Faculty of Science

Department of Physics

Proposed Syllabus

for

B.Sc. in Physics

From Academic Year 2019-2020

Submitted

to

Academic Council

of

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

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Preamble:

Physics is concerned with the study of the universe from the smallest to the largest scale: it is about unraveling its complexities to discover the way it is and how it works. Discoveries in physics have formed the foundation of countless technological advances and play an important role in many scientific areas. Many techniques used in medical imaging, nanotechnology and quantum computing are derived from physics instrumentation. Even the World Wide Web was a spin-off from the information processing and communications requirements of high-energy particle physics. The contributions of physics to solving global problems such as energy production, environmental protection, global warming and public health are essential and have an enormous impact on our society.

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Physics

Eligibility:

1. First Year B.Sc.: Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.
2. Second Year B.Sc.: Keeping terms of First Year of B. Sc. with Physics as one of the subjects. Other students if they fulfill the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.
3. Third Year B. Sc.: Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Admissions will be given as per the selection procedure/policies adopted by the Tuljaram Chaturchand College , in accordance with conditions laid down by the Academic Council of Anekant Education Society's, Tuljaram Chaturchand College, Baramati, Reservation and relaxation will be as per the Government rules for minority institution.

Proposed Structure of B.Sc. degree in physics and syllabus for first year degree in Physics as follows:

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Course Structure of

F. Y, S.Y, T.Y.B. Sc. [Physics]

Class	Semester	Paper-I	Paper-II	Paper-III
F. Y. B. Sc	I	Mechanics & Properties of Matter	Electromagnetics	Practical
	II	Heat and Thermodynamics	Waves and Optics	
S.Y.B.Sc	III	Electronics-I	Mathematical Physics	Practical
	IV	Thermal Physics	Elements of Modern Physics	
		Sem-I	**Sem-II**	
T.Y.B.Sc		1.Mathematical Methods of Physics	1.Electrodynamics	
		2.Classical Mechanics	2.Quantum Mechanics	
		3.Experimental Techniques	3.Statistical Physics	Practical -I Practical -II Project
		4.Solid State Physics	4.Nuclear Physics	
		5.Atomic and Molecular Physics	5.Electronics II	
		6. Elective-I (Select any One) i) Elements of Material Science ii) Renewable Energy Sources iii) Physics and Technology of Sensors. iv) Electronic instrumentation-I	6. Elective-II (Select any One) i) Physics of Nanomaterials ii) Solar Energy Conversion Devices iii) Sensors and its Applications iv) Electronic instrumentation-II	

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Course Structure for F. Y. B. Sc. Physics

Semester	Paper Code	Title of Paper	No. of Credits
I	PHY1101	Mechanics & Properties of Matter	2
	PHY1102	Electromagnetics	2
	PHY1103	Practical	2
II	PHY1201	Heat and Thermodynamics	2
	PHY1202	Waves and Optics	2
	PHY1203	Practical	2

SYLLABUS (CBCS) FOR F. Y. B. Sc. PHYSICS (w.e.f. June, 2019)

Academic Year 2019-2020

Class : F.Y. B. Sc. (Semester- I)
Paper Code: PHY1101
Paper : I Title of Paper: Mechanics & Properties of Matter
Credit : 2 No. of lectures: 36

A) Learning Outcome:

On successful completion of this course students will be able to do the following:

1. Understand the concepts of energy, work, power, conservation of energy and be able to perform calculations using them.
2. Understand the concepts of elasticity and be able to perform calculations using them.
3. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
4. Use of Bernoulli's Principle in real life examples.
5. Demonstrate quantitative problem solving skills in all the topics covered.

TOPICS/CONTENTS:

UNIT1: Motion (6L)

1.1 Introduction (motion, displacement, velocity, acceleration, forces)
1.2 Newton's laws & its applications.
1.3 Limitation of Newton's laws of motion
1.4 Newton's law of gravitation.
1.5 Frame of reference: Inertial and non- inertial
1.6 Introduction to classical relativity
Problem Solving

UNIT2: Work and Energy (8L)

2.1 Introduction (work, energy, power)
2.2 Work and Work-Energy theorem
2.3 Calculation of work done with constant force and variable force
2.4 Conservative and non-conservative forces
2.5 Potential energy and conservation of mechanical energy
2.6 Change in potential energy in rigid body motion
2.7 Mass-energy equivalence
Problem Soving

UNIT3: Elasticity (8L)

3.1 Introduction
(Hook's law and coefficient of elasticity, Young's modulus,
Bulk modulus and Modulus of rigidity)

3.2 Work done during longitudinal strain, volume strain, and shearing strain
Poisson's ratio.

3.3 Relation between three elastic moduli (Y, η, K)

3.4 Determination of Y of rectangular thin bar loaded at the centre

3.5 Torsional oscillations

3.6. Determination of rigidity of a wire by torsional oscillations

Problem solving

UNIT4: Surface Tension (6L)

4.1 Introduction: **(**surface tension, angle of contact)

4.2 Capillary rise method, rise of liquid in a conical capillary tube

4.3 Energy required to raise a liquid in capillary tube

4.4 Jaeger's method for determination of surface tension

4.5. Factors affecting surface tension

4.6. Applications of surface tension (washing of cloths with detergents,
surfactants, capillary action)

Problem Solving

Unit 5: Viscosity (8L)

5.1. Introduction**: (**Concept of viscous force and viscosity, Pressure in a fluid,
buoyancy, Pascal's law and Archimedes Principle)

5.2. Atmospheric Pressure and Barometer

5.3. Pressure difference in liquid accelerating vertically upward with an
acceleration a_0

5.4. Pressure difference in liquid accelerating horizontally with an acceleration a_0

5.5. Steady and turbulent flow, Reynolds's number

5.6. Equation of continuity

5.7. Poiseuille's equation

5.8. Bernoulli's Principle and its application

Problem Solving

References:

1. University Physics: Sears and Zeemansky, XIth edition, Pearson education
2. Concepts of Physics: H.C. Varma, Bharati Bhavan Publishers
3. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
4. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VI Edition,
5. Pearson Education/Prentice Hall International, New Delhi
6. Properties of Matter: D. S. Mathur, Shamlal Chritable Trust New Delhi
7. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

Class : F.Y. B. Sc. (Semester- I)
Paper Code: PHY1102
Paper : II Title of Paper: Electromagnetics
Credit : 2 No. of lectures: 36

A) Learning Outcome:
On successful completion of this course students will be able to do the following:

1. Demonstrate and understand the electric force, field, potential and related concepts for stationary charges.
2.Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
3. Demonstrate and understand the dielectrics and effect of dielectric on electric field.
4. Demonstrate and understand the magnetic field for steady currents using Biot-Savart and Ampere's law.
5. Understand the concept of magnetization of materials.
6. Demonstrate quantitative problem solving skills in all the topics covered.

TOPICS/CONTENTS:

UNIT1: Electrostatics (10L)

1.1 Introduction (Electric charge, Coulombs law, potential, electric field, electric flux)
1.2 Gauss's theorem of electrostatics.
1.3 Applications of Gauss theorem-
1.3.1 Electric field due to point charge
1.3.2 Infinite line of charge
1.3.3 Uniformly charged spherical shell
1.3.4 Solid sphere
1.4. Electric potential as line integral of electric field
1.5 Electric Potential due to
1.5.1 A point charge
1.5.2 Electric dipole
1.5.3 Uniformly charged non conducting spherical shell
1.5.4 Calculation of electric field from potential
Problem Solving

UNIT2: Dielectrics (10L)

2.1 Introduction (Dielectric constant, Polar & non-polar molecule)
2.2 Polarization
2.3 Polar and non-polar dielectrics
2.4 Capacitance due to parallel plate capacitor
2.5 Capacitance due to spherical capacitor and cylindrical capacitor
2.6. Energy per unit volume in electrostatic field
2.7 Effect of dielectric medium on capacitance of parallel plate capacitor
2.8 Displacement vector.

2.10 Gauss's theorem in dielectrics.
Problem Solving

UNIT3: Magnetism (10L)

3.1 Introduction (Lines of forces, Magnetization, Magnetic field)
3.2 Magnetostatics
3.3 Biot-Savart's law & its applications
3.3.1. Straight conductor
3.3.2. Circular coil
3.4 Ampere's circuital law and its applications
3.5 Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, Susceptibility, hysteresis
3.6. Magnetization of materials
3.7 Types of magnetic materials: dia, para, ferro, antiferro, and ferri magnetic
Problem Solving

UNIT4: Electromagnetic Induction (10L)

4.1 Introduction
4.2 Faraday's laws of electromagnetic induction
4.3 Lenz's law
4.4 Self and mutual inductance
4.5 Self inductance of single coil
4.6 Mutual inductance between two coils
4.7 Maxwell's equations and their significance
Problem Solving

References:

1. Electricity and Magnetism, D. C. Tayal, 1988, Himalaya Publishing House.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar

Class : F.Y. B. Sc. (Semester- I)
Paper Code: PHY1103
Paper : III Title of Paper: Practical
Credit : 2 No. of Practicals: 10

A) Learning Outcome:

After successfully completing this laboratory course, the students will be able to do the following:

1. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

1. Mechanics (Any Four)

1. Use of tools and instruments as a measuring device
(Vernier caliper, micrometer screw gauge, travelling microscope, spectrometer etc.)
2. Determination MI of disc using ring
3. MI of Flywheel
4. Determination of coefficient of Viscosity by Poiseuille's method
5. Determination of Y and n by flat spiral spring
6. Determination of Y by method of bending
7**.** Surface Tension by Jaeger's method.
8. To study one-dimensional elastic collisions using two hanging spheres.
9. To determine poisons ratio for rubber.

2. Electricity and magnetism (Any Four)

1. Charging and discharging of a capacitor
2. Study of LR circuit
3. Study of LCR series circuit
4. Study of Kirchhoff's laws
5. Diode characteristics
6. Use of multimeter to measure DC and AC current, voltage and resistance

3. Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)

1. Magnet –magnet interaction
2. Collision by using balls
3. Use of CRO (measurement of AC voltage, frequency)
4. Measurement of sound pressure level

2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments)

1. Coulomb's law

2. Visualization of vectors

3. Bohr's model

3. Student Involvement (Any one equivalent to two experiments)

1. Mini Projects

Group of 4 students should carry out miniproject with the report.

Students have to perform at least two additional activities out of three activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.

Class : F.Y. B. Sc. (Semester- II)
Paper Code: PHY1201
Paper : I Title of Paper: Heat and Thermodynamics
Credit : 2 No. of lectures: 36

A) Learning Outcome:

After successfully completing this course, the student will be able to:

1. Describe the thermodynamic properties of a material.
2. Understand the ideal gas equation and its limitations.
3. Understand the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Understand principle of heat engines and calculate thermal efficiency.
6. Understand the principle of the refrigerators to calculate coefficient of performance
7. Understand phenomenon of 'entropy'
8. Understand the types of thermometers and their uses

TOPICS/CONTENTS:

UNIT1: Equation of state (8L)

1.1 Introduction: (Equation of state, ideal and real gas).
1.2. Andrew's Experiment and Amagat's Experiment
1.3. Van der Waals 'equation of state, critical constants and reduced equation of state
1.4. Joule-Thomson porous plug experiment (Throttling process)
Problem Solving

UNIT2: Concepts of Thermodynamics (8L)

2.1 Introduction**:** (Thermodynamic state of a system, Zeroth law of thermodynamics, Thermodynamic equilibrium, reversible and irreversible processes)
2.2 Thermodynamic Processes: isothermal, adiabatic, isochoric and isobaric
2.3 Work done during isothermal change
2.4 Adiabatic relations for perfect gas
2.5 Work done during adiabatic change
2.6 First law of thermodynamics and its applications
Problem Solving

UNIT3: Applied Thermodynamics (8L)

3.1 Introduction (Joules law of heating)
3.2 Heat and work
3.3 Carnot's cycle and Carnot's heat engine and its efficiency
3.4 Second law of thermodynamics
3.5 Concept of entropy, Enthalpy, Free energy
3.6 Maxwell's relations in thermodynamics
3.7 T-dS Equation
3.8 Clausius-Clapeyron Latent heat equations (I and II)
Problem Solving

UNIT4: Heat Transfer Mechanisms (8L)

4.1 Introduction (Kinematics of heat)
4.2 Heat Engines: Otto cycle and its efficiency and Diesel cycle and its efficiency
4.3 Refrigerators: Principle and coefficient of performance of refrigerator
4.4 Air conditioning: Principle and its applications
Problem Solving

Unit 5: Thermometry (8L)

5.1 Introduction: (Temperature Scales: Celsius, Fahrenheit and Kelvin scale)
5.2 Principle, construction and working of thermometers
5.2.1 Liquid thermometers
5.2.2 Gas thermometers
5.2.3 Resistive type thermometer
5.2.4 Thermocouple as thermometer
5.2.5 Pyre-heliometers
Problem Solving

References:

1. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SON (SEA) PTE LTD
2. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
3. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
4. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
5. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Him

Class : F.Y. B. Sc. (Semester- II)
Paper Code: PHY1202
Paper : II Title of Paper: Waves and Optics
Credit : 2 No. of lectures: 36

A) Learning Outcome:
On successful completion of this course students will be able to do the following:

1. Understand the mathematical description of travelling and standing waves.
2. Recognize the one-dimensional classical wave equation and its solutions.
3. Calculate the phase velocity of a travelling wave.
4. Understand the concept of Doppler Effect.
5. Explain in qualitative terms how frequency, amplitude, and wave shape affect the pitch, intensity, and quality of tones produced by musical instruments.
6. Understand the phenomena like reflection, refraction, diffraction, dispersion.
7. Understand construction and working principle of optical instruments.
8.

TOPICS/CONTENTS:

1.1 UNIT1: Wave Motion (7L)

1.1 Introduction (Electromagnetic wave, Frequency, Amplitude, Period, Wavelength and wave equation)
1.2. Concept of wave motion
1.3. Transverse waves on a string
1.4 Travelling and standing waves on a string
1.5. Normal Modes of a string
1.6. Group velocity, Phase velocity
1.7. Plane waves, Spherical Waves, Wave intensity
Problem Solving

UNIT2: Sound (9L)

2.1 Introduction (Longitudinal wave, Sound velocity, Intensity, amplitude, frequency, Acoustic parameters)
2.2 Simple harmonic motion
2.3 Forced vibrations and resonance
2.4 Application to saw tooth wave and square wave
2.5 Intensity and loudness of sound
2.6 Decibel, Intensity level, musical notes, musical scale
2.7 Reverberation, time of reverberation and its measurement, Absorption coefficient
2.8 Sabine's formula
2.9 Acoustic aspects of auditorium.
Problem Solving

UNIT3: Geometrical Optics (8L)

3.1 Introduction (Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle)
3.2 Reflection of light, Refraction of light
3.3 Lens formula
3.4 Lens maker's formula
3.5 Magnifying power of a lens
3.6 Equivalent lens
3.7 Combination of two thin lenses
Problem Solving

UNIT4: Lens Aberrations (8L)

4.1 Introduction (Lenses, focal length)
4.2 Aberration and its types: Monochromatic and Chromatic
4.3 Types of Monochromatic Aberration: Spherical aberration, Coma, Curvature, Distortion, Astigmatism
4.4 Types of Chromatic Aberration: Axial and Transverse Chromatic aberration
4.5 Achromatism.
Problem Solving

Unit 5: Optical Instruments (4L)

5.1 Introduction
5.2 Simple microscope
5.3 Compound microscope
5.4 Ramsdens Eyepiece
5.5 Huygens Eyepiece
Problem Solving

References:

1. **1.**A Textbook of Optics : N. Subrahmanyam and Brij Lal: S. Chand Publication.
2. **2.**Waves and Oscillations : Stephenson
3. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co.ltd
4. Fundamentals of vibration and waves, SPPuri,Tata McGraw-Hill Publishing co. ltd.
5. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd.
6. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
7. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
8. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand publication
9. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986.Addison-Wesley

Class : F.Y. B. Sc. (Semester- II)
Paper Code: PHY1203
Paper : III Title of Paper: Practical
Credit : 2 No. of Practicals: 10

A) Learning Outcome:

After successfully completing this laboratory course, the students will be able to do the following:
1. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

1. Heat and Thermodynamics (Any Four)

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance
3. Determination of inversion temperature of a thermocouple
4. Thermal conductivity by Lee's method
5. Specific heat of graphite
6. Calibration of silicon diode/ Copper-constantan thermocouple as temperature sensor.
7. Study of Peltier effect

2. Waves & Optics (Any Four)

1. Study of spectrometer and determination of angle of prism
2. Total internal reflection using LASER
3. Polarization of light by reflection
4. Determination of wavelength of LASER light by plane diffraction grating
5. To determine the angular magnifying power of telescope by slit method.
6. To determine linear magnifying power of telescope.
7. Study of musical scales using a signal generator and musical instruments.
8. Determination of frequency of AC mains using sonometer.
9. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
10. Directional characteristics of Microphone.
11. To Study oscillations of rubber band and to draw potential energy curve for it.

3. Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)

1. Biprism

2. LASER
3. Goniometer
4. Center of Mass and Center of gravity

2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments)
1. Carnot engine, diesel engine
2. Graphs and their slopes, and Kinematics graphs (using computer simulations)
3. Mini projects/Hands on activities

3. Student Involvement (Any one equivalent to two experiments)

1. Mini Projects

Group of 4 students should carry out miniproject with the report.

Students have to perform at least two additional activities out of three activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.