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Item No. – 4.19

University of Mumbai

Syllabus for

B.Sc. Interdisciplinary

(Credit Based Semester and Grading system)

for

Physics courses

USIDPH01 & USIDPH02

With effect from the academic year 2014-15

These courses are to be offered by learners at Semester I or II or III or IV depending on the offers made by the respective institutions.

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Preamble:

As per the perspective plan of the University which was approved by the Management Council on 11th September 2013 & subsequently by the Academic Council on 19th September 2013, University of Mumbai is going to offer B.Sc. Interdisciplinary programme under the category of Innovative programmes from the academic year 2014-2015. The main objective of this course is to make the learner well versed with all science disciplines as science graduate so that he/she can have scope in schools, banks or any offices as well as they can persue post graduation in the major subject.

The Rational:

The basic thoughts and understanding in the programme of BSc with interdisciplinary science is, many or around 60 % students after their graduation leave higher education and opt for jobs. These jobs are in Government offices, Municipal Corporations, private companies or, in schools as teachers. They are absorbed as science graduates. Even when the students opt for management carriers they are considered as science graduates at entry level. Thus the specialization or the major subject does not have relevance unless the students want to pursue the carrier in the field of research or higher education. Similarly those who enter in jobs of teachers find it difficult to teach other science subjects as required, than the subject of specialization, because they are not exposed to those branches of science.

With all these requirements of job market University has decided to introduce the graduation course in science as BSc interdisciplinary science. In this a learner can take two subjects from science discipline at first year level, from among these one subject can be selected at Second Year and the same will be continued as major subject along with applied component for final year B. Sc. The learner will earn 70 credits as explained in this subject like the existing system.
In first year instead of the third subject the learner can opt any subject from the prescribed modules and as per the availability in the college / institute where admitted. These modules can be called as interdisciplinary modules. At the second year level instead of the second minor subject the learner can opt the modules from the interdisciplinary modules. The foundation course is also modified for interdisciplinary science which includes topics like Law, Economics, Sociology, Political Science etc.

Thus the learner will earn 70 credits in the major subject as obtained by any student in current traditional method. The remaining 50 credits can be earned from the interdisciplinary courses. The modules of interdisciplinary courses can be from science branches or arts / commerce / law / fine arts branches.

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.

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Course	Title
USIDPH01	Mechanics, Heat and Thermodynamics
USINPH02	Modern Physics, Electromagnetics

For each theory course:45 Lectures per course /2Credits per course. Each course will have minimum 4 practicals

MODULE I
USIDPH01

Mechanics, Heat and Thermodynamics

Lectures: 45 Credits:2

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 analyse the forces on the object.
3. Understand the concepts of energy, work, power, and the concepts of conservation of energy.
4. Understand the concepts of elasticity, surface tension and be able to perform calculations using them.
5. Understand the properties of and relationships between the thermodynamic properties of a pure substance.
6. Apply the laws of thermodynamics to formulate the relations necessary to analyse a thermodynamic process.
7. Understand the types of thermometers and their usage.
8. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I

1. Newton's laws of motion (8)

Newton's First, Second and Third Law and their explanation, working with Newton's First and Second Law. Various types of forces in nature, concept of field. Frame of reference (Inertial, Non-inertial), Pseudo Forces (e.g. Centrifugal Force)

2. Work and Energy (7)

Kinetic Energy, Work and Work-EnergyTheorem, Calculation of Workdone with Constant Force, Variable Force, Illustration. Conservative and Non-conservative Forces. Potential energy and conservation of Mechanical energy. Change in potential energy in rigid body motion, Mass-energy equivalence

Unit II

1. Elasticity (6)

Hook's law and coefficient of elasticity, Young's modulus, Bulk modulus and Modulus of

rigidity, Work done during longitudinal strain, volume strain, and shearing strain, Poisson's ratio, Relation between three elastic moduli(Y, η,K)
Determination of Y of rectangular thin bar loaded at the centre,

2. SurfaceTension (5)

Surface Tension, Angle of Contact, Capillary Rise Method, Energy required to raise a liquid in capillary tube, Factors affecting surface tension, Applications of Surface Tension

3. Viscosity and Fluid Mechanics (4)

Concept of Viscous Forces and Viscosity, Pressure in a fluid and buoyancy, Pascal's law, Pressure difference and Buoyant Force in accelerating fluids, Steady and Turbulent Flow, Reynolds's number, Equation of continuity, Bernoulli's Principle, 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.

Unit III

1. Concepts of Thermodynamics (6)

Thermodynamic state of a system and Zeroth law of Thermodynamics,Thermodynamic Equilibrium, Adiabatic and isothermal changes, Work done during isothermal changes, Adiabatic relations for perfect gas, Work done during adiabatic change, Indicator Diagram, First law of Thermodynamics, Reversible and irreversible processes

2. Applied Thermodynamics (5)

Conversion of Heat into Work and its converse, Carnot's Cycle and Carnot's Heat Engine and its efficiency, Second law of Thermodynamics

3. Thermometry (4)

Temperature Scales: Centigrade, Fahrenheit and Kelvin scale
Principle, construction and working of following thermometers

i. Liquid and gas thermometers
ii. ResistiveTypeThermometer
iii. Thermocouple as thermometer

Reference Books:

1. Concepts of Physics: H. C. Varma, Bharati Bhavan Publishers
2 Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
3. University Physics: Sears and Zeemansky, XIth edition, Pearson education
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
6. Mechanics: D.S Mathur,S Chand and Company New Delhi-5.
7. Physics: 4th Edition,Volume I, Resnick/Halliday /Krane JOHN WILEY & SONS (SEA) Pvt LTD
8. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S.Chand & Company Ltd, New Delhi
9. Thermal Physics (Heat &Thermodynamics):A. B. Gupta, H.P. Roy Books and Allied (P) Ltd, Calcutta.

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Practicals USIDPHP1:

A. 1. MI of Flywheel
2. Determination of coefficient of viscosity by Poiseulli's method
3. Determination of Y and n by flat spiral spring
4. Determination of Y by bending
5. Surface Tension by Jaeger's method.
6. Temperature coefficient of resistance
7. Study of thermocouple and determination of inversion temperature
8. Thermal conductivity by Lee's method

Students have to perform minimum five experiments from above list (A) and record them in journal. Certified journal is compulsory in order to appear for the practical exam. The practical examination will be based on these experiments.

B. Any one equivalent to two experiments

1. Students should collect the information of at least five Physicists with their work.
2. Students should carry out mini-project
3. Study tour. Students participated in study tour must submit a study tour report.

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Module II
USIDPH02

Modern physics and Electromagnetics

Lectures:45 Credits:2

Learning Outcomes:

On successful completion of this course learners 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. To understand the general structure of atom, spectrum of hydrogen atom.
4. To understand the atomic excitation and LASER principles.
5. Demonstrate an understanding of the electric force, field and potential, and related concepts, for stationary charges.
6. Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
7. Demonstrate an understanding of the magnetic field for steady currents using Biot-Savart and Ampere's laws.
8. Demonstrate an understanding of magnetization of materials.
9. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I

1. Physics of Atoms (8)

Atomic Models: Thompson and Rutherford, Atomic Spectra, Bohr Theory, Hydrogen atom Spectra, Frank Hertz experiment, The LASER, Absorption, Spontaneous Emission, and Stimulated Emission, Population, Inversion and Laser Action, Applications of Lasers.

2. Electromagnetic Waves (7)

Historical Perspective and production of Electromagnetic Waves, Hertz experiment, Electromagnetic spectrum, Planck hypothesis of photons (Concept only), Sources of electromagnetic waves: Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X-rays, Gamma rays, Applications of electromagnetic waves: micro-wave oven, RADAR, X-ray radiography and CT Scan, Solar cell

Unit II

1. Electrostatics (15)

Revision of Coulomb's law, Superposition principle, Electric field due to an electric dipole, line and disc, Revision of Gauss's law, Coulomb's law from Gauss's law, Gauss's law applications in Cylindrical, planar and spherical symmetry, Electric Dipole, Electric dipole and dipole moment, Electric potential and intensity at any point due to dipole, Torque on a dipole placed in an electric field

Unit III

1. Magnetostatics (7)

Revision of Biot-Savart's law with examples, Amperes' law,e.g.Solenoid and Toroid, Gauss law for magnetism

2. Magnetic properties of materials (8)

Magnetic materials and Bohr magneton, Magnetization (M), magnetic intensity(H), magnetic induction(B), magnetic susceptibility and permeability, Relation between B, M and H, Hysteresis.

References

1. Concepts of Modern Physics: A Beiser (6th ed.,Mc Graw Hill, 2003
2. Modern Physics: Raymond A. Serway, Clement J Moses, Curt A. Moyer
3. Sears and Zemansky's University Physics: H.D. Young R.A. Freedman, Sandin (11thEd. Pearson Education)
4. Nanotechnology: Principles and Practices:S. K.Kulkarni, Capital Publishing Company.
5. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar
6. Electromagnetics: B. B. Laud

Practicals: A:

1. Spectrometer calibration. Determination of refractive indices for different colours and plotting the graph of refractive index vs wavelength.
2. Study of total internal reflection using LASER
3. Study of polarization of light by reflection
4. Determination of wavelength of LASER light by plane diffraction grating or cylindrical obstacle.
5. Charging and discharging of a capacitor
6. Study of LR circuit
7. Study of Kirchhoff's laws
8. Determination of frequency of AC mains

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