UNIVERSITY OF PUNE

PROPOSED SYLLABUS FOR S.Y.B. Sc. (Physics)

FROM ACADEMIC YEAR 2009-2010

S.Y.B.Sc. (PHYSICS)

Structure of the course

Semester I

Paper	Title
Paper I (PH 211)	Mathematical Methods in Physics
Paper II (PH 212)	Electronics[#]/Instrumentation[*]

 # For students NOT opting Electronics subject at F.Y.B.Sc.

*** For students opting Electronics subject at F.Y.B.Sc.**

Semester II

Paper	Title
Paper I (PH 221)	Oscillations, Waves and Sound
Paper II (PH 222)	Optics

Paper III (PH 223)	**Practical Course (For Semester I and II)**

UNIVERSITY OF PUNE

PROPOSED SYLLABUS FOR S.Y.B. Sc. (Physics)

FROM ACADEMIC YEAR 2009-2010

S.Y.B.Sc. (PHYSICS)

Semester I (Paper I)

PH-211 MATHEMATICAL MEHODS IN PHYSICS

CH-1 Complex Numbers **(12 Periods)**

1.1 Introduction to complex numbers.

1.2 Algebra of complex numbers

1.3 Argand diagram, algebra of complex numbers using Argand diagram

1.4 Rectangular, polar and exponential forms of complex numbers.

1.5 De-Moivre's Theorem (statement only)

1.6 Trigonometric, hyperbolic and exponential functions.

1.7 Powers, roots and log of complex numbers.

1.8 Applications of complex numbers to determine velocity and acceleration in curved motion

1.9 Problems

CH-2 Vector Algebra **(04 Periods)**

2.1 Introduction to scalars, vectors: dot product and cross product.

2.2 Scalar triple product and its geometrical interpretation.

2.3 Vector triple product and its proof.

2.4 Problems.

CH-3 Vector Analysis **(16 Periods)**

3.1 Differentiation of vectors with respect to scalar.

3.2 Scalar and vector fields.

3.3 Vector differential operator.

3.4 Gradient of scalar field and its physical significance.

3.5 Divergence of scalar field and its physical significance

3.6 Curl of vector field and its physical significance

3.7 Vector integrals: line, surface and volume integral with their examples.

3.8 Statements of Gauss-Divergence theorem and Stoke's theorem.

3.9 Vector identities

a. $\nabla \times \nabla \phi = 0$

b. $\nabla .(\nabla \times \mathbf{V}) = 0$

c. $\nabla .(\nabla \phi) = \nabla^2 \phi$

d. $\nabla .(\phi \mathbf{A}) = \nabla \phi . \mathbf{A} + \phi (\nabla . \mathbf{A})$

e. $\nabla \times (\phi \mathbf{A}) = \phi(\nabla \times \mathbf{A}) + (\nabla \phi) \times \mathbf{A}$

f. $\nabla .(\mathbf{A} \times \mathbf{B}) = \mathbf{B} . (\nabla \times \mathbf{A}) - \mathbf{A} .(\nabla \times \mathbf{B})$

3.10 Problems.

CH-4 Partial Differentiation **(12 periods)**

4.1 Definition of partial differentiation

4.2 Successive differentiation

4.3 Total differentiation

4.4 Exact differential

4.5 Chain rule

4.6 Theorems of differentiation

4.7 Change of variables from Cartesian to polar co-ordinates.

4.8 Implicit and explicit functions

4.9 Conditions for maxima and minima (without proof)

4.10 Problems.

CH-5 Differential Equation **(04 Periods)**

5.1 Frequently occurring partial differential equations (Cartesian coordinates)

5.2 Degree, order, linearity and homogeneity of differential equation.

5.3 Singular points ($x = 0$, $x = x_0$) of differential equation.

5.4 Problems.

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir

2. Mathematical Physics by B. D. Gupta

3. Mathematical Physics by Rajput and Gupta

4. Mathematical Methods in Physical Science by Mary and Boas

5. Vector analysis by Spiegel and Murrey

6. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.

S.Y. B.Sc. (Physics)

Semester I (Paper II)

PH-212: ELECTRONICS

(For students Not opting Electronics at F.Y.B.Sc.)

CH-1 Basic Electronic Components **03 Lectures**

1.1 Definitions of resistance, capacitance and inductance

1.2 Equations defining resistance, capacitance and inductance

1.3 Concept of reactance and impedance

1.4 Transformers: Centre tapped, Step-up, Step-down, Various energy losses in transformer.

CH- 2 Network Theorems **07 Lectures**

2.1 Kirchhoff's laws (revision)

2.2 Voltage and current divider circuits

2.3 Thevenin's theorem

2.4 Norton's theorem

2.5 Super-position theorem

2.6 Maximum power transfer theorem (All theorems 2.3 to 2.6 without proof)

2.7 Problems.

CH- 3 Semiconductor Devices **12 Lectures**

3.1 Revision of bipolar junction transistor, types, symbols and basic action

3.2 Configurations (Common Base, Common Emitter & Common Collector)

3.3 Definition of alpha, beta and their relations.

3.4 Input, output and transfer characteristics of CE and CB configurations.

3.5 Biasing methods

3.6 AC and DC load lines, Operating point (Q point)

3.7 Transistor as a switch, Transistor as an amplifier (only concept)

3.8 Frequency response of CE transistor amplifier

3.9 Unijunction transistor: principle, construction and operation

3.10 Problems.

CH- 4 Operational Amplifiers and Oscillators **12 Lectures**

4.1 Operational amplifier: IC 741- Block diagram, Characteristics: ideal and practical

4.2 Concept of virtual ground

4.3 Inverting and non-inverting operational amplifiers with concept of gain.

4.4 Operational amplifier as an adder and subtracter.

4.5 Oscillators: concept of positive and negative feedback

4.6 Barkhausein criteria for an oscillator

4.7 Phase shift oscillator and Wien bridge oscillator (Derivation for frequency and feedback factor for both oscillators expected)

4.8 Problems.

CH- 5 Power Supplies **06 Lectures**

5.1 Half wave, Full wave and Bridge rectifier, ripple factor, capacitor filter

5.2 Difference between regulated and unregulated power supply

5.3 Definition of Line and Load regulation

5.4 Series and Shunt regulators- Block diagram and circuit of regulated power supply using discrete components, Simple current limiting circuit

5.5 Problems.

CH- 6 Digital Electronics **08 Lectures**

6.1 Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal

6.2 Addition and subtraction of binary numbers and binary fractions using one's and two's complement.

6.3 Basic logic gates: OR, AND, NOT, Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables

6.4 Boolean Algebra, Boolean Equations

6.5 De Morgan's theorems and its verification

6.6 Problems.

Reference Books:

1 Electronics Principles, Malvino**,** 7th Edition TaTa Mc-Graw Hills.

2 Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.

3 Op Amp and Linear integrated circuits, Ramakant Gaikwad, Prentice Hall of India Pub.

4 Integrated Circuts, Botkar, Khanna Publications, New Delhi

5 Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub.

S.Y.B.Sc. (PHYSICS)

Semester I (Paper II) (for students opting Electronics as one of the subjects at F.Y. B. Sc)

PH-212: INSTRUMENTATION

CH -1 Fundamentals of Measurement (16 periods)

1.1 Aims of measurement

1.2 Functional elements of typical measurement system (block diagram)

1.3 Standards of measurement (mass, length, time and current)

1.4 Static characteristics (accuracy, precision, sensitivity, linearity, repeatability, reproductibility, drift, dead zone, hysteresis, resolution)

1.5 Dynamic characteristics: concept, first and second order system
Example of first order: resistance transducer and thermal element
Example of second order: U-tube manometer and seismic motion
Speed of response, fidelity and lag.

1.6 Errors in measurements.

1.7 Transducers (Definition, classification and characteristics)

1.8 Problems.

CH-2 Measurement of Displacement and Force (06 periods)

2.1 Measurement of displacement (variable resistance, variable inductance, variable capacitance method.)

2.2 Measurement of force (load cell, column type devices, cantilever beam.)

2.3 Problems.

CH-3 Measurement of Pressure and Flow (12 periods)

3.1 Units of pressure and concept of vacuum, Absolute gauge and differential pressure.

3.2 Elastic transducers (diaphragm, corrugated diaphragm, bellows and Bourden tube.)

3.3 Electrical type- LVDT, strain gauge, piezoelectric.

3.4 Pressure transducer calibration by dead weight tester method.

3.5 Measurement of flow (Type of flow, classification of flow meters, Bernoulli's theorem [statement only] Venturi tube, Pitot tube, rotameter, ultrasonic flow meter.)

3.6 Problems.

CH-4 Measurement of Magnetic Field (06 periods)

4.1 Introduction to magnetic materials.

4.2 Hysterisis loop and its application.

4.3 Ballistic method for obtaining B-H curve

4.4 Measurement of magnetic field by search coil and Hall probe.

4.5 Problems.

CH-5 Biomedical and Environmental Instruments (08 periods)

5.1 Block diagram of ECG, MRI and B.P. apparatus- full form ECG, MRI, BP.

5.2 Pyranometer for solar radiation measurement.

5.3 Acoustics measurements, characteristic of sound, sound pressure and power level, Block diagram of sound level meter.

5.4 Hair Hygrometer, Smoke density measurement.

5.5 Problems.

Reference Books:

1. Instrumentation Device and System, Rangan, Mani Sharma, Tata Mc Graw Hill
2. Instrumentation Measurement and Analysis, Nakra, Choudhari, Tata Mc Graw Hill
3. Solar Energy, S.P. Sukhatme, Mc Graw Hill
4. Electricity & Magnetism, Khare, Shrivastav
5. Medical Instrumentation, Karr-Brown
6. Air pollution, M.N.Rao, H.V. Rao, Tata Mc Graw Hill
7. Hand Book of Biomedical Instrumentation, R.S.Kandpur, Tata Mc Graw Hill

S.Y.B.Sc. (PHYSICS)

Semester II (Paper I)

PH-221: OSCILLATIONS, WAVES AND SOUND

CH- 1 Undamped Free Oscillations (09 periods)

1.1 Different types of equilibria (stable, unstable, and neutral equilibrium)

1.2 Potential well and periodic oscillations, Approximation of a general potential well V(x) to a parabola for small oscillations

1.3 Definition of linear and angular S.H.M.

1.4 Differential equation of S.H.M. and its solution (exponential form)

1.5 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method)

1.6 Lissajous's figures and its uses, Applications (mechanical, electrical and optical)

1.7 Problems.

CH- 2 Damped Oscillations (09 periods)

2.1 Introduction

2.2 Differential equation of damped harmonic oscillator and its solution, discussion of different cases.

2.3 Logarithmic decrement

2.4 Energy equation of damped oscillations

2.5 Power dissipation

2.6 Quality factor

2.7 Application: LCR series circuit

2.8 Problems.

CH- 3 Forced Oscillations (10 periods)

3.1 Forced oscillation with one degree of freedom

3.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation

3.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapor lamp), electrical (LCR Circuit)

3.4 Velocity and Amplitude resonance

3.5 Sharpness of resonance

3.6 Energy of forced oscillations

3.7 Power dissipation

3.8 Quality factor and Bandwidth

3.9 Application of forced oscillations (LCR circuit)

3.10 Equation of coupled oscillations, electrically coupled oscillations

3.11 Problems

CH- 4 Wave Motion **(08 periods)**

4.1 Differential equations of wave motion in continuous media

4.2 Equations for longitudinal waves and it's solution (one dimension only)

4.3 Equation for transverse waves and its solution (one dimension only)

4.4 Energy density and intensity of a wave

4.5 Discussion of seismic waves

4.6 Problems

CH- 5 Doppler Effect **(06 periods)**

5.1 Explanation of Doppler effect in sound

5.2 Expression for apparent frequency in different cases.

5.3 Asymmetric nature of Doppler effect in sound

5.4 Doppler effect in light, symmetric nature of Doppler effect in light.

5.5 Applications: Red shift, Violet shift, Radar, Speed trap, Width of a spectral line.

5.6 Problems

CH- 6 Sound **(06 periods)**

6.1 Definition of sound intensity, loudness, pitch, quality and timber

6.2 Acoustic intensity level measurement

6.3 Acoustic pressure and it's measurement

6.4 Reverberation time and Reverberation of a hall

6.5 Sabine's formula (without derivation)

6.6 Stroboscope

6.7 Problems

Reference Books:

1. Waves and Oscillations, Stephenson
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, S. P. Puri, Tata McGraw- Hill, Publishing co. ltd.
4. A text book of sound, Subramanyam and Brijlal, Vikas Prakashan
5. Sound, Mee, Heinmann, Edition - London
6. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd.

S.Y.B.Sc. (PHYSICS)

SEMESTER II (PAPER II)

PH-222: OPTICS

CH- 1 Geometrical Optics (Lectures 08)

1.1 Introduction to development of Optics

1.2 Lenses: thin and thick lenses

1.3 Lens equation

1.4 Lens maker's formula

1.5 Cardinal points of an optical system

1.6 Combination of two thin lenses (equivalent lenses) (including derivation for focal length and cardinal points).

1.7 Problems.

CH- 2 Lens Aberrations (Lectures 08)

2.1 Introduction

2.2 Types of aberrations: monochromatic and chromatic aberration

2.3 Types of monochromatic aberration and their reduction

- 2.3.1 Spherical aberration
- 2.3.2 Coma
- 2.3.3 Astigmatism
- 2.3.4 Curvature of field
- 2.3.5 Distortion

2.4 Types of chromatic aberration: Achromatism (lenses in contact and separated by finite distance)

2.5 Problems.

CH- 3 Optical Instruments (Lectures 10)

3.1 Simple microscope and Compound microscope

3.2 Telescopes, Reflection and transmission type of telescope

3.3 Eyepieces: Huygen's eyepiece, Ramsden's eyepiece, Gauss's eyepiece

3.4 Constant deviation spectrometer

3.5 Problems

CH- 4 Interference and Diffraction (Lectures 12)

4.1 Classification of interference of thin films, Interference by division of amplitude

4.2 Interference by wedge shaped film: Interference due to reflected light and transmitted light.

4.3 Fringes of equal inclination, equal thickness, equal chromatic order (FECO fringes), colors of thin films

4.4 Interferometry: Michelson's interferometer and Fabry-Perot interferometer

4.5 Types of diffraction: Fresenel's diffraction and Fraunhoffer's diffraction

4.6 Fraunhoffer's diffraction at double slit and its analytical treatment, Fraunhoffer's diffraction at N slits

4.7 Plane diffraction grating

4.8 Rayleigh's criterian for resolution

4.9 Resolving power of a grating

4.7 Problems

CH- 5 Polarization **(Lectures 10)**

5.1 Introduction to polarization

5.2 Types of polarization- plane, circular, elliptical

5.3 Polarization by reflection of light

5.4 Brewster's law

5.5 Law of Malus

5.6 Polarisation by double refracting uniaxial crystals

5.7 Linear polarizer (Polaroid)

5.8 Fabrication of linear polarizer by Nicol prism

5.9 Problems.

Reference Books:

1. Optics, fourth edition, Pearson education, E. Hetch, A. R. Genesan
2. A Text book of Optics, N.Subhramanyam, Brijlal, M. N. Avadhanulu, S. Chand publication.
3. Introduction to Optics, Third Edition, F.L. Pedrotti, Pearson Education
4. Physical Optics by A.K.Ghatak, McMillan, New Delhi
5. Fundamental of Optics, F.A.Jenkins, H.E.White, McGraw-Hill international Edition.
6. Principles of optics, D.S. Mathur, Gopal Press, Kanpur
7. Optics and Atomic physics, D.P.Khandhelwal, Himalaya Publication Bombay.
8. Fundamentals of optics- Francies A Jenking, Harvey E.White, Tata McGraw Hill

S. Y. B. Sc. (PHYSICS)

PAPER III (SEMESTER I and II)

PH-223: PRACTICAL COURSE

Section I: 1) Oscillations, Waves and Sound (Any 4 experiments)

1. Resonance Pendulum: Determination of acceleration due to grevity (g)
2. Logarithmic decrement (in air and water)
3. Study of coupled oscillators comprising two simple pendulum (Mechanical)
4. Study of oscillations under gravitational and magnetic field.
5. Velocity of sound by Ruben's flame method
6. Stroboscope: Determination of frequency of AC mains or tuning fork.
7. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
8. Velocity of sound by phase shift method.
9. Audibility of human ear.
10. Directional characteristics of Microphone.

2) Optics (Any 4 experiments)

1. Newton's Ring: Determination of wavelength of monochromatic light source (λ)
2. Dispersive power of glass prism
3. Total internal reflection (using spectrometer, Na/Hg Source, glass prism) and determination of refractive index of a liquid.
4. Diffraction at straight edge/cylindrical obstacle
5. Optical activity of sugar solution (polarimeter)
6. Goniometer to determine cardinal points and focal length.
7. To determine temperature of sodium flame.
8. Dobule refracting prism.

Section II: 1) Electronics/Instrumentation (Any 6 experiments)

1. Circuit Theorems. (Thevenin's, Norton's and Maximum power transfer theorem)
2. Transistor characteristics (CE configuration)
3. RC coupled transistor amplifier (single stage)
4. Study of rectifiers (half wave and full wave), line and load regulations
5. I-V characteristics of UJT
6. Zener as a regulator.
7. Study of Wein bridge/Phase shift oscillator (using IC 741)
8. OPAMP as inverting and non inverting amplifier
9. OPAMP as an adder/subtractor.

10. Study of logic gates (using IC) and verification of De Morgan's theorem.
11. Use of CRO (AC/DC voltage measurement, frequency measurement).
12. To measure displacement (linear and angular) using potentiometer/variable inductor/variable capacitor.
13. To measure force using load cell.
14. To measure pressure using elastic diaphragm (in variable Capacitor/Bourden Tube)
15. To measure magnetic field using Hall Probe.

2) Computer (2 experiments)

1. Plotting of given data with Excel software.
2. Plotting various trigonometric functions using Excel/origin/graph softwares.

Ex: x^n and sin x

e^x and log x

e^{-x} and cos x

$\log_{10}x$ and tan x

Additional Activities (Any Two)

1) Demonstrations- Any 4 demonstrations equivalent to 2 experiments
2) Study tour with report equivalent to 2 experiments
3) Mini project equivalent to 2 experiments
4) Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities should be equivalent to twenty experiments.