Salient Features of Revised Syllabi in Physics

As far as possible to promote :

1) **Physics Education Through Master Texts :**

   It helps in understanding the theoretical and mathematical development of the subject and to create interest in the subject. So we are going to adopt the Master Texts, wherever possible, as our text books.

2) Physics Education Through Experimentation :

   It helps in general to improve scientific attitude. So emphasis is given on the development of experimental skills, data analysis, calculations, and also on the limitations of the experimental method and data and, results obtained.

3) Physics Education Through Problem Solving :

   It helps in understanding the concepts of physics. It underline the strength of equations, formulae, graphs, mathematical tools to tackle the problems. So accordingly, we have introduced compulsory problem part in the question paper; 25% for F. Y. B. Sc. and 37.5% for S.Y. B. Sc. and T. Y. B.Sc.

4) Physics Education through History and Philosophy :

   It helps in understanding the conceptual development of the subject and thereby increase the interest in the subject. A topic on this is introduced in the Emerging Physics Course.

5) Physics Education Through Awareness of Misconceptions :

   It improves the scientific awareness among the students. A discussion on Paradox etc. is encouraged.

6) Physics Education Through Proto-research:

   It creates interest in the subject and improves technological aspect. Accordingly, miniprojects, hands-on activities, projects, models and demonstrations etc. is included in the syllabi.

7) Physics Education Through Qualitative Overview :

   It creates interest in the subject to continue to work in the field of science in general and physics in particular. Accordingly future directions and frontiers of the subject are included in the syllabi.

F.Y. B.sc.

Physics

Paper I: Section I: Mechanics

1: Kinematics   **[8 Lectures]**

    1.1 Displacement, Time and Average Velocity

       (x-t graph illustrations to be included)

    1.2 Instantaneous Velocity

       (Finding of velocity on an x-t graph)

    1.3 Average and Instantaneous Acceleration

       (Illustration with $v - t$ and $a - t$ graph)

    1.4 Motion with Constant Acceleration

       (Illustration with $a - t$ and $v - t$ graph)

    1.5 Freely Falling Bodies

       (Up and Down motion in fall with y-t and v_y-t graph)

    1.6 Velocity and Position by Integration.

    1.7 Position and Velocity Vectors

    1.8 Acceleration Vector

    1.9 Problems

Ref. 1: Ch2

Ref. 2: Ch3

Ref. 3: § 1.1 & 1.3

2. Newton's laws of motion   **[6 Lectures]**

2.1 Newton's First and Second Law and their explanation

2.2 Working with Newton's First and Second Law.

2.3 Newton's Third Law of motion and its explanation with problems.

   Various types of forces in nature (explanation)

2.4 Pseudo Forces (e.g. Centrifugal Force)

2.5 Problems

Ref.1: Ch. 4 & 5

Ref.2: Ch. 5, Ch. 4

Ref.3: § 1.3

3: Work and Energy   **[8 Lectures]**

3.1 Kinetic Energy

3.2 Work and Work-Energy Theorem

3.3 Calculation of Workdone with

       i) Constant Force

       ii) Spring Force

       Illustration

3.4 Work-Energy Theorem

3.5 Potential Energy

3.6 Conservative and Non-conservative Forces.

3.7 Definition of potential energy and conservation of Mechanical energy.

3.8 Change in the potential energy in a rigid body motion.

    Mass-energy equivalence

    Problems

Ref.1: Ch.6

Ref.2: Ch.8

Ref.3: § 1.7

4 : Surface Tension   **[5 Lectures]**

4.1   Surface Tension (Definition), Angle of Contact, Revision of Capillary Rise Method.

4.2   Rise of liquid in capillary tube of insufficient length

4.3   Rise of liquid in a Conical capillary tube.

4.4   Energy required to raise a liquid in capillary tube.

4.5   Rise of liquid between two parallel plates.

4.6   Factors affecting surface tension.

4.7   Jeager's Method for Determination of surface tension

4.8   Applications of Surface Tension

Ref. : 5

5. Viscosity and Fluid Mechanics   **[9 Lectures]**

5.1 Fluids, Friction in Solid surfaces in contact verses Friction in Fluid

5.2 Pressure in a fluid

    5.2(a) Definition of buoyancy

5.3 Pascal's law

5.4 Atmospheric Pressure and Barometer

5.5 Archimedes' Principle

5.6 Pressure difference and Buoyant Force in accelerating fluids

5.7 Steady and Turbulent Flow.

5.8 Equation of continuity

5.9 Bernoulli's Principle

5.10 Application of Bernoulli's equation

       i) Speed of Efflux

       ii) Ventury meter

       iii) Aspirator Pump

       iv) Change of plane of motion of a spinning ball.

       v) Atomiser or spray

5.11 Aerodynamics, Concept of Aerofoil, Forces acting on aerofoil.

Ref.1: Ch.14

Ref.2: Ch.13

Ref.3: § 1.13

Ref.4: Ch.2 & 6

Reference Books:

1. University Physics,

   Sears and Zeemansky

   XIth edition, Pearson education.

2. Concepts of Physics

   H.C. Varma

   Bharati Bhavan Publishers

3. Problems in Physics

   P.K. Srivastava

   Wiley Eastern Ltd.

4. Applied Fluid Mechanics, Mott Robert

   Pearson Benjamin Cummir, VI Edition, Pearson Education/Prentice Hall International,

New Delhi

5. Properties of Matter, D. S. Mathur, Shamlal Chritable Trust New Delhi

F.Y.B.Sc.

Physics

Paper I: Section-II: Heat and Thermodynamics

1. Basic Concepts of Thermodynamics   **[6 lectures]**

   1.1   Thermodynamic state of a system

   1.2   Thermal Equilibrium

   1.3   Zeroth law of Thermodynamics

   1.4   Internal Energy of System-Concept of heat

   1.5   Equation of State : The Ideal Gas Equation

   1.6   Indicator Diagram

   1.7   First law of Thermodynamics

   1.8   Thermodynamic Process-Isothermal, Adiabatic, Isobaric, Isochoric.

   1.9   Adiabatic relations of system for perfect gas.

   1.10   Work done during Isothermal and Adiabatic changes.

   1.11   Reversible and Irreversible changes.

   1.12   Problems

2. Second Law of Thermodynamics: Entropy   **[9 lectures]**

   2.1   Conversion of Heat into Work and its converse

   2.2   Reversible and Irreversible Processes.

   2.3   Examples of Irreversible Processes.

   2.4   Carnot's Cycle and Carnot's Heat Engine and its efficiency

   2.5   Second law of Thermodynamics: Statements

   2.6   Carnot Theorem

   2.7   Entropy

   2.8   Principle of Increase in Entropy

   2.9   Generalised form of the First and Second laws:

               1)   Entropy changes for an Ideal Gas.

               2)   Entropy of van der Waals' gas.

   2.10 Problems

3. Heat engines & Refrigerators **[9 lectures]**

   3.1   Heat Engines

       3.1.1   Otto cycle and its efficiency

       3.1.2   Diesel cycle and its efficiency

       3.1.3   Comparison between Otto and Diesel cycle

   3.2   Refrigerators:

       3.2.1   General Principle and Coefficient of performance of refrigerator

       3.2.2   The Carnot Refrigerator

       3.2.3   Simple structure of vapour compression refrigerator

   3.3   Air conditioning: principle and its applications

   3.4   Problems

4. Equation of state and Thermodynamic relations **[8 lectures]**

   4.1   Various equations of state,

   4.2   Andrew's experiment,

   4.3   Amagat's experiment,

   4.4   van der Waals' equation of state, Critical constants,

   4.5   Reduced equation of state,

   4.6   Thermodynamic functions: Internal energy, Helmholtz' function, Enthalpy, Gibb's function.

   4.7   Problems

5. Thermometry **[4 lectures]**

   5.1   Principle and Types of Thermometry

   5.2   Gas filled and Liquid Filled Thermometers

   5.3   Problems

Reference Books:

1. Physics, 4th Edition, Volume I,

   Resnick/Halliday/Krane

   JOHN WILEY & SONS (SEA) PTE LTD.

2. Heat and Thermodynamics

Mark. W. Zemansky, Richard H. Dittman

Seventh Edition,

McGraw-Hill International Editions.

3. Thermal Physics

(Heat & Thermodynamics)

A.B. Gupta, H.P. Roy

Books and Allied (P) Ltd, Calcutta.

4. Heat and Thermodynamics

Brijlal, N. Subrahmanyam

S. Chand & Company Ltd, New Delhi

5. Thermodynamics and Statistical Physics

J.K. Sharma, K.K. Sarkar,

Himalaya Publishing House

6. Concept of Physics

H.C. Verma

Bharati Bhavan Publishers.

F. Y. B. Sc.
Physics
Paper – II, Section – I
EMERGING PHYSICS

1 : History and Philosophy of Physics   **(8 Lectures)**

1.1.   Introduction to the specific meaning of the world modern as in '*Modern Physics'*
1.2.   Early Modern Physics 16th century – scientific revolution, Work of Nicolus Copernicus
1.3.   Physics of 17th century –work of Galileo Galilei, Huygens, Robert Hooke, Torricelli, Vernier, Tycho Brache, Pascal, Kepler and Newton.
1.4.   Physics of 18th Century – Newton, Boyle and Young, Thompson, Coulomb, Amperes, Gauss, Biot – Savarts, Cavendish, Galvani, Franklin, Lagrange and Bernoulli
1.5.   Physics of 19th century – Volta, Dalton, Michael Faraday, Ohm, Oerested, Hamilton, Maxwell, J. J. Thomson, Clausius, Hall, Boltzmann, Joule, Mcihelson Morley expt, Miller, Tesla, Roentgen, Pierre and Marie Curie, Becquerel
1.6.   Physics of 20th century – Rutherford, Larmour, Lorentz, Einstein, Planck, Bohr, William, Bragg, Chadwick, Heisenberg, Fermi, Edwin Hubble, Karl Jansky, George Gamow, Pauli, Dirac, Max Born, Felix, Bloch, Ernest Lawrence, Shockley, Brattain, and Bardin, Fred Hoyle, Richard Feynman, Robert Mills, Murray Gell-Mann, Glashow, Abdus Salam, Steven Weinberg, K Onnes, A. Fert and Grunberg, Stephan Hawking.
1.7.   Indian Scientists : Bose, Raman, Saha and Chandrasekhar
Reference :
1.   http://en.wikipedia.org/wiki/History of Physics
2.   http://en.wikipedia.org/wiki/Nobel Prizes in Physics

2 : Lasers and Laser applications   **(8 Lectures)**

2.1.   A brief history of lasers
2.2.   Einstein prediction : The Three Processes
2.3.   Einstein's relations (qualitative discussion only)
2.4.   Pumping schemes (Ref.1, 1.1 – 1.12, 1.15, 1.16, 1.18-1.20)
2.5.   Characteristics of lasers (Ref.. 2, 11.7.1 – 11.7.4)
2.6.   Types of lasers : 1. Ruby laser, 2. He-Ne laser (Ref.1 , 2.2.1, 2.3.1)
2.7.   Applications of lasers (Ref. 2, 11.9, 11.10, 11.11, 11.12)

References :
1.   An introduction to Lasers – Theory and Applications
     M. N. Avadhanalu, S. Chand and Co, Ltd.
2.   Solid State Physics
     P. K. Palanisamy, Scitech Publications (India) Pvt. Ltd

3 : Sensors and Transducers   **(6 Lectures)**

3.1.   Overview – need, definition and qualities of transducers

3.2.   Temperature – thermocouples, thermisters, platinum resistance thermometer, IC temperature sensors, quartz thermometer, pyrometers, cryogenic temperature measurements

3.3.   Light Sensors-Photodiodes, Phototransistors, and Photomultipliers,

References :

1. Instrument measurement and Analysis by B. C. Narka and K. K. Chaudhary, Tata McGraw Hill Publishing Company 16th reprint Chapter 1.

4 : Bioelectricity   **(6 Lectures)**

4.1.   Electricity observed in living systems

4.2.   Origin of bioelectricity

4.3.   Sodium and potassium transport

4.4.   Resting potential and action potential

4.5.   Nernst's equation

4.6.   Conduction velocity

4.7.   Origin of compound action potential

4.8.   Neuron structure and function

4.9.   An axon as cable

4.10.   Membrane resistance and capacitance

Reference :

From Neuron to Brain, Kuffler and Nicholas,

Sinauer Associates, Inc Pub.

Sunderland, Masschuetts

5 : Nanomaterials

5.1.   Introduction

5.2.   Reduction of dimensions 3D, 2D, 1D, 0D materials.

5.3.   Surface and Interface effect

5.4.   Modelling of quantum size effect

5.5.   Synthesis of nano particles – Bottom Up and Top Down approach, Wet Chemical Method

5.6.   Idea of Biomimicking, naturally occurring nanocrystals

References :

1. Nanomaterial-

     Synthesis, Properties and Applications

         -   Edelstein, Camarata, Institute of Physics Publishing, Bristol and Philadelphia

2. Introduction to Nanotechnology

        Charles P. Poole Jr, Frank J. Owens

        John Wiley and Sons publications

3. Physics Education

        Vol. 14, No. 4, Jan – March 1998

4. Nanotechnology : Principles and Practices

        S. K. Kulkarni, Capital Publishing Company.

Physics Paper II, section II

ELECTRICITY AND MAGNETISM

1: ELECTROSTATICS   **(8 Lectures)**

1.1 Coulomb's law
1.1.1 Statement
1.1.2 Vector form of Coulomb's law for like and unlike charges.
1.1.3 Variation force with distance (F.vs.r graph) (Ref. 2, 21.3)

1.2 Superposition principle
1.2.1 Statement and explanation with illustration
1.2.2 Illustrations with specific configuration of three charges (triangular form) and four
charges (square form)
1.2.3 Problems on superposition principle

1.3 Energy of the system of charges
1.3.1 Illustration with three charges
1.3.2 Electric potential energy
(Ref. 1, 1.5 and Ref. 2, 23.1)

1.4 Concept of electric field
1.4.1 Electric field due to point charge
1.4.2 Electric field due to group of charges
1.4.3 Lines of force
1.4.4 Relation between electric intensity and electric potential
(Ref. 2, 21.4, 21.6, 22.1, 22.3, 23.5)

1.5 Concept of electric flux
1.5.1 Gauss's theorem in electrostatics (statement only and explanation)
1.5.2 Illustrations of Gauss law with examples.
(Ref. 2, 22.1, 22.3)

2 : DIELECTRICS   **(8 Lectures)**

2.1   Electric Dipole
2.1.1   Electric dipole and dipole moment
2.1.2   Electric potential due to dipole

2.1.3   Electric intensity due to dipole

2.1.4   Torque on electric dipole in external electric field

2.1.5   Polar and non – polar molecules with examples.

2.1.6   Effect of external electric field on polar and non – polar molecules.

2.2 Dielectric materials

2.2.1   Electric polarization of dielectric material

2.2.2   Electric polarization vector

2.2.3   Strength of dielectric material and Dielectric breakdown

2.2.4   Electric displacement and Gauss law in dielectric.

2.2.5.   Relation between three electric vectors (E, D and P)
             (Without derivation, qualitative discussion only)

2.2.6   Effect of dielectric on capacitance of problems (parallel plate capacitor only).

2.2.7   Problems

(Ref. 2, 21.7, 24.4, 24. 6)

3 : MAGNETOSTATICS (8 lectures)

3.1   Concept of magnetic field
         Definition and properties of magnetic field

3.2   Revision of Biot – Savart's law
         Examples :
                    1. Long straight conductor.
                    2. Current carrying circular loop on the axis

3.3.   Ampere's circuital law.
        Field of solenoid.
        Field of toroidal solenoid

3.4   Magnetic Field lines and Magnetic flux
       Gauss's law for magnetism

3.5   Problems
(Ref. 2, 27.2, 27.3, 28.2, 28.3, 28.4, 28.6) (Ref. 1, 6.2)

4 : MAGNETIC PROPERTIES OF MATERIAL   (7 lectures)

4.1.   Magnetic Materials
       Bohr magneton.

4.2.   Magnetisation (M), Magnetic Intensity (H) and magnetic induction (B)

4.3.   Magnetisation and Susceptibility and magnetic permeability

4.4. Relation between B, M and H (without derivation, qualitative discussion only)

4.5. Diamagnetic, paramagnetic and ferromagnetic. Explanation with the help of susceptibility and permeability .
Problems.

4.6. Hysteresis
(Ref. 2, 28.8)

5 : TRANSIENT CURRENTS **(5 lectures)**

5. 1 Transient currents

5.2 Growth of current in an inductive (LR) circuit

5.3 Decay of current in an inductive circuit
Physical meaning of time constant

5.4 Charging of condenser through resistance

5.5 Discharging of condenser through resistance
Time constant
(Ref. 2, 26.4, 30.4)

Reference books:

1 Berkeley Physics Course – Vol – II

Electricity and Magnetism. Edward M Purcell.

2 University Physics – H.D. Young

R. A. Freedman

Pearson – Freedman

3 Resnick and Halliday, Physics Vol – II

4. Electromagnetics by B.B.Laud

F. Y. B. Sc.
Physics paper III
Practical

1. Mechanics
(1) Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge, traveling microscope, spectrometer etc.)
(2) Interpretation of kinematics graphs – part I
From data plotting of x vs. t graph, From this graph plotting of v vs. t and a vs. t graph
(3) Interpretation of kinematics graphs – part II
From data plotting of a vs. t graph, From this graph plotting of v vs. t and x vs. t graph.
(4) Determination MI of disc using ring
(5) MI of Flywheel
(5) Determination of coefficient of viscosity by Poiseulli's method
(6) Determination of Y and n by flat spiral spring
(7) Determination of Y by bending
(8) Surface Tension by Jeager's method.

2. Heat and Thermodynamics
(1) Interpretation of isothermal and adiabatic curves on PV diagram (Theoretical).
Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
(2) Temperature coefficient of resistance
(3) Study of thermocouple and determination of inversion temperature
(4) Thermal conductivity by Lee's method
(5) Specific heat of graphite

3. Light
(1) Study of spectrometer and determination of angle of prism
(2) Spectrometer calibration. Determination of refractive indices of different colours and plotting the graph of refractive index vs . wavelength.
(3) Study of total internal reflection using LASER
(4) Study of polarization of light by reflection

(5) Determination of wavelength of LASER light by plane diffraction grating *or* cylindrical obstacle

4. **Electricity and magnetism**
    (1) Charging and discharging of a capacitor
    (2) Study of LR circuit
    (3) Study of LCR series circuit
    (4) Study of Krichhoff's laws
    (5) Diode characteristics
    (6) Study of multimeters (all AC, DC ranges, Least Count)
    (7) Determination of frequency of AC mains

Students have to perform minimum three experiments from each section and total sixteen experiments.

Additional Activities
1. **Demonstrations**
    (Any four demonstrations equivalent to two experiments)
    (1) Electromagnetic induction by using two coils
    (2) Magnet –magnet interaction
    (3) Collision by using balls
    (4) Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
    (5) Demonstration of action potential
    (6) Measurement of sound pressure level

2. **Computer aided demonstrations (Using computer simulations or animations)**
    (Any two demonstrations equivalent to two experiments)
    (1) Coulomb's law
    (2) Vectors : visualization of vectors
    (3) Bohr's model
    (4) Carnot engine, diesel engine
    (5) Graphs and their slopes, and Kinematics graphs (using computer simulations)

3. **Mini projects/Hand on activities**
    (Any one equivalent to two experiments)

(1) Students should carry out miniprojects

(2) Study of any two Laboratory equipments (e.g. Luxmeter, Sound Pressure level meter, Sphygmomanometer (Blood Pressure meter), Pulsoximeter)

4. **Study tour (Equivalent to two experiments)**

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

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