AC – 24-05-2024
Item No. – 6.5

As Per NEP 2020

University of Mumbai

Title of the program

A- U.G. Certificate in **Physics**

B- U.G. Diploma in **Physics**

C- B.Sc. (**Physics**)

D- B.Sc. (Hons.) in **Physics**

E- B.Sc. (Hons. with Research) in **Physics**

Syllabus for

Semester – Sem I & II (Scheme III)

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25 Progressively)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: _____A**	**A**	**U.G. Certificate in PHYSICS**
	O: _____B	**B**	**U.G. Diploma in PHYSICS**
	O: _____C	**C**	**B.Sc. (PHYSICS)**
	O: _____D	**D**	**B.Sc. (Hons.) in PHYSICS**
	O: _____E	**E**	**B.Sc. (Hons. with Research) in PHYSICS**
2	**Eligibility** **O: _____A**	**A**	H.S.C. **OR** Passed Equivalent Academic Level 4.0
	O: _____B	**B**	Under Graduate Certificate in Physics **OR** Passed equivalent Academic Level 4.5
	O: _____C	**C**	Under Graduate Diploma in Physics **OR** Passed equivalent Academic Level 5.0
	O: _____D	**D**	Bachelors of Science in Physics with minimum CGPA of 7.5 **OR** Passed equivalent Academic Level 5.5
	O: _____E	**E**	Bachelors of Science in Physics with minimum CGPA of 7.5 **OR** Passed equivalent Academic Level 5.5
3	**Duration of program** **R: _____**	**A**	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years
4	**Intake Capacity** **R: _____**	120 per division	

5	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	**R: _____ Standards of Passing**	40%	
7	**Credit Structure** **Sem. I - R: _____A** **Sem. II - R: _____B**	Attached herewith	
	Credit Structure **Sem. III - R: _____C** **Sem. IV - R: _____D**		
	Credit Structure **Sem. V - R: _____E** **Sem. VI - R: _____F**		
8	**Semesters**	A	Sem I & II
		B	Sem III& IV
		C	Sem V & VI
		D	Sem VII& VIII
		E	Sem VII & VIII
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2024-25	

NOTE: This Syllabus is applicable to IDOL students as well, w.e.f. 2025-26

Sign of the BOS
Chairman
Name:
Dr.T.N.GHORUDE
BOS in Physics

Sign of the
I/c. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of the
I/c Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

Preamble

1) Introduction:

The revised syllabus in Physics, as per credit based system for the First Year B. Sc. course will be implemented from the academic year 2024 – 2025.

2) Aims and Objectives

The systematic and planned curricula from these courses shall motivate and encourage learners to

understand basic concepts of Physics.

Objectives:

- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hands on activities, study visits, projects etc.
- To acquire knowledge of fundamental optics.

3) Learning Outcomes

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

1. Understand the Newton's laws of motion, friction, work, energy and able to solve problems using them.
2. Understand the mechanics of multi-particle system using concepts of center of mass and conservation laws.
3. Study the mechanics of undamped/ (simple harmonic motion, uniform circular motion) and damped oscillations (Forced oscillations, two body oscillation) and their implementation in physical applications such as torsional, compound, and simple pendulums.
4. Understand AC circuit theory in case of pure resistance, inductance, capacitance and series combinations of LR, CR and LCR circuits, the working of AC bridges such as Maxwell’s Inductance bridge, De Sauty’s bridge, Wien bridge.
5. Comprehend circuit theorems (Ohm’s law, Kirchoff’s laws, Thevenin’s, Norton’s, and
6. Maximum Power Transfer theorems). Also, understand magnetic properties of matter,
7. Concepts of magnetic permeability, magnetic forces, magnetic field, magnetization,
8. Biot-Savart’s law.
9. Study the Lens maker's equation, Newton's lens equation and principal foci positions.
10. Understand Lateral, Longitudinal and Angular magnification, Equivalent focal length and power of two thin lenses, Concept of cardinal points and their significance.

11. Comprehend Spherical aberration & reduction, chromatic aberration & reduction.
12. Understand Fresnel and Fraunhoffer type of diffraction and Fraunhoffer diffraction pattern due to a single slit and double slit, Michelson's Interferometer and its Application, Polarization and types of Polarization.
13. Comprehend the concepts of DC power supply and familiarize with diode and Zener diode circuits and its applications, Methods of Transistor Biasing, Base Resistor or fixed bias, Emitter Bias and Voltage Divider Bias Methods.
14. Understand DC transistors Biasing and α, β (dc and ac) gain, Inherent Variations of transistor Parameters and Stabilization, Derived Gates NAND,NOR and Ex-OR gate, Including their symbols and truth table.
15. Apply the knowledge to design logical circuit using basic gates and its applications.
16. Students must be able to work through problems pertaining to the topics covered in the syllabus.

Sem. - I

Syllabus
B.Sc. (Physics)
(Sem.- I)

Name of the Course: F.Y.B.Sc. SEM-I - Paper I – Introduction to Mechanics

Sr.No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to:**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	**Major**/Minor/Open Elective /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	**Type :**	**Theory / Practical**
4	**Credits :**	4 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	120 Hours
6	**Marks Allotted:**	100 Marks
7	**Course Objectives (CO):** After successful completion of this course students will be able to: CO 1. Explain Newton's laws of motion, friction, work, energy and able to solve problems using them. CO 2. Learn the mechanics of multi-particle system using concepts of center of mass and conservation laws. CO 3. Study the mechanics of undamped/ (simple harmonic motion, uniform circular motion) and damped oscillations (Forced oscillations, two body oscillation) CO 4. Describe qualitatively how undamped and damped oscillations are implemented in physical problems such as torsional, compound, and simple pendulums. CO 5. Demonstrate quantitative problem solving skills in all the topics covered in the syllabus.	
8	**Course Outcomes (OC):** After successful completion of this course the learner will be able to: OC 1. Understand Newton's laws of motion, friction, work, energy and able to solve problems using them.	

	OC 2. Comprehend Work and Energy equivalence and its applications through suitable numerical. OC 3. Understand mechanics of multi-particle system using concepts of center of mass and conservation laws. OC 4. Understand mechanics of undamped/ (simple harmonic motion, uniform circular motion) and damped oscillations OC 5. Understand how undamped and damped oscillations are implemented in physical problems OC 6. Demonstrate quantitative problem solving skills in all the topics covered
9	**Modules:-Paper 1 – Introduction to Mechanics (30Periods)**
	UNIT- I (15 Periods) **1. Newton's Laws of Motion:** Newton's first, second and third laws of motion, interpretation and applications, pseudo forces, inertial and non-inertial frames of reference Worked out examples (with friction present). **(HCV: 5.1 to 5.5)** **2. Friction:** Advantages & disadvantages of friction in daily life, Friction as the component of Contact force, Kinetic Friction, Static friction, laws of friction, Understanding friction at atomic level. **(HCV: 6.1 to 6.5)** **3. Work and Energy:** Kinetic Energy, Work and Work-energy theorem, Potential Energy, Conservative and Non-Conservative Forces, Different forms of Energy: Mass Energy Equivalence Worked out Examples. **(HCV: 8.1, 8.2, 8.5, 8.6, 8.11)** **UNIT- II (15 Periods)** **1.Many Particles System**, Centre of Mass of solid objects, Conservation of momentum in a system of particle, Angular momentum of a particle and system of particle, conservation of angular momentum. **(RH: 7.3, 7.4, 7.5, 10.1, 10.2, 10.4)** **Oscillations:** The Simple Harmonic Oscillator, Relation between Simple Harmonic Motion and Uniform Circular Motion, Damped Harmonic Motion, Forced Oscillations and Resonance, Two Body Oscillations. RH:17.2, 17.6, 17.7, 17.8, 17.9 Examples of Simple Harmonic oscillations: Simple Pendulum, Simple Pendulum, Torsional Pendulum and Compound pendulum **(**Qualitative study) HP: 9.1.1(1,3,4)

10	**Text Books**	
11	**Reference Books** 1. **HCV:** H.C. Verma, Concepts of Physics-Part I (Second Reprint of 2020) BharatiBhavan Publishers and Distributers 2. **RH:**Resnick and Halliday: Physics – I , 5th Edition. 3. **Mechanics** – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.).	
12	**Internal Continuous Assessment: 40% (40Marks)**	**Semester End Examination: 60% (60 Marks)**
13	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

14 **Format of Question Paper: 30 Marks Duration: One Hour**

Unit -I (15Marks)	Q:1 A) Attempt any **Two** 10Marks i) Theory ii) Theory iii) Theory iv) Theory B) Attempt any **One** 05 Marks i) Problem ii) Problrm
Unit -II (15Marks)	Q:2 A) Attempt any **Two** 10Marks i) Theory ii) Theory iii) Theory iv) Theory B) Attempt any **One** 05 Marks i) Problem ii) Problem

SEMESTER I

PHYSICS PRACTICAL COURSE –USPHP1

INSTRUCTIONS:

1) All the measurements and readings should be written with proper units in SI system only.
2) After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
3) While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
4) Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Note: Exemption of two experiments from section A and / or B and / or C may be given if student carries out any one of the following activities.

- Collect the information of at least five Physicists with their work or any three events on physics, report that in journal.
- Execute a mini project to the satisfaction of teacher in-charge of practical.
- Participate in a study tour or visit & submit a study tour report.
- For practical examinations, the learner will be examined in two experiments (one from each group).
- Each experiment will be of three lecture hours' duration.
- A Minimum 4 from each group and in all minimum 8 experiments must be reported in journal.
- All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester I as per the minimum requirements.

A. Regular Experiment:

Sr No	Name of the Experiment
	GROUP A
1	Torsional Oscillation: To determine modulus of rigidity η of a material of wire by Torsional oscillations
2	Bifilar Pendulum: Determination of moment of inertia of rectangular and cylindrical bar about an axis passing through its centre of gravity
3	Moment of inertial of Flywheel
4	Young's Modulus of a wire material by method of vibrations
5	Bar Pendulum- determination of g
6	LDR Characteristics: To study the dependence of LDR resistance on intensity of light
	GROUP B
7	Frequency of AC Mains: To determine frequency of AC mains (Sonometer wire)
8	To study Thermistor characteristics: Resistance Vs Temperature
9	To determine capacitance in AC circuits using R and C
10	To determine Inductance in AC circuits using L and C
11	To determine the horizontal component of Earth's magnetic field(H) in the laboratory using deflection and vibration magnetometer
12	To determine the self-inductance of a coil with Anderson's Bridge
	GROUP C:Skill Experiment
1	Use of Vernier Callipers, Micrometer Screw Gauge and Travelling Microscope
2	Graph plotting (Plot BE/A verses A graph for 30 atoms, Plot Packing Fraction graph for 30 atoms)
3	Spectrometer: Schuster's Method
4	To determine the Resistance & Capacitance using Color code/Number & verify using Multimeter (Analog/Digital).
5	Use of digital multimeter
6	Absolute and relative error calculation

Note: Minimum **8** experiments (Four From each group) and **4** Skill experiments should be completed and reported in the journal, in the first semester. **Certified Journal is a must,** to be eligible to appear for the semester end practical examination.

Semester End Practical Examination:

Scheme of Examination: 30 Marks Duration: TWO Hours

There will be no internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of F.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours per experiment. There will be two experiments (one from each group) through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

Internal Practical Examination Pattern for 30 marks Semester End Examination:

1. Duration - These examinations shall be of **Two hours** duration in laboratory

Sr. No.		**Total 30 Marks**
1	One Experiment	20 Marks
2	Certified Journal	05 Marks
3	Vi-va	05 Marks

Sem. – II

Syllabus
B.Sc. (Physics)
(Sem.- II)

Name of the Course: F.Y.B.Sc. SEM-II- Paper – I: Optics

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc
2	**Vertical :**	**Major**/Minor/Open Elective /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	**Type :**	Theory / Practical
4	**Credits :**	4 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	120 Marks
7	**Course Objectives (CO):** After successful completion of this course students will be able to: CO 1. Explain the nomenclature used in lenses, lens equations for single convex lenses, and sign convention. lens maker's equation, Newton's lens equation and principal foci positions. CO 2. Describe Lateral, Longitudinal and Angular magnification, Equivalent focal length and power of two thin lenses, Concept of cardinal points and their significance CO 3. Explain qualitatively Spherical aberration & reduction, chromatic aberration & reduction. CO 4. Study of Fresnel and Fraunhoffer type of diffraction and Fraunhoffer diffraction pattern due to a single slit and double slit, CO 5. Learn Michelson's Interferometer and its Applications CO 6. Describe Polarization and types of Polarization CO 7. The students learn to apply their knowledge to solve problems that are covered in the all syllabus.	
8	**Course Outcomes (OC):** After successful completion of this course students will be able to: OC 1.Understand the nomenclature used in lenses, lens equations for single convex lenses, and sign convention. lens maker's equation, Newton's lens equation and principal foci positions. OC 2.To Understand Lateral, Longitudinal and Angular magnification, Equivalent focal length and power of two thin lenses, Concept of cardinal points and their significance OC 3. To comprehend qualitatively Spherical aberration & reduction, chromatic aberration & reduction. OC 4.To understand Fresnel and Fraunhoffer type of diffraction and Fraunhoffer diffraction pattern due to a single slit and double slit, OC 5. To understand Michelson's Interferometer and its Applications	

	OC 6.To understand Polarization and types of Polarization OC 7.Students should be able to solve problems related to the topics that are covered in the syllabus.
9	**Paper – I: Optics (30 Periods)**
	UNIT-I (15 Periods) **1. Lenses and Lens Maker's Equation:** Introduction to lenses, Terminology and sign conventions, Introduction to Thin lenses and Lens equation for single convex lens, Lens maker's equation: Positions of the Principal Foci and Newton's Lens equation. **(SBA: 4.1, 4.2, 4.3, 4.7, 4.8, 4.9, 4.10, 4.10.1, 4.11)** **2. Magnification by a lens and power of lens:** Lateral, Longitudinal and Angular magnification, Deviation by a thin lens and its power, Equivalent focal length of two thin lenses, Focal length of the equivalent lens & power of two thin lenses, Concept of cardinal points and their significance **(SBA: 4.12, 4.12.1, 4.12.2, 4.12.3, 4.15, 4.16, 4.17, 4.17.1, 4.17.2, 4.17.3, 4.17.4, 5.2)** **3. Introduction to Aberration in lenses:** Spherical aberration & reduction, chromatic aberration & reduction (Qualitative). SBA: 9.2, 9.5, 9.5.1, 9.10 Suitable numerical with appropriate difficulty level. **UNIT-II (15 Periods)** **1. Fresnel diffraction:** Introduction, Huygens-Fresnel's theory, Fresnel's assumptions, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, (SBA: 17.1, **17.2, 17.3, 17.6, 17.7)** **2. Fraunhoffer diffraction:** Introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at double slit (Qualitative), Distinction between single slit and double slit diffraction patterns. **(SBA: 18.1, 18.2, 18.2.1, 18.4, 18.4.2)** **3. Michelson's Interferometer:** Principle, construction, working, Applications of Michelson Interferometer: a) Measurement of wavelength b) Determination of the difference in the wavelength of two waves c) Determination of the refractive index of gases. **(SBA: 15.7, 15.7.1 to 15.7.3, 15.8, 15.8.1, 15.8.2, 15.8.4)** **4. Polarization:** Introduction, Polarization, Types of Polarization **(SBA: 20.1, 20.2, 20.5,20.5.1, 20.5.2, 20.5.3)**
10	**Text Books**
11	**Reference Books** Dr. N. Subrhmanyam, Brijlal, and Dr. M. N. Avadhanulu, A Textbook of Optics, 25th Revised Edition (2012) S. Chand.

Internal Continuous Assessment: 40% (20 Marks)	**Semester End Examination: 60% (30 Marks)**

Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Format of Question Paper: 30 Marks Duration: ONE Hour

Unit -I (15Marks)	Q:1 A) Attempt any **Two** 10Marks v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any **One** 05 Marks iii) Problem iv) Problrm
Unit -II (15Marks)	Q:2 A) Attempt any **Two** 10Marks v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any **One** 05 Marks ii) Problem ii) Problem

A. Regular Experiment:

Sr No	Name of the Experiments
	GROUP A
1	Study of LASER Beam Divergence
2	Spectrometer: To determine of angle of Prism
3	Spectrometer: To determine refractive index of prism material
4	Combination of Lenses: To determine equivalent focal length of a lens system by magnification method
5	Newton's Rings: To determine radius of curvature of a given convex lens using Newton's rings.
6	Determination of diameter of thin wire using Wedge Shaped Film
	GROUP B
7	Study of Logic gates & To verify De Morgan's Theorems
8	To study EX-OR Gate and verify its truth table
9	To study half adder and full adder and verify their truth table Ex-OR Gate
10	To study load regulation of a Bridge Rectifier
11	To study Zener Diode as Regulator
12	Transistor configurations : CB/CE/CC (study of input-output characteristics)
	GROUP C: DEMONSTRATION EXPERIMENT
1	Radius of ball bearings (single pan balance)
2	Use of Oscilloscope: Wave forms at output of half wave , bridge rectifiers with and without Capacitor filter, Ripple
3	Use of PC for graph plotting
4	I-V Characteristics of LED
5	Testing of components (Resistors , Diode , Transistor , capacitor)
6	Study of I-V characteristics of solar cell

Note: Minimum **8** experiments (Four From each group) and **4** Demo experiments should be completed and reported in the journal, in the first semester. **Certified Journal is a must,** to be eligible to appear for the semester end practical examination.

Semester End Practical Examination:

Scheme of Examination: 50 Marks Duration: TWO Hours

There will be no internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of F.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours per experiment. There will be two experiments (one from each group) through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

Internal Practical Examination Pattern for 30 marks Semester End Examination:

1. Duration - These examinations shall be of **Two hours** duration in laboratory

Sr. No.		**Total 30 Marks**
1	One Experiment	20 Marks
2	Certified Journal	05 Marks
3	Vi-va	05Marks

Semester GPA/ Programme CGPA Semester/ Programme	**% of Marks**	**Alpha-Sign/ Letter Grade Result**	**Grading Point**
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Appendix B

Justification for B.Sc. (PHYSICS)

1.	Necessity for starting the course:	The necessity for starting the B.Sc. (Physics) course lies in its role as a foundational, interdisciplinary, and practical program that prepares students for higher education, diverse career opportunities and active participation in addressing scientific and societal challenges.
2.	Whether the UGC has recommended the course:	Yes
3.	Whether all the courses have commenced from the academic year 2023-24	The course has already commenced in the university and in the academic year 24-25, it is restructured under NEP 2020
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available:	This course is aided/self-financed based on sanction given by University of Mumbai to affiliated colleges time to time.
5.	To give details regarding the duration of the Course and is it possible to compress the course?	The duration of the program is three years (6 semesters). It is not possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	The intake capacity is variable from the college to college based on sections received from the University.
7.	Opportunities of Employability / Employment available after undertaking these courses:	B.Sc. (Physics) graduates are versatile and can adapt their skills to various industries, make them valuable assets in the workforce. Additionally, continuous learning and staying updated on industry trends can enhance career prospects and open up new opportunities.

Sign of the BOS
Chairman
Name:
Dr.T.N.GHORUDE
BOS in Physics

Sign of the
I/c. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of the
I/c Dean
Prof. Shivram S.
Faculty of Scienc
Technology