SYLLABUS

FOR

SEM I & II

Program: B.Sc.

Course: Physics

From

Academic year

2023-24

Board of studies in Physics

Undergraduate and Post graduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Dr. Deepak More	Chairman	K. J. Somaiya college of science and commerce
Subject Expert nominated by Vice-Chancellor			
1	Dr. Anita Kanwar	Principal	VES college, Chembur
Subject experts			
1	Dr. Nigvendra Sharma	Head of the Department	Maharashtra College of Arts, Science & Commerce
2	Dr Dinesh Kala	Head of the Department	G N Khalsa College of Arts, Science & Commerce
3	Dr. Paresh Joshi	Chairman, BASE	HBCSE
Representative from Industry/corporate sector/allied area			
1	R. Venkataraman	Director – Vision & Robotics	Tej Control System PVT LTD. Thane 400064
Meritorious Alumnus			
1	Vikrant Jadhav	Start-up	Panacea Intech PVT LTD
2			
Two experts from other than the parent University			
1	Raghunath Chelakkot	Associate Professor	Department of Physics, IITB, Mumbai
2	R. R. Deshmukh	Professor	Department of physics, ICT, Mumbai
Faculty of the specialisation			
1	Dr. Deepak More	Associate Professor	K. J. Somaiya college of science and commerce
2	Dr. Geeta Nair	Associate Professor	K. J. Somaiya college of science and commerce

3	Mr. A M Shaker	Associate Professor	K. J. Somaiya college of science and commerce
4	Dr. Jitendra Pendharkar	Associate Professor	K. J. Somaiya college of science and commerce
5	Dr. Smita Survase	Associate Professor	K. J. Somaiya college of science and commerce
6	Mr. Anshul Gupta	Assistant Professor	K. J. Somaiya college of science and commerce
7	Mr. Deepak Jalla	Assistant Professor	K. J. Somaiya college of science and commerce
8	Mr. Amit More	Assistant Professor	K. J. Somaiya college of science and commerce
9	Dr. Pallavi Raote	Assistant Professor	K. J. Somaiya college of science and commerce
10	Mr. Ketankumar Gayakwad	Assistant Professor	K. J. Somaiya college of science and commerce
11	Dr. Rucha Naik	Assistant Professor	K. J. Somaiya college of science and commerce
12	Dr. Shruti Barve	Assistant Professor	K. J. Somaiya college of science and commerce
13	Mr. Ranjit Yadav	Assistant Professor	K. J. Somaiya college of science and commerce

Acknowledgement

At the outset, I would like to thank our, Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Physics for the long and arduous work they have put in during the compiling of the restructured syllabus.

Dr. Deepak More
Chairperson
Board of Studies in Physics

Graduate Attributes

After the successful completion of modules in different courses of B.Sc. PHYSICS, the learner will be able to:

GA 1: Apply physics concepts and acquired skill sets to novel and unknown problems in order to establish an effective approach or strategy for dealing with them.

GA 2: Explore and derive quantitative data in the realms of physics.

GA 3: Collect, analyze, and interpret scientific data in the realms of physics using modern experimental apparatus and research methods.

GA 4: Develop Psycho-motive, analytical, observation skills through lab work

GA 5: Approach any real life problem with proper assumption, logic and constraints.

GA 6: Prepare for jobs, career development, and lifelong learning in Physics, by using acquired ICT skills, physics practical skills, and mathematical skills.

Programme Learning outcomes

After the successful completion of modules in different courses of B.Sc. physics the learner will be able to:

PLO I: Apply principles of physics on various physical phenomenon.

PLO II: Calculate physical parameters from the available data.

PLO III: Analyse and interpret the data in various forms (numerical/graphical)

PLO IV: Development of Psycho-motive, analytical, observation skills through lab work.

PLO V: Approach any real life problem with proper assumption, logic and constraints.

PLO VI: Compete and succeed in various qualifying examinations in various related fields. (Higher education/software/industry)

Content

Sr.No	Semester	Course number	Course Code	Course title
Core Course (CC)				
1	I	CC I	23US1PHCC1MNP	MODERN AND NUCLEAR PHYSICS
2		CC II	23US1PHCC2BEL	BASIC ELECTRONICS
1	**II**	CC I	23US1PHCC1THE	HEAT ENGINES AND THIRD LAW OF THERMODYNAMICS
2		CCII	23US1PHCC2MEC	MECHANICS AND WAVES
	Open Electives (OE)			
1	I	OE I	23US1PHOE1EAM	INTRODUCTION TO ENERGY AUDIT AND MANAGEMENT
2		OE II	23US1PHOE2BWD	BASICS OF WEB DESIGNING
3		OE III	23US1PHOE3FES	FUTURE ENERGY SOURCES
4		OE IV	23US1PHOE4IA	INTRODUCTORY ASTRONOMY
5		OE V	23US1PHOE5PH	PHOTOGRAPHY

Detailed B.Sc. Physics Syllabus

F. Y. B.Sc. Syllabus with effect from the Academic year 2023-24

Syllabus - F. Y. B.Sc. Physics

Course No.	Course Title	Course Code	Credits	Hour	Module	Lectures per module (60 minutes)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER I									
Core courses THEORY									
I	MODERN AND NUCLEAR PHYSICS	23US1PHCC1MNP	2	30	2	15	40	60	100
II	BASIC ELECTRONICS	23US1PHCC2BEL	2	30	2	15	40	60	100
Core Course PRACTICAL									
CCPI	PRACTICAL	23US1PHCCP	2	60			40	60	100

SEMESTER II									
Core courses THEORY									
I	HEAT ENGINES AND THIRD LAW OF THERMODYNAMICS	23US6PHCC1CLM	2	30	2	15	40	60	100
II	MECHANICS AND WAVES	23US6PHCC2ELE	2	30	2	15	40	60	100
Core Course PRACTICAL									
CCPI	PRACTICAL1	23US2PHCCP	2	60			40	60	100

F.Y. B. Sc. (Physics) SEMESTER I

Core Course- I

COURSE TITLE: MODERN AND NUCLEAR PHYSICS

COURSE CODE: 23US1PHCC1MNP [CREDITS - 02]

Course Learning Objective		
After the successful completion of the Course, the learner will be able to: 1. Understand the concept of waves and particles and their properties. 2. Discuss the production and application of X- rays 3. Explain the working of nuclear reactors. 4. Describe the various properties of nucleus. 5. Solve numerical based on the topics		
Module 1	**Particle Properties of Waves**	**[15Hr]**
Learning Objectives: The module is intended to 1. Explain production and applications of X rays. 2. Study the various particle properties of waves.		
Learning Outcomes: After the successful completion of the course, the learner will be able to **1.** Understand x rays and its applications. 2. Explain various particle properties of waves.		
1.1	Black body radiation (no derivation), ultraviolet catastrophe Photoelectric effect, Compton Effect, Pair production and annihilation, gravitational red shift. AB :2.2, 2.3,2.7,2.8 Problem solving session	**[5 Hr]** **[2 Hr]**
1.2	Discovery of X-ray, X-ray production, characteristic x-ray spectra, applications of X-ray, X-ray diffraction AB :2.5,2.6 Problem solving session	**[6 Hr]** **[2 Hr]**

	References: 1 Arthur Beiser , Concepts of Modern Physics Sixth Edition , McGraw-Hill Publications. 2. Stephen T. Thornton and Andrew Rex ,Modern Physics for scientists and Engineers 4th Edition	
Module 2	**Waves Properties of Particle and Nuclear Physics**	**[15 Hr]**
Learning Objectives: The module is intended to **1.** Explain the various nuclear properties **2.** Describe the working of nuclear reactors 3. Understand the various wave properties of matter.		
Learning Outcomes: After the successful completion of the course, the learner will be able to 1. Describe the working of nuclear reactors **2.** Explain various wave properties of matter		
2.1	De Broglie Waves, Davisson Germer Experiment, Heisenberg's Uncertainty Principle AB: 3.1, 3.5, 3.7,3.8 Problem solving session	**[2 Hr]** **[2 Hr]**
2.2	**Nuclear Physics** Nuclear properties (size, charge, density, mass, magnetic moment) Binding energy of nuclei SB: 4.1.3-4.1.5, 5.2 Neutron induced fission, Asymmetrical fission, emission of delayed neutrons, energy released in fission of U235, Fission chain reaction, neutron cycle in thermal nuclear reactor, nuclear reactor Ref: SB: 6.2,6.3,6.4,6.6,6.7,6.8,6.9 Problem solving session	**[3 Hr]** **[5 Hr]** **[3 Hr]**
	References: 1) Arthur Beiser, Concepts of Modern Physics Sixth Edition , McGraw-Hill Publications 2) S.B.Patel, Nuclear Physics, an introduction,2nd edition, New	

	Age International, Pvt Ltd. Additional Reference 1) Nuclear Physics by Irving Kaplan, Second Edition, Addison Wesley Publication	

F.Y. B. Sc. (Physics) SEMESTER I

Core Course- II

COURSE TITLE: BASIC ELECTRONICS

COURSE CODE: 23US1PHCC2BEL [CREDITS - 02]

Course Learning Objective		
After the successful completion of the Course, the learner will be able to: 1. Familiarize with diode circuits and applications 2. Apply concepts of number systems 3. Apply the concept of Digital Logic Families with circuit implementation 4. Analyze and design logic circuits 5. Solve numerical based on the topics		
Module 1	**Diode and Number System**	**[15 Hr]**
Learning Objectives: The module is intended to 1. Explain basic terms related with diodes. 2. Study the characteristics and applications of Zener Diode. 3. Demonstrate the ability to convert from one number system to another.		
Learning Outcomes: After the successful completion of the course, the learner will be able to		

1. Analyze and measures parameters in basic diode circuits **2.** Design a voltage stabilizer circuit **3.** Convert the numbers from one system to another.		
1.1	Types of diode biasing (review), Bridge rectifier-ripple factor-Types of filter circuits-Zener diode-Zener diode as a voltage stabilizer-solving Zener diode circuits. Problem solving sessions Reference: PRINCIPLES OF ELECTRONICS V.K.Mehta, Rohit MehtaS. CHAND & COMPANY LTD (6.1,6.6,6.8,6.9,6.10, 6.13 ,6.14, 6.15, 6.18, 6.21,6.25,6.27)	**[5** Hr] **[3** Hr**]**
1.2	Binary number system- Decimal to binary conversion- Binary to decimal conversion-octal number system-hexadecimal number system-binary coded decimal code (BCD)-binary addition and binary subtraction using 2's complement. Problem solving sessions Refeence: PRINCIPLES OF ELECTRONICS V.K.Mehta, Rohit MehtaS. CHAND & COMPANY LTD (26.3,26.5,26.6,26.7, 26.8, 26.9) RP Jain Modern digital electronics (2.4,2.5,2.6)	**[5** Hr] **[2 Hr]**
Module 2	**Digital Electronics**	**[15Hr]**
Learning Objectives: The module is intended to 1. Study the logic gates AND, NOT, and OR, including their symbols and truth tables **2.** Learn how logic gates are used in carrying out computation **3.** Design a logical circuit, combining logic gates to solve a problem		
Learning Outcomes: After the successful completion of the course, the learner will be able to **1.** Evaluate the output of two or more AND, OR, NOT, NAND, NOR, or XOR gates connected together **2.** Use Karnaugh map (K-map) technique for Boolean algebraic simplification		

2	Logic gates- Three basic logic gates, combination of basic logic gates-NAND as UBB-Ex-OR gate-Boolean theorems-De Morgans theorems-combinational logic circuits-developing logic circuit from Boolean expressions-SOP-POS, Half adder, Karnaugh Maps Problem solving sessions Reference: PRINCIPLES OF ELECTRONICS V.K.Mehta, Rohit Mehta S. CHAND & COMPANY LTD (26.10,26.11,26.12,26.13,26.14,26.15, 26.16, 26.17, 26.21, 26.22,26.24, 26.25,26.26, 26.28, 26.29, 26.30,26.32) RP Jain Modern digital electronics (5.3,5.4,5.5)	**[10** Hr] **[5** Hr**]**

F.Y. BSc. (PHYSICS) SEMESTER I

COURSE TITLE: LAB COURSE I

COURSE CODE: 23US1PHCCP Credit- 02

Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Handle measuring instruments. 2. Identify various electronic components and to connect them. 3. Use graphical representation to determine physical quantities. 4. Verify the truth table of ICs and laws
Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Demonstrate their practical skills. 2. Use apparatus with ease. 3. Correlate their physics theory concepts through practical. 4. Estimate errors in the measurements

PRACTICAL I

1	Helmholtz Resonator
2	To study of the I-V characteristics of Zener diode.
3	Spectrometer (A)

4	To verify the truth tables of all logic gates
5	To determine the Planck's constant using LEDs
6	EX-OR gate (Half Adder & Full Adder)
7	De-Morgan's Theorem
8	NAND as Universal Building block
9	NOR as Universal Building block
10	To study full wave Bridge Rectifier
11	Viscosity by Poiseuille's law method

Skill Experiments

1	Use of Vernier Callipers, Micrometre Screw Gauge and Travelling Microscope
2	Graph plotting (Exponential, Straight line with intercept, Resonance curve etc.

- **Minimum of 8 experiments from both the Courses should be completed in first semester. All the skill experiments are to be reported in journal. Certified journal is must to be eligible to appear for the semester end practical examination**

References:

FYBSc Sem II syllabus
Physics paper – I
COURSE TITLE: Thermodynamics
COURSE CODE: [CREDITS - 02]
Total contact hours : 30

Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Understand and solve problems involving the concept heat, Path function, process, heat engine, Carnot`s cycle and efficiency. 2. Understand and solve problems involving laws of thermodynamics, phase change, Triple point, latent heat, petrol engine and diesel engine. 3. Understand the concept of entropy in the context of second and third law of thermodynamics.

Module 1	**First & second Law of thermodynamics**	**[15Hr]**
	Learning Objectives: The module is intended to 1. present a comprehensive and rigorous treatment of classical thermodynamics. 2. lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in physics 3. Develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments. 4. Apply second law to general reversible processes and cycles **Learning Outcome:** After the successful completion of the module, the learner will be able to: 1. Explain the basic concepts of thermodynamics like system, properties, path functions, first law of thermodynamics and temperature measurement. 2. Understand Carnot Cycle to use for further applications. 3. State and prove the equivalence of two statements of second law of thermodynamics. 4. Define reversible process and state the propositions regarding efficiency of Carnot cycle.	
1.1	Concept of heat, The first law, Non adiabatic processes and Heat is a path function, Internal energy, Ref. BS: 4.3,4.5,.4.6, 4.7,4.8.4.10, 4.13	[3Hr]

1.2	Reversible and irreversible process, Heat engines, definition of efficiency, Carnot's ideal heat engine, Carnot's cycle, effective way to increase efficiency, Carnot's engines and refrigerator, coefficient of performance and related problems. Ref. BS: 4.20 To 4.29, 6.11	[7Hr]
1.3	Second law of thermodynamics, Carnot's theorem, Phase Change, Triple point of water, Latent heat, Clapeyron's latent heat equation using Carnot's cycle and its applications. Ref : 4.28,4.29, 6.11,16,23,	[5Hr]
Module 2	**Heat engines and Third Law of thermodynamics**	**[15 Hr]**

Learning Objectives:

The module is intended to

1. Understand working of different heat engines.
2. Calculate theoretical efficiencies of heat engines.
3. Understand latent heat and its applications.
4. Understand the concept of entropy as a state function.
5. Understand the role of entropy in reversible and irreversible processes.
6. Introduce the concept of negative temperature.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for understanding, applying, analysing heat engines.
2. Evaluate entropy changes for reversible and irreversible processes and use entropy as a state variable
3. Give different statements of the third law
4. Prove the unattainability of absolute zero

2.1	Heat engine : Otto engine, petrol engine, diesel engine, Related problems. 4.30 TO 4.33	[3 Hr]
2.2	Concept of entropy, change in entropy in adiabatic process, change in entropy in reversible cycle, Principle of increase of entropy, Change in entropy in irreversible process. BS : 5.1 to 5.6	[4 Hr]
2.3	T-S diagram, Physical significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic scale of temperature, (Omit alternative method using Carnot cycle), the size of a degree, Zero of absolute scale, Identity of a perfect gas scale and absolute scale.	[4 Hr]

	BS: 5.7 to 5.9, 5.11 to 5.13	
2.4	Third law of thermodynamics, Zero point energy, Negative temperatures (not possible), Heat death of the universe BS: 5.15 To 5.18	[4 Hr]

References:

1. BS : Brij Lal, Subrahmanyam, Hemne (S. Chand (Revised Multicoloured Ed. 2007)Heat, Thermodynamics and statistical Physics-

Additional References:

1. Yunus A Cengel; Michael A Boles, Thermodynamics: An Engineering Approach by Mcgreq Hill Publication
2. M W Zemansky and R H Dittman, Heat and Thermodynamics, McGraw Hill.
3. D K Chakrabarti, Theory and Experiments on Thermal Physics, (2006 Ed) Central book

FYBSc Sem II syllabus
Physics paper – II
COURSE TITLE: Mechanics and Waves
COURSE CODE: [CREDITS - 02]
Total contact hours : 30

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Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Apply the principle of superposition to two perpendicular SHMs 2. Understand the Physics of the compound pendulum 3. Apply the wave equation to derive velocity of waves in medium 4. Understand how ultrasound is produced and it's applications 5. Understand and apply the principles of acoustics

Module 1	**Mechanics**	**[15Hr]**

Learning Objectives:

The module is intended to

1. Lay the groundwork for Classical Mechanics
2. Apply Newtonian dynamics to complicated systems such as compound pendulums
3. Be able to apply conservation laws to a system of particles

Learning Outcome:

After the successful completion of the module, the learner will be able to:

	1. Elucidate the basic principles of mechanics 2. Apply mechanics to a system of particles 3. Solve a wide variety of problems in mechanics	
1.1	Composition of two SHM: (Only for review: Definition of SHM and composition of two parallel SHM's of same period.) Composition of two perpendicular S H M's having the same period and period in the ratio 1:2, Types of Lissajous figures. Problem solving Ref: SPP:2.4.1, 2.4.3, 2.4.	[3 Hr] [1 Hr]
1.2	Mechanics of a system of particles: Centre of mass of a system of particles, Linear momentum of a system of particles and its conservation. Angular momentum of a system of particles and its conservation (only statement). Rocket motion (neglecting gravity) (derivation up to maximum velocity and only final expression for distance travelled) Problem solving Ref: TM: 9.2, 9.3, 9.4, 9.11	[4 Hr] [2 Hr]
1.3	Compound pendulum: Expression for period, maximum and minimum time period, centers of suspension and oscillations, reversible compound pendulum, compound pendulum and simple pendulum- a relative study, torsion pendulum-measurements of rigidity modulus Problem solving KJ: 1.2 to 1.8	[3 Hr] [2 Hr]
Module 2	**Waves**	**[15Hr]**
	Learning Objectives: The module is intended to 1. Give a general overview of wave motion 2. Introduce the learner to Ultrasonic and its applications 3. Give a brief introduction to acoustics **Learning Outcome:** After the successful completion of the module, the learner will be able to: 1. Solve a wide variety of numerical related to wave motions 2. Understand how ultrasonic are produced and applied. 3. Understand the principles behind acoustic design	
2.1	Wave motion in one dimension: General solution of wave equation, Classification of waves, Examples of one-dimensional waves, derivation of velocity of Transverse wave on string, expression of velocity of longitudinal waves in rod. Problem solving	[3 Hr] [2 Hr]

	Ref: SPP: 6.1, 6.2, 6.5, 6.5.1, 6.5.2, 6.5.3.	
2.2	Ultrasonic: Piezoelectric effect, Production of Ultrasonic waves: Magnetostriction method and Piezoelectric Crystal Method, Detection, Properties and applications of Ultrasonic Waves, (Formula of frequency of ultrasonic waves) Problem solving Ref: MS: 5.1 to 5.6	[3 Hr] [2 Hr]
2.3	Acoustics of Buildings: Reverberation, Sabine's formula, Determination of Absorption coefficient, Acoustics of Buildings, factors affecting Acoustics of Buildings, Sound distribution in an auditorium. Distinction between sound and noise Sound isolation – transmission loss- noise reduction – Speech privacy-construction criteria. Noise control in specific types of buildings like – auditoriums, residential buildings, hotels, school, hospitals, offices, libraries Problem solving Ref: MS: 5.8, 5.9, 5.10, 5.12, 5.13, 5.14, and 5.15	[3 Hr] [2 Hr]

References:

1. SPP: Fundamentals of vibration and waves – S P Puri (Tata McGraw Hill)
2. TM: Classical Dynamics – Thornton and Marion (5th Ed.) Thomson Books.
3. MS: : Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand & Co. Ltd. (2005-Ed)
4. HP: H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.)
5. RHW:Fundamentals of Physics. Resnick, Halliday and Walker (9th Ed. 2012). Wiley.
6. KJ:College Physics I,Kailas R Jagdeo

Additional references :

Moore, J.E., Design for Good Acoustics and Noise Control

F.Y. BSc. (PHYSICS) SEMESTER II

COURSE TITLE: LAB COURSE II

COURSE CODE: 23US2PHCCP Credit- 02

Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Operate various mechanical instruments 2. Handle various optical instruments. 3. Use graphical representation to determine physical quantities. 4. Understand elastic properties of matter.
Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Develop the practical skills in physics. 2. Use various apparatus effectively. 3. Correlate physics theory concepts through practical. 4. Apply the concept of errors
PRACTICAL I

1	Spectrometer(μ)
2	Lens Combination
3	LASER Divergence
4	LDR Characteristics
5	Surface Tension of Biological fluid
6	Frequency of A.C. mains
7	Viscosity by Stoke's Method
8	Flywheel
9	Torsional Oscillations
10	Bifilar Pendulum
11	Y by vibrations
12	Thermocouple

Skill Experiments

1	Spectrometer: Schuster's Method.
2	Use of DMM.

- **Minimum of 8 experiments from both the Courses should be completed in first semester. All the skill experiments are to be reported in journal. Certified journal is must to be eligible to appear for the semester end practical examination**