Savitribai Phule Pune University

(Formerly University of Pune)

First Year B.Sc. Program in Physics

(Faculty of Science & Technology)

F.Y.B.Sc. (Physics)

To be implemented from Academic Year 2024-2025

Table of Contents

Abbreviations Used

- PO : Programme Outcomes
- PS : Programme Structure
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- OE : Generic Electives
- OP : Open Electives
- VSC : Vocational Skill Courses
- SEC : Skill Enhancement Courses
- VSC* : Vocational Skill Courses
  (Can be given as advanced practical course related to major)
- AEC : Ability Enhancement Courses

- IKS : Indian Knowledge System
- VEC : Value Education Courses
- OJT : On Job Training (Internship/ Apprenticeship)
- FP : Field projects
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project

1) Introduction to Undergraduate Degree Course in Physics:

As per the recommendations of UGC-F-2022, the undergraduate (UG) degree course in Physics is a 6-semester course spread over 3-academic years **OR** 8-semester course spread over 4-academic years. The Teaching Learning Process (TLP) is students' centric. It involves both theory and practical components. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. Besides the DSCs (Major Core), a student have options courses from the syllabus comprising of DSEs (Minor), GEs, SECs, IKSs and VSCs. Hence, this will be bring out the interdisciplinary as well as multidisciplinary approach and adherence to innovative ways within the curriculum framework. It also allow a students' maximum flexibility in pursuing his/her studies at the undergraduate (UG) level to the extent of having the liberty to eventually design the degree with multiple exit options. Students have these exits options depending upon the needs and aspirations of the student in terms of his/her goals of life, without compromising on the teaching learning, both in qualitative and quantitative terms. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

2) Programme Duration and Exit Options:

The minimum credit to be earned by a student per semester is 18-credits and the maximum is 26 credits. However, students are advised to earn 22-credits per semester. This provision is meant to provide students the comfort of the flexibility of semester-wise academic load and to learn at his/her own pace. However, the mandatory number of credits which have to be secured for the purpose of award of Undergraduate Certificate/Undergraduate Diploma/Appropriate Bachelor's Degree in Physics are listed in Table-1.

Table-1: List of award of Undergraduate Certificate/ Undergraduate Diploma/Appropriate Bachelor's Degree in Physics

S. No.	Type of Award	Stage of Exit	Mandatory Credits to be Secured for the Award
1	Undergraduate Certificate in Physics	After successful completion of Semester II	**44**
2	Undergraduate Diploma in Physics	After successful completion of Semester IV	**88**
3	Bachelor of Science Physics	After successful completion of Semester VI	**132**
4	Bachelor of Science Physics (Honours)	After successful completion of Semester VIII	**176**

5	Bachelor of Science Physics (Honours with Research)	After successful completion of Semester VIII with minimum 28 GE credits in Discipline-2 (Minor)	**176**

a) Major Discipline (Physics) : A student pursuing four-year undergraduate programme in Physics (Core course) shall be awarded B.Sc. Honours degree with Major in Physics on completion of VIII Semester, if he/she secures in Physics at least 50% of the total credits i.e., at least 88 credits in Physics out of the total of 176 credits. He/she shall study 20 DSCs and at least 2 DSEs of Physics in eight semesters.

b) Minor Discipline (Discipline-2): A student of B.Sc. (Hons.) Physics may be awarded Minor in a discipline, other than Physics, on completion of VIII Semester, if he/she earns minimum 28 credits from seven GE courses of that discipline

3) Programme Objectives :

The undergraduate (UG) degree course in Physics aims to provide:

a) Knowledge and skills to undertake higher studies/research in physics and related interdisciplinary areas thereby enabling students' employment/entrepreneurship.
b) Critical and analytical thinking, scientific reasoning, problem-solving skills, communication skills and teamwork.
c) Competence and skill in solving both theoretical and applied physics problems.
d) In-depth knowledge in physics through understanding of key physical concepts, principles, theories and their manifestations.
e) Exposure to the latest advances in physics, allied disciplines and research.
f) A conducive learning environment to ensure cognitive development of students.
g) Sufficient subject matter competence and enable students to prepare for various competitive examinations such as UGC-CSIR NET/JRF, GATE, GRE, IIT-JAM, and Civil Services Examinations.
h) Moral and ethical awareness, leadership qualities, innovation and life-long learning.
i) Multicultural competence and multilinguism.

4) Program Outcomes :

The learning outcomes of the undergraduate degree course in physics are as follows:

a) Role of Physics :

The students will develop awareness and appreciation for the significant role played by physics in current societal and global issues. They will be able to address and contribute to such issues through the skills and knowledge acquired during the programme. They will be able identify/mobilize appropriate resources required for a project, and managing a project through to completion, while observing responsible and ethical scientific conduct, safety and laboratory hygiene regulations and practices.

b) Research skills :

The course provides an opportunity to students to hone their research and innovation skills through internship/apprenticeship/project/community-outreach/dissertation/Entrepreneurship/Academic-Project. It will enable the students to demonstrate mature skills in literature survey, information management skills, data analysis and research ethics.

c) Hands-on/ Laboratory Skills :

Comprehensive hands-on/ laboratory exercises will impart analytical, computational and instrumentation skills. The students will be able to demonstrate mature skills for the collation, evaluation, analysis and presentation of information, ideas, concepts as well as quantitative and/or qualitative data.

d) In-depth disciplinary knowledge :

The student will acquire comprehensive knowledge and understanding of the fundamental concepts, theoretical principles and processes in the main and allied branches of physics. The core papers will provide in-depth understanding of the subject. A wide choice of elective courses offered to the student will provide specialized understanding rooted in the core and interdisciplinary areas.

e) Communication and IT Skills :

Various DSCs, DSEs, SECs, GEs and AECs have been designed to enhance student's ability to write methodical, logical and precise reports. The courses will, in addition, guide the student to communicate effectively through oral/poster presentations, writing laboratory/ project reports and dissertations. Several IT based papers in DSCs, DSEs, SECs and AECs will enable students to develop expertise in general and subject specific computational skills.

f) Critical and Lateral Thinking :

The programme will develop the ability to apply the underlying concepts and principles of physics and allied fields beyond the classrooms to real life applications, innovation and creativity. A student will be able to distinguish between relevant and irrelevant facts and information, discriminate between objective and biased information, apply logic to arrive at definitive conclusions, find out if conclusions are based upon sufficient evidence, derive correct quantitative results, make rational evaluations, and arrive at qualitative judgments according to established rules.

5) Programme Structure :

The detailed framework of undergraduate degree programme in Physics is provided in Table 2.

Semester	Credits related to major					Minor	GE/ OE	SEC	AEC	VEC	CC	Total
	Discipline Specific Core (DSC) **Major Core**	Discipline Specific Elective (DSE) **Major Elective**	VSC	IKS	FP/ OJT /CEP							
I	4T+2P	-	2T	2T	-	-	2T+2P	2(T/P)	2T	2	2	22
II	4T+2P	-	2P	-	-	2T	2T+2P	2(T/P)	2T	2	2	22
Students on exit shall be awarded **Undergraduate Certificate in Physics** after securing the requisite 44 credits after completion of Semester II.												**44**
III	6T+2P	-	2T	-	2(FP)	2T+2P	2T	-	2	-	2	22
IV	6T+2P	-	-	-	2(CEP)	2T+2P	2P	2(T/P)	2	-	2	22
Students on exit shall be awarded **Undergraduate Diploma in Physics** after securing the requisite 88 credits after completion of Semester IV.												**88**
V	6T+4P	2T+2P	2P	-	2(FP/ CEP)	2T+2P	-	-	-	-	-	22
VI	6T+4P	2T+2P	-	-	4(OJT)	2T+2P	-	-	-	-	-	22

Total 3-Years	**48**	**8**	**8**	**2**	**10**	**18**	**12**	**6**	**8**	**4**	**8**	**132**
Students on exit shall be awarded **Bachelor of Physics (Degree)** after securing the requisite 132 credits after completion of Semester VI.												**132**
VII	6T+4P	2T+2P	-	-	4(RP)	4T(RM)	-	-	-	-	-	22
VIII	6T+4P	2T+2P	-	-	8(RP)	-	-	-	-	-	-	22
Total 4-Years	**68**	**16**	**8**	**2**	**22**	**22**	**12**	**6**	**8**	**4**	**8**	**176**
Students on exit shall be awarded **Bachelor of Physics (Honours Degree)** after securing the requisite 176 credits after completion of Semester VIII.												**176**

OR

VII	10T+4P	2T+2P	-	-	-	4T(RM)	-	-	-	-	-	22
VIII	10T+4P	2T+2P	-	-	4(OJT)	-	-	-	-	-	-	22
Total 4-Years	**76**	**16**	**8**	**2**	**14**	**22**	**12**	**6**	**8**	**4**	**8**	**176**
Students on exit shall be awarded **Bachelor of Physics (Honours with Research Degree)** after securing the requisite 176 credits after completion of Semester VIII.												**176**

6) Teaching-Learning Process :

a) The undergraduate programme in Physics is designed to provide students with a sound theoretical background, practical training in all aspects of physics and research.
b) It will help them develop an appreciation of the importance of physics in different contexts.
c) The programme includes foundational as well as in-depth courses that span the traditional sub disciplines of physics.
d) Along with the DSCs there are DSEs, GEs, SECs, AECs and VACs which address the need of the hour.
e) Physics courses will be delivered through the conventional chalk and talk method, laboratory work, projects, case studies, field work, seminars, hands-on training/workshops in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and ICT enabled teaching-learning tools (PowerPoint presentations, audio visual resources, e-resources, models, software, simulations, virtual labs, etc.).
f) Students will be encouraged to carry out short term projects and participate in industrial and institutional visits and outreach programmes.
g) Students will be introduced to scientific reasoning and discovery, innovative problem-solving methodologies, online quizzes, surveys, critical analysis etc. to develop convergent and divergent thinking abilities.
h) The laboratory training complements the theoretical principles learned in the classroom and includes hands-on experience with modern instruments, computational data analysis, modelling, error estimation and laboratory safety procedures.
i) Different pedagogies such as experiential learning, participative learning, project-based learning, inquiry-based learning and ICT pedagogy integration instruction (blended and flipped learning) will be adopted wherever possible.

j) Students will be encouraged to work in groups to develop their interpersonal skills like communication and team work.

k) Students' diligent and active participation/ engagement in industrial visits / internships / academic projects / dissertations will lay a strong foundation for a successful career in academics, industry, research, entrepreneurship and community outreach.

7) Assessment Methods :

The primary objective of assessment will be to assess the learning outcomes of the course in tune with the broad outcomes of strengthening core theoretical knowledge base, practical laboratory skills, and research. Assessment will be based on continuous evaluation (MCQs, Short Questions (SQ), Class Test (CT), Seminar, Presentation (PPT), Group Discussion (GD), Quiz, Assignment, Tutorials, etc.) and end of semester examination of Savitribai Phule Pune University, Pune.

(i) Internal Assessment or Continuous Evaluation:

During a semester, students' mastery of the various learning outcomes as described in the syllabus will be assessed through MCQs, Short Questions (SQ), Class Test (CT), Seminar, Presentation (PPT), Group Discussion (GD), Quiz, Assignment, Tutorials, etc. Each theory paper and practical paper will have 15 marks for internal assessment. The critical analysis of internal assessment or continuous evaluation outcomes will provide opportunities to improve the teaching-learning process by focusing on the areas that need conceptual strengthening, laboratory exposure or design of new experiments, and research.

(ii) End of Semester University Examinations:

The summative end-semester university examinations will be conducted for both theory and practical courses. Besides internal assessment, each theory paper and each practical paper will be of 35 marks for end of semester examination of the university.

8) Scheme of Examination :

The total marks for a 2-credits course is 50, and for a 4-credits course is 100.

Internal exam will be conducted by particular college and external exam will be conducted by Savitribai Phule Pune University, Pune at the end of each semester.

Pattern for Internal Theory Assessment: (15 Marks)

Que-1: Choose correct option (MCQs) (10-MCQs with Multiple Options) – 5 marks

Que-2: Answer the following questions (Short answer questions) (any 5 out of 7) – 5 marks

Que-3: Answer the following questions (Short answer Definition/Problems/Diagram) (any 5 out of 7)–5 marks

Pattern for External Theory Assessment: (35 Marks)

Follow the pattern provided by University.

List of Courses

Note: Every subject has 2 credits

9) List of Discipline Specific Core (DSC) Courses (Major Core)

Major Core (Semester-I) (6 Credits) (2T+1P)

Semester I

PHY 101 MJ : Mechanics and its Applications
PHY 102 MJ : Physics Principles and Applications
PHY 103 MJP: General Physics Lab-I

Major Core (Semester-II) (6 Credits) (2T+1P)

Semester II

PHY 151 MJ : Thermal Physics
PHY 152 MJ : Electricity and Magnetism
PHY 153 MJP: General Physics Lab-II

Major Core (Semester-III) (8 Credits) (3T+1P)

Semester III

PHY 201 MJ : Mathematical Physics-I
PHY 202 MJ : Electronics
PHY 203 MJ : Waves and Oscillations
PHY 204 MJP : General Physics Lab-III

Major Core (Semester-IV) (8 Credits) (3T+1P)

Semester IV

PHY 251 MJ : Mathematical Physics-II
PHY 252 MJ : Classical Mechanics
PHY 253 MJ : Optics-I
PHY 254 MJP : General Physics Lab-IV

Major Core (Semester-V) (10 Credits) (3T+2P)

Semester V

PHY 301 MJ : Atomic and Molecular Physics-I
PHY 302 MJ : Solid State Physics-I
PHY 303 MJ : Electrodynamics-I
PHY 304 MJP : General Physics Lab-V
PHY 305 MJP : General Physics Lab-VI

Major Core (Semester-VI) (10 Credits) (3T+2P)

Semester VI

PHY 351 MJ : Quantum Mechanics-I
PHY 352 MJ : Statistical Mechanics-I
PHY 353 MJ : Nuclear Physics-I
PHY 354 MJP : General Physics Lab-VII
PHY 355 MJP : General Physics Lab-VIII

Major Core (Semester-VII) (10 Credits) (3T+2P)

Semester VII

PHY 401 MJ : Atomic and Molecular Physics-II
PHY 402 MJ : Solid State Physics-II
PHY 403 MJ : Electrodynamics-II
PHY 404 MJP : General Physics Lab-IX
PHY 405 MJP : General Physics Lab-X

Major Core (Semester-VIII) (10 Credits) (3T+2P)

Semester VIII

PHY 451 MJ : Quantum Mechanics-II
PHY 452 MJ : Statistical Mechanics-II
PHY 453 MJ : Nuclear Physics-II
PHY 454 MJP : General Physics Lab-XI
PHY 455 MJP : General Physics Lab-XII

10) List of Vocational Skill Courses (VSC):

Semester-I

PHY 121 VSC : Introduction to Computational Physics-I

Semester-II

PHY 171 VSC : Introduction to Computational Physics-II

Semester-III

PHY 221 VSC : Solar PV System: Installation, Repairing, and Maintenance

Semester-V

PHY 321 VSC : Electric Vehicle Technology

11) List of Indian Knowledge System (IKS) Courses :

Semester-I

PHY 121 IKS : India's Contribution to Science

12) List of Minor (MN) Courses :

Semester-II

PHY 191 MN : Fundamental of Physics

Semester-III

PHY 241 MN : Basic Mathematical Physics
PHY 242 MNP : Basic Physics Laboratory I

Semester-IV

PHY 291 MN : Basic of Waves and Oscillations
PHY 292 MNP : Basic Physics Laboratory II

Semester-V

PHY 341 MN : Optics
PHY 342 MNP : Basic Physics Laboratory III

Semester-VI

PHY 391 MN : Concepts of Modern Physics
PHY 392 MNP : Basic Physics Laboratory IV

Semester-VII

PHY 441 MN : Research Methodology

13) List of Generic Elective (GE)/Open Elective (OE) Courses :

Semester-I : Select any **one** subject for **4-credits (2T+2P)**

OE-101-PHY : LED Light Repair and Maintenance

OE-102-PHY : Biological Physics

Semester-II : Select any **one** subject for **4-credits (2T+2P)**

OE-151-PHY : Physics of Daily Life

OE-152-PHY : Introduction to Electronics

Semester-III : Select any **one** subject for **2-credits (2T)**

OE-201-PHY : Introduction to Nanotechnology

OE-202-PHY : Modern Physics

OE-203-PHY : Physics of Detectors

Semester-IV : Select any **one** subject for **2-credits (2P)**

OE-251-PHY : Numerical Analysis

OE-252-PHY : Nano Physics

OE-253-PHY : Electricity and Magnetism

14) List of Skill Enhancement Courses (SECs) :

Note : Select any **one** in **each semester** for 2(T/P)-credits

Semester-I

SEC-101-PHY : Experimental Skills in Physics

SEC-102-PHY : Physics of Water Filtration Systems

SEC-103-PHY : Renewable Energy and Energy Harvesting

SEC-104-PHY : Programming for Physical Applications (C++ / Python)

Semester-II

SEC-151-PHY : Numerical Techniques in Physics

SEC-152-PHY : Introduction to Laser and Fibre Optics

SEC-153-PHY : Radiation Safety

SEC-154-PHY : Basic Lab Electric devices and Circuits

Semester-IV

SEC-251-PHY : Basic Instrumentation Skills

SEC-252-PHY : Sensors and Detection Technology

SEC-253-PHY : Introduction to Physics of Devices

SEC-254-PHY : Data Analysis and Statistical Methods

SEC-255-PHY : Technical Circuit Drawing

15) List of Value Education Courses (VEC):

Semester-I

VEC-101-EVN : Environmental Physics I

Semester-II

VEC-151-EVN : Environmental Physics II

Syllabus of Courses

16) Syllabus of Discipline Specific Core (DSC) Courses (Major Core)

Major Core (Semester I) (6 Credits) (2T+1P)

Note: Every subject has 2 credits

Semester-I

F.Y.B.Sc. (Physics) (Sem-I)

PHY 101 MJ : Mechanics and its Applications

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduction of Mechanics.

1) Explain the meanings of and relationships among displacement, velocity, and acceleration in one dimension as well as three dimensional motions.
2) Explain Newton's Laws of motion along with example and motivate students to address the real world problem using the Newton's Laws.
3) Explain the concept of force and its role in causing change in motion. Introduce concept of work and explain the relation between the energy and work.
4) Explain the difference between conservative and non-conservative forces, describe the concept of potential energy, and calculate potential energy given a conservative force as a function of position.
5) Explain the concept of center of mass of systems of individual particles and of continuous distributions of matter, explain the principle of momentum conservation. Describe the difference between inelastic and elastic collisions.
6) Describe the rotational motion of rigid bodies using the concepts of angular velocity and acceleration, rotational inertia, torque, and the rotational analog of Newton's law.
7) Explain the relation between pressure and force. Explain why some objects float and others sink. Express conservation of mass and energy for fluids through the continuity equation and Bernoulli's equation.

B) Learning Outcomes (CO): - Upon completion of this course student will able to

1) Calculate average and instantaneous velocities and accelerations, Solve problems involving motion under constant acceleration, including the acceleration of gravity at Earth's surface. Use vectors to describe position, velocity, and acceleration in three dimensions.
2) Solve quantitative problems involving motion in two dimensions with constant acceleration, including projectile motion with the acceleration of gravity.
3) Understood the relation between force and work, meaning of the work and solve various problems based on the work using concept like force, displacement and energy. Describe the relation between energy and power.
4) Articulate and apply the principle of conservation of mechanical energy to solve real life problems. Show the relation between force and energy using potential-energy curves.

5) Understood the concept of center of mass and find out center of mass of systems of individual particles and of continuous distributions of matter. Apply principle of momentum conservation to systems of particles. Apply the appropriate conservation laws to analyze real world problems.
6) Calculate the rotational inertias of objects with sufficient symmetry by summing or integrating. Solve problems that involve both linear and rotational motion. Calculate rotational kinetic energy, and explain its relation to torque and work.
7) Understand relation between pressure and force; calculate pressure as a function of depth in liquids. Determine quantitatively the position of floating objects and the apparent weight of submerged objects. Use the continuity equation and Bernoulli's equation to solve problems involving fluid dynamics.

C) Instructional Design: -

1) Lecture method 2) Tutorial method 3) Use of Computer

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Prerequisites:

1. **Algebra and trigonometry:** Basic foundation in algebra and trigonometry
2. **Calculus:** Basic background of Calculus
3. **Physics Fundamentals:** Knowledge about the basic physical quantities and their SI and CGS unit system along with dimensions

F) Course Contents: - **Lectures: 30 hrs**

Module - 01	Newtonian Mechanics and Applications	10 H
	Motion along Straight Line: • Distance and Displacement, Average Velocity, Average Speed, Instantaneous Velocity, Average and Instantaneous Acceleration • Graphical representation of Motion and Analysis. (x-t graph, v-t graph) • Motion with Constant Acceleration (Equations of Kinematics) – Free Fall Numerical Problems	
	Motion in Two and Three Dimensions: • Vectors form of Displacement, Velocity and Acceleration (Three dimension) • Projectile Motion and trajectories • Uniform and Non-uniform Circular Motion. Numerical Problems	
	Newton Laws of motion and Application • Newton's First Law (Law of Inertia) • Newton's Second Laws (Law of Force) - Net Force, Free Body diagram, Force of Gravity, Weightlessness • Newton's Third Law • Applications of Newton's Laws	

	Numerical Problems	
Module - 02	**Work, Energy and Power**	**06 H**
	• Work – Definition, unit and dimensions • Kinetic Energy, Work-Energy Theorem • Work in Conservative force – Gravitational Force • Work in Non-conservative Forces – Spring Force • Potential Energy - Gravitational Potential Energy, Elastic Potential Energy (Overview) • Conservation of Mechanical Energy, Potential-Energy Curves (Graphical Description) • Power- Bicycling, Climbing Mount • Work, Energy, and Power in Humans Numerical problems	
Module - 03	**Rotational Dynamics**	**06H**
	• Torque, Angular Velocity and Angular Acceleration • Principle of Conservation of Angular Momentum • Centre of Mass in uniformly distributed object • Statement of parallel axis and perpendicular axis theorem. • Moment of Inertia and Radius of gyration • Calculation of moment of inertia for cylindrical, spherical and rectangular bodies at different position of axis of rotation using theorems • Kinetic Energy of Rotation • Rolling Motion on inclined plane • Moment of Inertia of a Flywheel Numerical Problem	
Module - 04	**Fluid Mechanics**	**08H**
	Fluid Statics • Definition of a Fluid. • Pressure, Absolute Pressure and Gauge Pressure. • Variation of Pressure with Depth. • Pascal's Laws. • Buoyancy and Archimedes Principle. Numerical Problem	
	Fluid Dynamics • Equation of Continuity. • Bernoulli's Theorem. • Application Based on Bernoulli's Equation: Torricelli's Theorem and Venturimeter. • Viscosity, viscous force and Effect of Temperature. • Stokes' Law and Terminal Velocity. • Surface Tension, Surface Energy and angle of contact. • Excess Pressure Inside liquid drop and Soap Bubble. • Determination of Surface Tension by Jaeger's Method. Numerical Problem	

Activities: Conduct **any one** classroom activity during class lecture for each module.

Module 1: Newtonian Mechanics and Applications

Activity 1: Egg drop experiment:

Demonstrate Newton's First Law and Second Law by designing and testing protective covering to the raw egg from breaking when dropped.

Activity 2: Balloon Rocket / Straw Rocket Launch / Balloon Powered Car:

Demonstrate and understand Newton's Third Law by creating a balloon powered rocket/straw rocket launch / Balloon Powered Car.

Activity 3: Circular Vs Non-circular motion

Demonstrate circular and non-circular motion with help of string and mass. Rotate tied mass to explain circular motion and release mass and explain non-circular motion. Note down the key characteristics of each.

Module 2: Work, Energy and Power

Activity 1: Building Simple Pulley System / Simple Lever System

Illustrate and understand the concept of work done by building a pulley system / simple Lever system.

Activity 2: Roller Coaster Energy Transfer

Demonstrate and understand the concept of work done and energy transfer in the context of roller coaster.

Activity 3: Converting Potential Energy to Kinetic Energy

Calculate the potential energy of an object and predict the object's speed when all that potential energy has been converted to kinetic energy.

Module 3: Rotational Dynamics

Activity 1: Linear velocity of rotating objects.

Compare velocities of solid sphere, solid cylinder, hollow sphere and hollow cylinder on inclined plane.

Activity 2: Exploring Rotational Dynamics with Spinning Tops

Explain principle of rotational dynamics through hands on experiment with spinning top.

Activity 3: Spinning Wheel Challenge

Apply concepts of rotational dynamics, specifically related to angular velocity and angular acceleration.

Module 4: Fluid Mechanics

Activity 1: Sticky and non-sticky liquid

Demonstrate viscosity using sticky or non-sticky liquids.

Activity 2: Mixture of Sticky and non-sticky liquid

Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration.

Activity 3: Surface Tension

Explain surface tension using soap solution and piece of paper

Reference Books:

1. Richard Wolfson, "Essential UNIVERSITY PHYSICS" 2nd Ed., Pearson Education, Inc., 2012.
2. David Halliday, Robert Resnick, and Jearl Walker, "Fundamentals of Physics", 9th Ed., 2011.
3. H.C Verma, "Concept of Physics Part – I", Bharati Bhawan Publication, 2021.
4. Hugh D. Young and Roger A. Freedman, "University Physics With Modern Physics", 14th Ed., Pearson Education, 2017.
5. David Kleppner, Robert Kolenkow, "An Introduction to Mechanics (SIE)", 1st Ed., McGraw Hill Education, 2017.
6. Herbert Goldstein, "Classical Mechanics" 3rd Ed., Pearson Education, 2011.

******XXX******

F.Y.B.Sc. (Physics) (Sem-I)

PHY 102 MJ : Physics Principles and Application

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduction of Mechanics.

1) Introduce basic concept and principles in Physics.
2) Introduce applications of basic Physics concept and principles for modern life.

B) Learning Outcomes (CO): - Upon completion of this course student will able to

1) Understand basic principles in Physics.
2) Applications of physics principles to resolve community problems.
3) Develop advanced thinking in future life style.
4) Apply Knowledge of Physics principles in day today life

C) Instructional Design: -

1) Lecture method 2) Tutorial method 3) Use of Computer 4) Seminars

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Course Contents: - **Lectures: 30 hrs**

Module – 1	**Universal Gravitation**	**7 hrs**
	1. Introduction to Universal Gravitation (3 hrs) • Newton's law of universal gravitation: the inverse square law. • Gravitational constant (G) and its determination. • Gravitational force between two point masses. • Gravitational Potential Energy • Gravitational potential due to extended Objects • The concept of equipotential surfaces ***2. Applications of Universal Gravitation Laws (4hrs)*** • Tidal Phenomenon (Causes and types of tides (Spring Tides and Neap Tides) • Planetary Motion (Orbital speed and Escape velocity) • Celestial Mechanics (Celestial events such as eclipses and planetary conjunctions) • Space Exploration (Role of Gravitational forces in launching spacecrafts and predicting trajectories) • Cosmology (Role of universal gravitation in understanding Big bang theory, expansion of the universe and distribution of the dark matter)	
Module – 2	**Conservation Laws**	**7 hrs**
	1. Introduction to various Conservation Laws (3L) • Conservation of Energy (First Law of Thermodynamics) • Conservation of Momentum (Newton's Third Law) • Conservation of Angular Momentum • Charge –Conservation Law • Law of Conservation of Mass	

	• Conservation of Linear Momentum (Fluid Dynamics) • Conservation of Energy and Mass (Nuclear Reactions) ***2. Applications of Various Conservation Laws (4L)*** • Electric Power Generation • Rocket Propulsion • Satellite Orbits • Conservation of charge at all points in an electrical circuits • Mass Conservation in Chemical Reactions • Design of pipelines for transportation of fluids • Mass conservation to optimize fluid mixing • Energy and Mass Conservation in Nuclear Reactions	
Module - 03	**Wave-particle Duality**	**8 hrs**
	1. Introduction to wave – particle duality (4 Hrs.) • De Broglie's hypothesis and the wave nature of particles. • The classic double-slit experiment with electrons, photons, and other particles. • Interference patterns and the wave-like behavior of particles. • The wave-particle duality of light and photons. ***2. Applications of Wave-particle duality (4 Hrs.)*** • Electron Microscope (Role of wave particle duality in Electron Microscope) • Waveguides (Role of wave-particle duality principle in the design of optical waveguides) • Photoelectric Effect	
Module - 04	**Surface tension and its applications**	**8 hrs**
	1. Introduction to surface tension principles (4 Hrs) • Cohesion, Adhesion, Molecular attraction, • Definition of Surface Tension, Angle of contact, Capillary action • Young Laplace Equation, Kelvin's Equation • Factors affecting surface tension ***2. Applications of surface tension (4 Hrs.)*** • Role of surface tension in Agriculture (Irrigation efficiency-surfactant, Droplet size and distribution, Soil Moisture and Root Uptake, Adherence of pesticides) • Role of surface tension in water treatment (Filtration, Foam Formation, Coagulation and Flocculation, Adsorption, Membrane Filteration)	

Activities: Conduct **any one** classroom activity during class lecture for each module.

Module 1: Universal Gravitation

i. **Activity 1:** ***The Falling Apple Experiment:*** Recreate Sir Isaac Newton's famous experiment by dropping various objects from different heights and measuring the time it takes for them to fall. Discuss the factors affecting the rate of free fall.

ii. ***Weightlessness and Microgravity***: How astronauts experience weightlessness in space. Show the videos of astronauts aboard the International Space Station (ISS) and discuss the effects of microgravity on the human body

Module 2: Conservation Laws

Pendulum Conservation of Mechanical Energy

Module 3: Wave-particle Duality

Wave-particle duality simulation software (e.g., PhET Interactive Simulations)

.**Module 4: Surface tension and its applications**

1. Spread of oil on water
2. Formation of water droplets with different surface tensions on various leaves
3. Floating Needle
4. Soap-powered boat
5. Soap film Interference Pattern
6. Capillary rise and Measurement

Reference Books:

1) The Feynman Lectures on Physics, The Millenium Edition, Vol. 1, Pearson
2) University Physics with Modern Physics (14th Edition), Authors: Hugh D Young and Roger A. Freedman, Publisher: Pearson
3) Physics: Resnick, Halliday& Walker, Wiley
4) Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
5) Elements of Properties of Matter : D. S. Mathur, S. Chand, New Delhi.
6) Concepts of Physics: H. C. Verma, BharatiBhavan Publisher.
7) Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. Pearson Education/Prentice Hall International, New Delhi.
8) Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
9) Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
10) Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003)
11) Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
12) Principles of Conservation Laws by Andrew Resnick and Robert Eisberg
13) Modern Classical Physics: Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics by Kip S. Thorne and Roger D. Blandford
14) Introduction to Electrodynamics by David J. Griffiths
15) Principles of Quantum Mechanics by R. Shankar
16) Introduction to Quantum Mechanics by David J. Griffiths
17) Surface Tension by C. V. Boys, https://www.gutenberg.org/ebooks/33370
18) Intermolecular and Surface Forces by Jacob N. Israelachvili

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F.Y.B.Sc. (Physics) (Sem-I)

PHY 103 MJP : General Physics Lab-I

Lectures: 30 hrs **(Credits-02)**

Course Contents: - **Lectures: 30 hrs**

Section I: Mechanics and its application (Any-6)

Sr. No.	Title of the Experiments
1	To study and use of various measuring Instrument's 1. Vernier caliper 2. Micrometer Screw Gauge 3. Travelling Microscope 4. Spectrometer
2	Determination of Young's Modulus Y and Modulus of Rigidity η by Flat Spiral Spring
3	Determination of Young's Modulus Y by uniform Bending method.
4	Determination of Modulus of Rigidity η by Torsional Oscillations.
5	Determination of Acceleration due to gravity g by using Keter's Pendulum
6	Determination of Coefficient of Viscosity by using Poiseuille's method
7	Determination of Surface Tension of Water by using Jaeger's method
8	To study and verify Bernoulli's Theorem.
9	Determination of Acceleration due to Gravity g by using Bar Pendulum
10	Determination of Surface Tension of Mercury by using Quincke's Method.
11	Determination of Surface Tension of Mercury by using Method of Ripples.

Section II: Physics Principles and Applications (Any-6)

Sr. No.	Title of the experiments
1	Study of Spectrometer Calibration and determination of the Angle of the Prism
2	To determine the Dispersive Power of the Material of a Prism.
3	Determination of Cauchy's Constants A and B of the Material of a Prism
4	Study of Spectrometer Calibration and determination of Refractive Indices of different colors
5	To study of Divergence of LASER beam.
6	Determination of Planck's Constant.
7	Determination of wavelength of LASER light by using Plane Diffraction Grating.
8	Study of I-V characteristics of Solar Cell.
9	To determine the Diameter of Thin Wire by using LASER light.
10	Study of Total Internal Reflection using LASER light.
11	Determination of particle size of any sample Material Powder by using LASER light.

Section III: Additional Activities to be conducted during the semester (Any one)

1. Mini Projects with report.
2. Study tour / industrial visit / Field visit with report.
3. Plotting of any two graphs using spreadsheets (of data obtained from various

experiments performed by the student in the semester).

4. Any two computer aided demonstrations (Using computer simulations or animations on YouTube).
5. Demonstrations – Any one demonstrations.

Study tour: Participate study tour (Industry/Oganization/Research Institute/Research organization/ Small scale industry/University Department) with study tour report equivalent to 2-experiments.

Note: Students have to perform total **12-**experiments (6-experiments from Section-I and 6-experimentsfrom Section-II)

OR

Participated in Additional any **one** activity equivalent to **2-experiments** with 10-experiments (5-experiments from Section-I and 5-experiments from Section-II) mentioned above. Total laboratory work with additional **one** activity should be equivalent to **12**-experiments.

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Semester-II

Major Core (Semester-II) (6 Credits) (2T+1P)

Note: Every subject has 2 credits

F.Y.B.Sc. (Physics) (Sem-II)

PHY 151 MJ : Thermal Physics

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduce Physics of Thermodynamics to the students. Objectives are.

1) To Study the basic concepts of Thermal Physics.
2) To impart the knowledge and applications about thermal physics in our day to day life.

B) Learning Outcomes (CO): Upon Completion of this course, the students will be able to:

1) Understand the basic concepts of Thermodynamics and laws of thermodynamics.
2) Identify the different states of system and their dependence on various thermodynamic variables.
3) Understand different thermodynamic processes and their applications.
4) Understand different heat engines and their working principles.
5) Learn the heat radiation mechanism and relate this course to the daily chores through some applications.

C) Instructional Design: -

1) Lecture Method 2) Tutorial Method 3) Seminars 4) Use of Multimedia 5) Creation of online resources

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Prerequisites:

Physics Fundamentals: Knowledge about the basic physical quantities and their SI and CGS unit system along with dimensions

F) Course Contents: - **Lectures: 30 hrs**

Module - 01	Fundamentals of Thermodynamics	08 H
	• Review on: Concepts of Heat and Temperature, Zeroth law of thermodynamics, Thermodynamic variables, and equation of state. • Van der Waal's equation of state, • Estimation of critical constants. • Differential form of the First Law of Thermodynamics • Application of the first law for (i) Cyclic Process (ii) Adiabatic Process	

	(iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process. ● Adiabatic Equations for Perfect gas ● Work done during isothermal change, and adiabatic change Numerical Problems	
Module - 02	**Thermodynamics of Engines**	**08 H**
	● Second law of thermodynamics (Kelvin's & Clausius' statements), ● Carnot's cycle, ● Work done by Carnot's heat engine per cycle and its efficiency, ● Applications of Second law of thermodynamics: 1. Otto (Petrol) engine & its efficiency. 2. Diesel engine & its efficiency. 3. Refrigerators: General principle and coefficient of performance of refrigerator. 4. Air Conditioning: Principle and its applications. Numerical problems	
Module - 03	**Entropy and its Applications**	**07H**
	● Concept of Entropy, ● Second Law of Thermodynamics in terms of change in Entropy, ● Entropy in reversible process, ● Entropy in irreversible process, ● Principle of increase of entropy, ● T-S diagram of Carnot cycle and its efficiency, ● Entropy of steam, Third law of ThermodynamicsNumerical Problem	
Module - 04	**Radiation Thermodynamics**	**08H**
	● Concept of Black body and its radiations, ● Emissive and Absorptive power, ● Stefan- Boltzmann law and its Experimental verification , ● Solar constant, ● Wien-displacement law ● Temperature of Sun, ● Angstrom's Pyrheliometer, ● Solar Spectrum, ● Sources of Solar radiations, ● Greenhouse effect. Numerical Problem	

Activities: Conduct **any one** classroom activity during class lecture for each module.

Module 1: Newtonian Mechanics and Applications

Activity 1: Egg drop experiment:

Demonstrate Newton's First Law and Second Law by designing and testing protective covering to the raw egg from breaking when dropped.

Activity 2: Balloon Rocket / Straw Rocket Launch / Balloon Powered Car:

Demonstrate and understand Newton's Third Law by creating a balloon powered rocket/straw rocket launch / Balloon Powered Car.

Activity 3: Circular Vs Non-circular motion

Demonstrate circular and non-circular motion with help of string and mass. Rotate tied mass to explain circular motion and release mass and explain non-circular motion. Note down the key characteristics of each.

Module 2: Work, Energy and Power

Activity 1: Building Simple Pulley System / Simple Lever System

Illustrate and understand the concept of work done by building a pulley system / simple Lever system.

Activity 2: Roller Coaster Energy Transfer

Demonstrate and understand the concept of work done and energy transfer in the context of roller coaster.

Activity 3: Converting Potential Energy to Kinetic Energy

Calculate the potential energy of an object and predict the object's speed when all that potential energy has been converted to kinetic energy.

Module 3: Rotational Dynamics

Activity 1: Linear velocity of rotating objects.

Compare velocities of solid sphere, solid cylinder, hollow sphere and hollow cylinder on inclined plane.

Activity 2: Exploring Rotational Dynamics with Spinning Tops

Explain principle of rotational dynamics through hands on experiment with spinning top.

Activity 3: Spinning Wheel Challenge

Apply concepts of rotational dynamics, specifically related to angular velocity and angular acceleration.

Module 4: Fluid Mechanics

Activity 1: Sticky and non-sticky liquid

Demonstrate viscosity using sticky or non-sticky liquids.

Activity 2: Mixture of Sticky and non-sticky liquid

Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration.

Activity 3: Surface Tension

Explain surface tension using soap solution and piece of paper

Reference Books:

1) Concept of Physics: H. C. Verma, Bharati Bhavan Publisher.
2) Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3) Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7th Edition, Mc-Graw Hill, International Edition.
4) Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5) Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta.
6) Instrumentation: Devices & Systems by Rangan, Mani, and Sarma.
7) Theory and Experiments on Thermal Physics by P. K. Chakrabarti, New Central Book Agency (P) Ltd. Landon.

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F.Y.B.Sc. (Physics) (Sem-II)

PHY 152 MJ : Electricity and Magnetism

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduce Electricity and Magnetism to the students. Objectives are.

1) To Study the basic concepts of Electricity and Magnetism.
2) To impart the knowledge and applications about Electricity and Magnetism in our day to day life.

B) Learning Outcomes (CO): After completion of the course, students would be able to

1. Understand the basic concepts of electric and magnetic fields.
2. Understand the concept of conductors, dielectrics, inductance and capacitance.
3. Gain knowledge on the nature of magnetic materials.
4. Gain knowledge on electromagnetic induction and its applications.

C) Instructional Design: -

1) Lecture Method 2) Tutorial Method 3) Seminars 4) Use of Multimedia 5) Creation of online resources

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Prerequisites:

XIIth Science or Equivalent

Physics Fundamentals: Knowledge about the basic electrical quantities and their SI and CGS unit system along with dimensions.

F) Course Contents: - **Lectures: 30 hrs**

Module - 01	Electrostatics	08 H
	○ Electric Charge ▪ Static Charge ▪ Charge transfer methods - Rubbing method, Contact method, and induction method ▪ Basic Properties of Charge – Additivity, Conservation, Quantisation of Charge ○ Electrostatic Forces between Charges (F) ▪ Coulomb's law ▪ Principle of Superposition – Statement & Explanation with example ○ Electric Field (E) ▪ Electric field & its Physical significance ▪ Electric Field Lines ▪ Concept of electric flux ▪ Charge distribution & Electric Field over it ▪ Gauss's law in electrostatics ▪ Application of Gauss Law • Cylindrical Symmetry	

	• Planner Symmetry • Spherical Symmetry ○ Electric Potential (V) ▪ Electric Potential due to point charge, group of charge ○ Electrostatic Energy (W) ▪ Energy of system of charges ○ The four quantities for point charges & Relationship between Electric Field, Electric Force, Electric Potential, and Electric Potential Energy ○ Electrostatics of Conductor Numerical Problem	
Module - 02	**Dielectrics**	**07 H**
	○ Electric Dipole ▪ Electric dipole & Dipole moment ▪ Electric potential and Electric Field at any point due to dipole (without derivation) ▪ Torque on a dipole placed in an electric field: ○ Dielectric & Polarization ▪ Introduction to dielectric materials ▪ Polar and non-polar molecules ▪ Electric Susceptibility and Polarizability ▪ Displacement Vector ▪ Relation between E, D & P ▪ Gauss law in dielectric (without derivation) ○ Capacitor ▪ Capacitor & Capacitance ▪ Calculation of Capacitance for parallel plate capacitor ▪ Capacitor with dielectric medium ▪ Charging & Discharging of Capacitor ▪ Capacitor for energy storage applications Numerical Problem	
Module - 03	**Transient Current**	**07H**
	○ Moving Charges and Electric Currents ○ Current Density ○ Resistance & Resistivity ○ Ohms Law ○ AC voltage applied to Resistor ○ AC voltage applied to Capacitor ○ AC voltage applied to Inductor ○ LR Circuit ○ LCR Series Circuit – Resonance, Q-factor, Power factor Numerical Problem	
Module - 04	**Magnetostatics**	**08H**
	○ Magnetic Field Lines & its properties ○ Magnetic Force ○ Right Hand thumb Rule with examples	

	○ Biot-Savart's law ▪ Statement ▪ Long straight conductor ▪ Circular Coil ○ Ampere's circuital law ▪ Field of Solenoid ▪ Field of Toroid ▪ Gauss law for magnetism • Magnetism and Matter ○ Introduction to magnetization (without derivation) ▪ Definitions ▪ Magnetization (M) ▪ Magnetic Intensity (H) ▪ Magnetic Induction (B) ▪ Magnetic Susceptibility (χ) ▪ Magnetic Permeability (μ) ○ Types of Magnetic Materials ▪ Diamagnetic Materials ▪ Paramagnetic Materials ▪ Ferromagnetic Materials ▪ Antiferromagnetic Materials Numerical Problem	

Activities: Conduct **any one** classroom activity during class lecture for each module.

Module 1: Electrostatics

Activity 1: Perform an activity to explain the concept of static charges:

Module 2: Dielectrics

Activity 1:https://phet.colorado.edu/en/simulations/capacitor-lab-basics

Use the link to

1. Explain the relationships between voltage, charge, stored energy, and capacitance
2. Predict how capacitance changes when the plate area or plate separation changes
3. Describe how charge drains away from a capacitor into a light bulb

Module 3: Transient Current

Activity 1: https://phet.colorado.edu/en/simulations/circuit-construction-kit-ac-virtual-lab

Use the link to

1. Explain basic electricity relationships in series and parallel circuits.
2. Describe how capacitors and inductors behave in a circuit.
3. Experimentally determine the RC time constant.
4. Construct LCR circuits and determine the conditions for resonance.

Module 4: Magnetostatics

Activity 1:

1. Levitating magnets with eddy currents

2. Maglev train
3. Perform an activity to show magnetic field lines using bar magnet and iron filings(particles)

Reference Books:

1. Electricity and Magnetism: Brij Lal, N. Subramanyan, S. Chand & Co.
2. Electricity and Magnetism : R. Murugesan, S. Chand & Co.
3. Concept of Physics : H. C. Verma
4. Fundamentals of Physics: D. Halliday and R. Resnick and J. Walker, Wiley Publications
5. Electromagnetics: B.B. Laud, New Age International (P) Ltd.
6. Electricity and Electronics: D.C. Tayal, Himalaya Publishing House, Mumbai
7. Introduction to Electrodynamics: D.G. Griffith, Pearson Publications
8. Electricity and Magnetism: N.S. Khare and S.S. Shrivastav, Atmaram and Sons
9. Classical Electromagnetism: H.C. Verma, Bharati Bhavan Publisher

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F.Y.B.Sc. (Physics) (Sem-II)

PHY 153 MJP : General Physics Lab-II

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduce the practicals related with thermal Physics and Electricity and Magnetism.

Section I: Thermal Physics **(any 6)**

Sr.No	Title of the Experiments
1	Study of Thermal Conductivity by Lee's method.
2	Study of Specific Heat of Graphite.
3	Interpretation of Isothermal and Adiabatic curve on P-V diagram and theoretical study of Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves.
4	Study of Solar Constant.
5	Study of Temperature Coefficient of Thermistor.
6	Study of Thermocouple and determination of Inversion Temperature.
7	Determination of Calorific Values of Different Fuels.
8	To determine the Temperature Coefficient of Resistivity of PTC or NTC type Material.
9	To determine the Coefficient of Liner Expansion of Metals.
10	To determine Joule Equivalent of Electrical Energy.
11	To determine Specific Heat Capacity of Water by Electrical Method.

Section II: Electricity and Magnetism (**any 6**)

Sr. No	Title of the experiments
1	Study of Kirchhoff's Voltage and Current Law.
2	Study of AC and DC Voltage Sensitivity by using CRO.
3	Study of I-V Characteristics of Zener Diode.
4	Study of Charging and Discharging of a Capacitor.
5	Study of L-R Circuit
6	Study of Impedance of series LCR series circuit.
7	Study of Series and Parallel circuit using Capacitor (Voltage-Current Division Rule)
8	Determination of Frequency of AC by using Sonometer.
9	Study of Digital Multimeter for measuring (i) Resistances, (ii) AC and DC Voltages, (iii) DC Current, and (iv) checking electrical fuses.
10	Study of Half Wave, Full Wave and Bridge Wave Rectifier circuit.
11	Comparison of Capacitor using De Sauty's Method
12	Charges and Fields 1.0.59 (colorado.edu) : To study lines of forces and electric field due to a dipole. Place 1 nC charge at 2m apart and determine the electric field at given positions(0,0,), (1,0), (0,1), (0,-1), (-1,0), (2,0), (3,0), (2,1),(2,-1), (1,1),(-1,-1) and also draw equipotential surface for 1 V, 2 V, 3 V, 5 V, 10 V, 20 V and -1V, -2V, -3V, -5V, -10V, -20V
13	Coulomb's Law (colorado.edu) On Coulomb's Law

Section III: Additional Activities to be conducted during the semester (Any one)

1. Mini Projects with report.
2. Study tour / industrial visit / Field visit with report.
3. Plotting of any two graphs using spreadsheets (of data obtained from various experimentsperformed by the student).
4. Any two computer aided demonstrations (Using computer simulations or animations).
5. Demonstrations – Any one demonstrations.

Study tour: Participate study tour (Industry/Oganization/Research Institute/Research organization/ Small scale industry/University Department) with study tour report equivalent to **2-**experiments.

Note: Students have to perform total **12-**experiments (6-experiments from Section-I and 6-experimentsfrom Section-II)

OR

Participated in Additional any **one** activity equivalent to **2-**experiments with **10-**experiments (5-experiments from Section-I and 5-experiments from Section-II) mentioned above. Total laboratory work with additional **one** activity should be equivalent to **12-**experiments.

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17) Syllabus of Vocational Skill Courses (VSC):

F.Y.B.Sc. (Physics) (Sem-I)

PHY 121 VSC : Introduction to Computational Physics-I

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduction of Computational Physics.

1) To study basic concept of Programming.
2) To import knowledge of Programing language in study of physics.

B) Learning Outcomes (CO): - Upon completion of this course student will able to

1) Understand algorithm, Flowchart.
2) Can writ C-program.
3) Can study basic concept of Physics through C-program.
4) Apply Knowledge of Physics through C-program

C) Instructional Design: -

1) Lecture method
2) Tutorial method
3) Creation of Program
4) Use of Computer

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Course Contents **Lecture 30 Hrs**

Module: - 01	**Concepts of Programming: - Introduction**	**8H**
	Definition and Properties of algorithms, Algorithm development, Flow charts- symbols and simpleflowcharts.	
	Introduction and Structure of C-program, 'C' Character set, key words, Constants and variables,Variable names, Data types, qualifiers and their declarations, Symbolic Constants.	
	Input/output functions: scanf (), printf( ), getchar(), putchar(), gets(), puts().	
	Examples	
Module: - 02	**Operators and Expressions: - Introduction**	**8H**
	Definition of Operators.	
	Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator.	
	Control statements: if, if else, while, do while, for loop, nested control structures (nested if, nestedloops), break, continue, switch- case statement, go to statement.	
	Use of Library functions: e. g. mathematical, trigonometric, graphics.	
	Examples.	

Module: - 03	**Arrays, Pointers, and user defined function in C-Language**	**10H**
	Arrays: 1-D, 2-D: Arranging numbers in descending and ascending order, Sum of matrices,multiplication of matrices.	
	Concept of pointers with suitable illustrative examples.	
	User defined functions: Definitions and declaration of function, function prototype, passingarguments.	
	Simples' illustration Examples	
Module: - 04	**Study of Motion in C-program**	**06H**
	Kinematic Equation of Motion	
	Simple Harmonic Equation of Motion	
	Wave and Oscillation motion	
	Projectile Motion	
	Examples	

Reference Books:

1. Programming in C : Schaum's series, Gottfreid, TMH
2. Programming in C : Balgurusami, Prentice Hall publications
3. Let us C : Yashwant Kanetkar, BPB publications
4. Programming with C : K.R. Venugopal, S. R. Prasad, TMH.
5. Introductory methods of numerical analysis : S. Sastry, Prentice Hall
6. Computer oriented numerical methods : V. Rajaraman

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F.Y.B.Sc. (Physics) (Sem-II)

PHY 171 VSC : Introduction to Computational Physics-II

Lectures: 30 hrs **(Credits-02)**

A) Course Objectives: - This course aims to introduction of Computational Physics.

1) To study basic concept of Programming.
2) To import knowledge of Programing language in study of physics.

B) Learning Outcomes (CO): - Upon completion of this course student will able to

1) Understand algorithm, Flowchart.
2) Can writ C-program.
3) Can study basic concept of Physics through C-program.
4) Apply Knowledge of Physics through C-program

C) Instructional Design: -

1) Lecture method
2) Tutorial method
3) Creation of Program
4) Use of Computer

D) Evaluation Strategies

1) Descriptive written exam 2) Assignments 3) Seminars, Oral, Viva.

E) Course Contents: - **Lecture 30 Hrs**

Module: - 01	**Arrays: - Introduction**	**04 H**
	Definition of arrays and types of arrays	
	1D, 2D, 3D, use of array in C- program.	
	Arranging Number in ascending/ descending order.	
	Sum of metrics Multiplication	
	Examples	
Module: - 02	**Pointer: - Introduction**	**06 H**
	Definition of Pointer, types of pointers and use of pointer	
	Chain of Pointers, Pointer Arithmetic, Pointers, and Arrays	
	Pointers and Character Strings, Array of Pointers	
	Pointers as Function Arguments,	
	Examples	
Module: - 03	**Definition of Function and Use: -**	**08 H**
	Definition of Function, Library Functions, declaration of function.	
	Types of Function and Give the Properties.	
	User defined functions, Function prototype, Function call, and Function Definition	
	Nested and Recursive Function, Function Arguments and Return Types.	
	Passing Arguments by Value, Passing Arguments by Address	

	Scope visibility and lifetime of a variable, Local and Global Variable.	
	Example	
Module: - 04	**Graphics.**	**04 H**
	Concepts of Graphics (graphics' header file),	
	Graphics Initialization and Modes (graphics driver and graphics mode)	
	Graphics Function (Basic functions of graphics.h e.g. line(), arc(), circle(), ellipse(), floodfill(), getmaxx(), getmaxy())	
	Suitable Examples	
Module: - 05	**Computational Physics:**	**11 H**
	Numerical Methods to solve the Physics Problems	
	1.1 Iterative methods: Bisection method and Newton-Raphson Method–Algorithm, Flowchart andwriting C- program for finding the roots of the equation, problems	
	1.2 Integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule – Algorithm, Flowchart and C-program, problems.	

Reference Books:

1) Programming in C : Schaum's series, Gottfreid, TMH
2) Programming in C : Balgurusami, Prentice Hall publications
3) Let us C : Yashwant Kanetkar, BPB publications
4) Programming with C : K.R. Venugopal, S. R. Prasad, TMH.
5) Introductory methods of numerical analysis : S. Sastry, Prentice Hall
6) Computer oriented numerical methods : V. Rajar

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18) Syllabus of Indian Knowledge System (IKS) Courses :

F.Y.B.Sc. (Physics) (Sem-I)

PHY 121 IKS : India's Contribution to Science

Lectures: 30 hrs **(Credits-02)**

A) Course Objective : The course aims to introduce **India's Contribution to Science**

1. To understand the past scientific events in India
2. To impart knowledge about the earlier techniques used in scientific events

B) Learning Outcomes : Upon completion of the course, the students will able to

1. Understand history of Indian Science and basic literature
2. Apply the past knowledge for the future perspective
3. Identify the importance of Indian Scientists and Intellectual Property Rights (IPR)

C) Instructional Design :

1. Lecture Method 2. Use of Multimedia, 3. Creation of Online resources 4. Seminars

D) Evaluation Strategies :

1. Descriptive, 2. Assignments 3. Seminars

E) Course Content : **Lecture : 30 hrs**

Module: - 01	**India's Contribution to Science and Technology**	**12 hrs**
	Grate Indian Scientist- • Lagadha, Araybhat, Bramhagupta, • Varahmihira, • Bhaskara-I, II, • Lalla, • Sripati, • CV Raman, • Vikram Sarabhai, • SN Bose, • Jayant Naralikar, • Anil Kakodakar, • Raghunath Mashelkar, • Vijay Bhatkar etc. Contribution in Physics : Iron and Steel, Medicine and Surgery, Shipping and Ship building, Astronomy and astronomical events, Atomic energy and space, Review of Ancient Indian Literature	
Module: - 02	**Measurements**	**12 hrs**
	Components used for measurements like time Laghu samrat yantra, Samart yantra, Rashivalay, Ram yantra, Misra yantra.), height, distance (vertical, horizontal), water flow capacity etc. with respect to ancient and modern techniques.	
Module: - 03	**Application of Technology in Various Fields**	**06 hrs**

	Agriculture. Energy, Biotechnology, Space, Medicine, Mission Managal, Chandrayan, Gagayan. Various Institutes related to Science and Technology in India	

Activities:

1. Observation of astronomical events throughout the period.
2. Field visits to the heritage sites which enhances the practical knowledge of students.

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19) Syllabus of Minor (MN) Courses :

F.Y.B.Sc. (Physics) (Sem-II)

PHY 191 MN : Fundamental of Physics

Lectures: 30 hrs **(Credits-02)**

A) Course Objective : The course aims to introduce **Fundamental of Physics**

1) To understand the simple concepts of Physics and some fun
2) To impart knowledge about the earlier techniques used in scientific events

B) Learning Outcomes : Upon completion of the course, the students will able to

1) Understand history of Indian Science and basic literature
2) Apply the past knowledge for the future perspective
3) Identify the importance of Indian Scientists and Intellectual Property Rights (IPR)

C) Instructional Design :

1. Lecture Method 2. Use of Multimedia, 3. Creation of Online resources 4. Seminars

D) Evaluation Strategies :

1. Descriptive, 2. Assignments 3. Seminars

E) Course Content : **Lecture : 30 hrs**

Module: - 01	**Physical quantities and their measurements**	**04 hrs**
	• System of units (CGS and SI), measurement of length, mass, time, temperature, quantity of a substance, current, and luminous intensity. • Derived physical quantities and their equations such as Angle, Area, Volume, Density, Weight, Force, Pressure, velocity, acceleration, work, heat, energy and power etc. • Error and its types. Problems	
Module: - 02	**Fundamental Laws of Physics**	**10 hrs**
	• Laws of motions: Newton's laws: first law of motion, Second law of motion, Third law of motion, Kepler's laws of planetary motion. ➢ Applications in dynamics, planetary motion and rocket propulsion. • Laws of thermodynamics: Zeroth law of thermodynamics, First law of thermodynamics, Second law of thermodynamics, Third law of thermodynamics, Boyles's law, Charles's law, Gay-Lussac law. ➢ Applications in heat engines, pressure cooker and Refrigerator	

	• Laws of Electricity and Magnetism: Coulomb's law, Ampere's law, Ohm's law, Gauss's law in electric and magnetic field, Biot-Savart law, Faraday's law, Lenz's law. ➢ Applications in electricity generation using turbines, electric generators, transformers, and induction motors. ➢ Problems	
Module: - 03	**Fundamental of Atoms**	**10 hrs**
	• Atom and its constituents: Electron, proton, neutron, nucleus, • Atomic Models (Overview): Thomson, Rutherford and Bohr atomic models • Spin motion, spin angular momentum and orbital motion, orbital angular momentum. • Quantum number and Quantum state • Aufbau principle, Pauli Exclusion Principle, Hund's rule of maximum multiplicity • Electronic configuration, atomic number, atomic mass number • Ionization potential and work function	
Module: - 04	**Forms of Light and its Applications**	**06 hrs**
	• Concept of photon, frequency, wavelength, wavenumber and energy relation • Electromagnetic wave and its properties, Electromagnetic spectrum • Applications of electromagnetic waves (overview) : RADAR, Mobile Tower, Microwave oven, FTIR, UV-VIS spectroscopy, X-ray radiography and diffractometry	

Activities:

1) Measurement of least count of various measuring instruments
2) Visit to wind mill
3) Visit to hydro-electric power plant
4) Demonstration through animation of atomic models
5) Demonstration of working of transformers, and induction motors.
6) Demonstration through animation of various spectroscopic techniques

Reference Books:

Sr. No.	Title of Books	Name of Author/s	Publisher	Year
1	Fundamentals of Physics	D. Halliday, R. Resnick, R. Walker	Wiley India Pvt Ltd (12th edition)	(2021)
2	Electricity and Magnetism	Brijlal, Subramanyan	S. Chand & Co., New Delhi	(2016)
3	Heat and Thermodynamics	Brijlal, N. Subrahmanyam	S. Chand and Company Ltd.	(2008)
4	Concept of Physics	H. C. Verma	Bharati Bhavan Publisher	(2019)
5	Heat and Thermodynamics	Mark W. Zemansky, Richard H. Dittman	Mc-Graw Hill International Edition (7th Edition)	(1997)
6	University Physics	Sears and Zeemansky	Pearson Education (14th edition)	(1949)
7	Mechanics	D. S. Mathur	S. Chand and Company, New Delhi.	(2006)

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20) Syllabus of Generic Elective (GE)/Open Elective (OE) Courses :

F.Y.B.Sc. (Physics) (Sem-I)

OE-101-PHY : LED Light Repairing and Maintenance

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objective- The course aims to

1. Use the knowledge of basics of electronics and LED to carryout work
2. Perform LED repair and assembly as per the recommended quality standards
3. Implement the soft skills that are required to carry out work efficiently

B) Learning Outcomes- Upon completion of the course, the students will able to

4. Understand basics of LED and semiconductor
5. Apply the knowledge for the repair of LEDs
6. Identify the importance of reduction electronic waste management and Intellectual Property Rights (IPR)

C) Instructional Design-

2. Lecture Method 2. Use of Multimedia, 3. Creation of Online resources 4. Seminars

D) Evaluation Strategies-

2. Objective 2. Assignments 3. Seminars 4. Practical

F) Course Content : **Lecture : 30 hrs**

Module: - 01	**Physical quantities and their measurement Basics of Electronics and LED s**	**15 hrs**
	• Differentiate between various electronic and electrical components, materials and their specific properties, types and usages • Calculate resistance by identifying the colour codes • Define capacitance of a capacitor • List and define the parameters of an electric circuit such as voltage, current and resistance • Define Ohm's law and implement it forcalculations • Differentiate between alternatingcurrent (AC) and direct current (DC) • Measure power and energy using relevant formula • Identify the basics of power electronics and its usages in lightingcontrols or LED power supplies andLED drivers • Identify the types of solder and flux • List the function of the different components of a soldering iron • Identify the selection criteria of a suitable tip • Demonstrate the LED working principle • List the parameters which affect theoverall life of LED. • Categorize LED into its various types such as indicator,	

	illuminator and Chip on Board (COB) • List the advantages of LED light products • List the basic parameters of LEDs and their importance in an LED product • Distinguish between the different types of power sources used in LEDlighting and their characteristics • Illustrate the different ways LEDscan be connected in a circuit and list the advantages and disadvantagesof each • Identify the steps of heat transfer procedure in an LED • List the components of passive thermal designs to maintain low junction temperature such as adhesive and heat sinks Identify the use of constant current LED Driver	
Module: - 02	**LED LuminaryRepair and Assembly**	**15 hrs**
	• List the major components of an LED luminary such as LED lightengine, LED Driver, LED heat sink and thermal pads • Identify the tools required for LED product assembly • List the materials used in LED product assembly • Demonstrate basic knowledge of assembly of products such as spotlight, LED bulb and LED tube light • Analyse the Importance of IP ratingin Led products and its requirementfor different products based on the product area of use • Categorise LED drivers into different types as per the type of LED • Demonstrate driver selectionaccording to the LED • Follow the steps of driver selectionaccording to the LED • Identify the function and characteristics and application of aconstant current LED driver and a constant voltage driver • Assess the reason for LED failure including hot environment, incorrect LED driver and incorrect polarity • Identify and analyse the LED luminaire failure types such as LEDfailure modes, secondary optics failure modes, thermal management system failure and LED driver failure • Follow the steps to diagnose and repair fault in an LED light both at the component level and the strip level • Demonstrate the process of soldering if loose, de-soldered wires and connections are found	

	• Check the LED light engine with DC supply as per the voltage / current requirements of the product • Check the supply unit with AC supply / multimeter to find out the voltage /current output in case LEDlight engine is not found defective • Check voltage / current output at different sections of the supply unitin case of no voltage / current • Check the components with multimeter individually of the section where voltage output is found to be less than desired / no output • Perform repair / replacement of the damaged components / SMPs • Check and replace the burnt out /damaged LED strips • Identify 5S work standards • Perform repair as per productivityand quality standards • Report faults found in the LED lights document the fault diagnosis and repair process as per SOP	

Activities (Experiments) (any-6): 30 hrs

1. Identify the electronic components and its measurements
2. Measurement of Power and Energy
3. Soldering and desoldering of Electronic components
4. Check the voltage and current output at different sections of units of LED
5. LEDs series and parallel circuit
6. Check the burnt out and damage LEDs in bulbs
7. Perform repair and replacement of LEDs and other components
8. Assembly of LED bulbs/ strips dismantle, assembly with different power and wattage.

Reference Books:

1. NSDC Skill Based Participant Handbook LED Light Repair Technician (E), Publisher-Rachna Sagar Pvt Ltd.
2. Vigyan Ashram, Design Manual (LED)

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F.Y.B.Sc. (Physics) (Sem-I)

OE-102-PHY : Biological Physics

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objective- The course aims to –

1. Understanding of Biological Systems
2. Bridging the Gap Between Physics and Biology
3. Understand the role of light in the physiology of living organisms.
4. Understand the physical principles that govern cellular processes, such as transport across cell membranes, cell division, and signal transduction.

B) Learning Outcomes- Upon completion of the course, the students will able to

1. Understand the biological systems.
2. Understand the principles of interaction of light with organic molecules and their significance in environment.
3. Understand the physics principles and concepts with living systems and their significance.

C) Instructional Design-

1. Lecture Method 2. Use of Multimedia, 3. Creation of Online resources 4. Seminars

D) Evaluation Strategies-

1. Descriptive 2. Assignments 3. Seminars

E) Course Content- **Lectures- 30hrs**

Module- 1	**Cell Organization**	**8 hrs**
	Cell as the basic structural unit, Origin & organization of Prokaryotic and Eukaryotic cell, Cell size & shape, Fine structure of Prokaryotic & Eukaryotic cell organization Internal architecture of cells, cell organelles, compartment & assemblies membrane system, Ribosome, Polysomes, Lysosomes & Peroxisomes, Connection between cell & its environment, Extracellular Matrix. Structure & function of Nucleic acids, Amino acids & Proteins, Carbohydrates, Lipids, Vitamins & hormones	
Module-2	**Photosynthesis**	**10 hrs**
	Photosynthesis phenomenon, Chlorophyll molecules, Chloroplasts, Photochemical Systems, Interaction of photons with chemical compounds, photosensitive chemicals, photo induced electronic transitions in organic molecules, quantum yield, photo induced chemical reactions, Electron Transport Processes, Molecular Mechanism of Photoreception, Bioluminescence, Bacteriorodopsin.	
Module– 3	**Physical Concepts in Biophysics**	**12 hrs**
	Thermodynamics of Biological system: First and second laws of thermodynamics, activation energy, Biological systems as open, non-equilibrium systems, Concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry, Enthalpy, Negative	

	entropy as applicable to biological systems. Thermodynamics of passive and active transport, glycolytic oscillations, biological clocks. Bioenergetics: Concept of energy coupling in biological processors, Energy requirements in cell metabolism, structure and role of mitochondria, high energy phosphate bond, energy currency of cell, Biological oxidation, Electron-transport chain, Oxidative Phosphorylation including chemiosmotic hypothesis.	

F) Demonstrations and Experiments : (any 6) 30 hrs

1. Preparation of buffers (acetate, phosphate, citrate, borate buffers). Preparation of Normal, molar and standard solutions, serial dilutions
2. To study the principle of spectrophotometer. To verify the Lambert Beer's law.
3. To determine the beer's limit and measurement of molar and percent extinction coefficient.
4. To plot absorption spectrum of DNA and protein(BSA/Egg Albumin) and find λmax
5. Estimation of Glycine or any other by formal titration method.
6. Estimation of reducing sugars by Benedict's Method
7. Spot test for carbohydrates.
8. To Isolate of Casein from milk.
9. Estimation of protein from animal and plant sources.
10. Microscopic observation of bacteria, microalgae, fungi, lichen and protists; Cell staining – Staining of Plant cell (onion epidermal cell), Animal cell (Squamous epithelial cell), Blood cell, Microbial cells (Bacteria & Yeast).
11. Preparation of Media (Media preparation: Nutrient agar and Nutrient broth)
12. Bacterial growth curve - To raise the culture of E. coli and estimate the culture density by turbidity method. Draw a growth curve from the available data. Determination of generation time.
13. To obtain relation between concentration & Refractive Index for solutions of proteins and sugars and estimation of specific refraction increment for proteins.
14. Determination of specific and equivalent conductance of electrolyte (NaCl and HCl) and Bio-fluids
15. Use of Ostwald viscometer and Determination of coefficient of viscosity η of biofluids.
16. Use of pH meter and measuring the pH of the buffer solutions
17. Separation of amino acids and sugars using paper and Thin layer chromatography. Estimate their Rf value

G) Reference Books:

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.
2. Barrow. C. (1974), Physical Chemistry for Life Sciences, McGraw-Hill.
3. Berns M.W. (1982), Cells, Holt Sounders International Editors.

4. Bloomfield V.A. and Harrington R.E. (1975), Biophysical chemistry, W.A. Freeman and CO.
5. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A. Fremman and Co.
6. Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west press.

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F.Y.B.Sc. (Physics) (Sem-II)

OE-151-PHY : Physics of Daily Life

Lectures: 60 hrs **(Credits-04[2T+2P])**

F) Course Objective- - The course aims to

1) The Recall, understand, use and apply the scientific knowledge set out in the syllabus.
2) Learn, recognize and apply basic physical principles related to climate, human body and Technology.
3) Learn about earth's atmosphere and related phenomena.
4) Solve simple physics related problems. Apply the simple law of nature to different fields of science, engineering and technology.
5) Evaluate relevant scientific information and make informed judgements about it.

G) Learning Outcomes- Upon completion of the course, the students will able to

1) Every student will be able to study physics on a deeper level and to uses basic physics concepts to navigate everyday life.
2) Every student will be able to build essential scientific knowledge and skills for life-long learning.

H) Instructional Design-

1) Lecture Method 2) Use of Multimedia, 3) Creation of Online resources 4) Seminars

I) Evaluation Strategies-

1) Objective 2) Assignments 3) Seminars 4) Practical

J) Course Content : **Lecture : 30 hrs**

Module: - 01	**Physics in Earth's Atmosphere**	**10 hrs**
	Sun, Earth's atmosphere as an ideal gas; Pressure, temperature and density, Pascal's Law and Archimedes' Principle, Corioli's acceleration and weather systems, Rayleigh scattering, the red sunset, Reflection, refraction and dispersion of light, Total internal reflection, Rainbow.	
Module: - 02	**Physics in Human Body and Sports**	**10 hrs**
	The eyes as an optical instrument, Vision defects, Rayleigh criterion and resolving power, Sound waves and hearing, Sound intensity, Decibel scale, Energy budget and temperature control, Physics in Sports: The sweet spot, Dynamics of rotating objects, Running, Jumping and pole vaulting, Motion of a spinning ball, Continuity and Bernoulli equations, Turbulence and drag.	
Module: - 03	**Physics in Technology**	**10 hrs**
	Microwave ovens, Lorentz force, Global Positioning System, CCDs, Lasers, Displays, Optical recording, CD, DVD Player, Tape records, Electric motors, Hybrid car, Telescope, Microscope, Projector etc.	

Reference Books:

1. H. C. Verma, Concepts of Physics (Bharati Bhawan publishers and distributers, New Delhi, India) 2011.
2. Sears and Zeemansky, University Physics (Addison Wesley, Boston, USA) 2007.
3. B. Lal and Subramaniam, Electricity and Magnetism (Ratan Prakashan Mandir, Agra, India) 2013.
4. Physics in Daily Life, Jo Hermans, EDP Sciences 5. E. Hecht, Optics (Addison Wesley, Boston, USA) 2001.
6. M. Nelkon and P. Parker, Advanced Level Physics (Heinemann International, London, U.K.)
   2012.
7. How Things Work, The Physics of Everyday Life, Louis A. Bloomfield, Wiley, 2013.

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F.Y.B.Sc. (Physics) (Sem-II)

OE-152-PHY : Introduction to Electronics

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objective- The course aims to introduce

1. To understand the basic electronic terms in Physics.
2. To impart knowledge about the daily life instrument and devices.

B) Learning Outcomes- Upon completion of the course, the students will able to

1. Understand the measurement/identification of resistance, Capacitance, inductance values and types
2. Apply the knowledge for the use of component for signal processing
3. Identify characteristics of BJT and Applications of Logic gates in Computer

C) Instructional Design-

1. Lecture Method 2. Use of Multimedia, charts, PPT 3. Creation of Online resources 4. Seminars and U- tubes Lectures.

D) Evaluation Strategies-

1. Descriptive 2. Assignments 3. Seminars

E) Course Content-

Module- 1	**Basic Circuit Concepts and DC Circuits:**	**08 hrs**
	Resistance, Inductance, Capacitance, Sources, Some Definitions, Ohm's Law, Effect of Temperature on Resistance, Series Circuit, Parallel Circuit, Kirchhoff's Laws, Kirchhoff's Laws, Source Transformation, Source Shifting, simple DC Circuits	
Module-2	**AC Circuits and Single-Phase Transformer:**	**08 hrs**
	Terms Related with Alternating Quantity, Root Mean Square (RMS) or Effective Value, Average Value, Behavior of a Pure Resistor in an AC Circuit, Series R-C Circuit. Single-Phase Transformer: Construction, Working Principle, EMF Equation of a Transformer, Transformation Ratio (K), Efficiency	
Module-3	**Semiconductor Diode and Rectifiers:**	**06 hrs**
	P-N Junction Diode, forward and reverse bias, Zener Diode, Zener as voltage Regulator, Introduction to Rectifiers, Half-Wave Rectifiers, Full-Wave Rectifies, Filters and their types, Problems	
Module-4	**Digital Electronics and Number System:**	**08 hrs**
	Introduction, Digital signal, Basic Digital Circuit, AND,OR and NOT Gate, NAND and NOR Operation, EX-OR, EX-NOR Operation, Boolean Algebra, De-Morgan's theorem, Number System, Decimal Number system, Binary number system, Hexadecimal Number system, Binary Arithmetic	

F) Demonstrations and Experiments

1. Demonstration of resistors and its color codes,
2. Demonstration of basic types and measurement of Capacitors values.
3. Demonstration of basic types and measurement of Resistors values,
4. Demonstration of Transistor and its basic types

5. Demonstration Logic Gates and De-Morgan's theorem
6. Demonstration of Basic types logic gates and verification.
7. Demonstration of Universal types logic gates and verification.
8. Study of KVL and KCL.
9. Study use of CRO to measure current, voltage and frequency.
10. Study use of DMM to measure current, voltage and resistors.
11. Study use of Transformer (step-up and step-down)

G) Reference Books:

1. SINGH, RAVISH R, Basic electrical & Electronics Engineering, Tata McGraw Hill, 2009.
2. R.P. Jain, B M Institute of Engineering and technology, Sonepat
3. Digital Electronics 1 : Combinational Logic Circuits, by Tertulien Ndjountche, John Wiley & Sons, Incorporated
4. Digital Logic Design, Brian Holdsworth and Clive Woods.

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21) Syllabus of Skill Enhancement Courses (SECs) :

F.Y.B.Sc. (Physics) (Sem-I)

SEC-103-PHY : Renewable Energy and Energy Harvesting

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objectives:- This course aim to introduce "Renewable Energy and Energy Harvesting".

1) To study the Renewable Energy and Energy Harvesting.
2) To improve the knowledge of Renewable Energy and Energy Harvesting.
3) Using the knowledge of Renewable Energy and Energy Harvesting to solve the problems in Physics.

B) Learning Course outcome (CO): Upon completion of the course the student will be able to

1) The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible. Some of the renewable sources of energy which should be studied here are: (i) off-shore wind energy, (ii) tidal energy, (iii) solar energy, (iv) biogas energy and (v) hydroelectricity.
2) All these energy sources should be studied in detail.
3) Learn about piezoelectricity, carbon- captured technologies like cells, batteries.
4) The students should observe practical demonstrations of (i) training modules of solar energy, wind energy etc., (ii) Conversion of vibration into voltage using piezoelectric materials, (iv) conversion of thermal energy into voltage using thermoelectric modules

C) Instructional Design:

1) **Lecture method** 2) **Tutorial method** **3)Lab sessions** **4) Group projects** **5)Seminars**: To take seminars on different tropics. **6)Create online resources**: Through YouTube or other platform we will create online resources.

D) Evaluation Strategies:

1) Descriptive written examinations
2) Assignments
3) Seminars, Orals and Viva

H) Course Contents:

Module: - 01	**Fossil fuels and Alternate Sources of energy**	**09 hrs**
	• Fossil fuels and nuclear energy, their limitation, need of renewable energy, nonconventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	

	• Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	
Module: - 02	**Wind Energy harvesting**	**12 hrs**
	• Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. • Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Energy: Geothermal Resources, Geothermal Technologies. • Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	
Module: - 03	**Piezoelectric Energy harvesting**	**09 hrs**
	• Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric Energy harvesting applications, Human power. • Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications Carbon captured technologies, cell, batteries, power consumption • Environmental issues and Renewable sources.	

Activities :

1. Demonstration of Training modules on solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

References:

1. Non-conventional energy sources - G. D. Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhatme Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6. J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

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F.Y.B.Sc. (Physics) (Sem-I)

SEC-104-PHY : Programming for Physical Applications (Python)

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objective- The course aims to introduce

1. To understand the fundamental programming concepts and problem solving skills using high level language like Python with no prior knowledge of programming.
2. To understand key concepts in programming such as variables or objects, data types, control structures, functions and basic algorithmic thinking.

B) Learning Outcomes- Upon completion of the course, the students will able to

1. Understand the problem solving approach in any computational problem.
2. Student will be able to write algorithms and draw flowcharts for simple computational problem in physical science or mathematics.
3. Able to write and test code for simple problems of his class
4. Able to understand different interactive development environment (IDLE) for python3.10 and onward.

C) Instructional Design-

1. Lecture Method 2. Lecture method supported with use of LCD /multimedia
3. Creation of Online resources 4. Seminars

D) Evaluation Strategies-

1. Descriptive 2. Assignments 3. Seminars 4. Writing codes as assignments

E) Course Content- Theory

Module	Title and Topics in the Unit	No lectures
Module-1	**Introduction: The Python Programming Language**	**8 hrs**
	History, features, Installing Python, Running Python program, Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging, Formal and Natural Languages, The Difference Between Brackets, Braces, and Parentheses, Variables and Expressions Values and Types, Variables, Variable Names and Keywords, Type conversion, Operators and Operands, Expressions, Interactive Mode and Script Mode, Order of Operations. Conditional Statements: if, if-else, nested if–else Looping: for, while, nested loops Control statements: Terminating loops, skipping specific conditions Algorithm, flowchart and code for simple problems such as calculation of Area, volume, displacement, speed, acceleration and force etc.	
Module-2	**String and its operation**	**08 hrs**
	Definition of string variable, Operations on string as slicing, len, max, min, sun, count etc string methods such as .capitalize(), .upper(), .lower(), and similar and their uses	

Module-3	Data Structures List, Tuple, Dictionaries and sets	07 hrs
	Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods Tuples and Dictionaries: Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in Tuple Functions Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods Sets, basic set operations and methods.	
Module-4	**Functions**	**07 hrs**
	Built in Functions and user defined functions lambda function and importing modules such as math, random, datetime	

F) Demonstrations and Experiments: (Any 6) 30 hrs

1) Write a program to calculate simple interest, compound interest and total amount for a given principal, rate of interest and duration in years
2) Write a program to check whether given no is even/odd
3) Write a program to calculate salary of employee when basic pay is give (vary various conditions for dearness and other allowances)
4) Write a program of simple calculator when two operands and operation is entered (include operations options as add, subtract, multiply, divide, module etc
5) Write a program to check entered string for palindrome
6) Write a program to check whether entered no is prime or not
7) Write a program to generate Fibonacci numbers series with starting no (up to 10)
8) Write a program using dictionary to write given number in words for example 100 – one zero zero
9) Write a program to calculate values of pair of points (x, t) for a given equation of motion x = 5 + 9.8 * t * t where t varies from 0 to 10 seconds at every second
10) Write a program to calculate factorial of a number

Reference Books:

5. Introduction to problem solving using python by E. Balgurswami TMH
6. Exploring Python by Budd TMH
7. Let us Python by Aditya Kanetkar BPB Publication

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F.Y.B.Sc. (Physics) (Sem-I)

SEC-101-PHY : Experimental Skills in Physics

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objective- The course aims to introduce

1. To understand working principle and its applications the various instruments in physics
2. To impart knowledge about the measurement of physical quantity and its analysis

B) Learning Outcomes- Upon completion of the course, the students will able to

1. Understand the working principles of various measuring instruments.
2. Acquire the scientific information of various physical and electrical instruments used in physics practical.
3. Identify the errors in instrument and study their analysis.

C) Instructional Design-

1. Lecture Method 2. Use of Multimedia, 3. Creation of Online resources 4. Seminars

D) Evaluation Strategies-

1. Descriptive 2. Assignments 3. Seminars

E) Course Content-

Module- 1	**Measurement and statistical analysis of data**	**04 hrs**
	• Accuracy and precision, Significant figures, Error and uncertainty analysis, Types of errors: Gross error, systematic error, random error, • Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation and curve fitting.	
Module-2	**Physical Instruments and its applications**	**10 hrs**
	• Vernier Calliper, Micrometer Screw guage, Travelling microscope Spectrometer, Spherometer, Thermometers, • Barometer, Viscometer, Hygrometer, Speedometer, Sound Level Meter, Gauss meter, Lux meter/Power meter , Solar insolation measurements	
Module-3	**Electrical Instruments and its applications**	**12 hrs**
	• **Voltmeter:** Introduction, Principles of voltmeter, Construction (block diagram only), Analog Electronic Voltmeter, Digital Electronic Voltmeter, Types of Voltmeter (qualitatively) Specifications of an electronic Voltmeter and their significance. AC Milli-voltmeter, Sensitivity, Loading Effect. • **Digital Multimeter:** Comparison of analog and digital instruments. Block diagram of digital multimeter, principle	

	of measurement of I, V, C. Accuracy and resolution of measurement, Voltmeters • **Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Specifications of a CRO and their significance, Special features of dual trace oscilloscope. Introduction to digital oscilloscope and its applications	
Module 4	**Signal testing and analysis**	**04 hrs**
	Block diagram, working principles specifications and applications of : Signal generators, Pulse generator, Function generator, LCR bridge, Q- Meter	

F) Demonstrations and Experiments: (Any 6) 30 hrs

1) Plot the graph of distance verses time, Velocity verses time by given data and write the conclusion.
2) Determine the least count of instruments like Vernier Calliper, Micrometer Screw Gauge, Travelling Microscope, Spectrometer, etc.
3) Determine the inner and outer radius of given pipe by using Vernier Calliper and determine the diameter of pin by using micrometer screw gauge.
4) Determine the radius of curvature of the lenses by using spherometer.
5) Measurement of relative humidity using hygrometer.
6) To find unknown incident power using solar insolation calibration curve.
7) Determine the coefficient of viscosity of water by Viscometer
8) Determine the angle of prism by using spectrometer.
9) To measure ac, dc voltages and frequency of signal by using CRO
10) To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
11) Measurement of Q factor using LCR bridge
12) To measure Q of a coil and its dependence on frequency, using a Q- meter.
13) Measurement of rise, fall and delay times using a CRO.

Reference Books:

1. Digital Circuits and systems - K. R. Venugopal, Tata McGraw Hill Publishing Company Ltd.
2. Electronic circuits: Handbook of design and applications - U.Tietze, Ch.Schenk
3. A text book in Electrical Technology - B L Theraja- S Chand and Co. (Volume III) Publishers, New Delhi
4. BSc Practical Physics,-Harnam Singh, S Chand Publishers, New Delhi
5. Advanced Practical Physics, B.L. Worsnop and H. T. Flint, Khosla Publishing House, New Delhi
6. B.Sc. Practical Physics, Arora C.L., S Chand & Company, New Delhi

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F.Y.B.Sc. (Physics) (Sem-I)

SEC-102-PHY : Physics of Water Filtration Systems

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objectives:- This course aim to introduce "Physics of construction, service and maintenance of water filtration systems.

1) To study the fundamental principles and concepts of physics as they pertain to water filtration systems.
2) Improving import knowledge of talents in the construction service and maintenance of RO and conventional water filtration systems.
3) Discuss the importance of water filtration and how it affects public health and environmental sustainability.
4) Examine the factors influencing water quality and identify the many forms of water pollutants.
5) Understand the principles of operation of reverse osmosis and normal filtration systems.
6) Distinguish between various filtering processes and their applicability in various water treatment scenarios. Design and optimize water filtration systems based on specified requirements.
7) Use testing and analysis to assess the performance of water filtration systems.
8) Create maintenance and troubleshooting techniques for RO and normal filtration systems. Apply water filtration knowledge to unique water treatment difficulties and to respond to changing water quality conditions.

B) Learning Course outcome (CO): Upon completion of the course the student will be able to

1) Understand the physical processes at work in water filtration systems.
2) Determine how to create an effective water filtering system.
3) To build, maintain, and service various water filtration systems and to understand their relevance.
4) When working with water filtration systems, apply your knowledge of safety protocols.
5) Students will be able to make money by learning this information.

C) Instructional Design:

(1) **Lecture method**: Theoretical concept and principles related to the Physics of water filtration system will be covered through the interactive lectures.

(2) **Tutorial method:**

(3) **Lab sessions:** Practical handon sessions will allow students to construct, service and maintenance of different water filtration systems.

(4) **Group projects:** To design and build different water filtration systems.

(5) **Seminars**: To take seminars on different tropics.

(6) **Create online resources**: Through YouTube or other platform we will create online resources.

D) Evaluation Strategies:

4) Descriptive written examinations
5) Assignments
6) Seminars, Orals and Viva

E) Course Contents:

Module: - 01	**Introduction to Water Filtration Systems**	**05 hrs**
	• Define and explain the significance of water filtration. • Water filtration system types include reverse osmosis (RO), ultrafiltration (UF), gravity filters, activated carbon filters, and so on.	
Module: - 02	**Reverse Osmosis Water Filtration System**	**05 hrs**
	• Reverse Osmosis definition and principle • RO membrane properties and operation • RO system components: pre-filters, post-filters, booster pump, storage tank, and faucet • RO system benefits and drawbacks • RO maintenance and troubleshooting.	
Module: - 03	**Ultrafiltration Water Filtration System**	**05 hrs**
	• Ultrafiltration definition and principle. • The UF membrane, its qualities, and how it works. • UF system components: pre-filters, UF membrane, post-filters, storage tank, faucet. • The benefits and drawbacks of UF systems - UF maintenance and troubleshooting.	
Module: - 04	**Gravity Water Filtration System**	**05 hrs**
	• The definition and operation of Gravity Filters. • Gravity Filter components include a ceramic filter, an activated carbon filter, mineral stones, and a storage tank. • The benefits and drawbacks of the Gravity Filter. Maintenance and troubleshooting of gravity filters	
Module: - 05	**Activated Carbon Water Filtration System**	**05 hrs**
	• Activated Carbon Filter Definition and Principle • Activated carbon filter components: activated carbon block, sediment pre-filter • Activated Carbon Filter Benefits and Drawbacks - Activated Carbon Filter Maintenance and Troubleshooting.	
Module: - 06	**Practical Applications of Water Filtration Systems**	**05 hrs**
	• Choosing the best water filtration system for your needs • Installing and operating water filtration systems; - Testing and analyzing water quality; -	

	Troubleshooting common water filtration system problems; and - Maintaining and cleaning water filtration systems.	

F) Experimental List: (Minimum 6) (30 Hrs)

a. Various Cartage Types in Filters.
b. Building, assembling, and operating an Activated Carbon Water Filtration System.
c. Building, assembling, and operating an Ultrafiltration Water Filtration System.
d. Building, assembling, and operating a Reverse Osmosis Water Filtration System.
e. To investigate how UV light kills germs in water.
f. Research into the usage of power supplies in water filters.
g. The operation of the Gravity Water Filtration System assembly.

References:

1) Water Treatment Plants: Planning, Design, and Operations by Syed R. Qasim
2) Water Supply and Pollution Control by Warren Viessman, Jr., Mark J. Hammer, Elizabeth M. Perez, and Paul A. Chadik
3) Water Treatment: Principles and Design by MWH
4) Principles of Water Treatment by Kerry J. Howe
5) Handbook of Water and Wastewater Treatment Plant Operations by Frank R. Spellman
6) Water Purification (Science and Technology) by Satinder Ahuja
7) Water Treatment Technologies for the Removal of High-Toxicity Pollutants (NATO Science for Peace and Security Series C: Environmental Security) by Despo Fatta-Kassinos
8) Advanced Materials for Water Purification (Woodhead Publishing Series in Energy) by Maria
9) D. Kennedy and Giuseppe Cirillo
10) Nanotechnology-Enabled Water Treatment by Jeffery L. Coffer and P. Davide Ferreira
11) Sustainable Water Treatment: Engineering Solutions for a Variable Climate by Jason Montgomery
12) Sustainable Water Purification (Green Chemistry and Chemical Engineering) by Rajindar Singh.

Website references:

1) World Health Organization (WHO) - Water Sanitation and Health:
   Website: https://www.who.int/water_sanitation_health/en/
2) United Nations Environment Programme (UNEP) - Water and Sanitation:
   Website: https://www.unep.org/our-work/water-and-sanitation
3) American Water Works Association (AWWA):
   Website: https://www.awwa.org/
4) Water Research Foundation (WRF):
   Website: https://www.waterrf.org/
5) International Water Association (IWA):

Website: https://iwa-network.org/
6) Environmental Protection Agency (EPA) - Drinking Water Standards and Regulations:
Website: https://www.epa.gov/dwstandardsregulations
7) United States Geological Survey (USGS) - Water Science School:
Website: https://www.usgs.gov/special-topic/water-science-school
8) National Environmental Services Center (NESC) - Training Resources:
Website: https://www.nesc.wvu.edu/training/
9) Center for Disease Control and Prevention (CDC) - Water-Related Diseases:
Website: https://www.cdc.gov/healthywater/diseases/index.html
10) International Association for Water Quality (IAWQ):
Website: https://iawq.org/

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F.Y.B.Sc. (Physics) (Sem-II)

SEC-151-PHY : Numerical Techniques in Physics

Lectures: 60 hrs **(Credits-04[2T+2P]**

i. **Course Objectives:-** This course aim to introduce "Numerical Techniques in Physics".

4) To study the Numerical Techniques in Physics.
5) To improve the knowledge of Numerical Techniques in Physics.
6) Using the knowledge of Numerical Techniques to solve the problems in Physics.

ii. **Learning Course outcome (CO):** Upon completion of the course the student will be able to

1) Identify modern numerical techniques and describe the extent and limitations of computational methods in physics.
2) Discuss the characteristics of various numerical methods.
3) Solve the problem using numerical methods techniques and computationally solve a selection of problems in physics.
4) Explain and solve the physics problem using numerical methods, write a program for it using leading-edge tools.
5) Compare the tools, methodologies, language to test various physics problems.
6) Design the physics system and solve it, collect the result and discuss, justify and communicate ideas and explanations.

iii. Instructional Design:

2) **Lecture method** 2) **Tutorial method** **3)Lab sessions** **4) Group projects**

5)Seminars: To take seminars on different tropics.

6)Create online resources: Through YouTube or other platform we will create online resources.

iv. Evaluation Strategies:

7) Descriptive written examinations
8) Assignments
9) Seminars, Orals and Viva

v. Course Contents:

Module: - 01	**Iterative Methods**	**08 hrs**
	• Beginning an iterative method • The method of successive bisection, • The method of false position, Newton-Raphson iterative method, • The secant method, • The method of successive approximations, • The Gauss elimination method	
Module: - 02	**Interpolation**	**08 hrs**
	• Lagrange interpolation, • Difference tables, • Truncation error in interpolation, • Linear regression,	

	• Polynomial regression, • Fitting exponential and trigonometric functions	
Module: - 03	**Integration**	**07 hrs**
	• Numerical integration, • Simpson's rule, • Trapezoidal Rule, • Errors in integration formulae, • Algorithms for integration of tabulated function,	
Module: - 04	**Solving Differential equations**	**07 hrs**
	• Euler's method, • Taylor series method, • Runge-Kutta methods, • Predictor-corrector method, • Higher order differential equations	

References:

1. Computer Oriented Numerical Methods, by V. Rajaraman (PHI Learning Publications)
2. Numerical methods for scientists and engineers, by H. M. Antia (Hindustan Book Agency)
3. Computational Physics, by N. J. Giordano and Hisao Nakanishi (Pearson Education India

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F.Y.B.Sc. (Physics) (Sem-II)

SEC-152-PHY : Introduction to Laser and Fiber Optics

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objectives:- This course aim to introduce "Laser and Fiber Optics" to contribute the knowledge of Fibre optics and Laser Instrumentation and its Industrial and Medical Application.

B) Learning Course outcome (CO): Upon completion of the course the student will be able

1) To expose the students to the basic concepts of optical fibres and their properties.

2) To provide adequate knowledge about the Industrial applications of optical fibres.

3) To expose the students to the Laser fundamentals.

4) To provide adequate knowledge about Industrial application of lasers.

5) To provide adequate knowledge about holography and Medical applications of Lasers.

C) Instructional Design:

1) **Lecture method** 2) **Tutorial method** **3)Lab sessions** **4) Group projects**

5) Seminars: To take seminars on different tropics.

6) Create online resources: Through YouTube or other platform we will create online resources.

D) Evaluation Strategies:

1) Descriptive written examinations
2) Assignments
3) Seminars, Orals and Viva

vi. Course Contents:

Module: - 01	**Laser Fundamentals**	**09 hrs**
	• Introduction to LASER • Basic principle of LASER • Fundamental characteristics / Properties of LASER • Types of LASER	
Module: - 02	**Application of Lasers**	**09 hrs**
	• Laser for measurement of distance, • Laser for measurement of length, • Laser for measurement of velocity, • Laser for measurement of acceleration, • Laser for measurement of current, voltage and • Laser for measurement of Atmospheric Effect • Laser instrumentation for material processing, • Laser Welding, • Laser Melting, • Laser Trimming,	
Module: - 03	**Optical Fibre and Its properties**	**06 hrs**

	• Introduction to Optical Fibre • Basic principle of Optical Fibre • Fundamental characteristics / Properties of Optical Fibre • Types of Optical Fibre	
Module: - 04	**Industrial Applications of Optical Fibre**	**06 hrs**
	Fibre optic sensors: • Intrinsic sensor • Extrinsic Sensor	

Experimets: (any 6) 30 hrs

1) To determine acceptance angle and numerical aperture of an optical fiber.
2) To determine the wavelength of the laser source using a diffraction grating elements.
3) To study Laser beam divergence and spot size.
4) To study characteristics of LASER light
5) To measurement of Bending Losses in Optical Fiber
6) To study Fiber Optic Bi-directional Communication
7) To measure wavelength of Laser light using diffraction by single slit
8) To study total internal reflection by laser
9) To measure the intensity using photosensor and laser in diffraction patterns of single slits
10) To measure the intensity using photosensor and laser in diffraction patterns of double slits
11) To determine the Resolving Power of a Plane Diffraction Grating using laser light.
12) To determine the Resolving Power of a Prism using laser light

References:

1) G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2) M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3) John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4) Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5) John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6) Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000. http://nptel.ac.in/courses/117101002/

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F.Y.B.Sc. (Physics) (Sem-II)

SEC-153-PHY : Radiation Safety

Lectures: 60 hrs **(Credits-04[2T+2P])**

D) Course Objectives:- This course aim to introduce "Radiation Safety" to contribute the knowledge of radiation and its safety, and also aware about Instrumentation and its Industrial, and Medical Application.

E) Learning Course outcome (CO): Upon completion of the course the student will be able

1) To expose the students to the basic concepts of radiation and their properties.
2) To provide adequate knowledge about the Industrial applications of instruments.
3) To provide adequate knowledge about Medical applications of radiation therapy.

F) Instructional Design:

1) Lecture method 2) **Tutorial method** **3) Lab sessions** **4) Group projects**
5) Seminars, **6) Create online resources**: YouTube or other platform

G) Evaluation Strategies:

Descriptive written examinations, Assignments, Seminars, Orals and Viva, etc.

H) Course Contents:

Module: 01	**Basic Radiation Physics**	**08 hrs**
	• Atomic structure, atomic number, mass number, isotopes, radioisotopes, radioactivity, specific activity, • General properties of alpha, beta and gamma rays; • Laws of radioactivity and successive transformations, • Half-life, decay constant, mean life, • Natural radioactive series, radioactive equilibrium, artificial radioactivity, • Production of radioisotopes by neutron and charged particle bombardments, nuclear cross sections.	
Module: 02	**Radiation Quantities and Units**	**07 hrs**
	• Particle flux and fluence, energy flux and fluence, cross section, energy, • Linear energy transfer (LET), linear and mass attenuation coefficients, mass stopping power, W-value, • Exposure (rate), Kerma (rate), Terma, absorbed dose (rate), activity, rate constants, • Charged particle equilibrium (CPE), radiation weighting factors, tissue weighting factors, • Equivalent dose, effective dose, collective effective dose,	

	• Annual Limit of Intake {ALI}, Derived Air Concentration {DAC}, personnel dose equivalent, committed dose.	
Module: 03	**Diagnostic Radiology**	**08 hrs**
	• Physical principles of X-ray diagnosis, density, contrast, detail and definition of radiographs, selection of kV, mAs, filtration, FSD, screens, films, grids, contrast media, • Basics of radiography, myelography, tomography, fluoroscopy, pelvimetry, stereoscopy, film processing, image intensifiers, optimization of patient dose, guidance levels, • CT scanners and their applications, digital subtraction angiography (DSA), mammography, bone densitometry, • Dental radiography, interventional radiology, digital radiology, performance standards and acceptance criteria for diagnostic equipment, quality assurance (QA) in diagnostic radiology.	
Module: 04	**Introduction to Radiotherapy**	**07 hrs**
	• Benign and malignant tumors, palliative and curative therapy, • Beam therapy equipment - kV X-ray machine, telecobalt units, medical electron linear accelerators; output calibration procedures for photon and electron beams, • Dosimetry parameters, • Patient dose calculations, • Neutron capture therapy, • Proton and heavy ion therapy, • Radioisotopes used in brachytherapy, LDR, MDR, HDR and PDR • Brachytherapy; remote afterloading brachytherapy units, • Source strength measurement, integrity checks for sources, • Treatment planning system (TPS) used in radiotherapy,	

Experimets: (any 6) 30 hrs

1) Quality Assurance and radiation protection survey of a conventional X-ray installation
2) Quality Assurance and radiation protection survey of interventional X-ray equipment
3) Quality Assurance and radiation protection survey of a CT scanner installation
4) Radiation absorption characteristics and HVT, TVT measurements
5) Familiarization with therapy and protection level equipment and radiation protection survey of a radiotherapy facility
6) Quality Assurance of radiotherapy equipment(s)
7) Introduction to radiation monitoring instruments
8) Characteristics of GM counter
9) Statistics of counting and activity measurement
10) Calibration of survey instruments and pocket dosimeter
11) Dose distribution measurement in the product box(s)
12) Radiation protection survey of IRGDs /NGs installations
13) Standardization of reference radiation field
14) Calibration of radiation monitoring instruments
15) Operational Aspects of calibration exposure devices (CED)
16) Calibration of personnel monitoring instruments and badges

References:

1) Advisory Committee on X-ray and Radium Protection. 1941. Safe Handling of Radioactive Luminous Compounds. In: National Bureau of Standards Handbook 27. Washington, DC: National Bureau of Standards.
2) Ahmed JU. 1992. Regulatory approach toward controlling exposure to radon in dwellings. Radiation Protection Dosimetry 45(1/4):745-750.
3) Alter HW, Oswald RA. 1987. Nationwide distribution of indoor radon measurements: a preliminary data base. Journal of the Air Pollution Control Association 37:227-231. [PubMed]
4) Anonymous. 1995. New rules could bring ceramics industry under LLW standards. Nuclear Waste News 15(44):435.
5) Textbook of Radiological Safety, by Kuppusamy Thayalan, 2023
6) Workbook for Radiation Protection in Medical Radiography - E-Book, By Mary Alice Statkiewicz Sherer, Kelli Haynes, Paula J. Visconti, E. Russell Ritenour · 2014

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F.Y.B.Sc. (Physics) (Sem-II)

SEC-154-PHY : Basic Lab Electric Devices and Circuits

Lectures: 60 hrs **(Credits-04[2T+2P])**

A) Course Objectives:- This course aim to introduce "Electric circuits and Networks" to contribute the knowledge of electric elements and its uses, and also aware about Instrumentation and its Industrial Application.

B) Learning Course outcome (CO): Upon completion of the course the student will be able

1) To expose the students to the basic concepts of electric elements and their functions.

2) To provide adequate knowledge about the Industrial applications of electric instruments.

3) To provide adequate knowledge about its applications.

4) Students can study Electrical Engineering.

5) Students can understand about devices and systems that use electricity and electromagnetism and their design and application.

C) Instructional Design:

1) Lecture method 2) Tutorial method 3) Lab sessions 4) Group projects
5) Seminars, 6) Create online resources: YouTube or other platform

D) Evaluation Strategies:

Descriptive written examinations, Assignments, Seminars, Orals and Viva, etc.

E) Course Contents:

Module: 01	**Semiconductor Physics**	**08 hrs**
	• Review of basic atomic structure and energy levels, concept of insulators, conductors and semiconductors, atomic structure of Germanium (Ge) and Silicon (Si), covalent bonds • Concept of intrinsic and extrinsic semiconductor, process of doping. • Energy level diagram of conductors, insulators and semiconductors; minority and majority charge carriers. • P and N type semiconductors and their conductivity, effect of temperature on conductivity of intrinsic semiconductors.	
Module: 02	**Semiconductor DIODE**	**10 hrs**
	• PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer, concept of junction capacitance in forward and reverse biased condition. • V-I characteristics, static and dynamic resistance and their value calculation from the characteristics. • Application of diode as half-wave, full wave and bridge rectifiers. PIV, rectification efficiencies and ripple	

	factor calculations, shunt capacitor filter, series inductor filter, LC and RC filters. • Types of diodes, characteristics and applications of Zener diodes. Zener and avalanche breakdown.	
Module: 03	**Introduction to BIPOLAR TRANSISTORS**	**05 hrs**
	• Concept of a bipolar transistor, its structure, PNP and NPN transistors, their symbols and mechanism of current flow; • Current relations in a transistor; • Concept of leakage current;	
Module: 04	**Networks**	**07 hrs**
	• Introduction to Network circuits • PCB board • Connection to circuit • Finding fault in circuit and repair it	

Experimets: (any 6) 30 hrs

1) Familiarization with operation and use of Multi-meter,
2) Familiarization with operation and use of CRO,
3) Familiarization with operation and use of Signal generator,
4) Familiarization with operation and use of LCR meter,
5) Familiarization with operation and use of Regulated Power Supply
6) Plotting of V-I characteristics of a PN junction diode
7) Plotting of V-I characteristics of a Zener diode
8) Measurement of the current, voltage, input and output impedance using multimeter
9) Fabrication of HWR and its measurement
10) Fabrication of FWR and its measurement
11) To study the use of transistor in circuit

References:

1) Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd., New Delhi.
2) Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
3) Electrical and Electronics Engineering by SK Bhattacharya, Pearson Education, New Delhi
4) Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi
5) Electronics Devices and Circuits by Millman and Halkias; McGraw Hill.

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22) Syllabus of Value Education Courses (VEC):

F.Y.B.Sc. (Physics) (Sem-I)

VEC-101-EVN : Environmental Physics I

Lectures: 30 hrs **(Credits-02)**

i. **Course Objectives:-** This course aim to introduce "Environmental Physics".
1) To study environmental issues and sustainable development in the context of physics.

ii. **Learning Course outcome (CO):** Upon completion of the course the student will be able to
1) To make simpler resource and sustainability analyses
2) To describe and explain the global energy balance
3) To explain the principles of solar, nuclear, water and wind power
4) To explain how physical principles are connected to resource management and recycling issues
5) Both orally and in writing convince about sustainability using proper analyzed and balanced arguments

iii. **Instructional Design:**
2) **Lecture method** 2) **Tutorial method** **3)Lab sessions** **4) Group projects**
5) Seminars: To take seminars on different tropics.
6) Create online resources: Through YouTube or other platform we will create online resources.

iv. **Evaluation Strategies:**
1) Descriptive written examinations
2) Assignments
3) Seminars, Orals and Viva

v. **Course Contents:**

Module: - 01	**Introduction: Human Environment**	**04 hrs**
	• Laws of thermodynamics and the human body, • Energy transfers, • Newton's law of cooling, • Survival in cold and hot climates.	
Module: - 02	**Natural Resources**	**08 hrs**
	• Renewable and non-renewable resources: • Natural resources and associated problems. • Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.	
Module: - 03	**Environmental Pollution**	**08 hrs**
	• Definition, Causes, effects and control measures of: a. Air pollution b. Water pollution	

	c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards • Disaster management: earthquake and cyclone	
Module: - 04	**Solar energy**	**10 hrs**
	• Sun as a source of energy- Solar radiation, Solar Constant • Solar pond • Flat plate collector; • Solar water heater • Solar dryer • Solar cooker; • Solar heating of buildings; • Solar greenhouses; • Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency; • PV Sun tracking systems; • Merits and demerits of solar energy.	

References:

1) Nigel Mason and Peter Hughes: Introduction to Environmental Physics: Planet Earth, Life
2) and Climate, Taylor and Francis, 2001.Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari
3) K. C. Singal Rakesh Ranjan - PHI Learning Pvt. Ltd, 2011.
4) Solar energy - M P Agarwal - S Chand and Co. Ltd.
5) Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

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F.Y.B.Sc. (Physics) (Sem-II)

VEC-151-EVN : Environmental Physics II

Lectures: 30 hrs **(Credits-02)**

vi. **Course Objectives:-** This course aim to introduce "Environmental Physics".

1) To study environmental issues and sustainable development in the context of physics.

vii. **Learning Course outcome (CO):** Upon completion of the course the student will be able to

1) Use basic physical principles to understand environmental processes with emphasis on the atmosphere and climate change
2) Sketch graphs and diagrams that illustrate fundamental physical phenomena
3) Perform calculations of fundamental physical phenomena
4) Communicate technical information clearly, both in written form and verbally
5) Work cooperatively and productively in a team situation in a laboratory and tutorial setting
6) Develop analytical and critical-thinking skills through an examination of the peer-reviewed science about climate change

viii. **Instructional Design:**

1) Lecture method 2) **Tutorial method** **3) Lab sessions** **4) Group projects**

5) Seminars: To take seminars on different tropics.

6) Create online resources: Through YouTube or other platform we will create online resources.

ix. **Evaluation Strategies:**

1) Descriptive written examinations
2) Assignments
3) Seminars, Orals and Viva

x. **Course Contents:**

Module: - 01	**Energy, Environment and Society**	**08 hrs**
	• Nature, scope and analysis of local and global impacts of energy use on the environment; • Fossil fuel burning and related issues of air pollution, • Greenhouse effect, • Global warming, • Urban heat island effect; • Nuclear energy and related issues such as radioactive waste, spent fuel; • Social inequalities related to energy production, distribution, and use	
Module: - 02	**Physics of Ground**	**06 hrs**
	• Soils, soil and hydrologic cycle, • Surface tension and soils, • Water flow, and water evaporation, • Soil temperature.	
Module: - 03	**Energy for living**	**10 hrs**

	• Solar Energy • Hydropower Energy • Nuclear Energy • Geothermal Energy • Energy From Biomass; Bio-Diesel • Tidal Energy; • Wave Energy; • Ocean Thermal Energy • Geothermal Energy	
Module: - 04	**Physics behind Natural hazards**	**06 hrs**
	• Natural hazards: hydrological, atmospheric & geological hazards; • Earthquake: Seismic waves, Epicenter; • Volcanoes: Causes of volcanism; • Cyclone; • Tsunamis: Causes and location of tsunamis;	

References:

1) Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari
2) K. C. Singal Rakesh Ranjan - PHI Learning Pvt. Ltd, 2011.
3) Solar energy - M P Agarwal - S Chand and Co. Ltd.
4) Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

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