UNIVERSITY OF MUMBAI

Syllabus for Sem I & II
Program: B.Sc.
Course: Physics

(Credit Based Semester and Grading
System for Academic year 2016-17)

<p align="center">**Syllabus for B.Sc. Physics(Theory&Practical)**
As per credit based system
First Year B.Sc. 2016–2017.</p>

The revised syllabus in Physics as per credit based system for the First Year B.Sc. Course will be implemented from the academic year **2016–2017.**

Preamble:

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.

Course code	Title	Credits
	Semester I	
USPH101	Classical Physics	2
USPH102	Modern Physics	2
USPHP1	Practical I	2
		Total= 06
	Semester II	
USPH201	Mathematical Physics	2
USPH202	Electricity and Electronics	2
USPHP2	Practical II	2
		Total=06

Name of the Programme	Duration	Semester	Subject
Programme			
B.Sc.inPhysics	Sixsemesters	I	Physics
CourseCode	Title	Credits	
USPH101	**Classical Physics**	2for USPH101	

Learning Outcomes:

On successful completion of this course students will be able to:
1. Understand Newton's laws and apply them in calculations of the motion of simple systems.
2. Use the free body diagrams to analyzetheforces on the object.
3. Understand the concepts of friction and the concepts of elasticity, fluid mechanics and be able to perform calculations using them.
4. Understand the concepts of lens system and interference.
5. Apply the laws of thermodynamics to formulate the relations necessary toanalyze athermodynamic process.
6. Demonstrate quantitative problem solving skills in all the topics covered

Unit:I   **15lectures**

- Newton's Laws**:**

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)

- Elasticity:

Review of Elastic constants Y, K, η and σ;Equivalence of shear strain to compression and extension strains. Relations between elastic constants, Couple for twist in cylinder.

- Fluid Dynamics**:**

Equation of continuity, Bernoulli's equation, applications of Bernoulli's equation, streamline and turbulent flow, lines of flow in airfoil, Poiseuille's equation.

Unit:II   **15lectures**

1. Lens Maker's Formula (Review), Newton's lens equation,magnification-lateral, longitudinal and angular.
2. Equivalent focal length of two thin lenses, thick lens, cardinal points of thick lens, Ramsdenand Huygens eyepiece.
3. Aberration: Spherical Aberration, Reduction of Spherical Aberration, Chromatic aberration and condition for achromatic aberration.
3. Interference: Interference in thin films, Fringes in Wedge shaped films, Newton's Rings (Reflective).

UNIT III   15 lectures

1. Behavior of real gases and real gas equation, Van der Waal equation
2.Thermodynamic Systems, Zeroth law of thermodynamics, Concept of Heat, The first law, Non Adiabatic process and Heat as a path function, Internal energy, , Heat Capacity and specific heat, Applications of first law to simple processes, general relations from the first law, Indicator diagrams, Work done during isothermal and adiabatic processes, Worked examples, Problems.

Note:Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe   prescribed lectures.

References:

- Halliday, Resnick and Walker, Fundamental of Physics (extended) – (6th Ed.), John Wiley and Sons.
- H. C. Verma, Concepts of Physics – (Part–I),   2002 Ed. BharatiBhavan Publishers.

- Iradov

- Brijlal,Subramanyam and Avadhanulu   A Textbook of Optics, 25th revised ed.(2012) S. Chand

- Brijlal, Subramanyam and Hemne, Heat Thermodynamics and Statistical Physics, S Chand, Revised,   Multi-coloured,2007 Ed.

- Jenkins and White, Fundamentals of Optics by (4th Ed.), McGraw Hill International.

Additional References :

- Thornton and Marion, Classical Dynamics – (5th Ed)
- D S Mathur, Element of Properties of Matter, S Chand & Co.
- R Murugeshan and K Shivprasath, Properties of Matter and Acoustics   S Chand.
- M W Zemansky and R H Dittman, Heat and Thermodynamics, McGraw Hill.
- D K Chakrabarti, Theory and Experiments on Thermal Physics, (2006   Ed) Central books.
- C L Arora, Optics, S Chand.
- Hans and Puri, Mechanics –, 2nd Ed. Tata McGraw Hill

SEMESTER-I

Nameofthe Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	I	Physics
CourseCode	Title	Credits	
USPH102	**Modern Physics**	2for USPH102	

Learning Outcomes:

After successful completion of this course students will be able to
1. Understand nuclear properties and nuclear behavior.
2. Understand the type isotopes and their applications.
3. Demonstrate and understand the quantum mechanical concepts.
4. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I
15lectures

- Structure of Nuclei:Basic properties of nuclei, Composition, Charge, Size, Rutherford's expt. for estimation of nuclear size, density of nucleus,   Mass defect and Binding energy, Packing fraction, BE/A vs A plot, stability of nuclei (N Vs Z plot) and problems.
- Radioactivity: Radioactive disintegration concept of natural and artificial radioactivity, Properties of α, β, γ-rays, laws of radioactive decay, half-life, mean life (derivation not required), units of radioactivity, successive disintegration and equilibriums, radioisotopes.   Numerical Problems.
- Carbon dating and other applications of radioactive isotopes (Agricultural, Medical,

Industrial, Archaeological -information from net).

Unit II   15 lectures

Interaction between particles and matter, Ionization chamber, Proportional counter and GM counter, problems
Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, problems.
Fusion and fission definitions and qualitative discussion with examples.

Unit   III   15 lectures

1. Origin of Quantum theory, Black body (definition), Black Body spectrum, Wien's displacement law, Matter waves, wave particle duality, Heisenberg's uncertainty Principle.
Davisson-Germer experiment, G. P. Thompson experiment.
2. X-Rays production and properties. Continuous and characteristic X-Ray spectra, X-Ray Diffraction, Bragg's Law, Applications of X-Rays.
3. Compton Effect, Pair production, Photons and Gravity, Gravitational Red Shift.

Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe   prescribed lectures

References:

- Kaplan: Nuclear Physics, Irving Kaplan, 2nd Ed. Narosa Publishing House
- SBP: Dr. S. B. Patel, Nuclear Physics Reprint 2009, New Age International
3.BSS: N Subrahmanyam, Brijlal and Seshan, Atomic and Nuclear Physics   Revised   Ed. Reprint 2012, S. Chand
4. Arthur Beiser, Perspectives ofModernPhysics : Tata McGraw Hill

Additional References:

- S N Ghosal,   Atomic Physics   S Chand
- S N Ghosal, Nuclear Physics   2nd ed. S Chand

Name of the Programme	Duration		Semester	Subject
B.Sc.inPhysics	Sixsemesters		I	Physics
CourseCode	Title		Credits	
USPHP1	**Practical I**		2	

Leaning Outcome:

On successful completion of this course students will be able to:
- To demonstrate their practical skills.
- To understand and practice the skills while doing physics practical.
- To understand the use of apparatus and their use without fear.
- To correlate their physics theory concepts through practical.
- Understand the concepts of errors and their estimation.

- **Regularexperiments:**

1	J by Electrical Method: To determine mechanical equivalent of heat (Radiation correction by graph method)
2	Torsional Oscillation: To determine modulus of rigidity η of a material of wire by torsional oscillations
3	Bifilar Pendulum
4	Spectrometer: To determine of angle of Prism.
5	Y by vibrations: To determine Y Young's Modulus of a wire material by method of vibrations- Flat spiral Spring
6	To determine Coefficient of Viscosity (η) of a given liquid by Poisseuli's Method
7	Surface Tension/ Angle of contact
8	Combination of Lenses To determine equivalent focal length of a lens system by magnification method.
9	Spectrometer: To determine refractive index μ of the material of prism
10	To study Thermistor characteristic Resistance vs Temperature
11	Constant volume/constant pressure
12	Newton's Rings To determine radius of curvature of a given convex lens using Newton's rings.

13	Wedge Shaped Film

B. Skill Experiments:

1.	Use of Verniercalipers, Micrometer Screw Gauge, Travelling Microscope
2.	Graph Plotting : Experimental, Straight Line with intercept, Resonance Curve etc.
3.	Spectrometer: Schuster's Method
4.	Use of DMM
5	Absolute and relative errors calculation.

C) Any one out of following isequivalent to two experiments from section A and/ or B

     1. Students should collect the information of at least five Physicists with their work. Report that in journal.

   2. Students should carry out mini-project upto the satisfaction of professor In-charge of practical.

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

Minimum 8experiments from the list should be completed in the first semester. Any four skill experiments are to be reported in journal. Certified journal is a must to be eligible to appear for the semester end practical.

The scheme of examination for the revised course in Physics at the FirstYear B.Sc. Semester end examination will be as follows.

SemesterEnd Practical Examination:
   Schemeof
examination:

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 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.

Name of the Programme	Duration	Semester	Subject
B.Sc.in Physics	Six semesters	II	Physics
CourseCode	Title	Credits	
USPH201	**Mathematical Physics**	2for USPH201	

Learning Outcomes:

On successful completion of this course students will be able to:
1. Understand the basic mathematical concepts and applications of them in physical situations.
2. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I
15 lectures
- Vector Algebra :

Vectors, Scalars, Vector algebra, Laws of Vector algebra, Unit vector, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Problems based on Vector algebra.

Dot or Scalar product, Cross or Vector product, Commutative and Distributive Laws, Scalar Triple product, Vector Triple product (Omit proofs). Problems and applications based on Dot, Cross and Triple products.

2. Gradient, divergence and curl:

The ∇ operator, Definitions and physical significance of Gradient, Divergence and Curl; Distributive Laws for Gradient, Divergence and Curl (Omit proofs); Problems based on Gradient, Divergence and Curl.

Unit: II
15lectures
- Differential equations**:**

Introduction, Ordinary differential equations, First order homogeneous and non- homogeneous equations with variable coefficients, Exact differentials, General first order Linear Differential Equation, Second-order homogeneous equations with constant coefficients. Problems depicting physical situations like LC and LR circuits, Simple Harmonic motion (spring mass system).

- Transient response of circuits: Series LR, CR, LCR circuits. Growth and decay of currents/charge.

Unit:III   **15lectures**
- Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).
- Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses
- Wave Motion: Transverse waves on string, Travelling and standing waves on a string. Normal modes of a string, Group velocity, Phase velocity, Plane waves, Spherical waves, Wave intensity.

Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe   prescribed lectures

References:

1.MS:Murray R Spiegel, Schaum's outline of Theory and problems of Vector Analysis,   Asian Student Edition
2. CH**:** Charlie Harper, Introduction to Mathematical Physics , 2009 (EEE) PHI Learning Pvt. Ltd.
3. CR: D. Chattopadhyay,   P C Rakshit ,   Electricity and Magnetism   7th Ed. New Central Book agency.
4. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Additional References:
- BrijLal**,N.** Subrahmanyam **,** JivanSeshan,   Mechanics and Electrodynamics, , (S. Chand) (Revised & Enlarged ED. 2005)
- A K Ghatak, Chua, Mathematical Physics, 1995, Macmillan India Ltd.
- Ken Riley**, Michael** Hobson **and Stephen** Bence, Mathematical Methods for Physics and Engineering, Cambridge (Indian edition).
- H. K. Dass, Mathematical Physics, S. Chand & Co.
- Jon Mathews & R. L. Walker, Mathematical Methods of Physics: W A Benjamin Inc.

SEMESTER II

Name of the Programme	Duration	Semester	Subject
B.Sc.inPhysics	Six semesters	II	Physics
CourseCode	Title	Credits	
USPH202	**Electricity and Electronics**	2for USPH202	

Unit I :   **15 lectures**
- Alternating current theory:(Concept of L, R, and C: Review)

AC circuit containing pure R, pure L and pure C, representation of sinusoids by complex numbers, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in ac circuit. Q-factor.
- AC bridges: AC-bridges: General AC bridge, Maxwell,de-Sauty, Wien Bridge , Hay Bridge.

Unit II: Electronics   **15 lectures**
1.Circuit theorems: (Review: ohm's law,   Kirchhoff's   laws)
Superposition Theorem, Thevenin's Theorem, Ideal Current Sources, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem.
Numericals related to circuit analysis using the above theorems.
2.DC power supply:Half wave rectifier , Full wave rectifier,   Bridge rectifier, PIV and Ripple factor of full wave rectifier, Clipper and Clampers(Basic circuits only), Capacitor Filter.
Zener diode as voltage stabilizer.
3.Digital electronics : Logic gates(Review), NAND and NOR as universal building blocks.
EXOR gate: logic expression, logic symbol, truth table, Implementation using basic gates and its applications, Boolean algebra, Boolean theorems. De-Morgan theorems, Half adder and Full adder

Unit III : Electrostatics and Magnetostatics   **15 lectures**
1.The Electric Field : Introduction, Coulomb's Law, The Electric Field, Continuous charge Distribution, Electric Potential, Introduction to Potential, Comments on Potential,
The Potential of a Localized Charge Distribution
2.Work and Energy in Electrostatics**:** The Work Done to Move a charge, The Energy of
a Point Charge Distribution
3.Magnetostatics**:** Magnetic Fields
4.TheBiotSavart Law**:** Steady Currents,The Magnetic Field of a Steady Current

Helmholtz coil and solenoid.

*Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe   prescribed
lectures*

References :
CR: D. Chattopadhyay,   P C Rakshit ,   Electricity and Magnetism   7th Ed. New Central
Book agency.
TT :B.L. Theraja and A.K. Theraja , A Textbook of Electrical Technology Vol. I , S. Chand
Publication
BN :Boylestad and Nashelsky, Electronic devices and Circuit Theory: 7th edition, Prentice Hall
of India.
VKM: V K Mehta and R Mehta Electronics Principals, MulticolouredRevised   11th Ed.
reprint in 2012 ,S Chand.
David J. Griffiths : Introduction to Electrodynamics, Prentice Hall India (EEE) 3rd Ed.
A B Bhattacharya, Electronics Principlesand Applications, Central publisher.
A P Malvino, Digital Principles and Applications: Tata McGraw Hill
Tokhiem, Digital electronics, 4[th]ed, McGraw Hill International Edition.

SEMESTER II

Name of the Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	II	Physics
CourseCode	Title	Credits	
USPHP2	**Practical II**	2	

Leaning Outcome:

- To understand and practice the skills while doing physics practical.
- To understand the use of apparatus and their use without fear.
- To correlate their physics theory concepts through practical.
- Understand the concepts of errors and their estimation.

- Regular experiments:

1	Flywheel
2	To study Zener Diode as Regulator
3	To study load regulation of a Bridge Rectifier
4	LR Circuit: To determine the value of given inductance and phase angle
5	CR Circuit: To determine value of given capacitor and Phase angle
6	Frequency of AC Mains: To determine frequency of AC mains.
7	LCR series Resonance: To determine resonance frequency of LCR series circuit.
8	To study NAND and NOR gates as Universal Building Blocks
9	To study EX-OR Gate, half adder and full adder and verify their truth tables.
10	To verify De Morgan's Theorems
11	Thevenin's Theorem: To verify Thevenin's theorem for DC circuits
12	Norton's Theorem: To verify Norton's Theorem for DC circuits
13	LDR Characteristics: To study the dependence of LDR resistance on intensity of light.

B) List of Demo-experiments: (Min. four)

1.	Angular Momentum conservation (Rotating Platform)
2.	Light dependent switch
3.	Laser beam divergence, Intensity
4.	Use of Oscilloscope
5	Charging and discharging of a capacitor
6	Use of PC for graph plotting
7	Clipper and Clamper circuits.

C) Any one out of following isequivalentto two experiments from section A and/ or B
      1. Students should collect the information of at least fourPhysics events and their outcome. Report that in journal.
      2. Students should carry out mini-project up to the satisfaction of professor In-charge of practical
      3. Study tour. Students participated in study tour must submit a study tour report.

Minimum 8experiments from the list should be completed in the first semester. Any   four skill experiments are to be reported in journal.Certified journal is must to be eligible to appear for the semester end practical.

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