

2024-2025

F. Y. B.Sc.

Physics

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

Sr. No.	List of Contents	Page Number
	Abbreviations used	2
1	Introduction to Undergraduate Degree Course in Physics	3
2	Programme Duration and Exit Options	3-4
3	Programme Objectives	4
4	Programme Outcomes (PO)	4-5
5	Programme Structure (PS)	5-6
6	Teaching-Learning Process (TLP)	6
7	Assessment Methods (AM)	6-7
8	Scheme of Examination	7-8
List of Courses		
9	List of Discipline Specific Core (DSC) Courses (Major Core)	9-10
10	List of Discipline Specific Elective (DSE) Courses (Major Elective)	10
11	List of Vocational Skill Courses (VSC)	10
12	List of Indian Knowledge System (IKS) Courses	10-11
13	List of Minor (MN) Courses	11
14	List of Generic Elective (GE) /Open Elective (OE) Courses	11
15	List of Skill Enhancement Courses (SECs)	11
16	List of Value Education Courses (VEC)	12
17	List of Ability Enhance Courses (AEC)	12
18	List of Co-curricular Courses (CC)	12
Syllabus of Courses		
19	Syllabus of Discipline Specific Core (DSC) Courses (Major Core)	13-23
20	Syllabus of Generic Elective (GE) /Open Elective (OE) Courses	24-31
21	Syllabus of Skill Enhancement Courses (SECs)	32-49
22	Syllabus of Value Education Courses (VEC)	50-53

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 has options courses from the syllabus comprising of DSEs (Electives), Minor, OE/GEs, SECs, AECs, RPs, RMs, OJT, FP, CEP, IKSs, VECs, CCs and VSCs. Hence, this will 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 and an additional 4 credits core NSQF Course/Internship
2	Undergraduate Diploma in Physics	After successful completion of Semester IV	88 and an additional 4 credits core NSQF Course/Internship
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	176

		minimum 28 GE credits in Discipline-2 (Minor)	
--	--	---	--

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:

- Knowledge and skills to undertake higher studies/research in physics and related interdisciplinary areas thereby enabling students' employment/entrepreneurship.
- Critical and analytical thinking, scientific reasoning, problem-solving skills, communication skills and teamwork.
- Competence and skill in solving both theoretical and applied physics problems.
- In-depth knowledge in physics through understanding of key physical concepts, principles, theories and their manifestations.
- Exposure to the latest advances in physics, allied disciplines and research.
- A conducive learning environment to ensure cognitive development of students.
- 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.
- Moral and ethical awareness, leadership qualities, innovation and life-long learning.
- Multicultural competence and multilingualism.

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

Table-2: Credit framework of undergraduate degree programme in Physics.

Level /Difficulty	Sem	Subject-1				Subject-2	Subject-3	GE/ OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(T)	2(T/P)	2(T) Generic	2(T)	2	-	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2(T/P)	-	2(T)	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor. Continue Option: Student will select one subject among the (Subject-1, Subject-2, and Subject-3) as major and another as minor and third subject will be dropped.														
Level /Difficulty	Sem	Credits related to major				Minor	GE/ OE	SEC	IKS	AEC	VEC	CC	Total	
		Discipline Specific Core (DSC) Major Core	Discipline Specific Elective (DSE) Major Elective	VSC	FP/ OJT /CEP									
5.0/200	III	4(T)+2(P)	-	2(T/P)	2 (FP)	2(T)+2(P)	-	2(T)	-	2(T) Major Subject Specific	2(T)	-	2	22
	IV	4(T)+2(P)	-	2(T/P)	2(CEP)	2(T)+2(P)	-	2(P)	2(T/P)	-	2(T)	-	2	22
Exit Option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor.														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2(T/P)	2 (FP/ CEP)	2(T)	-	-	-	-	-	-	-	22
	VI	8(T)+4(P)	2(T)+2(P)	2(T/P)	4(OJT)	-	-	-	-	-	-	-	-	22
Total 3 Years		44	8	8	10	18	8	8	6	4	8	4	6	132
Exit Option: Award of UG degree in Major with 132 credits OR Continue with Major and Minor.														
6.0/400	VII	6(T)+4(P)	2(T)+2(P)	-	4(RP)	4(T)(RM)	-	-	-	-	-	-	-	22
	VIII	6(T)+4(P)	2(T)+2(P)	-	8(RP)	-	-	-	-	-	-	-	-	22

Total 4 Years	64	16	8	22	22	8	8	6	4	8	4	6	132
Exit Option: Award of UG Honours with Research Degree in Major and Minor with 176 credits.													
-OR-													
6.0/400	VII	10(T)+4(P)	2(T)+2(P)	-	-	4(T)(RM)	-	-	-	-	-	-	22
	VIII	10(T)+4(P)	2(T)+2(P)	-	4(ort)	-	-	-	-	-	-	-	22
Total 4 Years	72	16	8	14	22	8	8	6	4	8	4	6	132
Exit Option: Award of UG Honours Degree in Major and Minor with 176 credits.													

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.

- Theory Paper of 02 Credits:
 - o Internal Exam (15 M) + University Theory Exam (35 M) = Total 50 M
 - o Duration: For Internal exam = 40 Min. and for University Exam = 02 hours.
- Practical Paper of 2 Credits:
 - o Internal Exam (15 M) + University Practical Exam (35 M) = Total 50 M
 - o Duration: For Internal exam = 40 Min. and for University Exam = More than 04 hours.

Internal exam will be conducted by particular college/institutes at the end of each semester.

External exam will be conducted by Savitribai Phule Pune University, Pune at the end of each semester.

Note:

- a) Each semester comprises of 15 weeks.
(12 weeks Actual Teaching + 3 weeks for Continuous Internal Evaluation).
- b) One Credit of the Theory is equal to 15 clock hours (Teaching 1 hour per week for each credit).
(12 hours Actual Teaching + 3 hours Continuous Internal Evaluation – Assignments, Tutorials, Practice, Problem solving sessions, Group discussion, Seminars and Unit Tests.)
- c) One Credit of Practical = 30 clock hours (2 Contact hours per credit per week)
(24 hours' Actual Table work + 6 hours for journal competition, and Continuous Internal Evaluation of each practical).
- d) Practical for each course comprises of 02 Credits = 60 clock hours.
 - Minimum 12 laboratory/ Filed sessions of 04 clock hours must be conducted in one semester.
 - In case of short practical, two practical's should be conducted in one session.

- Each practical of 04 clock hours in the laboratory should consist of table performance for concerned practical, careful observations, calculation, writing results and conclusion, and submission of practical in written form.
- Pre-laboratory reading and post laboratory assignments should be given on each practical as a part of continuous internal evaluation.

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)

Que-1: Answer the following questions (Short answer/Definition/Problems/Diagram, etc.) (any 5 out of 7)–**5 marks**

Que-2: A) Answer the following questions (Long answer questions) – **6 marks**

i) -----

ii) -----

B) Answer the following questions (Long answer questions/Problems) – **4 marks**

i) -----

ii) -----

Que-3: A) Answer the following questions (Long answer questions) – **6 marks**

i) -----

ii) -----

B) Answer the following questions (Long answer questions/Problems) – **4 marks**

i) -----

ii) -----

Que-4: Write a short notes on following. (any 4 out of 6) –**10 marks**

a) -----

b) -----

c) -----

d) -----

e) -----

f) -----

List of Courses

Note: Every theory/practical subject has 2 credits.

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

Major Core (Semester-I) (4 Credits) (2T+2P)

Semester I

PHY-101-T : Fundamental of Physics-I

PHY 102-P : General Physics Lab-I

Major Core (Semester-II) (4 Credits) (2T+2P)

Semester II

PHY-151-T : Fundamental of Physics-II

PHY-152-P : General Physics Lab-II

Major Core (Semester-III) (6 Credits) (4T+2P)

Semester III

PHY 201 MJ : Mathematical Physics-I

PHY 202 MJ : Electronics

PHY 203 MJP : General Physics Lab-III

Major Core (Semester-IV) (6 Credits) (4T+2P)

Semester IV

PHY 251 MJ : Waves and Oscillations

PHY 252 MJ : Optics-I

PHY 253 MJP : General Physics Lab-IV

Major Core (Semester-V) (12 Credits) (8T+4P)

Semester V

PHY 301 MJ : Mathematical Physics-II

PHY 302 MJ : Solid State Physics-I

PHY 303 MJ : Electrodynamics-I

PHY 304 MJ : Classical Mechanics

PHY 305 MJP : General Physics Lab-V

PHY 306 MJP : General Physics Lab-VI

Major Core (Semester-VI) (12 Credits) (8T+4P)

Semester VI

PHY 351 MJ : Atomic and Molecular Physics-I

PHY 352 MJ : Quantum Mechanics-I

PHY 353 MJ : Statistical Mechanics-I

PHY 354 MJ : Nuclear Physics-I

PHY 355 MJP : General Physics Lab-VII

PHY 356 MJP : General Physics Lab-VIII

Major Core (Semester-VII) (10 Credits) (6T+4P)

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) (6T+4P)

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 Discipline Specific Electives (DSE) Courses (Major Electives)

Semester V : 4 Credits. (2T+2P)

PHY 310 MJ : Thin films Technology
PHY 311 MJP : Special Physics Lab-I

Semester VI : 4 Credits. (2T+2P)

PHY 360 MJ : Lasers Technology
PHY 361 MJP : Special Physics Lab-II

Semester VII : 4 Credits. (2T+2T/P)

PHY 410 MJ : Radiation Physics
PHY 411 MJP : Special Physics Lab-III

Semester VIII : 4 Credits. (2T+2T/P)

PHY 460 MJ : Energy Studies
PHY 461 MJP : Special Physics Lab-IV

11) List of Vocational Skill Courses (VSC): (Each semester: 2 Credits) (T/P)

Semester-III

PHY 221 VSC : Introduction to Computational Physics-I

Semester-IV

PHY 271 VSC : Introduction to Computational Physics-II

Semester-V

PHY 321 VSC : Solar PV System: Installation, Repairing, and Maintenance

Semester-VI

PHY 371 VSC : Electric Vehicle Technology

12) List of Indian Knowledge System (IKS) Courses : (Each semester:2 Credits) (T)

Semester.-I

Generic

Semester.-III

PHY 201 IKS : India's Contribution to Physics

13) List of Minor (MN) Courses :

Semester-III : (4 Credits) (2T+2P)

PHY 241 MN : Basic Mathematical Physics

PHY 242 MNP : Basic Physics Laboratory I

Semester-IV : (4 Credits) (2T+2P)

PHY 291 MN : Electricity and Magnetism

PHY 292 MNP : Basic Physics Laboratory II

Semester-V : (2 Credits) (T)

PHY 341 MN : Concepts of Modern Physics

Semester-VII : (4 Credits) (T)

PHY 441 MN : Research Methodology

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

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

OE-101-PHY : Physics of Daily Life

OE-102-PHY : Biological Physics

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

OE-151-PHY : LED Light Repairing and Maintenance

OE-152-PHY : Maintenance and Repairing of Physics Lab equipment

Semester-III : 2-credits (T)

OE-221-PHY : Renewable Energy for daily Life

Semester-IV : 2-credits (P)

OE-271-PHY : Li-Battery Storage, Repairing and Maintenance

15) List of Skill Enhancement Courses (SECs) :

Note : Each semester for 2(T/P)-credits

Semester-I : Select any one

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 : Select any one

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 : Select any one

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

16) List of Value Education Courses (VEC): 2-Credits (T)

Semester-I

VEC-101-EVN : Environmental Physics-I

Semester-II

VEC-151-EVN : Environmental Physics-II

17) List of Ability Enhance Courses (AEC): 2-Credits (T)

Semester-I: Select any **one**

AEC-101-ENG : English

Semester-II: Select any **one**

AEC-151-ENG : English

Semester-III: Select any **one**

AEC-231-HIN : Hindi

AEC-232-MAR : Marathi

Semester-IV: Select any **one**

AEC-281-HIN : Hindi

AEC-282-MAR : Marathi

18) List of Co-Curricular Courses (CC): 2-Credits

Semester-II: Select any **one**

A) CC-151-HEFP: Health Education and Family Planning-I

B) CC-152-HEFP: Sports-I

C) CC-153-HEFP: Population Education-I

D) CC-154-HEFP: National Service Scheme-I

E) CC-155-HEFP: National Cadet Corp-I

Semester-III: Select any **one**

A) CC-201-HEFP: Health Education and Family Planning-II

B) CC-202-HEFP: Sports-II

C) CC-203-HEFP: Population Education-II

D) CC-204-HEFP: National Service Scheme-II

E) CC-205-HEFP: National Cadet Corp-II

Semester-IV: Select any **one**

A) CC-251-HEFP: Health Education and Family Planning-III

B) CC-252-HEFP: Sports-III

C) CC-253-HEFP: Population Education-III

D) CC-254-HEFP: National Service Scheme-III

E) CC-255-HEFP: National Cadet Corp-III



Syllabus of Courses

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

Major Core (Semester I) (4 Credits) (2T+2P)

Semester-I

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

PHY-101-T : Fundamentals of Physics-I

Lectures: 30 hrs

(Credits-02)

- A) Course Objectives:** - This course aims to introduction of Mechanics.
- 1) 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.
 - 2) 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.
 - 3) 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.
 - 4) Introduce basic concept and principles in Physics.
 - 5) Introduce applications of basic Physics concept and principles for modern life.
- B) Course Outcomes (CO):** - Upon completion of this course student will able to
- 1) 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.
 - 2) 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.
 - 3) 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.
 - 4) 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.
 - 5) Understand basic principles in Physics.
 - 6) Applications of physics principles to resolve community problems.
 - 7) Develop advanced thinking in future life style.
 - 8) Apply Knowledge of Physics principles in day today life

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	Rotational Dynamics	10 H
	1.1 Torque, Angular Velocity and Angular Acceleration 1.2 Principle of Conservation of Angular Momentum 1.3 Centre of Mass in uniformly distributed object 1.4 Statement of parallel axis and perpendicular axis theorem. 1.5 Moment of Inertia and Radius of gyration 1.6 Calculation of moment of inertia for cylindrical, spherical and rectangular bodies at different position of axis of rotation using theorems 1.7 Kinetic Energy of Rotation 1.8 Rolling Motion on inclined plane 1.9 Moment of Inertia of a Flywheel Numerical Problem	
Module - 02	Fluid Mechanics	06 H
	i) Fluid Statics 2.1 Definition of a Fluid. 2.2 Pressure, Absolute Pressure and Gauge Pressure. 2.3 Variation of Pressure with Depth. 2.4 Pascal's Laws. 2.5 Buoyancy and Archimedes Principle. Numerical Problem ii) Fluid Dynamics 2.6 Equation of Continuity. 2.7 Bernoulli's Theorem. 2.8 Application Based on Bernoulli's Equation: Torricelli's Theorem and Venturimeter. 2.9 Viscosity, viscous force and Effect of Temperature. 2.10 Stokes' Law and Terminal Velocity. 2.11 Surface Tension, Surface Energy and angle of contact. 2.12 Excess Pressure Inside liquid drop and Soap Bubble.	

	2.13 Determination of Surface Tension by Jaeger's Method. Numerical Problem	
Module - 03	Atomic Spectra	08H
	3.1 Inadequacy of classical physics, 3.2 Brief Review of Black body Radiation, 3.3 Photoelectric effect, 3.4 Compton Effect, 3.5 Dual nature of radiation wave nature of particles, 3.6 Atomic spectra, 3.7 Line spectra of hydrogen atom, 3.8 Ritz Rydberg combination principle, 3.9 Alpha Particle Scattering, 3.10 Rutherford Scattering Formula, 3.11 Rutherford Model of atom and its limitations. Numerical Problem	
Module - 04	Atomic Models	07H
	4.1 Bohr's Model of Hydrogen atom, 4.2 Explanation of atomic spectra, 4.3 Correction for finite mass of the nucleus, 4.4 Bohr correspondence principle, 4.5 Limitations of Bohr model, 4.6 Discrete energy exchange by atom, 4.7 Frank Hertz Experiment, 4.8 Sommerfeld's modification of Bohr's Theory Numerical Problem	

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

Module 1: 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 2: 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

- Spread of oil on water

- Formation of water droplets with different surface tensions on various leaves
- Floating Needle
- Soap-powered boat
- Soap film Interference Pattern
- Explain surface tension using soap solution and piece of paper

Module 3: Atomic Spectra

- Line spectra of hydrogen atom
- Photoelectric effect
- Compton Effect,
- Scattering of particles
- Black body Radiation

Module 4: Atomic Models

- Correction for finite mass of the nucleus
- Discrete energy exchange by atom
- Frank Hertz Experiment

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. Surface Tension by C. V. Boys, <https://www.gutenberg.org/ebooks/33370>
7. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003)
8. Intermolecular and Surface Forces by Jacob N. Israelachvili
9. Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
10. Mechanics-M. Das, P. K. Jena and R.N. Mishra (Srikrishna Publications)
11. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
12. Physics: Resnick, Halliday & Walker, Wiley
13. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
14. Modern Physics-Serway (CENGAGE Learnings)
15. Physics of Atoms and Molecules Bransden and Joachim (Pearson India)
16. Atomic and Nuclear Physics-A. B. Gupta (New Central)

*****XXX*****

PHY-102-P : General Physics Lab-I

Lectures: 60 hrs

(Credits-02)

- A) Course Contents:** - This course aims to introduce the practical related with Mechanics and Physics Principles and its applications.
- B) Course Outcomes:** The practical knowledge of mechanics doing experiments. They would also learn optical phenomena such as interference, diffraction and dispersion and do experiments related to optical devices: Prism, grating, spectrometers

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	To determine an acceleration due to gravity "g" by using Bar Pendulum
3	To determine an acceleration due to gravity "g" by using Kater's Pendulum
4	To determine the Coefficient of Viscosity by using Poiseuille's method
5	To study and verify Bernoulli's Theorem.
6	To determine the moment of inertia of Disc by Torsional Oscillations.
7	To determine the moment of inertia of a Flywheel.
8	To determine the surface tension using Capillary Rise method
9	To determine the Surface Tension of Water by using Jaeger's method
10	To determine the Surface Tension of Mercury by using Quincke's Method.
11	To determine the Surface Tension of Mercury by using Method of Ripples.

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

Sr. No.	Title of the experiments
1	To study of Spectrometer Calibration (Determination of Angle of the Prism and Refractive Indices of different colors)
2	To determine the Dispersive Power of the Material of a Prism.
3	To determine the Cauchy's Constants A and B of the Material of a Prism
4	To determine the Planck's Constant.
5	To study the I-V characteristics, and calculate FF, Efficiency of p-n junction Solar Cell
6	To determine the first excitation potential of gas by Frank Hertz Experiment
7	To study of Divergence of LASER beam.
8	To determine the Diameter of Thin Wire by using LASER light.
9	To determine the wavelength of LASER light by using Plane Diffraction Grating.
10	To study of Total Internal Reflection using LASER light.
11	To determine the particle size of any sample material powder by using LASER light.
12	To determine wavelength of LASER using Metric Ruler (Scale)
13	To demonstrate how the gamma-ray energy varies following Compton scattering.

Section III: Additional Activities to be conducted during the semester (Any-3)

1. Mini Projects with report (Minimum 10 pages with completion certificate daily signed by project guide and HOD of Department).
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 of other experiments.

Study tour: Student have to participate in study tour organized by department to study about physics in Industry / Company / Organization / Research Institute / Research organization / Small scale industry / University Department and compulsory submitted study tour report.

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

And

Participated in additional any **three** activities equivalent to **3-experiments** with 12-experiments. Total laboratory work with additional activities should be **15**-experiments.

References :

1. B. L. Flint and H.T. Worsnop, “*Advanced Practical Physics for students*”, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, “*Advanced level Physics Practical*”, 4th Edition, Heinemann Educational Publishers, reprinted 1985.
3. I. Prakash and Ramakrishna, “*A Text Book of Practical Physics*”, 11th Edition, Kitab Mahal, 2011.

Xxxxxx ooo xxxxx

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-T : Fundamentals of Physics-II

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 Study the basic concepts of electricity and magnetism
 - 3) To impart the knowledge and applications about thermal physics, electricity and magnetism in our day to day life.
- B) Course 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.
 - 6) Understand concept of electricity and magnetism.
- 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, and basics concept about electric circuits
- F) Course Contents:** - **Lectures: 30 hrs**

Module - 01	Thermal Physics	15 H
	1.1 Concepts of Heat and Temperature, 1.2 Zeroth law of thermodynamics, 1.3 Thermodynamic variables, and equation of state. 1.4 Van der Waal's equation of state, 1.5 First Law of Thermodynamics and its differential form	

	1.6 Application of the first law of Thermodynamics 1.7 Second law of thermodynamics (Kelvin's & Clausius' statements), 1.8 Carnot's cycle, and its efficiency 1.9 Concept of Entropy, principle of increase of entropy, Entropy of steam 1.10 Applications of Second law of thermodynamics: 1.11 Third law of Thermodynamics 1.12 Applications of Third law of thermodynamics: Numerical problems	
Module - 02	Electrostatics	10 H
	2.1 Concept of Electric Charge, Electrostatic Forces (Coulomb's law) 2.2 Electric lines, field & its Physical significance 2.3 Concept of electric flux 2.4 Gauss's law in electrostatics and its applications 2.5 Concept of Electric Potential 2.6 Concept of Electrostatic Energy 2.7 The four quantities for point charges 2.8 Relationship between Electric Field, Electric Force, Electric Potential, and Electric Potential Energy 2.9 Concept of Electric dipole & Dipole moment 2.10 Torque on a dipole placed in an electric field 2.11 Concept of Dielectric & Polarization 2.12 Relation between E, D & P 2.13 Gauss law in dielectric 2.14 Concept of Capacitor, Capacitance and it applications Numerical Problem	
Module - 03	Magnetostatics	05H
	<ul style="list-style-type: none"> ○ Magnetic Field Lines, Magnetic Force & its properties ○ Biot-Savart's law and its applications ○ Ampere's circuital law and its applications ○ Introduction to Magnetization ○ Types of Magnetic Materials Numerical Problem	

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

Module 1: Thermal Physics

Activity 1: Perform an activity to understand the concept of Carnot Engine:

Activity 2: Perform an activity to explain the concept of Otto Engine:

Activity 3: Perform an activity to explain the concept of Diesel Engine:

Activity 4: Perform an activity to understand the applications of Thermodynamics first law:

Activity 5: Perform an activity to understand the applications of Thermodynamics second law:

Activity 6: Perform an activity to understand the applications of Thermodynamics third law:

Module 2: Electrostatics

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

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

*****XXX*****

PHY-152-P : General Physics Lab-II

Lectures: 60 hrs

(Credits-02)

- A) Course Objectives:** - This course aims to introduce the practical related with thermal Physics and Electricity and Magnetism.
- B) Course Outcomes:** The practical knowledge of Thermodynamics, Electricity and magnetism doing experiments: Engine, electric vibrations. They would also learn electric phenomena such as diode, CRO and do experiments related to electric devices.

Section I: Thermal Physics (any 6)

Sr.No	Title of the Experiments
1	To determine the Coefficient of Thermal Conductivity by Lee's method.
2	To determine the Specific Heat of Graphite.
3	To study the Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves.
4	To investigate the first law and Second law of thermodynamic using heat Engine
5	To study the 2 / 4-Stroke Petrol Engine.
6	To study the 4-Stroke Diesel Engine.
7	To determine the Temperature Coefficient of Thermistor.
8	To study the Thermocouple as a Thermometer
9	To determine the Calorific Values of Different Fuels.
10	To determine the Temperature Coefficient of Resistivity of PTC / NTC type Material.
11	To determine the Coefficient of Linear Expansion of Metals.
12	To determine the specific heat capacity of water by electrical method.
13	To determine the specific heat capacity of a given solid by the method of mixtures.

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 p-n Diode and 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	Comparison of Capacitor using De Sauty's Method
11	Measurement of Dielectric Constant using Schering Bridge Experiment
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	To verify Ampere's Law experimentally by graphing the magnetic field strength.

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

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

Study tour: Student have to participate in study tour organized by department to study about physics in Industry / Company / Organization / Research Institute / Research organization / Small scale industry / University Department and compulsory submitted study tour report.

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

And

Participated in additional any **three** activities equivalent to **3-experiments** with 12-experiments. Total laboratory work with additional activities should be **15**-experiments.

References :

1. B. L. Flint and H.T. Worsnop, “*Advanced Practical Physics for students*”, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, “*Advanced level Physics Practical*”, 4th Edition, Heinemann Educational Publishers, reprinted 1985.
3. I. Prakash and Ramakrishna, “*A Text Book of Practical Physics*”, 11th Edition, Kitab Mahal, 2011.
4. D. P. Khandelwal, “*A Laboratory Manual of Physics for undergraduate classes*”, Vani Publication, 1985,

Xxxxxx ooo xxxX

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

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

OE-101-PHY : Physics of Daily Life

Lectures: 30 hrs

(Credits-02)

A) 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.

B) Course 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.

C) Instructional Design-

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

D) Evaluation Strategies-

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

E) Course Content :

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 distributors, 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.

*****XOX*****

F.Y.B.Sc. (Physics) (Sem-I)
OE-102-PHY : Biological Physics

Lectures: 30 hrs

(Credits-02)

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) Course 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-

2. Descriptive
2. Assignments
3. Seminars

E) Course Content-

Module- 1	Cell Organization	7 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	7 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, Bacteriorhodopsin.	
Module- 3	Physical Concepts in Biophysics	6 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.	
Module–4	Physical Concepts understanding through Demonstrations / Experiments	10 hrs
	<ol style="list-style-type: none"> 1. To study the principle of spectrophotometer. To verify the Lambert Beer's law. 2. To determine the beer's limit and measurement of molar and percent extinction coefficient. 3. Spot test for carbohydrates. 4. To Isolate of Casein from milk. 5. Use of pH meter and measuring the pH of the buffer solutions 	

F) 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.

*****XOX*****

OE-151-PHY : LED Light Repairing and Maintenance

Lectures: 30 hrs

(Credits-02)

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

1. Understand basics of LED and semiconductor
2. Apply the knowledge for the repair of LEDs
3. Identify the importance of reduction electronic waste management 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. Objective
2. Assignments
3. Seminars
4. Practical

E) Course Content :

Module: - 01	Physical quantities and their measurement Basics of Electronics and LED s	10 hrs
	<ul style="list-style-type: none"> • 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 for calculations • Differentiate between alternating current (AC) and direct current (DC) • Measure power and energy using relevant formula • Identify the basics of power electronics and its usages in lighting controls or LED power supplies and LED 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 the overall 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 	

	<ul style="list-style-type: none"> • List the basic parameters of LEDs and their importance in an LED product • Distinguish between the different types of power sources used in LED lighting and their characteristics • Illustrate the different ways LEDs can be connected in a circuit and list the advantages and disadvantages of 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 <p>Identify the use of constant current LED Driver</p>	
Module: - 02	LED Luminary Repair and Assembly	10 hrs
	<ul style="list-style-type: none"> • List the major components of an LED luminary such as LED light engine, 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 • Analyze the Importance of IP rating in LED products and its requirement for different products based on the product area of use • Categorize LED drivers into different types as per the type of LED • Demonstrate driver selection according to the LED • Follow the steps of driver selection according to the LED • Identify the function and characteristics and application of a constant 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 LED failure 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 	

	<ul style="list-style-type: none"> • 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 unit in 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 productivity and quality standards • Report faults found in the LED lights document the fault diagnosis and repair process as per SOP 	
Module– 03	Physical Concepts understanding through Demonstrations / Experiments	10 hrs
	<ol style="list-style-type: none"> 1. Identify the electronic components and its measurements 2. Measurement of Power and Energy 3. Soldering and de-soldering of Electronic components 4. Perform repair and replacement of LEDs and other components 5. 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)

*****XOX*****

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

OE-152-PHY : Maintenance and Repairing of Physics Lab Equipment

Lectures: 30 hrs

(Credits-02)

A) Course Objective- The course aims to

1. Use the knowledge of basics laboratory equipment's to carryout work
2. Knowledge to create awareness of Lab Equipment
3. Perform equipment repair and assembly as per the recommended quality standards
4. Implement the soft skills that are required to carry out work efficiently
5. To expose the students to the repairing of equipment.

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

1. Awareness of Lab Equipment and Electronic Components
2. Understand basics principle of physical instruments.
3. Apply the knowledge for the repair.
4. Identify the importance of reduction electronic waste management\

C) Instructional Design-

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

D) Evaluation Strategies-

1. Assignments
2. Oral
3. Practical

F) Course Content :

Module: - 01	General Lab Apparatus-Working and Maintenances	12 hrs
	Sonometer, Potentiometer, Cantilever, Torsion Pendulum, Keter's Pendulum, Compound Pendulum, Microscope, Telescope, Spectrometer, Newton's Ring apparatus, Air wedge apparatus	
Module: - 02	Fundamental Electronic and Electric lab Apparatus	12 hrs
	Volt meter, Ammeter, Galvanometer, Multimeter, PCB, Breadboard, Resistors Color Code, Capacitors-type and identification, Diode, Zener Diode, Transistors, IC, IC- Gates checking, CRO	
Module: - 03	Advanced Physics Lab Apparatus	6 hrs
	Hall Effect Apparatus, Laser, Four Probe Apparatus	

Reference Books:

NSDC Skill Based Participant Handbook LED Light Repair Technician (E), Publisher- Rachna Sagar Pvt Ltd.

*****XOX*****

21) Syllabus of Skill Enhancement Courses (SECs) :

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

SEC-101-PHY : Experimental Skills in Physics

Lectures: 30 hrs

(Credits-02[T/P])

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) **Course 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-**

Lectures: 30 hrs

Module- 1	Measurement and statistical analysis of data	05 hrs
	<ul style="list-style-type: none">• 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	05 hrs
	<ul style="list-style-type: none">• 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	05 hrs
	<ul style="list-style-type: none">• 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	

	<ul style="list-style-type: none"> • 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	05 hrs
	Block diagram, working principles specifications and applications of : Signal generators, Pulse generator, Function generator, LCR bridge, Q- Meter	
Module-5	Physical Concepts understanding through Demonstrations / Experiments	10 hrs
	<ol style="list-style-type: none"> 1) Determine the radius of curvature of the lenses by using spherometer. 2) Measurement of relative humidity using hygrometer. 3) To find unknown incident power using solar insolation calibration curve. 4) Determine the coefficient of viscosity of water by Viscometer 5) Determine the angle of prism by using spectrometer. 6) To measure ac, dc voltages and frequency of signal by using 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

*****XoX*****

SEC-102-PHY : Physics of Water Filtration Systems

Lectures: 30 hrs

(Credits-02[T/P])

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) 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:

Descriptive written examinations, Assignments, Seminars, Orals and Viva

E) Course Contents:

Lectures: 30 hrs

Module: - 01	Introduction to Water Filtration Systems	04 hrs
	<ul style="list-style-type: none"> 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	04 hrs
	<ul style="list-style-type: none"> 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	04 hrs
	<ul style="list-style-type: none"> 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	04 hrs
	<ul style="list-style-type: none"> 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	04 hrs
	<ul style="list-style-type: none"> 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	04 hrs
	<ul style="list-style-type: none"> 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. 	
Module-07	Physical Concepts understanding through Demonstrations / Experiments	06 hrs

	<ol style="list-style-type: none"> 1. To study various Cartage Types in Filters. 2. To building, assembling, and operating an Activated Carbon Water Filtration System. 3. To building, assembling, and operating an Ultrafiltration Water Filtration System. 4. To building, assembling, and operating a Reverse Osmosis Water Filtration System. 5. To investigate how UV light kills germs in water. 6. To study 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-Kassinou
- 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. Coffey 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>

*****XOX*****

SEC-103-PHY : Renewable Energy and Energy Harvesting

Lectures: 30 hrs

(Credits-02)

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

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

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

D) Evaluation Strategies:

Descriptive written examinations, Assignments, Seminars, Orals and Viva

E) Course Contents:

Module: - 01	Fossil fuels and Alternate Sources of energy	09 hrs
	<ul style="list-style-type: none">• 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
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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).

*****XOX*****

F.Y.B.Sc. (Physics) (Sem-I)
SEC-104-PHY : Programming for Physical Applications
(Python)

Lectures: 30 hrs

(Credits-02[T/P])

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) Course 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 : 30 Hrs

Module-1	Introduction: The Python Programming Language	08 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	04 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	10 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	Physical Concepts understanding through Demonstrations / Experiments	08 hrs
	<ol style="list-style-type: none"> 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 entered string for palindrome 3) Write a program to calculate factorial of a number 4) Write a program of simple calculator when two operands and operation is entered (include operations options as add, subtract, multiply, divide, module, etc 	

Reference Books:

1. Introduction to problem solving using python by E. Balgurswami TMH
2. Exploring Python by Budd TMH
3. Let us Python by Aditya Kanetkar BPB Publication

*****XoX*****

SEC-151-PHY : Numerical Techniques in Physics

Lectures: 30 hrs

Credits-02[T]

A) **Course Objectives:-** This course aim to introduce “Numerical Techniques in Physics”.

- To study the Numerical Techniques in Physics.
- To improve the knowledge of Numerical Techniques in Physics.
- Using the knowledge of Numerical Techniques to solve the problems in Physics.

B) **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.

C) **Instructional Design:**

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

5) **Seminars:** To take seminars on different topics.

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

E) **Course Contents:**

Module: - 01	Iterative Methods	08 hrs
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Lagrange interpolation, • Difference tables, • Truncation error in interpolation, • Linear regression, 	

	<ul style="list-style-type: none"> • Polynomial regression, • Fitting exponential and trigonometric functions 	
Module: - 03	Integration	07 hrs
	<ul style="list-style-type: none"> • Numerical integration, • Simpson's rule, • Trapezoidal Rule, • Errors in integration formulae, • Algorithms for integration of tabulated function, 	
Module: - 04	Solving Differential equations	07 hrs
	<ul style="list-style-type: none"> • 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)

*****xox*****

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

Lectures: 30 hrs

(Credits-02[T/P])

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) **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

D) **Course Contents:**

Module: - 01	Laser Fundamentals	05 hrs
	<ul style="list-style-type: none"> • Introduction to LASER • Basic principle of LASER • Fundamental characteristics / Properties of LASER • Types of LASER 	
Module: - 02	Application of Lasers	06 hrs
	<ul style="list-style-type: none"> • 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	05 hrs

	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Intrinsic sensor • Extrinsic Sensor 	
Module-05	Physical Concepts understanding through Demonstrations / Experiments	08 hrs
	<ol style="list-style-type: none"> 1) To determine acceptance angle and numerical aperture of an optical fiber. 2) To measurement of Bending Losses in Optical Fiber 3) To measure the intensity using photosensor and laser in diffraction patterns of single slits 4) To study total internal reflection by laser 	

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/>

*****xox*****

F.Y.B.Sc. (Physics) (Sem-II)
SEC-153-PHY : Radiation Safety

Lectures: 30 hrs

(Credits-02[T/P])

A) 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.

B) 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.

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

E) Evaluation Strategies:

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

F) Course Contents:

Lectures: 30 hrs

Module: 01	Basic Radiation Physics	07 hrs
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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, 	

	<ul style="list-style-type: none"> • Annual Limit of Intake {ALI}, Derived Air Concentration {DAC}, personnel dose equivalent, committed dose. 	
Module: 03	Diagnostic Radiology	08 hrs
	<ul style="list-style-type: none"> • 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	08 hrs
	<ul style="list-style-type: none"> • 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, 	

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

*******XOX*******

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

Lectures: 30 hrs

(Credits-02[T/P])

- 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) **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	06 hrs
	<ul style="list-style-type: none"> • 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	06 hrs
	<ul style="list-style-type: none"> • 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 	

	<p>factor calculations, shunt capacitor filter, series inductor filter, LC and RC filters.</p> <ul style="list-style-type: none"> Types of diodes, characteristics and applications of Zener diodes. Zener and avalanche breakdown. 	
Module: 03	Introduction to BIPOLAR TRANSISTORS	05 hrs
	<ul style="list-style-type: none"> 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	05 hrs
	<ul style="list-style-type: none"> Introduction to Network circuits PCB board Connection to circuit Finding fault in circuit and repair it 	
Module-05	Physical Concepts understanding through Demonstrations / Experiments	08 hrs
	<ol style="list-style-type: none"> Familiarization with operation and use of Multi-meter, CRO, Signal generator Familiarization with operation and use of LCR meter Familiarization with operation and use of Regulated Power Supply To study the use of diode and 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.

*****XOX*****

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)

C) Course Objectives:- This course aim to introduce “Environmental Physics”.

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

D) 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

E) 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.

D) Evaluation Strategies:

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

E) Course Contents:

Module: - 01	Introduction: Human Environment	04 hrs
	<ul style="list-style-type: none">• 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
	<ul style="list-style-type: none">• 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
	<ul style="list-style-type: none">• Definition, Causes, effects and control measures of:<ol style="list-style-type: none">a. Air pollutionb. 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
	<ul style="list-style-type: none"> • 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.

*******xxx*******

VEC-151-EVN : Environmental Physics II

Lectures: 30 hrs

(Credits-02)

A) Course Objectives:- This course aim to introduce “Environmental Physics”.

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

B) 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

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

E) Course Contents:

Module: - 01	Energy, Environment and Society	08 hrs
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Soils, soil and hydrologic cycle, • Surface tension and soils, • Water flow, and water evaporation, • Soil temperature. 	
Module: - 03	Energy for living	10 hrs

	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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.

*****XOX*****