*Progressive Education Society's*

# Modern College of Arts, Science and Commerce,

**Shivajinagar, Pune 5**

**(An Autonomous College Affiliated to Savitribai Phule Pune University)**

# Framework of Syllabus

## For M.Sc. Physics

## (2019-20 Course)

## (with effect from 2019-20 )

**Semester 1 (First Year)**

| Course Type | Course Code | Course / Paper Title | Hours / Week | Credit | CIA | End Sem Exam | Total |
|---|---|---|---|---|---|---|---|
| CCT-1 | 19ScPhyU101 | Mechanics | 03 | 02 | 40 | 60 | 100 |
| CCT-2 | 19ScPhyU102 | Modern Physics | 03 | 02 | 40 | 60 | 100 |
| CCP-1 | 19ScPhyU103 | Practical Course-I | 03 | 02 | 40 | 60 | 100 |
| | | **Total Credits** | - | **06** | | | |

**Semester 2 (First Year)**

| Course Type | Course Code | Course / Paper Title | Hours / Week | Credit | CIA | End Sem Exam | Total |
|---|---|---|---|---|---|---|---|
| CCT-9 | 19ScPhyU201 | Heat and Thermodynamics | 03 | 02 | 40 | 60 | 100 |
| CCT-10 | 19ScPhyU202 | Electricity and Magnetism | 03 | 02 | 40 | 60 | 100 |
| CCP-5 | 19ScPhyU203 | Practical Course-II | 03 | 02 | 40 | 60 | 100 |
| | | **Total Credits** | - | **06** | | | |

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU101

## Course Name: Mechanics and Properties of Matter

**Teaching Scheme: TH: 3 Lectures /Week** **Credit: 02**

**Examination Scheme: CIA: 40 Marks** **End-Sem: 60 Marks**

**Prerequisite Courses**:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of Motion, work and Energy, Fluid Mechanics, Properties of Matter

**Course Objectives:**

- To Study and. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
- Use the free body diagrams to analyse the forces on the object.
- Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
- Understand the concepts of elasticity and be able to perform calculations using them.
- To learn/Understand the concepts of
    1. Surface tension and viscosity and be able to perform calculations using them. .
    2. Use of Bernoulli's theorem in real life problems.
    3. Demonstrate quantitative problem solving skills in all the topics covered.

**Course Outcomes:**

On completion of the course, student will be able to–

- Understand the Applications of Bernoulli's Principle.
- Understand the surface Tension and Viscosity of Fluid, Law of Energy Conservation, Applications of Elasticity

**Semester I**

**Course Contents**

| | | |
|---|---|---|
| Chapter 1 | **Motion** | 09 Lectures |
| | • Introduction to Motion,<br>• Types of Motion<br>• Displacement, Velocity, Acceleration, Inertia<br>• Newton's Laws of Motion with their explanation<br>• Various types of forces in nature,<br>• Frame of References (Inertial and Non inertial)<br>• Laws of Motions and its real life applications<br>• Problems<br>• **Experiential Learning** | |
| Chapter 2 | **Work and Energy** | 07 Lectures |
| | • Kinetic Energy<br>• Work Energy Theorem<br>• Work done with Constant Force, Work done with Varying Force (Hook's Law) | |

| | | |
|---|---|---|
| | • Conservative and Non conservative forces<br>• Potential Energy<br>• Law of Energy Conservation<br>• Gravitational Potential Energy<br>• Problems<br>• **Experiential Learning** | |
| Chapter 3 | **Fluid Mechanics** | 08 Lectures |
| | • Concept of Viscous force and Viscosity<br>• Coefficient of Viscosity<br>• Steady and Turbulent flow<br>• Reynolds number<br>• Equation of Continuity<br>• Bernoulli's Principle<br>• Applications of Bernoulli's Principle (Ventury Meter, Pitot Tube)<br>• Applications of Viscous Fluids<br>• Problems<br>• **Experiential Learning** | |
| Chapter 4 | **Properties of Matter** | 12 Lectures |
| | A) **Fluids (4 Lectures) :**<br>• Surface Tension<br>• Angle of Contact<br>• Factors affecting on Surface Tension<br>• Jaeger's Method for determination of Surface Tension<br>• Applications of Surface Tension<br>B) **Solids (8 Lectures):**<br>• Stress and Strain<br>• Hook's Law and Coefficient of Elasticity<br>• Young's Modulus, Bulk Modulus, Modulus of Rigidity<br>• Work done during Longitudinal Strain, Volume Strain, Shearing Strain<br>• Poisson's Ratio<br>• Relation between three Elastic Moduli<br>• Applications of Elasticity<br>• Problems<br>• **Experiential Learning** | |
| | **Total Lectures** | **36** |

**References**


1. Physics:Resnick, Halliday & Walker 9/e, Wiley
2. Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
3. Elements of Properties of Matter: D. S. Mathur, S. Chand, New Delhi
4. Concepts of Physics: H. C. Verma, Bharati Bhavan Publisher
5. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU102

## Course Name: Modern Physics

**Teaching Scheme: TH: 3 Lectures /Week** **Credit : 02**

**Examination Scheme: CIA : 40 Marks** **End-Sem : 60 Marks**

**Prerequisite Courses:**

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of calculus

**Course Objectives:**

- To Study Historical Development of modern theories of Special Theory of Relativity and Quantum Mechanics
- To Learn Concept of- Length Contraction, Time Dilation in Special Theory of Relativity
- To Learn Dual Nature of Waves and Matter
- To Study Historical Evolution of Atomic Models
- To Learn Basics of Concept of Quantization of Energy Levels in Atoms
- To Study Basics of LASER
- To enrich knowledge of modern physics through problem solving

**Course Outcomes:**

On completion of the course, student should be able to–

- Understand how theories in physics develop from Experimental Results and Hypothesis
- Apply Special Theory of Relativity for Simple Situations
- Understand Dual Nature of Waves and Matter
- Apply Bohr's Atomic Model to Hydrogen Atom
- Understand fundamental principles of LASER

**Semester I**

**Course Contents**

| | | |
|---|---|---|
| Chapter 1 | **Special Theory of Relativity** | 09 Lectures |
| | • Postulates of Theory of Relativity<br>• Time Dilation, Doppler Effect, Length Contraction<br>• Relativistic Momentum, Mass Energy and Momentum relations<br>• Galilean and Lorentz Transformationss<br>• Problems<br>• **Experiential Learning** | |
| Chapter 2 | **Particle Properties of Waves** | 09 Lectures |
| | • Electromagnetic Waves,<br>• Blackbody Radiations (Stefan's law of radiation, Wein's Displacement Law)<br>• Photoelectric Effect, Einstein's Equation for photoelectric effect | |

| | | |
|---|---|---|
| | • Dual Nature of Light, Compton Effect- Conservation of photon momentum<br>• Pair Production<br>• Problems<br>• **Experiential Learning** | |
| Chapter 3 | **Wave Nature of Particles** | 09 Lectures |
| | • De-Bloglie's Hypothesis, Wavelength of De-Bloglie Waves<br>• Equation of Waves, Travelling Sinusoidal Waves<br>• Phase and Group Velocities, Particle Diffraction<br>• Davisson-Germer Experiment<br>• Uncertainty Principle<br>• Problems<br>• **Experiential Learning** | |
| Chapter 4 | **Atomic Models** | 9 Lectures |
| | • Thomson's Atomic Model, The Nuclear Atom, Electron Orbits<br>• Planck's hypothesis, Atomic Spectra, The Bohr's Atomic Model<br>• Energy Levels and Spectra, Frank-Hertz experiment<br>• Atomic Excitation, Stimulated Absorption, Spontaneous Emission, Stimulated Emission,<br>• LASER<br>• Problems<br>• **Experiential Learning** | |
| | | |

**References**


1. Concepts of Modern Physics Arthur Beiser, Shobit Mahajan, S Rai Choudhury, Mc-Graw Hill
2. Fundamentals of Physics, Haliday, Resnick and Walker
3. Perspective of Modern Physics- Arthur Beiser
4. Quantum Mechanics: AjoyGhatak and S. Loknanthan
5. Quantum Physics: Eisberg and Resnick

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU103

## Course Name: Practical Course - I

**Teaching Scheme: TH: 3 Lectures /Week** **Credit : 02**

**Examination Scheme: CIA: 40 Marks** **End-Sem : 60 Marks**

**Prerequisite Courses:**

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic Science Instruments /Apparatus

**Course Objectives:**

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

**Course Outcomes:**

On completion of the course, student should be able to–

- Apply the various procedures and techniques for the experiments.
- Use the different measuring devices and meters to record the data with precision
- Apply the mathematical concepts/equations to obtain quantitative results
- Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result
- Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
- Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
- Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
- Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
- Acquire the complementary skills of collaborative learning and teamwork in laboratory settings

**Semester I**

**Course Contents**

| | | |
|---|---|---|
| | **Measurements** | 8 Lectures |
| | 1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge)<br>2. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Travelling Microscope, Spectrometer etc.)<br>3. Measurement using Analog Meters(Voltage and Current ) and Digital Multimeter (Voltage Current ,Resistance, Continuity, Capacitor Check) | |
| | **Mechanics** | 12 Lectures |

| | | |
|---|---|---|
| | 4.MI of Flywheel<br>5.Determination of Y and n by flat spiral spring<br>6. Determination of Y by bending | |
| | **Light** | 8 Lectures |
| | 7.Study of Spectrometer-Angle of Prism<br>8.Plane Diffraction Grating | |
| | **Electricity and Magnetism** | 12 Lectures |
| | 9.Verification of Kirchhoff's Current Law | |
| | 10.Verification of Kirchhoff's Voltage Law | |

**Additional Activities**

1. Demonstrations (Any four demonstrations equivalent to two experiments)
2. Magnet –magnet interaction
3. Collision by using balls
4. Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
5. Demonstration of action potential
6. Measurement of sound pressure level
7. Computer aided demonstrations (Using computer simulations or animations)

(Any two demonstrations equivalent to two experiments)

1. Coulomb's law
2. Vectors : visualization of vectors
3. Bohr's model
4. Carnot engine, diesel engine
5. Graphs and their slopes, and Kinematics graphs (using computer simulations)
6. Mini projects/Hand on activities

(Any one equivalent to two experiments)

1. Students should collect the information of at least five Physicists with their work.
2. Students should carry out mini projects

4. Study tour (Equivalent to two experiments)

Students participated in study tour must submit a study tour report.

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

**References:**


1. F. Y. B. Sc. practical manual prepared and compiled by physics department.
2. Advanced Practical Physics for Students by B. L. Worsnop and H. T. Flint
3. B. Sc. Practical Physics by S. Chand

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU201

## Course Name: Heat and Thermodynamics

**Teaching Scheme: TH: 3 Lectures/Week** **Credit : 02**
**Examination Scheme: CIA : 40 Marks** **End-Sem : 60 Marks**

**Prerequisite Courses:**

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of Thermodynamics and Thermometry

**Course Objectives:**

- This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
- To prepare them to carry out experimental investigation and analysis at later stages of graduation.

**Course Outcomes:**

- To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
- To identify and formulate power production based on the fundamentals laws of thermal engineering.
- To instill upon to envisage appropriate experiments related to heat engines.
- To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
- To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.
- To communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy.

**Semester II**

**Course Contents**

| | | |
|---|---|---|
| Chapter 1 | **Fundamentals of Thermodynamics** | 10 Lectures |
| | • Concept of Thermodynamic State,<br>• Equation of State, Van der Waal's Equation of State, Thermal equilibrium<br>• Zeroth Law of Thermodynamics, Thermodynamic process: Adiabatic , Isothermal , Isobaric and Isochoric Changes, Indicator diagram<br>• Work done during Isothermal Change, Adiabatic Relations<br>• Work done during Adiabatic Change, Internal Energy, Internal energy as State Function<br>• First Law of Thermodynamics, Reversible and Irreversible Changes<br>• Problems<br>• **Experiential Learning** | |
| Chapter 2 | **Applied Thermodynamics:** | 09 Lectures |

| | | |
|---|---|---|
| | • Conversion of Heat into Work and it's Converse<br>• Second Law of Thermodynamics, Concept of Entropy<br>• Temperature-Entropy Diagram, T-dS Equations<br>• Clausius-Clapeyron Latent Heat Equations<br>• Problems<br>• **Experiential Learning** | |
| Chapter 3 | **Heat Transfer Mechanisms** | 09 Lectures |
| | • Carnot's Cycle and Carnot's Heat Engine and its efficiency<br>• Heat Engines: Otto Cycle & its Efficiency, Diesel Cycle & its efficiency<br>• Refrigerators: General Principle and Coefficient of performance of Refrigerator<br>• Simple Structure of Vapour Compression Refrigerator, Air Conditioning: Principle and it's Applications<br>• Problems<br>• **Experiential Learning** | |
| Chapter 4 | **Thermometry** | 08 Lectures |
| | • Concept of Heat & Temperature, Principle of Thermometry<br>• Temperature Scales & interconversions<br>• Principle-Construction and Working: (Liquid Thermometers, Liquid Filled Thermometers, Gas filled Thermometers<br>• Bimetallic Thermometers, Platinum Resistance Thermometer, Thermocouple),<br>• Problems<br>• **Experiential Learning** | |
| | | |

**References**


1. Concept of Physics: H. C. Verma, BharatiBhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, Mc –Graw Hill International Edition
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5. Instrumentation :Devices & Systems: Rangan, Mani, Sarma

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU202

## Course Name: Electricity and Magnetism

**Teaching Scheme: TH: 3 Lectures /Week** **Credit : 02**
**Examination Scheme: CIA : 40 Marks** **End-Sem : 60 Marks**

**Prerequisite Courses:**

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of calculus

**Course Objectives:**

- To Study Basics of Electrostatics and Magnetostatics in Vacuum and in Dielectric Media
- To enrich knowledge of Electricity and Magnetism through problem solving

**Course Outcomes:**

On completion of the course, student should be able to–

- Apply classical theory of Electrostatics and Magnetostatics

**Semester II**

**Course Contents**

| | | |
|---|---|---|
| Chapter 1 | **Electrostatics** | 09 Lectures |
| | • Revision of Coulomb's Law<br>• Superposition Principle, Electrostatic Potential, Concept of electron Volt (eV)<br>• Electric Field and Electric Potential due to- Point Charge, Group of Charges and Continuous Charge Distribution, Line of Charge, Charged Disc, Charged Sphere<br>• Revision of Gauss's Law, Comparison between Coulomb's Law and Gauss's Law, Applications of Gauss's Law- Cylindrical, Spherical and Planar symmetry<br>• Problems<br>• **Experiential Learning** | |
| Chapter 2 | **Dielectrics** | 09 Lectures |
| | • Electric Dipole, Dipole Moment<br>• Electric Potential and Electric Field Intensity at any Point due to Dipole<br>• Torque on Dipole placed in Uniform Electric Field<br>• Polar and Non-Polar Molecules<br>• Electric Polarization of Dielectric Material, Gauss's Law in Dielectrics<br>• Problems<br>• **Experiential Learning** | |
| Chapter 3 | **Magnetostatics** | 09 Lectures |
| | • Revision of Biot- Savart's Law And Applications of Biot-Savart's Law<br>• Ampere's Law, Applications of Amperes | |

| | | |
|---|---|---|
| | Law-Straight Current Carrying Wire, Circular Loop ofCurrent Carrying Wire, Solenoid and Toroid<br>• Gauss's Law for Magnetism<br>• Problems<br>• **Experiential Learning** | |
| Chapter 4 | **Magnetic Prperties of Materials** | 9 Lectures |
| | • Magnetic Materials- Paramagnetic, Diamagnetic and Ferromagnetic<br>• Introduction to Bohr Magneton, Magnetization (M), Magnetic Intensity (H), Magnetic Induction (B)<br>• Magnetic Susceptibility and Permeability<br>• Relation between **B**, **M** and **H**, Hysteresis<br>• Problems<br>• **Experiential Learning** | |
| | | |

**Reference Books:**


1. Fundamentals of Physics, Haliday, Resnick and Walker
2. Introduction to Electrodynamics, D. J. Griffitths
3. Feynman's Lectures on Physics (Volume 2)
4. Concepts of Physics, H. C. Verma

*Progressive Education Society's*

# Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune – 5

## First Year of B. Sc. Physics (2019 Course)

## Course Code: 19ScPhyU203

## Course Name: Practical

**Teaching Scheme: TH: 3 Hours/Week** **Credit : 02**
**Examination Scheme: CIA : 40 Marks** **End-Sem : 60 Marks**

**Prerequisite Courses:**

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic Science Instruments /Apparatus

**Course Objectives:**

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of electrical and optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

**Course Outcomes:**

On completion of the course, student should be able to–

- Apply the various procedures and techniques for the experiments.
- Use the different measuring devices and meters to record the data with precision
- Apply the mathematical concepts/equations to obtain quantitative results
- Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result
- Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
- Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
- Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
- Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
- Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

**Course Contents**

| | | |
|---|---|---|
| | **Heat and Thermodynamics** | 12 Lectures |
| | 1.Thermal Conductivity by Lee's method<br>2.Study of Temperature Coefficient of Resistance<br>3.Study of Temperature Coefficient of Resistance | |
| | **Mechanics** | 12 Lectures |
| | 4.Surface Tension by Capillary Rise Method<br>5.Viscocity by Stoke's Method<br>6.Modulus of Rigidity of Disc by Torsional Oscillations | |
| | **Light** | 4 Lectures |
| | 7.Calibration of Spectrometer | |
| | **Electricity and Magnetism** | 12 Lectures |
| | 8.Vector Diagram of L-R Circuit<br>9.Characteristics of a Diode<br>10. Frequency of A. C. | |

**Additional Activities**

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

1. Magnet –magnet interaction
2. Collision by using balls
3. Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
4. Demonstration of action potential
5. Measurement of sound pressure level

2. Computer aided demonstrations (Using computer simulations or animations)

(Any two demonstrations equivalent to two experiments)

1. Coulomb's law
2. Vectors : visualization of vectors
3. Bohr's model
4. Carnot engine, diesel engine
5. Graphs and their slopes, and Kinematics graphs (using computer simulations)

3. Mini projects/Hand on activities

(Any one equivalent to two experiments)

1. Students should collect the information of at least five Physicists with their work.
2. Students should carry out mini projects

4. Study tour (Equivalent to two experiments)

Students participated in study tour must submit a study tour report.

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

**References:**


1. F. Y. B. Sc. practical manual prepared and compiled by physics department.
2. Advanced Practical Physics for Students by B. L. Worsnop and H. T. Flint
3. B. Sc. Practical Physics by S. Chand