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

"A" Road, Churchgate, Mumbai - 400020, India.

Affiliated to
University of Mumbai

Program: B.Sc.

Proposed Course:Physics

Semester IV

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

S.Y.B.Sc. Physics Syllabus

Academic year 2020-21

Semester IV			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SPHY401	Optics and Digital Electronics	3	3
SPHY402	Quantum Mechanics	3	3
SPHY403	Applied Physics-II	3	3
SPHY4PR	Practical-IV	2.5	9

Semester IV – Theory

Course Code: SPHY401	Course Title -:Optics and Digital Electronics. (Credits: 3, Lectures/Week: 03)	
	Objectives : On successful completion of this course students will be able to: • Understand the diffraction and polarization processes and applications of them in physical situations. • Understand the interference in design and working of interferometers. • Understand the resolving power of different optical instruments. • Understand the working of digital circuits. **Outcomes:** • Applications of interference in design and working of interferometers. • Working of digital circuits • Developing quantitative problem solving skills in all the topics covered	
Unit – I	**Diffraction** Background knowledge Introduction, Huygens's - Fresnel theory, Distinction between interference and diffraction, Fresnel and Fraunh offer types of diffraction.. Fresnel's Diffraction: Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straight edge), Diffraction due to a narrow slit, Diffraction due to a narrow wire. Fraunh offer Diffraction : Introduction, Fraunh offer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunh offer diffraction at a double slit, Distinction between single slit and double slit diffraction pattern and missing orders Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima.	**15 L**
Unit – II	**Polarization** Background knowledge: Introduction of Polarization, Natural light is unpolarized, Unpolarized and Polarized light iii. Brewster's law, Polaroid sheets iv. Prism and grating spectra, Cornu's spiral, Fresnel's integrals Types of polarization, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Polarization by refraction–pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction, Polarizer and Analyzer, Malus' Law, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray, Retarders. Quarter wave plate, Half wave plate, Production of linearly polarized light, Production of elliptically polarized light, Production of circularly polarized light, Analysis of polarized light, Applications of polarized light.	**15 L**

Unit – III	**Digital Electronics:** Binary number system, Arithmetic building blocks, Types of registers, Digital IC signal levels, Binary to Decimal, Decimal to binary, Hexadecimal number, Hexadecimal to decimal Conversion, Decimal to hexadecimal conversion, Hexadecimal to binary conversion, Binary to hexadecimal conversion, Binary addition, Unsigned binary numbers, Sign magnitude numbers, 1's complement, 2's complement, Converting to and from 2's complement representation, 2's complement arithmetic, The adder-subtractor (omit IC specific diagrams) . RS Flip-Flops (only NOR gate latch, NAND gate latch) , Gated Flip-Flops, Edge T riggered RS Flip-Flop, Edge- Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master- Slave Flip-Flops. Bounce elimination switch Types of registers: SISO, SIPO, PISO, PIPO [any one type in detail] Asynchronous, Synchronous counter with one example each.	**15 L**
(CA)	Test, Class test, Seminars, Assignments, Class Performance	
References:	1. Dr. N. Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (25th Revised edition2012 Reprint 2013)S.Chand, 2. AJOY GHATAK: OPTICS (5thEdition) A Text Book Of Optics 3. Leach, Malvino, Saha 6thedition, Digital Principles and Applications (LMS) 4. Thomas L Floyd (10thedn). Digital Fundamentals by (Additional Reading) 5.R P Jain 4th edn., Modern Digital Electronics (Additional Reading)	

Course Code SPHY402	**Course Title : Quantum Mechanics** **(Credits: 03, Lectures/Week: 03)**	
	Objectives: To develop conceptual understanding of Quantum Mechanics. **Outcomes:** To understand the postulates of Quantum Mechanics. To comprehend the basic concepts of Quantum Mechanics & to understand its importance in explaining different phenomena in Physics. To develop problem solving skills.	
Unit – I	**The Schrodinger wave equation** i) Concept of wave function, Born interpretation of wave function. ii) Concepts of operator in quantum mechanics examples–position, momentum and energy operators. iii) Eigenvalue equations, expectation values of operators. iv) Postulates of Quantum Mechanics. v) Analogy between Wave equation and Schrodinger equation. vi) Time dependent and time independent (SteadyState) Schrodinger equation, Stationary State. vii) Superposition principle. viii) Probability current density, Equation of continuity and its physical significance.	**15 L**
Unit – II	**Applications of Schrodinger steady state equation-I** i) Free particle. ii) Particle in infinitely deep potential well(one-dimension). iii) Particle infinitely deep potential well(one-dimension). iv) Step potential. v) Particle in three dimension rigid box, degeneracy of energy state. Analogy between Wave equation and Schrodinger equation.	**15 L**
Unit – III	**Applications of Schrodinger steady state equation-II** i) Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability). ii) Theory of alpha particle decay from radio active nucleus. iii) Harmonic oscillator(one-dimension - ground state and first excited state.), correspondence principle.	**15 L**
(CA)	Test ,Class test, Seminars, Assignments, Class performance .	

References:	1.A.Beiser(6thEd.), Concepts of Modern Physics, Tata Mc GrawHill. 2.S P Singh, M K Bagade, Kamal Singh(2004), Quantum Mechanics, S. Chand. 3.R. Eisbergand R. Resnik, (2nd Ed) Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles, Wiley. 4.D.Griffiths,(2nd Ed) Introduction to Quantum Mechanics, Prentice Hall. 5.Ghatak and Lokanathan, (5th Ed) Quantum Mechanics, Mc.Millan. 6. L.I.Schiff, (2nd Ed) , Quantum Mechanics :	

Course: SPHY403	Course Title -:Applied Physics II (Credits 03: Lectures/Week: 03)	
	Objectives: 1) To understand different types of errors in measurements 2) To understand crystalline nature of matter 3) Understand the importance and applications of optical instruments **Outcomes:** On successful completion student will learn 1) To calculate the errors and improve accuracy of measurements 2) To differentiate various crystals according to their lattice properties 3) Understand the significance of Michelson and Fabryparot interferometer and study resolving power	
Unit I	Theory of errors, uncertainty and significant digits, Dropping of non significant digits, rounding of numbers, Accuracy of a function Different ways of measuring random errors, fractional uncertainty and significant digits. The estimation of errors: The normal distribution, The mean value of measurements, average errors, standard errors, probable errors, The practical determination of errors, Peter's formula (without proof), reliability of measurements.	**15 L**
Unit II	The crystalline state, Basic definitions of crystal lattice, basis vectors, unit cell, primitive and non primitive cells, Fourteen Bravice lattices, seven crystal systems, elements of symmetry, nomenclature of crystal directions and crystal planes, Millar indices, Spacing between planes, X ray diffraction technique, Real crystals, Crystal defects, Ionic crystal ligancy (3, 4, 6, 8)	**15 L**
Unit III	**Optical Instruments** **Resolving power** Rayleigh's criteria, resolving power of optical instruments, Criteria for resolution, resolving power of telescope, resolving power of prism, resolving power of a plane transmission grating **Interferometers** Michelson interferometer, principle, construction, Working, Circular fringes, localised fringes, Applications a) measurement of wavelength, b) Determination of difference in wavelength, c) thickness of thin transparent sheet, standardisation of meter. Fabry –Perot interferometer, etalon, formation of fringes, determination of wavelength, Measurement of difference in wavelengths.	**15 L**
(CA)	Test, Class test, Seminars, Assignments, Class performance .	

Textbook:

1. The theory of errors in physical measurements. J. C. Pal, New Central book agency, reprint 2008

2. Elementary solid state physics- Principles and applications, M. Ali Omar, Pearson education, 2012

3. A text book of optics – Subramanyam, BrijLal, Avadhanulu

Course Code SPHY4PR	Practical-IV (Credits-2.5 , Lectures/week-9)
Group-A	1. Optical lever: Determination of Refractive index (μ) 2. Determination of Cauchy's constants 3. R.P. of Telescope 4. Double Refraction 5. Determination of wavelength of laser using transmission grating 6. R.P. of Grating
Group-B	1. Half adder and Full adder (IC 7486, 7408) 2. LCR Transients 3. CE amplifier: Gain with Load. 4.Op-amp as Integrater 5. Op-amp as Difference amplifier 6. Absolute capacity
Group-C	Research project
Demonstration Experiments	1. Error analysis of a given experiment 2. Wave form generator using Op-amp 3. PC simulations: graph, curve fitting etc. 4. Straight edge Fresnel diffraction 5. First order active low pass /high pass filter.
CA (Continuous Assessment)	Continuous laboratory performance evaluation /Seminar on experiments / Journal Report, Project Report and Viva-voce.
References	1. D. Chattopadhya, P.C. Rakshit & B. Saha, (8^{th}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, (4^{th} edition), *A Text book of Practical Physics:* New Central Book Agency 4. C. L. Arora, (1^{st} Edition) – 2001), *B Sc. Practical Physics*: S. Chand & Co.Ltd. 5. C. L. Squires, *Practical Physics*: (3^{rd} Edition) , Cambridge University Press. 6. D C Tayal,(I^{st} edition, 2000) , *University Practical Physics:* Himalaya Publication. 7.Worsnop & Flint, *Advanced Practical Physics*:Methuen

Note:
Students will come for three turns per week eac hof two and half hours for the laboratory session (Performing practicals and making project).
ii) Regular Physics Experiments: A minimum of **five** experiments from each group of the practical course are to be performed and reported in the journal.
iii) Demonstrations : Five demonstrations are to be performed in the laboratory and students should be encouraged to participate and take observation wherever required.
iv) **Certified Journal:** The certified journal must contain a minimum of **ten** regular experiments, four from each group and **four** demonstrations and the project.
A separate index and certificate in the journal is a must for each course in each semester.

Evaluation Scheme

[A] Evaluation scheme for Theory courses

- **Continuous Internal Assessment (C.I.A.) : 20+20= 40 Marks**
  - **C.A.-I: Test – 20 Marks of 40 mins. Duration.**
  - **C.A.-II : Assignment on Numericals / Seminars/ Assignments/Class performance/Poster/Projects . (20 Marks)**

Semester End Examination (SEE)- 60 Marks

[B] Evaluation scheme for Practical course:

Total marks : 150						
Continuous Internal Assessment (CIA)40% (60 marks)			**Semester End Examination (SEE)60% (90 marks)**			**Total**
Laboratory performance	Journal assessment	Viva	Expt -I	Expt- II	Expt -III	
30	15	15	30	30	30	150

External practical evaluation: Students will be evaluated on the basis of experiments performed from each group of 2 hours duration (Group A and B experiments). For Group C (Expt -III) the evaluation would be on the basis of project assessment and viva-voice.