JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : BSc

Proposed Course :Physics

Semester VI

Credit Based Semester and Grading System (CBGS) with effect from the academic year 2020-21

T.Y.B.S.c Physics Syllabus

Academic year 2020-2021

Semester VI			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SPHY601	Classical Mechanics	4	4
SPHY602	Solid State Physics	4	4
SPHY603	Nuclear Physics	4	4
SPHY604	Special theory of relativity	4	4
SPHY6PR1	Practical I	4	8
SPHY6PR2	Practical II	4	8

Semester VI– Theory

Course code: SPHY601	**Classical Mechanics (Credits: 04, Lectures/Week: 04)**	
	Objectives: To learn basic concepts in classical mechanics **Outcomes:** Students should be able to: 1. understand different aspects of central force motion, moving coordinate systems, fluid mechanics and mechanics of rigid bodies 2. frame classical Lagrange's equations for various problems encountered in classical mechanics. 3. understand basic concepts of non linear mechanics.	
Unit I	**Central Force** 1. Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem. 2. Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem.	**15 L**
Unit II	**Lagrange's equations** 1. D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of nonholonomic constraints, degrees of freedom and generalized coordinates, virtual displacement, virtual work, D'Alembert's principle, illustrative problems. 2. Lagrange's equations (using D'Alembert's principle), properties of Lagrange's equations, illustrative problems, canonical momentum, cyclic or ignorable coordinates.	**15 L**
Unit III	**Fluid Motion and Rigid body rotation** Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. 2. Rigid dynamics: introduction, degrees of freedom, rotation about an axis: orthogonal matrix, Euler's theorem, Eulerian angles, inertia tensor, angular momentum of rigid body, Euler's equation of motion of rigid body, free motion of rigid body, motion of symmetric top (without notation).	**15 L**
Unit IV	**Non Linear Mechanics** 1. Nonlinear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation. 2. Transition to chaos: Bifurcations and strange attractors, Aspects of chaoticbehavior	**15 L**

CA (Continuous Assessment)	Class test, Seminars, Assignments and Class performance.	

Textbook:

1. PVP: Classical Mechanics, P. V. Panat (Narosa).
2. KRS: Mechanics : Keith R. Symon, (Addision Wesely) 3rd Ed.
3. BO: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.)

Additional References:

1 Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.).

2.An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata Mc Graw Hill (Indian Ed. 2007).

3.Chaotic Dynamics- an introduction: Baker and Gollub (Cambridge Univ. Press).

4. Classical Mechanics: J. C. Upadhyaya (Himalaya Publishing House).

Course: Code SPHY602	SOLID STATE PHYSICS **(Credits 04: Lectures/Week: 04)**	
	Objectives: 1. Understand crystal defects in real crystals, ligancy and Superconductivity. 2. Understand electrical properties of metals and Band theory of solids. 3. Understand the basic concepts of conduction in semiconductors and junction diode theory. **Outcome:** To study the basics of Solid State Physics and Semiconductor Physics	
Unit I	**Electrical properties of metals:** Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states (derivation omitted) and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory.	15
Unit II	**Thermionic Emission and Band theory of solids :** Thermionic Emission, Richardson- Dushman equation. The Kronig- Penney model, Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, concept of effective mass, Distinction between metals, insulators and intrinsic semiconductors.	15
Unit III	**Superconductivity and Real crystals:** Superconductivity: Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS theory of superconductivity, band gap of superconductors Type I and Type II Superconductors, Hi-Tc superconductors . Application : MagLev and SQUID Real crystals: Crystal defects(1-D,2-D,3-D); Ionic crystal ligancy (3,4,6,8).	15

Unit IV	**Semiconductor Physics and Junction Diode Theory:** Electrons and Holes in an Intrinsic Semiconductor, Conductivity of a Semiconductor, Carrier concentrations in an intrinsic semiconductor, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect. Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics.	15
CA (Continuous Assessment)	Class test, Seminars, Assignments and Class performance.	
References:	References: 1. M.Ali Omar, 2012, *Elementary Solid State Physics-Principles and Applications*, Pearson Education 2. S. O. Pillai, 6th Ed, *Solid State Physics*, New Age International Publications 3. Millman, Halkias & Satyabrata Jit., 3rd Ed.*Electronic Devices and Circuits*, Tata McGraw Hill. 4. Charles Kittel, 7th Ed, *Introduction to Solid State Physics*-. John Wiley & Sons 5. S.O. Pillai, 2008, *Modern Physics and Solid State Physics: Problems and solutions*, New Age International. Additional References: 1. A. J. Dekker,1st edition, *Solid State Physics*, Prentice Hall. 2. Rolf Hummel, 3rd Ed, *Electronic Properties of Materials*, Springer. 3. S. M. Sze, 2nd ed, *Semiconductor Devices: Physics and Technology*. John Wiley & Sons. 4. Ashcroft & Mermin,1st ed., *Solid State Physics*: Harcourt College Publisher.	

Course code: SPHY603	**Nuclear Physics (Credits: 04, Lectures/Week: 04)**	
	Objectives: To learn basic concepts in nuclear physics **Outcomes:** **1. To understand alpha , beta, gamma decay processes** **2. To understand Nuclear models and particle accelerators** **3. To learn about elementary particles and quark model**	
Unit I	**Alpha and beta decay** 1. Alpha decay: Velocity, energy and absorption of alpha particles, Range, Ionization and stopping power, Nuclear energy levels, range of alpha particles, apha particle spectrum, fine structure, long range alpha particles, alpha decay paradox, barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law) 2. Beta decay: Introduction, velocity and energy of beta particles, energy levels and decay schemes, continuous beta ray spectrum, difficulties encountered to understand it, pauli's neutrino hypothesis, detection of neutrino, energetics of beta decay.	**15 L**
Unit II	**Gamma decay and nuclear models** 1. Gamma decay: Introduction, internal conversion, nuclear isomerism, mossbauer effect 2. Nuclear Models: Liquid drop model, Weizsacher's semi-empirical mass formula, Mass parabolas- prediction of stability against beta decay for members of an isobaric family, stability limits against spontaneous fission Shell model(Qualitative), magic numbers in the nucleus	**15 L**
Unit III	**Nuclear Energy & Particle Accelerators** **1. Nuclear energy:** Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion. **2. Particle Accelerators:** Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider.	**15 L**

Unit IV	**Nuclear force & Elementary particles** **1. Nuclear force:** Introduction, Deuteron problem, Meson theory of Nuclear Force- A qualitative discussion. **2. Elementary particles:** Introduction, Classification of elementary particles,Particle interactions, Conservation laws (linear &angular momentum, energy,charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and anti-neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative).	**15 L**
CA (Continuous Assessment)	Class test, Seminars, Assignments and Class performance.	

Textbook:

- Modern Atomic and Nuclear Physics, A.B.Gupta, Book and Allied Pvt. Ltd., 2014
- Concepts of modern physics, Arthur Beiser, Tata mac graw hill publications, 6th edition
- Nuclear Physics, S. B. Patel, Willey Eastern Ltd, 2nd edition.
- Nuclear Physics, S. N. Ghoshal, S. Chand and publications, 2010.

Additional References:

- Nuclear Physics, D. C. Tayal, Himalayan publishing house, 5th edition.

Course code SPHY604	**Special Theory of Relativity (Credits 04: Lectures/Week: 04)**	
	Objectives: On sussessful completion students should know 1. The need to improve laws of physics and the attempts in details. How Einstein solved the problem. Understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, Absolutism and relativity, Common sense versus Einstein concept of Space and time. 3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, Energy, Charge and current density, electric and magnetic fields. **Outcome:** 1. Understand the significance of Michelson Morley experiment and failure ofthe existing theories to explain the null result 2. Solve problems based on length contraction, time dilation, velocity addition, Doppler effect, mass energy relation and resolve paradoxes in relativity like twin paradox etc. Learn Minkowki techniques for the same.	
Unit I	**Introduction to Special theory of relativity:** Inertial and Non-inertial frames of reference, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment (omit derivation part), Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and Ether drag hypothesis (conceptual), Stellar aberration, Attemptto modify electrodynamics. **Relativistic Kinematics - I**: Postulates of the special theory of relativity,Simultaneity, Derivation of Lorentz transformation equations. length contraction, time dilation and meson experiment, The observer in relativity.	**15 L**
Unit II	**Relativistic Kinematics - II**: The relativistic addition of velocities, acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. **The Geometric Representation of Space-Time:** Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox.	**15 L**
Unit III	**Relativistic Dynamics**: Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass.	**15 L**
Unit IV	**Relativity and Electromagnetism**: Introduction, The interdependence of	**15 L**

	Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, The invariance of Maxwell's equations. The principle of equivalence and general relativity, Gravitational red shift.	
CA (Continuous Assessment)	Class test, Seminars, Assignments and Class performance.	

Textbook:

1. Introduction to Special Relativity:, Robert Resnick, (Wiley Student Edition) 1968

Additional References:

1. Special theory of Relativity, A. P. French, CRC press,

2. Very Special Relativity – An illustrated guide: Sander Bais - Amsterdam University Press.

3. Concepts of Modern Physics, Arthur Beiser. Peterson, 6th Edition 2003

Course Code SPHY6PR1 and SPHY6PR2	Practical-I and Practical- II (Credits-08, Lectures/week-16)
SPHY6PR1	1. Study of JFET characteristics 2. Study of UJT characteristics 3. Study of Photo diode characteristics 4. Study of Photo transistor characteristics 5. Determination of h/e by photocell 6. Brewster's law 7. Koenig's method 8. Determination of Poisson's ratio 9. Hall effect 10. Flat spiral spring
SPHY6PR2	1. R. P. Of Prism 2. Application of Op-Amp as a Log amplifier 3. Application of Op-Amp as a differentiator (BB) 4. IC-555 as astable multivibrator and VCO 5. LM-317 as variable voltage source 6. Schmitt Trigger 7. Seven segment display 8. IC 555 as a monostable multivibrator 9. Determination of mutual inductance by BG
Both SPHY6PR1 and SPHY6PR2 Demonstrations	1. Open CRO, Power Supply, and Signal Generator: block diagrams 2 Data sheets: Diodes, Transistor, Op-amp & Optoelectronic devices 3.Amplitude modulation 4. Zeeman Effect 5. Michelson's interferometer 6.Iodine absorption spectra 7.Ultrasonic interferrometer
CA (Continuous Assessment)	Continuous practical evaluation /seminar / Journal Report and Viva-voce.
References:	1. D. Chattopadhya, PC. Rakshit & B. Saha, (8th Edition), Advanced course in Practical Physics: Book & Allied Pvt. Ltd. 2. Harnam Singh, (17 th edition 2001), BSc Practical Physics: S. Chand & Co. Ltd. 3. Samir Kumar Ghosh, (4th edition), A Text book of Practical Physics: New Central Book Agency 4. C. L. Arora, (1st Edition) – 2001), B Sc. Practical Physics: S. Chand & Co.Ltd. 5. C. L. Squires, Practical Physics: (3rd Edition) , Cambridge University Press. 6. D C Tayal, (I st edition, 2000) , University Practical PhysicsHimalaya Publication. 7.Worsnop & Flint, Advanced Practical Physics:

Students will come for 4 turns of 3 hours per week for the laboratory session (Performing practicals).

ii) Regular Physics Experiments: A minimum of **08** experiments from each group of the practical course are to be performed and reported in the journal.

iii) Demonstrations: Any 05 demonstrations are to be performed by the teacher in the laboratory and students should be encouraged to participate and take observation wherever possible.

Demonstrations are designed to bring about interest and excitement in Physics. Students are required to enter details of these 'demonstration' experiments in their journal.

The certified journal must contain a minimum of **16** regular experiments and 05 demonstrations. A separate index and certificate in journal is must for each course in each semester.

Evaluation Scheme

[A] Evaluation scheme for Theory courses SPHY601, SPHY602 and SPHY603 and SPHY604

- **Continuous Assessment (C.A.) - 40 Marks**
  - **C.A.-I : Test – 20 Marks of 40 mins. Duration**
  - **C.A. –II: Assignment of problems/seminar/class performance**
- **Semester End Examination (SEE)- 60 Marks**

[B] Evaluation scheme for Practical course

Total marks : 200					
Continuous Assessment (CA) **40% (80 marks)**			**Semester End Examination (SEE)** **60% (120 marks)**		**Total**
Rough journal	**Journal**	**Viva-voce**	**Expt -I**	**Expt- II**	
(20+20)	**20**	**20**	**60**	**60**	**200**

Practical examination will be of **5 hours**. Students will perform **2** experiments of **two and half** hours each from group-A and B .

Note: Certified journal is a must for the student to appear for practical examination.