Department of Physics
School of Basic & Applied Sciences
H.B.T.U. Kanpur

Minutes of BOS meeting of Physics Department

A meeting of BOS was organised by the Physics department on 10.03.2018 at 11:00 A.M. to discuss the Course Structure and to revise the curriculum of Physics to make it suitable for new entrants of B.Tech. Programme (Engg. & Technology), Second year undergraduate degree course in Electronics Engineering and pre PhD courses of this University as per AICTE guidelines. The following members participated in the meeting:

1.	Prof. R.K.Shukla	Convener & HOD Physics
2.	Dr. S.K.Sharma	Member
3.	Prof. Ashok Kumar	Member
4.	Prof. M. Zulfequar	Member
5.	Dr. Hari Om Yadav	Member

After welcoming the members in the first meeting of BOS of the university, a thorough discussion on the course structure & curriculum of Physics took place on the basis of "Model Curriculum for Undergraduate Degree Courses in Engineering & Technology, January 2018 (Volume –I and Volume – II) of All India Council for Technical Education (AICTE).

The following decisions were taken:

1. All members were agreed for the merger of Theory & lab courses for new entrants within one course (BPH 101/102).
2. All members agreed with the course content to be taught to new entrants during I & II semester of B.Tech. programme.
3. The total credits for the combined Theory & Lab course of new entrants should be strictly in accordance with "Model Curriculum for Undergraduate Degree Courses in Engineering & Technology, January 2018 (Volume –I and Volume – II) of All India Council for Technical Education (AICTE), which is 5.5.
4. The above modifications should be effective from July, 2018.
5. The End Semester Examination of Physics Lab should also be conducted for new entrants.
6. The course structure, credits and evaluation scheme for second year B.Tech. Electronics Engineering and Pre. PhD courses were also approved.

(Prof. Ashok Kumar) 10.03.2018
Member

(Prof. M.Zulfequar)
Member

(Dr. Hari Om Yadav) 10/3/18
Member

(Dr. S.K.Sharma)
Member

(Prof. R.K.Shukla)
Convener & HOD Physics

Course Objective, Structure, Credits & Assessment Scheme

Course Objective: To understand the fundamentals of Physics and to apply these in solving engineering problems.

Course Code	BPH – 101 / 102				
Category	Basic Science Course				
Course Title	Physics (Theory & Lab.)				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester- I / II
	3	**1**	**3**	**5.5** Proposed	
Assessment Scheme	**Sessional : 50 Marks** **End Semester Exam : 50 Marks**				
Course Content	**Attached below**				

Reader

Dr. R. K. Shukla
Professor & Head
Department of Physics
H.B.T.U, Kanpur

Course Objective, Structure, Credits & Assessment Scheme

Course Objective: To understand the fundamentals of Physics and to apply these in solving engineering problems.

Course Code	BPH – 101 / 102				
Category	Basic Science Course				
Course Title	Physics (Theory & Lab.)				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester- I / II
	3	**0**	**2**	**4**	Implemented Recently.
Assessment Scheme	**Sessional : 50 Marks** **End Semester Exam : 50 Marks**				
Course Content	**Attached below**				

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Course Content: Physics (Theory & Lab)

Code: BPH – 101/102

Pre-requisites	Basic knowledge of Maths (12^{th} level) and preliminary idea of Vector calculus

MODULE- 1 (Lectures: 08)

Introductory Mechanics& Theory of Relativity:

Potential energy function F = −grad (V), equipotential surfaces, meaning of gradient, divergence, curl and their physical significance, Conservative and Non-Conservative forces, Curl of a force, Central forces, Examples of Central forces,Conservation of Angular Momentum,.

Inertial and Non- Inertial Frames of reference, Galilean transformation, Michelson Morley Experiment, Lorentz Transformation, Length contraction, Time dilation and Evidences for time dilation, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Einstein's Mass energy equivalence, Examples from nuclear physics, Relativistic energy momentum relation.

MODULE -2 (Lectures: 08)

Quantum Mechanics-Schrodinger Equation and its Applications:

Dual Nature of matter & Radiation, Heisenberg's uncertainty Principleand their applications, wave group concept, Davisson Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.

Application of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional).

MODULE – 3 (Lectures: 08)

Electromagnetic Theory:

Ampere's law and Faraday's law of electromagnetic induction, Maxwell's equations, Correction of Ampere's law by Maxwell (concept of displacement current), transformation from integral to differential form, Physical significance of each equation,Poynting theorem, Maxwell's equations in free space, velocity of electromagnetic wave, Transverse character of the wave and orthogonality of **E**, **H** and **v** vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media, Solution of differential equation in this case,penetration depth, its significance.

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MODULE – 4 (Lectures: 08)

Materials of Technological Importance:

Dielectric Materials: Electric field in presence of dielectric medium,concept of electric polarization, different types of polarizations, dielectric in a.c. field,concept of dielectric loss and loss energy.

Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.

Nano Materials: Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

MODULE: 5 (Lectures: 08)

Statistical Mechanics & Lasers:

Phase space, the probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applicationsof Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above case, Bose-Einstein Statistics, application to black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law. Fermi – Dirac statics, application in case offree electrons in metals, energy distribution, Fermi energy.

Lasers: Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, properties of laser beams, mono-chromaticity, coherence, directionality, and brightness, applications of lasers

References:

1. Physics, Marcelo Alonso, J. Finn Edwards, Addison Wesley
2. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
3. Engineering Physics, R. K.Shukla, Pearson Education
4. Electrical Engineering Materials, R.K.Shukla, McGraw Hill
5. Introduction to Electrodynamics, David Griffiths, Cambridge University Press
6. Principles of Engineering Physics, R.K.Shukla, Ira Books
7. Introduction to Solid State Physics, Charles Kittel, Willey

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List of Experiments: (Any ten experiments)

1. To determine the energy of band gap of a N-type Ge-semiconductor using four probe method
2. Verification of Stefan's fourth power law for black body radiation, determination of the exponent of the temperature
3. Study of thermoelectricity: Determination of thermo-power of Copper-constantan thermo-couple
4. To study the variation of magnetic field with distance along the axis of current carrying coil and then to estimate the radius of the coil
5. Study of Carrey Foster's bridge: determination of resistance per unit length of the bridge wire and of a given unknown resistance
6. Determination of specific charge (charge to mass ratio; e/m) for electron
7. Study of tangent galvanometer: determination of reduction factor and horizontal component of earth's magnetic field
8. Determination of the wavelength of sodium light using Newton Rings' method
9. To determine the concentration of sugar solution using half shade polarimeter
10. Determination of wavelength of spectral lines of mercury (for violet, green, yellow-1 and yellow-2) using plane transmission grating
11. Determination of charge sensitivity and ballistic constant of a ballistic galvanometer
12. To determine the wavelength of spectral lines of hydrogen & hence to determine the value of Rydberg Constant
13. Draw the V-I characteristic of Light Emitting Diode (LED) and determine the value of Planck's constant

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Course Outcome

Module -1 To understand and to apply principle of conservation of momentum. e.g. in rocket propulsion and in many other space applications.
To understand the theory of relativity and to analyse how the physical quantities undergo drastic changes in their original value at very high velocities and also to see how its principles are applicable in particle accelerators, nuclear devices as an alternative sources of energy and for defence purpose.

Module-2 To understand the basics of quantum mechanics, and to apply its principles to learn the phenomena that occur at subatomic dimensions.

Module–3 To understand and to apply Maxwell's equations which forms the basis of electromagnetic theory. This has a wide application in communication systems. All the information propagating in the universe utilises the principle of electromagnetic theory.

Module–4 To study the fundamentals of material science especially dielectric materials, semiconducting materials and nanomaterial and to apply the knowledge to use how dielectrics are used for the storage of charge. infrared detectors, crystal oscillators, manufacture of microphones, headsets loudspeakers, transducers, ultrasound applications, gas ignitors, accelerometers etc.

Semiconductor material technology which has completely changed the scenario by replacing the older vacuum tube technology, are another technologically important materials which are widely used in LEDs, miniaturisation of electronic devices and to develop materials with improved efficiency and economy.

Nanotechnology is the most emerging field at present and is extremely important. It has got various applications in many areas including information technology, biomedical, energy-storage, automotive industry, electronics industry, textiles and chemical industries.

Model – 5 To understand the statistical behaviour of the constituent particles which give rise to form a material, and to apply the principles of statistical mechanics and to understand the basics of Laser.

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Proposed Curriculum
for
Second Year Undergraduate Degree Course
in
Electronics Engineering

Solid State Physics

Couse Code: BPH - 402

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Course Objective, Structure, Credits & Assessment Scheme

Course Objective: To get acquainted with basics of Solid State Physics and to apply these in Material Science.

Course Code	**BPH – 402**				
Category	Basic Science Course				
Course Title	Solid State Physics				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester- IV
	3	**1**	**0**	**4**	
Assessment Scheme	**Sessional : 50 Marks** **End Semester Exam : 50 Marks**				
Course Content	**See Attachment**				

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Course Content: Solid State Physics

Code: BPH – 402

MODULE- 1 (Lectures: 08)

Crystal Structure & Atomic Bonding:

Classification of solids, space lattice, Bravias lattice, primitive and Non-primitive unit cells, co-ordination number, atomic packing factor, atomic radii, crystal structure and Miller indices, inter planner spacing, some important structures

Primary and secondary bonds, ionic bonds, covalent bonds, metallic bonds, hydrogen bond, Vander-Wall bond, forces between atoms, bond dislocation energy cohesive energy

MODULE -2 (Lectures: 08)

Crystal Defects and X-Ray diffraction:

Various kinds of crystal imperfections, point defect, Schottky defect and Frenkel defect, Dislocations, edge and screw dislocation, grain boundary, effect of defects on electrical properties of materials. Bragg's law. Laue's pattern, X-ray diffractometer, determination of lattice parameter using XRD, absorption edge

MODULE – 3 (Lectures: 08)

Band Theory of Solids:

Free electron model, Allowed and forbidden energy bands, formation of energy bands, classification of materials on the basis of energy bands, energy bands in insulators and semiconductors, Fermi energy, effect of impurity addition on the position of Fermi-level in Semiconductors

MODULE – 4 (Lectures: 08)

Semiconductors:

Semiconductors, carrier generation and recombination, carrier drift and carrier diffusion, concept of Fermi energy, effect of temperature and impurity addition on the conductivity of semiconductor, mobility of charge carriers, effect of temperature on mobility, Hall effect in semiconductors, junction properties, compound semiconductors of interest in optoelectronic devices, absorption process, photoconductivity and dark conductivity, photo-voltaic effect, photoluminescence, color centres, types of color centres, generation of color centres

MODULE: 5 (Lectures: 08)

Superconductivity:

Super conduction state, dependence of electrical resistivity on temperature, superconductivity, Meissner effect, qualitative explanation of superconductivity. High

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temperature superconductors, critical magnetic field and critical current, application of superconductors,

References:

1. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
2. Electrical Engineering Materials, R.K.Shukla, McGraw Hill
3. Introduction to Solid State Physics, Charles Kittel, Willey
4. Solid State Physics, Adrianus J. Dekker, Prentice-Hall Technical Books

Course Outcome

- To understand the fundamentals of solid state physics and to apply the knowledge to solve the problem of material science.
- To get the basic knowledge of crystal systems, spatial symmetries, crystalline and amorphous materials.
- To acquire the knowledge of X- Ray diffraction, and to apply it to determine various parameters related with crystal structure.
- To get the basic knowledge of thermal and electrical properties of materials.
- To understand the fundamental principles of nonpolar semiconductors and compound semiconductors and to apply it in electronic devices.
- To understand the basic concept of Fermi energy.
- To understand the importance of solid state physics in the modern society for developing new materials.

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