Academic Council 26/02/2015
Item No. 4.40

UNIVERSITY OF MUMBAI

Syllabus for the F.Y.B.Sc.
Program: B.Sc.
Subject: Physics

(Credit Based Semester and Grading System with effect from the academic year 2015–2016)

Revised Syllabus in Physics (Theory & Practical)
As per credit based system
First Year B. Sc. 2015 – 2016.

The revised syllabus in Physics, as per credit based system for the First Year B. Sc. course will be implemented from the academic year 2015 – 2016.

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	Mathematical Methods, Mechanics and Properties of Matter	2
USPH102	Optics Heat and Thermodynamics	2
USPHP1	Practical I	2
		Total= 06
	Semester II	
USPH201	Electricity and Electronics	2
USPH202	Nuclear and Modern Physics	2
USPHP2	Practical II	2
		Total=06

SEMESTER-I

Name of the	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	I	Physics
Course Code	Title	Credits	
USPH101	Mathematical Methods, Mechanics and Properties of Matter,	2 for 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 analyze the forces 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 basic mathematical concepts and application of them in physical situations
5. Demonstrate quantitative problem solving skills in all the topics covered.

Unit : I **15 lectures**

1. Vector and Scalars:

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.

MS: Ch. 1, 2(Omit Reciprocal sets of vectors)

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.

MS: Ch. 4 (Omit formulae no 4 to 12 involving ∇ and Invariance)

Unit: II **15 lectures**

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).

CH: 5.1, 5.2, 5.2.1 (A, B, C)(Omit D), 5.2.3.

Unit: III **15 lectures**

1. 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): 1, 2, 3, 4 of Chapter 6 – HCV

HCV: Ch. 5.1 to 5.5 and 5.7 Ch. 6 (Worked out problems 1 to 4)

2. 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.

HP: 15.3.A to 15.5.A and 15.7.A

3. 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.

HP: 15.2B to 15.6B

Note: A good number of numerical examples are expected to be covered during the prescribed lectures.

References:

1. MS: Murray R Spiegel, Schaum's outline of Theory and problems of Vector Analysis, Asian Student Edition

2**.** HCV**:** H. C. Verma, Concepts of Physics – (Part–I), 2002 Ed. Bharati Bhavan Publishers.

3. HP**:** Hans and Puri, Mechanics –, 2nd Ed. Tata McGraw Hill.

4. CH**:** Charlie Harper, Introduction to Mathematical Physics , 2009 (EEE) PHI Learning Pvt. Ltd.

Additional References

1. Thornton and Marion, Classical Dynamics – (5th Ed)
2. D S Mathur, Element of Properties of Matter, S Chand & Co.
3. Halliday, Resnick and Walker, Fundamental of Physics (extended) – (6th Ed.), John Wiley and Sons.
4. David J. Griffiths, Introduction to Electrodynamics, Prentice Hall India (EEE), 3rd Ed.
5. Z. Capri and P. V. Panat, Introduction to Electrodynamics, (Narosa Pub. House)
6. **Brij Lal** , N. **Subrahmanyam** , **Jivan** Seshan, Mechanics and Electrodynamics, , (S. Chand) (Revised & Enlarged ED. 2005)
7. A K Ghatak, Chua, Mathematical Physics, 1995, Macmillan India Ltd.
8. Ken **Riley**, Michael **Hobson** and Stephen **Bence**, Mathematical Methods for Physics and Engineering, Cambridge (Indian edition).
9. H. K. Dass, Mathematical Physics, S. Chand & Co.
10. Jon Mathews & R. L. Walker, Mathematical Methods of Physics: W A Benjamin Inc.

Name of the Programme	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	I	Physics
Course Code	Title	Credits	
USPH102	Optics Heat and Thermodynamics	2 for USPH102	

Learning Outcomes:

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

1. Demonstrate an understanding of electromagnetic waves and its spectrum.
2. Understand the types and sources of electromagnetic waves and applications.
3. Understand the concepts of lens system and interference.
4. To understand the atomic excitation and LASER principles.
5. Understand the applications of Lasers and Fibre optic communication
6. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
7. Demonstrate quantitative problem solving skills in all the topics covered.

Unit: I **15 lectures**

Lens Maker's Formula (Review), Newton's lens equation, magnification-lateral, longitudinal and angular

1. Equivalent focal length of two thin lenses, thick lens, cardinal points of thick lens, Ramsden and Huygens eyepiece,

BS: 4.9 to 4.12, 4.17.1 to 4.17.4, 6.2, 6.2.1 to 6.2.3, 6.3.1.1 to 6.3.1.3, 10.10, 10.11.

2. Aberration: Spherical Aberration, Reduction of Spherical Aberration, Chromatic aberration and condition for achromatic aberration.

BS: 9.2, 9.3, 9.4, 9.5, 9.5.1, 9.6, 9.10, 9.11, 9.12, 9.13(1) (2)

3. Interference: Interference in thin films, Fringes in Wedge shaped films, Newton's Rings (Reflective).

BS: 15.1, 15.2.1 to 15.2.5, 15.3, 15.5, 15.6.1, 15.6.2, 15.6.3

UNIT: II (15 Lectures)

1. LASER: Introduction, transition between atomic energy states (without derivation), Principle of LASER, Properties of LASER, Helium –Neon LASER, Ruby LASER, Applications of LASER to Holography and other applications.

SP: 9.1 to 9.6
BS: 23.21, 23.2.2, 23.9

2. Optical Fibre: Light propagation through Fibres, Fibre Geometry, Internal Reflection, Numerical Aperture, Step-Index and Graded-Index Fibres, Applications of fibres.

SP: 13.3, 13.5, 13.9

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.

BSH: 2.1 to 2.12, 4.1 to 4.14

Note: A good number of numerical examples are expected to be covered during the prescribed lectures.

References:

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

SP: Sanjeev Puri, Modern Physics Concepts and Applications Narosa Publications, 2nd reprint, 2007.

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

Additional References

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.

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

C L Arora, Optics, S Chand.

Kaiser, Fibre Optics, McGraw Hill.

Name of the Programme	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	I	Physics [USPHP1]
Course Code	Title	Credits	
USPHP1	Practical I	2	

Leaning Outcome:

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

i) To demonstrate their practical skills.
ii) To understand and practice the skills while doing physics practical.
iii) To understand the use of apparatus and their use without fear.
iv) To correlate their physics theory concepts through practical.
v) Understand the concepts of errors and their estimation.

A. <u>Regular experiments:</u>

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.	Thermocouple
11.	To study Thermistor characteristic
12.	Constant volume/constant pressure
13.	Newton's Rings To determine radius of curvature of a given convex lens using Newton's rings.
14	Wedge Shaped Film

B. Skill Experiments:

	Skill Experiments:
1.	Use of Vernier calipers, 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 is equivalent 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 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 8 experiments 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.

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

Semester End Practical Examination:
Scheme of 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.

SEMESTER II

Name of the Programme	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	II	Physics
Course Code	Title	Credits	
USPH201	Electricity and Electronics	2 for USPH201	

Learning Outcomes:

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

1. Understand electrical concepts and applications of passive components in everyday life.
2. Troubleshoot the electrical circuits for minor faults.
3. Understand the basic mathematical concepts and application of them in physical situations
4. Learn and understand operation of basic electronic components like transistor, diodes etc.
4. Demonstrate quantitative problem solving skills in all the topics covered.

Unit : I **15 lectures**

1. Circuit theorems: (Review: ohm's law, Kirchhoff's laws)

Thevenin's Theorem, Current Sources, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, Superposition Theorem.

Numericals related to circuit analysis using the above theorems.

Ref: CR: (7.3, 7.6 for Review), 7.7 to 7.11

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

Ref: CR: 14.1 to 14.3

Unit-II: (15 Lectures)

1.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.

Ref: CR: 15.2, 15.5 to 15.11

DC/ AC bridges: DC Wheat-stone's bridge, AC-bridges: General AC bridge, Maxwell, de-Sauty, Wien Bridge.

Ref: CR: 7.12 (i), 15.14

Unit-III: Electronics: (15 Lectures)

DC power supply: (Half wave and Full wave rectifier: Review)
Bridge rectifier, Efficiency and Ripple factor of full wave rectifier, Filter circuits: Capacitor filter, Choke input filter, π filter. Voltage stabilization: zener diode as voltage stabilizer.

Ref: VKM: 6.8 to 6.15, 6.17 to 6.20, 6.21,6.27

Transistor as amplifier: CB, CE, CC modes. Definition of gains α, β (dc and ac) and relation between them. CE amplifier: operation, load line analysis, operating point, cut-off and saturation points.

Ref: VKM: 8.6 to 8.10, 8.16, 8.17, 8.18, 8.22

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

Ref: VKM: 26.15 to 26.17, 26.20, 26.21, 26.22, 26.32

Note: A good number of numerical examples are expected to be covered during the prescribed lectures.

References

CR: D. Chattopadhyay, P C Rakshit , Electricity and Magnetism 7th Ed. New Central Book agency.

VKM: V K Mehta and R Mehta Electronics Principals, Multicoloured Revised 11th Ed. reprint in 2012 ,S Chand.

Additional references:

A B Bhattacharya, Electronics Principles and Applications, Central publisher.

Boylestad and Nashelsky, Electronic devices and Circuit Theory: 6th edition, Prentice Hall of India.

A P Malvino, Digital Principles and Applications: Tata McGraw Hill

Tokhiem, Digital electronics, 4thed, McGraw Hill International Edition.

Name of the Programme	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	II	Physics
Course Code	Title	Credits	
USPH202	Nuclear and Modern Physics	2 for USPH202	

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 **15 lectures**

1. 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.

   Kaplan 9.4, 9.5, SBP 4.1.1, 4.1.2

2. 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).

   SBP : 2.1 to 2.3, 2.6 to 2.10, 2.12, 2.13

Unit II (15 Lectures)

Interaction between particles and matter, Ionization chamber, Proportional counter and GM counter, problems

SBP: 1.1.2, 1.1.3(i and ii) Kaplan 2.8

Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, problems

SBP: 3.1 to 3.5

Fusion and fission definitions and qualitative discussion with examples.

BSS 12.3, 12.7

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

BSS: 2.1 to 2.6, 3.1 to 3.6 and 3.9(without applications)

2. X-Rays production and properties. Continuous and characteristic X-Ray spectra, X-Ray Diffraction, Bragg's Law, Applications of X-Rays

BSS: 6.2, 6.3, 6.4; AB: 2.5, 2.6

3. Compton Effect, Pair production, Photons and Gravity, Gravitational Red Shift.

AB: 2.7 to 2.9,

Note: A good number of numerical examples are expected to be covered during the 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

BSS: N Subrahmanyam, Brijlal and Seshan, Atomic and Nuclear Physics Revised Ed. Reprint 2012, S. Chand

AB: Arthur Beiser, Concepts of Modern Physics 6th Ed. Tata McGraw Hill

Additional references:

Arthur Beiser, Perspectives of Modern Physics : Tata McGraw Hill
S N Ghosal, Atomic Physics S Chand
S N Ghosal, Nuclear Physics 2nd ed. S Chand

USPHP2

Name of the Programme	Duration	Semester	Subject
B.Sc. in Physics	Six semesters	I	Physics [courses USPHP2]
Course Code	Title	Credits	
USPHP2	Practical II	2	

Leaning Outcome:

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

A) Regular experiments:

1	Flywheel
2	To study Zener Diode as Regulator
3	Transistor (CE) characteristics

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

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

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

1. Students should collect the information of at least four Physics 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 8 experiments from the list should be completed in the second semester. Demo experiments (min. four) are to be reported in journal in order to get it certified.

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

Semester End Practical Examination: Scheme of 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 hour 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 the experiment.