mode.	
	4.4	Transistor as an amplifier in CE mode, Comparative study of CB, CE and CC configurations	

Reference Books:-

1. D. C. Tayal, *Electricity and Magnetism* (Mumbai: Himalaya Publishing House, 4th Edition, 2016).
2. S. Mahajan and Chaudhary, *Electricity, Magnetism and Electromagnetic Theory* (Tata McGraw Hill, 2012).
3. V. K. Mehta, *Principles of Electronics*, (New Delhi: S. Chand and Co., 11th Edition, 2009).
4. David J. Griffith, *Introduction to Electrodynamics* (New Jersey: Prentice Hall Publisher,3rd Edition, 1999).
5. Bagde and Singh, Elements *of Electronics*, (New Delhi: S. Chand and Co., 18thEdition, 1997).
6. B. B. Laud, *Electromagnetics,* (New Delhi: New age international (P) Ltd.,2nd Edition, 1987).
7. J. Yarwood & J. H. Fewkes, *Electricity & Magnetism* (London: University Tutorial Press, 2nd Edition,1965).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 30 Marks	**End Semester Examination: Total- 50 Marks**
CCE- I: 10 Marks	Question -1 – Attempt any five (5 x 2 Marks – 10 Marks)
CCE- II: 10 Marks	Question -2 – Solve any two (2 x 10 Marks – 20 Marks)
CCE- III: 10 Marks	Question -3 – Solve any four (4 x 5 Marks – 20 Marks)
(Best of Two CCE)	(50 Marks converted to 30 Marks)

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Faculty of Science and Technology

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Board of Studies in Physics

Programme: B.Sc. I	**Semester** – I
Type : DSC P I	**Marks:** 50
Credits : 02 (60 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPP 113: Physics Practical Course I
(Based on BPT 111 and BPT112)

Course Objectives: Students should be able to,

1. develop fundamental experimental skills to perform an experiment and learn the experimental setup and procedure to perform given experiment.
2. develop skills in taking readings/observations obtained from these instruments and learn how to analyze and interpret experimental data, including error analysis, graphical representation.
3. perform calculations to obtain the experimental results and test whether the experimental results hold good with theoretical results.
4. acquire knowledge and practice safe laboratory procedures, including proper handling of equipment, electrical, and potential hazards.

Course Outcomes: Students will be able to,

1. demonstrate basic experimental skills by setting up laboratory equipment/ experiment set up safely and efficiently, instruments calibration, carry out experimental procedure, data collection, analysis and report it in a written sheet manner.
2. exhibit practical skills in using various measuring instruments (vernier caliper, micrometer screw gauge, travelling microscope, multimeter, stopwatch etc.) and learn to select and use the appropriate instrument for a given measuring task.
3. display practical skills in measuring moment of inertia using various experimental setups such as flywheel, torsional oscillating annular disk and bifilar suspension arrangement.
4. exhibit practical skills in measuring time period of oscillation for Kater's and bar pendulum and demonstrate electronics practical skills by measuring various electronic components and verification of network theorems (Kirchhoff's laws, Thevenin's theorem, Norton's theorem).

Practical No.	Title and Contents	Hrs
1	Measurements of length/diameter using Vernier caliper, Screw gauge and Travelling Microscope	4
2	To determine the Moment of Inertia of a Flywheel	4
3	To determine Moment of inertia of a disc using auxiliary annular ring	4
4	To determine 'g' by bar pendulum	4
5	To determine 'g' by Kater's pendulum (fixed knife edges)	4
6	To determine 'g' by Kater's pendulum (movable knife edges)	4
7	To study the motion of a spring and calculate (a) spring constant (b) value of 'g'	4
8	To use a multimeter for measuring (a) Resistance, (b) AC and DC voltages, (c) DC current, and (d) checking electrical fuses	4

9	Input, output and transfer characteristics of common emitter (CE) transistor	4
10	To verify Kirchhoff 's laws	4
11	To verify Thevenin's theorem	4
12	To verify Norton's theorem	4
13	To determine the moment of inertia of a body using bifilar suspension method (with parallel thread)	4
14	To study the oscillations in a bifilar suspension arrangement	4
15	To determine order and degree of given differential equation	4

Reference Books:-

1. Gupta S.L. and V. Kumar., *Practical physics*. (Meerut: Pragati Prakashan,29thEdition.2017).
2. Chattopadhyay D. and P. C. Rakshit, *An advanced course in practical physics* (Calcutta: New Central Book,8th Edition,2013).
3. I. Prakash and Ramakrishna, *A Textbook of Practical Physics*, (Kitab Mahal,11th Edition, 2011).
4. Singh H. Harnam and Hemne P. S., B.Sc. Practical Physics, (New Delhi, S. Chand & Co. Ltd., 17th Edition, 2011)
5. White, Marsh W. and Kenneth V. Manning, *Experimental college physics; a laboratory manual*, (New York: McGraw-Hill Publication,3rd Edition, 1954).
6. Worsnop B. L. and H. T. Flint., *Advanced practical physics for students*, (London: Methuen & Co., Ltd, 9th Edition, 1951).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 20 Marks	**End Semester Examination: 30 Marks**
Journal: 10 Marks Student performance (Oral): 10 Marks	Question -1 – 30 Marks

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Board of Studies in Physics

Programme: B.Sc. I	**Semester** – II
Type : DSC III	**Marks:** 50
Credits : 02 (30 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPT 121: Gravitation and Properties of Matter

Course Objectives: Students should be able to,

1. learn about the motion of a particle under central force field, Newton's Law of Gravitation, Kepler's laws of planetary motion and their applications.
2. study flow of liquid using concept of viscosity and various physical parameters affecting it.
3. understand basic behavior of beam under different types loading, torsional pendulum and correlation between elastic constants.
4. know the concept of surface tension, angle of contact and wettability of the liquid, excess pressure under a bubble and its experimental determination and application.

Course Outcomes: Students will be able to,

1. state and explain Newton's law of gravitation and Kepler's laws of planetary motion, geosynchronous orbits and global positioning system (GPS), enlist and prove the properties of the particle moving in central force field and interpret the motion of satellite in circular orbit, its applications and geosynchronous orbits, basic idea of global positioning system (GPS).
2. distinguished between streamline and turbulent flow, explain the effect of temperature and pressure on viscosity of liquid and derive Poiseuille's formula for flow of liquid through a capillary tube and apply it to calculate coefficient of viscosity.
3. define beam, cantilever to formulate the expression of depression under various types of loading and describe torsional pendulum, twisting behavior of wire and corelate Y, n and σ.
4. define and corelate surface tension, angle of contact and wettability of the liquid, formulate the relation between surface tension, excess pressure and radius of curvature of liquid bubble, describe experimental determination of surface tension by Jaeger's method and effect of temperature, impurity on it.

Module	Title and Contents		Hrs
Module -1	**Gravitation**		08
	1.1	Newton's Law of Gravitation	
	1.2	Motion of particle in central force field (motion in a plane, angular momentum is conserved, areal velocity is constant), Kepler's laws of planetary motion (statements only)	
	1.3	Satellite in circular orbit and its applications, Geosynchronous orbits	
	1.4	Weightlessness, Basic idea of global positioning system (GPS), Problems	
Module -2	**Viscosity**		07
	2.1	Introduction, Newton's law of viscosity and coefficient of viscosity, Rate of flow of liquid in a capillary tube, Tubes of flow (streamline and turbulent)	

	2.2	Poiseuille's formula (derivation) (formula and physical significance) and determination of coefficient of viscosity of liquid by Poiseuille's method	
	2.3	Variation of viscosity of liquid with temperature and pressure, Problems	
	2.4	Applications: Poiseuille's formula: blood flow in arteries (medical diagnosis of atherosclerosis), design of IV drip tubes in hospitals; Viscosity: lubrication in engines, design of hydraulic brakes, inkjet printer ink selection; Temperature dependence: engine oil grades (5W-30), lava flow behavior in volcanology; Turbulent flow: aircraft wing design, water pipeline efficiency	
Module -3	**Elasticity**		
	3.1	Bending of beam, Bending moment, Cantilever (without considering weight of cantilever) (formula and physical significance)	
	3.2	Beam supported at both ends (without considering weight of beam) (formula and physical significance)	
	3.3	Torsional pendulum and torsional couple per unit twist (formula and physical significance), Work done in twisting a wire, Determination of modulus of rigidity	
	3.4	Determination of Y, n and σ by Searle's method (qualitative), Problems	
	3.5	Applications: Elasticity: Why Girders are made I shaped, Application of Elastic Behavior of Materials; Cantilever: design of aircraft wings, balconies, bridge construction (Konkan Railway viaducts); Beam bending: selection of steel vs. wood in building construction, railway track design; Torsional pendulum: determination of material properties in industries, watch springs; Modulus of rigidity: design of drive shafts in automobiles, earthquake-resistant structures; Poisson's ratio: design of rubber gaskets, seals in pipelines, shock absorbers	08
Module- 4	**Surface Tension**		
	4.1	Molecular forces, Surface tension (definition), Molecular theory of surface tension	
	4.2	Angle of contact and wettability, Relation between surface tension, excess pressure and radius of curvature	
	4.3	Experimental determination of surface tension by Jaeger's method, Effect of temperature, impurity on surface tension	
	4.4	Applications: Surface tension: water strider insect walking on water, needle floating on water; Wettability: waterproof jackets (lotus leaf effect), non-stick cookware coating; Excess pressure in bubbles: lung alveoli inflation in breathing (respiratory physiology); Effect of impurity: detergent/soap reduces surface tension to clean clothes, dishwashing;	07

		Capillarity (related): water transport in plants (xylem), rise of oil in lamp wick; Jaeger's method: surface tension variation determination due to change in physical parameter, quality control of surfactants in pharmaceutical and cosmetic industries	

Reference Books:-

1. Walker, Halliday and Resnick, *Fundamentals of Physics* (Hoboken, New Jersey: John Wiley & Sons, 11th Edition, 2018).
2. J.C. Upadhyaya, *General Properties of Matter*, (Agra: Ram Prasad Publication,3rd Edition,2017).
3. R. Murugeshan, *Properties of Matter*, (New Delhi: S Chand & Company, 2017).
4. D. S. Mathur, *Elements of Properties of Matter*, (New York: S. Chand & Company, 2010).
5. Brij Lal and N. Subrahmanyam, *Properties of Matter*, (New Delhi: Eurasia Publishing House Limited, 1993).
6. S. G. Sterling and A. J. Woodal, *Physics* (London: Longman's & Green Co. Ltd.,2nd Edition, 1963).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 30 Marks	**End Semester Examination: Total- 50 Marks**
CCE- I: 10 Marks	Question -1 – Attempt any five (5 x 2 Marks – 10 Marks)
CCE- II: 10 Marks	Question -2 – Solve any two (2 x 10 Marks – 20 Marks)
CCE- III: 10 Marks	Question -3 – Solve any four (4 x 5 Marks – 20 Marks)
(Best of Two CCE)	(50 Marks converted to 30 Marks)

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Faculty of Science and Technology

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Board of Studies in Physics

Programme: B.Sc. I	**Semester** – II
Type : DSC IV	**Marks:** 50
Credits : 02 (30 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPT 122: Electricity & Magnetism

Course Objectives: Students should be able to,

1. use complex number to study the concept of resonance phenomenon, sharpness and quality factor for a series LCR circuit.
2. study the concepts of magnetostatics using Biot - Savart's law and apply it to calculate magnetic field for various current carrying elements.
3. know various magnetization entities with their interrelations and different types of magnetic materials and impart knowledge on concepts of Faraday's law, Lenz law, electromagnetic induction and Ballistic galvanometer.
4. interpret importance of Maxwell's equations and electromagnetic Wave propagation.

Course Outcomes: Students will be able to,

1. differentiate between alternating (AC), direct current (DC), complex impedance, reactance, admittance and susceptance and draw phasor diagram and formulate impedance, phase angle, resonance frequency, quality factor and sharpness in series LCR circuit.
2. state Biot-Savart Law and apply it to find magnetic field for straight conductor, circular coil & solenoid and describe nature and source of diamagnetism, paramagnetism and ferromagnetism as well as relate among magnetization vector (M), magnetic intensity (H), magnetic induction (B), permeability, susceptibility.
3. state Faraday's and Lenz's law and use it to determine direction and magnitude of an induced emf and differentiate between self-inductance and mutual inductance and determine energy stored in magnetic field.
4. explain the theory of ballistic galvanometer to measured small currents, Maxwell's correction of Ampere's law by including displacement current and enlist Maxwell's equations, interpret its physical interpretation and design wave equation from the Maxwell's equations.

Module		Title and Contents	Hrs
Module -1	**AC Circuits**		07
	1.1	Complex numbers and their application in solving for AC series & parallel LCR circuit (phaser diagram, formula and physical significance)	
	1.2	Complex impedance, Reactance, Admittance and Susceptance (definitions and physical meaning)	
	1.3	Resonance in LCR series circuit (condition and physical interpretation)	
	1.4	Sharpness of resonance, (qualitative treatment only), Q-factor (definition and physical significance), AC Bridge- Owen's Bridge (working principle), Problems.	
	1.5	Applications: LCR resonance: radio and television tuning circuits (selecting a channel/station);	

		Q-factor: design of filters in mobile phones, noise suppression in audio systems; Owen's Bridge: precision measurement of inductance in electrical laboratories; Reactance concept: design of power factor correction capacitors in industries	
Module -2	**Magnetostatics and Magnetism**		
	2.1	Magnetostatics, Biot - Savart's law (statement and physical significance) & its applications – straight conductor, circular coil, solenoid carrying current (formula with physical significance)	08
	2.2	Divergence and curl of magnetic field (physical meaning), Ampere's circuital law (statement and physical significance)	
	2.3	Properties of magnetic materials – Magnetic intensity (H), magnetic induction (B), permeability, susceptibility (definitions and interrelations), Brief introduction of dia, para, and ferro magnetic materials, Problems	
	2.4	Applications: Biot-Savart law: design of MRI machines, electromagnets in electric motors; Solenoid: electric doorbells, relay switches, fuel injectors in cars; Ampere's law: design of toroidal transformers, magnetic shielding; Ferromagnetism: hard disk drives (magnetic data storage), permanent magnets in loudspeakers; Paramagnetism: oxygen sensing in medical equipment (MRI contrast)	
Module -3	**Electromagnetic Induction**		
	3.1	Faraday's laws of electromagnetic induction (statement and physical meaning), Lenz's law (concept and examples), self and mutual induction (formula and physical concept)	08
	3.2	Reciprocity Theorem (statement), Self-inductance of solenoid (formula and physical significance), Energy stored in a magnetic field (formula and physical significance)	
	3.3	Ballistic Galvanometer, construction and working (Revision), Expression for charge flowing through ballistic galvanometer (formula), Correction for damping in galvanometer (concept), Constants of ballistic galvanometer (physical significance)	
	3.4	Applications: Faraday's law: electric generators (power stations - Koyna Dam), alternators in cars; Lenz's law : eddy current brakes in trains, electromagnetic damping in meters; Mutual induction: transformer working (step-up/step-down for power transmission), wireless charging (phone chargers); Self-inductance: choke coils in fluorescent lamps, inductors in switching power supplies; Ballistic galvanometer: measurement of magnetic flux, charge in ballistic experiments	
Module- 4	**Maxwell's equations and Electromagnetic Wave propagation**		
	4.1	Equation of continuity of current (formula and physical significance)	07
	4.2	Maxwell's correction to Ampere's law (displacement current), Maxwell's equations (formula) and its physical interpretation	
	4.3	Poynting vector (concept and physical meaning, Energy density in electromagnetic field (qualitative)	

	4.4	electromagnetic wave propagation through vacuum and isotropic dielectric medium (key results and physical picture), transverse nature of EM waves, polarization (Concept)	
	4.5	Applications: Displacement current: working of capacitor in AC circuit, antenna radiation; Maxwell's equations: foundation of all wireless communication (Wi-Fi, 5G, Bluetooth); Poynting vector: calculation of intensity of sunlight, solar panel power estimation; EM wave propagation: optical fibre communication, RADAR, microwave ovens; Polarization: polaroid sunglasses, LCD displays, 3D movie glasses, photography filters; Transverse nature: antenna orientation design in mobile towers	

Reference Books:-

1. Matthew N. O. Sadiku, *Elements of Electromagnetism* (New York: Oxford University Press, 7th Edition, 2018).
2. D. C. Tayal, *Electricity and Magnetism* (Mumbai: Himalaya Publishing House, 4th Edition, 2016).
3. S. Mahajan and Chaudhary, *Electricity, Magnetism and Electromagnetic Theory* (Tata McGraw Hill,2012).
4. David J. Griffith, *Introduction to Electrodynamics* (New Jersey: Prentice Hall Publisher,3rd Edition, 1999).
5. B. B. Laud, *Electromagnetics,* (New Delhi: New age international (P) Ltd.,2nd Edition, 1987).
6. N. Subramanyam, Brij Lal*, Textbook of Electricity and Magnetism,* (Agra: Ratan Prakashan,1966).
7. J. Yarwood & J. H. Fewkes, *Electricity & Magnetism* (London: University Tutorial Press, 2nd Edition,1965).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 30 Marks	**End Semester Examination: Total- 50 Marks**
CCE- I: 10 Marks	Question -1 – Attempt any five (5 x 2 Marks – 10 Marks)
CCE- II: 10 Marks	Question -2 – Solve any two (2 x 10 Marks – 20 Marks)
CCE- III: 10 Marks	Question -3 – Solve any four (4 x 5 Marks – 20 Marks)
(Best of Two CCE)	(50 Marks converted to 30 Marks)

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc. I	**Semester** – II
Type : DSC P II	**Marks:** 50
Credits : 02 (60 Hrs)	**From:** A. Y. 2026-27

Name of Course: BPP 123: Physics Practical Course II
(Based on BPT 121 and BPT 122)

Course Objectives: Students should be able to,

1. develop fundamental experimental skills to perform an experiment and learn the experimental setup and procedure to perform given experiment.
2. develop skills in taking readings/observations obtained from these instruments and learn how to analyze and interpret experimental data, including error analysis, graphical representation.
3. perform calculations to obtain the experimental results and test whether the experimental results hold good with theoretical results.
4. acquire knowledge and practice safe laboratory procedures, including proper handling of equipment, electrical, and potential hazards.

Course Outcomes: Students will be able to,

1. demonstrate basic experimental skills by setting up laboratory equipment/ experiment set up safely and efficiently, instruments calibration, carry out experimental procedure, data collection, analysis and report it in a written sheet manner.
2. exhibit practical skills in using various measuring instruments (vernier caliper, micrometer screw gauge, travelling microscope, multimeter, stopwatch, measuring cylinder etc.) and learn to select and use the appropriate instrument for a given measuring task.
3. display practical skills in measuring elastic constants (Young's modulus, Modulus of rigidity, Poisson's ratio) using various experimental setups such as vibration of bar, Searle's method, rubber tube and torsional oscillations of disc.
4. exhibit practical skills in tunning vibrating length in sonometer and input frequency in series/ parallel LCR.

Practical No.	Title and Contents	Hrs
1	Young's modulus of material of bar by vibration method	4
2	Young's modulus of material of bar by cantilever method	4
3	Young's modulus of material of rectangular bar by method of bending (using travelling microscope)	4
4	Modulus of rigidity of material of wire by torsional oscillations	4
5	Y and n of wire by Searle's method	4
6	Poisson's ratio for rubber using rubber tube	4
7	Coefficient of viscosity by Poiseiulle's Method	4
8	Surface Tension by Jaegar's method	4
9	Surface tension and angle of contact by Quincke's method	4

10	To study a series LCR circuit and determine its (a) resonant frequency (b) quality factor Q	4
11	To study a parallel LCR circuit and determine its (a) anti-resonant frequency (b) quality factor Q	4
12	Frequency of AC mains by sonometer using magnetic wire	4
13	Frequency of AC mains by sonometer using non- magnetic wire	4
14	To compare capacitance using De Sauty's bridge	4
15	Impedance of series LCR circuit	4

Reference Books:-

1. Gupta S.L. and V. Kumar., *Practical physics,* (Meerut: Pragati Prakashan,29th Edition.2017).
2. Chattopadhyay D. and P. C. Rakshit, *An advanced course in practical physics* (Calcutta: New Central Book,8th Edition,2013).
3. I. Prakash and Ramakrishna, *A Textbook of Practical Physics*, (Kitab Mahal,11th Edition, 2011).
4. Singh H. Harnam and Hemne P. S., B.Sc. Practical Physics, (New Delhi, S. Chand & Co. Ltd., 17th Edition, 2011)
5. White, Marsh W. and Kenneth V. Manning, *Experimental college physics; a laboratory manual*, (New York: McGraw-Hill Publication,3rd Edition, 1954).
6. Worsnop B. L. and H. T. Flint., *Advanced practical physics for students*, (London: Methuen & Co., Ltd, 9th Edition, 1951).

Evaluation Pattern: 40:60

Total Marks: 50

Internal Examination: 20 Marks	**End Semester Examination: 30 Marks**
Journal: 10 Marks Student performance (Oral): 10 Marks	Question -1 – 30 Marks