K. J. SOMAIYA COLLEGE OF SCIENCE AND COMMERCE, VIDYAVIHAR, MUMBAI 400 077

(AUTONOMOUS- AFFILIATED TO UNIVERSITY OF MUMBAI

Scheme of Course Structure (Faculty of Science) 2019-2020

Syllabus for S.Y.B.Sc.

Program: B.Sc.

Course: Physics

(Choice based Credit System with effect from

The academic year 2019–2020)

Syllabus -S. Y.B. Sc. PHYSICS

Semester	Course	Course Title	Course code	Credits	Periods per week	Unit/	Lect	Examination

							Module	ures (50 min)	**Int**	**Ext**	**Total**
III	SY BSc	PHYSICS	19US3PH1 19US3PH2 19US3PH3	2 2 2							
Theory											
Core Course											
III	I	Mechanics	19US3PH1	2	30	36	Mathematical methods/ theory of errors/ SWAYAM course	12	40	60	100
							Damped & forced vibrations	12			
							Bending of beams	12			
	II	Electronics	19US3PH2	2	30	36	Transistor fundamentals & Amplifiers	12	40	60	100
							Feedback & Op-amp	12			
							Digital Electronics	12			
	III	Thermo dynamics	19US3PH3	2	30	36	First Law of Thermodynamics	12	40	60	100
							Second law of Thermodynamics	12			
							Third law of Thermodynamics	12			
	PRACTICAL										
	CORE COURSES 198US3PHP										
	I	Practical I	19US3PHP1	1	2	2.4	Practical based on all three courses (Group A,B,C and Skill)		20	30	50
	II	Practical II	19US3PHP2	1	2	2.4			20	30	50
	III	Practical III	19US3PHP3	1	2	2.4			20	30	50

Semester	Course	Course Title	Course code	Credits	Hours	Period	Unit/ Module	Lectures (50 min)	Examination		
									Int	**Ext**	**Total**
IV	SY BSc	PHYSICS	19US4PH1 19US4PH2 19US4PH3	2 2 2							
Theory											
Core Course											
IV	I	Optics	19US4PH1	2	30	36	Interference & Polarization	12	40	60	100
							Diffraction	12			
							Interferometer	12			
	II	Electricity & Magnetism	19US4PH2	2	30	36	Vector analysis	12	40	60	100
							Electrostatics & Magneto statics	12			
							Charged particle dynamics	12			
	III	Quantum Mechanics	19US4PH3	2	30	36	Schrodinger wave equation	12	40	60	100
							Applications of Schrodinger steady state equation I	12			
							Applications of Schrodinger steady state equation II	12			
	PRACTICAL										
	CORE COURSES 198US3PHP										
	I	Practical I	19US3PHP1	1	2	2.4	Practical based on all three courses (Group A,B,C and Skill)		20	30	50
	II	Practical II	19US3PHP2	1	2	2.4			20	30	50
	III	Practical III	19US3PHP3	1	2	2.4			20	30	50

Graduate attributes in Physics

Some of the characteristic attributes of a graduate in Physics are

- **Disciplinary knowledge and skills**:
  Capable of demonstrating (i) good knowledge and understanding of major concepts, theoretical principles experimental findings in Physics and its different subfields like Astrophysics and Cosmology, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, and other related fields of study, including broader interdisciplinary subfields like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology etc. (ii) Ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Physics listed above

- **Skilled communicator**:
  Ability to transmit complex technical information relating all areas in Physics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.

- **Critical thinker and problem solver**:
  Ability to employ critical thinking and efficient problem solving skills in all the basic areas of Physics.

- **Sense of inquiry**:
  Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics, and planning, executing and reporting the results of a theoretical or experimental investigation.

- **Skilled project manager**:
  Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices.

- **Digitally Efficient**:
  Capable of using computers for simulation studies in Physics and computation and appropriate software for numerical and statistical analysis of data, and employing modern e-library search tools, various websites of the renowned Physics labs in various countries to locate, retrieve, and evaluate Physics information.

- **Ethical awareness / reasoning**:
  The graduate should be capable of demonstrating ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work.

- **National and international perspective**:
  The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.

- **Lifelong learners**:
  Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and excelling in all areas of Physics.

S.Y. B. Sc. (PHYSICS) SEMESTER III

Course – I

Preamble--

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.

This is a revised part of the undergraduate programme (Six Semesters) in Physics, to be taught in Semester III & IV from the academic year 2019-20 onwards. Developing Curriculum that is progressive and purposeful to create positive improvement in the education system is the logic behind this revision.

In each Semester, courses are devoted to core Physics, catering to Mechanics, Thermodynamics, Optics , Electrodynamics, Quantum Mechanics, Mathematical Physics and Digital and Analog Electronics. These have been tailored to fit in with the existing FYBSc syllabus (Semester I and Semester II) in terms of continuity and to ensure delivery of quality content to the learner.

The elective in first semester offers interdisciplinary application- oriented topics. It will be offered as a choice to all learners across various combinations. This course will seek to foster a spirit of multidisciplinary approach in learning.

Course Objective --

Upon completion of the course, students should have acquired the following knowledge and skills:

1. A thorough quantitative and conceptual understanding of the core areas of physics, including mechanics, , thermodynamics, quantum mechanics, electronics at a level compatible with graduate programs in physics at peer institutions.
2. The ability to analyze and interpret quantitative results, both in the core areas of physics and interdisciplinary areas.
3. The ability to use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data.
4. The ability to apply the principles of physics to solve new and unfamiliar problems.
5. The ability to communicate scientific results effectively in presentations or posters.
6. To develop analytical abilities towards real world problems
7. To familiarize with current and recent scientific and technological developments

Course outcome ---

After completion of the course, Learners will have adequate background, conceptual clarity and knowledge of mathematical principles related to

- Develop analytical abilities towards real world problems
- Familiarize with current and recent scientific and technological developments
- Enrich knowledge through problem solving, hands on activities, study visits, projects etc.

S.Y. B. Sc. (PHYSICS) SEMESTER III

Course – I
COURSE TITLE: **Mechanics**
COURSE CODE: 19US3PH1
[CREDITS - 02]

UNIT 1	**Theory of errors**:	No Of Lectures
UNIT 1	Learning Objective ----- On successful completion of this course Learners will be able to: • Understand the basic mathematical concepts and applications of them in physical situations • Understand the concepts of mechanics, and the properties of matter and be able to perform calculations using them • Demonstrate quantitative problem solving skills in all the topics covered. • Describe the difference between accuracy and precision, and identify sources of error in measurement Learning Outcome -- At the end of this course, learner will be able to: • have a good grasp of the basic elements of complex analysis, including the important integral theorems. , residues of a complex function and use the residue theorem to compute certain types of integrals. • Be able to solve ordinary second order differential equations important in the physical sciences; solve physically relevant partial differential equations using standard methods • Learn various types of errors & different methods to evaluate them.	12

	The elective in first semester offers interdisciplinary application- oriented topics **For paper I --------Unit II and Unit III are compulsory, choose any one option from Unit**	
	Theory of errors : **Methods of Data Collection**: Collection of primary data, Observation method, Interview method, collection of data through Questionnaires. **Theory of errors**: Significant Digits – Dropping of non-significant digits, Rounding of numbers, Absolute and relative errors, relative errors and significant digits, errors o computation, Accuracy of a function, various kinds of errors, Different ways of measuring random errors, Uncertainty and Significant digits, fractional uncertainty and significant digits, significance of uncertainty. **The estimation of errors:** The normal distribution, The average or mean value of measurements, average errors, the average or mean value of measurements, average errors, standard errors, probable errors. Propagation of errors. JCP: 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.7, 2.7(a), 2.9, 3.4, 3.5, 3.6, 3.6(a), 3.6(b), 3.10, 3.10(a), 3.11. CRK: chapter 6 (Page 95-103) **OR** **MATHEMATICAL METHODS** **Integration:** Integration from first principles, integration as the inverse of differentiation, integration by parts, integration in the plane polar co-ordinates, application of integration (mean value of a function, finding the length of a curve) R. H 2.2.1, 2.2.2, 2.2.8, 2.2.11, 2.2.13 **Matrices**: Introduction to Matrices, Types of Matrices (Review), Inverse of Matrix, Solving Simultaneous and homogenous equation using matrices. H.D: 4.18, 4.19, 4.34, 4.37, 4.40 **Ordinary Differential equation** Ordinary differential equations, First order homogeneous and nonhomogeneous equations with variable coefficients, Second-order homogeneous equations with constant coefficients, Second order non-homogeneous equations with constant coefficients. CH : 5.1, 5.2.1 (omit D), 5.2.3, 5.2.4 CH : Introduction to Mathematical Physics : Charlie Harper 2009 (EEE) PHI Learning Pvt. Ltd **OR** **SWAYAM Course/MOOC**	

	1 Introduction to Research. Or any other equivalent course

UNIT 2	Damped and Forced Vibrations	NO OF LECTURES 12
2	Learning Objective ---- • To understand the fundamentals of Vibration Theory • To be able to mathematically model real-world mechanical vibration problems • To use computer software programs to investigate and understand vibration problems. • This course contributes to the assessment of the following program (student) outcomes: a. an ability to apply knowledge of mathematics, science and engineering Learning Outcome--- • Apply Newton's equation of motion and energy methods to model basic vibrating mechanical systems • Model reciprocating and oscillatory motions of mechanical systems • . model undamped and damped mechanical systems and structures • model free and harmonically forced vibrations v. model single- and multi-degree of freedom systems • perform and verify computer simulations employing time integration and modal analysis of discrete vibrating systems.	
2	**Damped Vibrations** Decay of free vibrations of a simple harmonic oscillator due to the damping force proportional to the first power of velocity, types of damping, Energy of a damped oscillator, logarithmic decrement, relaxation time and quality factor. HP: 9.3, 9.4. **Forced vibration and resonance** Forced damped harmonic oscillator, special cases: low driving frequency, high driving frequency, Resonance. Quality factor of a driven oscillator. HP: 9.6, 9.7. **Compound pendulum**: Expression for period, maximum and minimum time periods, Centres of suspension and oscillations, Kater's reversible pendulum, Advantages of a compound pendulum over a simple pendulum.	

	HP: (pages 279 to 289)	
UNIT 3	Bending of beams	NO OF LECTURES 12
3	**Learning Objective:** • Understand the theory, its limitations and its applications for strength based design and analysis of symmetric bending of beams. • Develop the discipline to visualize the normal and shear stresses in symmetric bending of beams. **Learning Outcome** : Having successfully completed this module learner will be able to • Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tri dimensional elastic solids • Calculate and represent the stress diagrams in bars and simple structures • Solve problems relating to pure and non-uniform bending of beams and other simple structures • Solve problems relating to torsional deformation of bars and other simple tri-dimensional	
3	**Collisions**: Introduction, types of collisions, laboratory and centre of mass systems, relationship between displacements and velocities, relationship between angles. H. P.: 7.1, 7.3, 7.3.1, 7.3.2. **Bending of beams**: bending moment, Basic assumptions for theory of bending, cantilever, beam supported at its ends and loaded in the middle, I-section girders, determination of Y by bending, Determination of elastic constants by Searle's method. BS: 10.16, 10.17, 10.18, 10.19, 10.20, 10.22, 10.23, 10.26. *[Note: A good number of numerical examples are expected to be covered during the prescribed lectures.]*	

References:

- CH : Introduction to Mathematical Physics : Charlie Harper 2009 (EEE) PHI Learning Pvt. Ltd
- H. P. : Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd Ed.)
- B. S. : Mechanics and Electrodynamics. – Brij Lal, N. Subramanyam, Jivan Seshan, S. Chand (Revised and Enlarged Edition 2005)
- R.H: Mathematical methods for Physics & Engineering (3rd Edition)-K.F.Riley, M.V.Hobson & S.J.Bence Cambridge University Press.

- HD: Mathematical Physics- H.K Dass- S Chandand Company LTD
- P N Roy: A text book of Bio Physics- P N Roy, New Central Book Agency Ltd. Revised Edition, Reprinted in 2009.
- CRK: Research Methodology- C R Kothari, New Age International- second revised edition 2004.
- S P Puri. Fundamental of Vibrations and Waves. (Tata Mc Graw Hill)
- K R Symon Mechanics: [Addition & Wesley (3rd Ed)]
- D. S. Mathur Mechanics – (S Chand & Co.)
- Bhargava and Sharma Text book of Mechanics:.
- J Topping Error of observation and their treatment – (Institute of Physics Monographs for students Series.)
- John R Taylor An introduction to error Analysis:, University Science Books: Mill Valley California

S.Y. B. Sc. (PHYSICS) SEMESTER III

Course – II
COURSE TITLE: Electronics.
COURSE CODE: 19US3PH2
[CREDITS - 02]

Learning Outcomes:

1. On successful completion of this course students will be able to:
2. Understand the basics of transistor biasing, operational amplifiers, their applications.
3. Understand the basic concepts of oscillators and be able to perform calculations using them.
4. Understand the working of digital circuits.
5. Demonstrate quantitative problem solving skills in all the topics covered.

UNIT 1	**Amplifiers**	NO OF LECTURES 12

UNIT 1	**Learning Objective** ----- On successful completion of this course Learners will be able to: • To recall various BJT parameters, connections and configurations. • To Explain and Demonstrate BJT Amplifier, Hybrid Equivalent and Hybrid Models. • To Demonstrate and Construct Frequency response of BJT and FET amplifiers at various frequencies. • To Define, Demonstrate and Analyze Power amplifier circuits in different modes of operation. • To Demonstrate and Apply Feedback and Oscillator circuits. Prerequisites: Basic knowledge and understanding of semiconductor devices and transistors **Learning Outcome** -- At the end of this course, learner will be able to: ▪ Acquire knowledge of and Working principles, characteristics and basic applications of BJT and amplifiers ▪ Single stage, cascaded and feedback amplifier configurations and Frequency response characteristics of BJT ▪ Analyse the performance of amplifier in CS configuration and Power Amplifiers and Oscillator circuits. ▪ Interpretation of performance characteristics of transistors amplifiers, frequency Response and Oscillators. ▪ Apply the knowledge gained in the design of transistorized circuits, amplifiers and Oscillators.	

1	(i) **Transistor fundamentals**: The load line, operating point, recognizing saturation, transistor switch, Base Bias method, Emitter biased method, Voltage divider bias method, load line and Q-point. M: 7.2, 7.3, 7.4, 7.5, 8.1, 8.3 (ii) **Transistor amplifiers**: Base-biased amplifiers, Emitter-biased amplifier, small-signal operation, Current gainβ, AC resistance of the emitter diode, Two (π & T)) transistor model, analyzing an amplifier, voltage gain, frequency response of an ac amplifier, decibel voltage gain. M: 9.1, 9.2, 9.3, 9.3, 9.4, 9.5, 9.6, 9.7, 10.1, 16.1, 6.3, 16.4	
UNIT 2	Feedback Amplifier & Operational amplifier	Total No of Lectures 12
2	Learning Objective ---- On successful completion of this course Learners will be able to: • Provide a strong foundation on Linear Circuits. • Familiarize students with applications of various IC's • Have a broad coverage in the field that is relevant for engineers to design Linear circuits using Op-amps Learning Outcome--- At the end of this course, learner will be able to: • Define significance of Op Amps and their importance. • Build circuits using Analog IC's. • In-depth knowledge of feedback phenomenon applying the concepts in real time applications. • Ability to use OP Amp as adder, Subtractor, Multiplier and Divider. • Able to use OP Amp to generate sine waveform, Square wave form,	
2	**Feedback amplifiers**:	

	(a) Negative feedback- principles, Gain, advantages (b) Positive feedback-oscillator, essentials of transistor oscillator and Barkhausen criterion for self-sustained oscillations, Colpitt's oscillator, Wien bridge oscillator. **Operational Amplifiers**: Schematic symbol, output voltage, ac analysis of op-amp, bandwidth, slew rate, applications: inverting amplifier, non-inverting amplifier, voltage follower, summing amplifier, integrator, differentiator, comparator with Zero reference and Non Zero reference (only). M&M: 13.1, 13.2, 13.3, 13.4, 13.5, 14.5, 14.6, 14.7, 14.10, 14.17, 14.18, 14.19, 14.20, 22.1,22.2,25.15, 25.16, 25.17,25.18, 25.19, 25.20, 25.24, 25.26, 25.27, 25.32, 25.35, 25.37	
UNIT 3	Combinational Logic circuits	Total No of Lectures 12
3	**Learning Objective:** Having successfully completed this module learner will be able to • To study the theory of Boolean algebra and to study representation of switching functions using Boolean expressions and their minimization techniques. • To study the combinational logic design of various logic and switching devices and their realization. • To study the sequential logic circuits design both in synchronous and Asynchronous modes for various complex logic and switching devices, their minimization techniques and their realizations. • To study some of the programmable logic devices and their use in realization of switching functions. Learning Outcomes: Students will be aware of • Theory of Boolean Algebra & the underlying features of various number systems. • Students will be able to use the concepts of Boolean Algebra for the analysis & design of various combinational & sequential logic circuits.	

	• Students will be able to design various logic gates starting from simple ordinary gates to complex programmable logic devices & arrays.
3	Review: Boolean laws and Theorems, implementation of the logic circuits) (i) Implementation of logic circuit from truth tables: Sum of products and product of sums method (ii) Combinational logic circuits: Karnaugh Map: truth table to Karnaugh Map, Pair, QUADs, OCTETs, don't care condition. (iii) Flip flops. Flip-flop and counters: R-S flip flops, clocked RS flip flop D Flip flop, edge triggered J K flip flop, Master slave flip flop, T flip flop, 4-bit binary ripple counter ,Decade counter M&L:, 3.3,3.4,3.5,3.6, 8.1, 8.2, 8.5, 8.7, 10.1

References:

- **M**: A P Malvino and David J Bates Electronics principles: , 7th Ed. The McGraw-Hill companies.
- **M&M**: V K Mehta, Rohit Mehta.Principles of Electronics:
- **M&L:** Malvino and Leach Digital Principles and Applications: fifth Ed
- D. Chattopadhyay & P. C. Rakshit Electronics Fundamental and applications (8th Ed.) (New Age International)
- Robert Boylestand & Louis Nashelsky Electronic Devices and Circuit theory, (PHI)
- Allan Mottershead Electronic devices and circuits – An introduction (PHI Pvt. Ltd. – EEE – Reprint – 2007)

S.Y. B. Sc. (PHYSICS) SEMESTER III

Course – III

COURSE TITLE: **Thermodynamics**

COURSE CODE: 19US3PH3

[CREDITS - 02]

Learning Outcomes: On successful completion of this course students will be able to:

1. Understand the basic concepts of thermodynamics and its applications in physical situations.

2. Understand and learn low temperature physics

3. Demonstrate quantitative problem solving skills in all the topics covered

UNIT 1	Thermodynamics	NO OF LECTURES 12
UNIT 1	**Learning Objective** ----- On successful completion of this course Learners will be able to: • To present a comprehensive and rigorous treatment of classical thermodynamics. • To lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in physics • To develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments. **Learning Outcome** -- At the end of this course, learner will be able to: ▪ Explain the basic concepts of thermodynamics like system, properties, equilibrium, pressure, specific volume, temperature, zeroth law of thermodynamics, temperature measurement and temperature scale	
1	**Concept of heat,** The first law, Non adiabatic processes and Heat is a path function, Internal energy, Ref. EG: Chapter 3, Page No. 44 to 64. Reversible and irreversible process, Heat engines, definition, of efficiency,	

	Carnot's ideal heat engine, Carnot's cycle, effective way to increase efficiency, Carnot's engines and refrigerator, coefficient of performance and related problems. Ref. BS: 4.20 To 4.29, 6.11
UNIT 2	Second law of Thermodynamics
2	Learning Objective ---- • To lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in the practice of physics. • To develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments. • To be able to apply second law to general reversible processes and cycles • To derive the inequality of Clausius Learning Outcome--- Learner will be able to • State and prove the equivalence of two statements of second law of thermodynamics. • Define reversible process and state the propositions regarding efficiency of Carnot cycle. • Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for Understanding, applying, analyse Course Objectives: • State & explain Kelvin-Planck & Clausius statements of second law of thermodynamics, Prove the equivalence of two statements of 2nd law
2	Second law of thermodynamics, Carnot's theorem, Phase Change, Triple point of water, Latent heat, Clapeyron's latent heat equation using Carnot's cycle and its applications. Otto engine, petrol engine, diesel engine , Related problems. BS: 1) 4.20 TO 4.29, 6.11

	BS: 2) 4.30 TO 4.33
UNIT 3	Third law of Thermodynamics
3	**Learning Outcome** : Having successfully completed this module learner will be able to • To lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in the practice of physics. • To develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments. • To prove that entropy is a property • To prove the principle of entropy increase • To evaluate entropy changes for processes undergone in closed and open systems • To use entropy as a coordinate • To give different statements of the third law • To evaluate entropy, specific heats and β at absolute zero • To prove the unattainability of absolute zero • To establish the molecular basis of entropy
3	Concept of entropy, Change in entropy in adiabatic process, Change in entropy in reversible cycle, Principle of increase of entropy, Change in entropy in irreversible process. T-S diagram, Physical significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic scale of temperature, (Omit alternative method using Carnot cycle), the size of a degree, Zero of absolute scale, Identity of a perfect gas scale and absolute scale. Third law of thermodynamics, Zero point energy, Negative temperatures (not possible), Heat death of the universe. Low temperature Physics: Different methods of liquification of gases(Not in detail, just introduction), Method of freezing, Cooling by Adiabatic Expansion BS: 5.1 TO 5.9, 5.11 TO 5.18 *[Note: A good number of numerical examples are expected to be covered during the prescribed lectures.]*

References:

- BS : Brij Lal, Subrahmanyam, Hemne (S. Chand (Revised Multicoloured Ed. 2007)Heat, Thermodynamics and statistical Physics-
- KK : S. K. Kakani and Amit Kakani,Material Science –New Age International (P) Ltd. – Reprint 2004.
- BV: B. Viswanathan, Nano materials, Narosa Publication House, Fourth Reprint- 2013.
- S: Solar Photovoltaics Fundamentals, technologies and applications (2nd Edition) PHI Learning Private Limited

UNIT - I and II:

- Evelyn Guha Basic Thermodynamics – (Narosa Publications)
- Philip M. Morse Thermal Physics - (W. A. Benjamin Inc, New Yark)
- Robert and Miller Heat & Thermodynamics – (E LBS)
- Saha and Srivastava.A treatise of Heat -

UNIT – III

1. Ajay Kumar Saxena Solid State Physics:. Macmillian India Ltd. (2006 Ed)
2. R. S. Khurmi & R. S. Sedha Material Science: (S. Chand & Co. Ltd.) 5th Rev. & Enlarged Ed-2007.
3. O P Khanna- Dhanpat Rai Material Science and Metallurgy –Publication (XI Reprint)
4. Hans. C. Chanian Modern Physics:– Prentice – Hall of India.
5. D S Murty, V. Laxminarayana, Bangar Raju. Atomic Physics: Tata Mc. Graw Hill Publication co. Ltd.
6. B S Murthy, P Sarkar, Baldev Raj, R B Rathi, James Murday Textbook of Nano science and Nano technology:. University Press. First Ed.

Evaluation Pattern: Theory

For each course I, II ,III

External Evaluation – Semester End Examination (60 M) - Duration : 2 hours

Paper Pattern

Question No	Module	Marks with Option	Marks without Option
Q.1 (A) Attempt any One/Two (B) Attempt Three/Four	1	08 12	16 16
Q.2 (A) Attempt any One/Two (B) Attempt Three/Four	2	08 12	16 16
Q.3 (A) Attempt any One/Two (B) Attempt Three/Four	3	08 12	16 16

Internal Evaluation - (40 M)

Evaluation type	Marks
Class Test /online class test Assignment Poster presentation field visit report simple project OR Project +presentation+ report writing+ Viva **OR** Chapter review +presentation+ report writing +Viva	30 10 40 40

S. Y. B. Sc. (PHYSICS)

SEMESTER I - Practicals

Course-I & II

COURSE CODE: ----19US3PHP

Instructions:

i) All the measurements and readings should be written with proper units in SI system only

ii) After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.

iii) While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skill and procedure, graph, calculation and result.

iv) Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Leaning Outcome: On successful completion of this course students will be able to:

i) To demonstrate their practical skills more effectively.

ii) To understand and practice the skills while doing physics practical.

iii) To understand the use of apparatus and their use without fear.

iv) To correlate their physics theory concepts through practical.

v) Understand the concepts of errors and their estimation

Experiments Group I	Group II	Group III	Numbe No. of Credits	Number no. of hours
• Bar Pendulum. determination of g • Resonance Pendulum. • Searle's Experiment: determination of Y. • Logarithmic Decrement.(By lamp and scale) • Y by bending. • Optical Lever (Determination of R.I.)	• CE Amplifier: • Frequency response. • CE Amplifier: Gain Vs Load. • Colpitt's Oscillator • Wein bridge oscillator (transistorized). • Opamp:: Inverting amplifier./ Non Inverting amplifier with different gains • Op amp: Difference amplifier	• Temperature Coefficient of thermistor and determining its band gap. • Surface Tension by Jager's method • Determination of thermal conductivity of bad conductor by Lee's Method. • Verification of Stefan's Law • Refractive Index of liquid using LASER • Refractive Index using total internal reflection.	2	3 HOURS /EXPERIMENT

Skill Experiments:

1) Wiring of a simple circuit using bread board Connections.
2) Focal length by auto collimation method.
3) Phase shift measurement using dual trace CRO.
4) Designing & Soldering of simple Circuits.(e.g. Filter circuits)
5) Radius of ball bearing using single pan balance.
6) Spectrometer--Schuster's method

There will be no internal assessment for practical.

For practical examination the learner will be examined in **three experiments** (one from each Group. Minimum **3** from each group and in all minimum **12** experiments and 4 skill experiments are required to be completed and reported in journal compulsorily.
The learner be evaluated at the time of viva voce on the basis of regular experiments and skill experiments.
A learner will be allowed to appear for the semester end practical examination only if he /she submits a Certified journal at the time of practical examination or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Physics as per the minimum requirement.

The duration of the practical examination will be three hours per experiment. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics

REFERENCES

1. D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition)Advanced course in Practical Physics Book & Allied Pvt. Ltd.

2. Harnam Singh S. Chand & Co. BSc Practical Physics –Ltd. – 2001

3. Samir Kumar Ghosh, A Text book of advanced Practical Physics –New Central Book Agency – (3rd edition)

4. CL Arora (1st Edition) – 2001 B Sc. Practical Physics –S. Chand & Co. Ltd.

5. CL Squires – (3rd Edition Practical Physics –) Cambridge University Press.

6. D C Tayal. University Practical Physics –Himalaya Publication.

7. Worsnop & Flint.Advanced Practical Physics –

Main Reference: Manual provided by Department of Physics

S.Y. B. Sc. (PHYSICS) SEMESTER IV

Course – I

COURSE TITLE: **Optics**

COURSE CODE: 19US4PH1

[CREDITS - 02]

Learning Outcomes:

On successful completion of this course students will be able to:

1. Understand the diffraction and polarization processes and applications of them in physical situations.
2. Understand the applications of interference in design and working of interferometers.
3. Understand the resolving power of different optical instruments.
4. Demonstrate quantitative problem solving skills in all the topics covered.

UNIT 1	**Interference**	**No, of lectures : 12**
	Learning Objective— This Course Enables the Learner to ➢ Study and develop the Bohr theory of the hydrogen atom . • To aware the students about various phenomenon of optics. • The study of the paper describes the phenomenon like Interference, Diffraction and Polarization. • The study describes the principals behind various phenomenon as described earlier. Learning Outcomes After the completion of the course, Students will be able to • Understand the physics behind various optical phenomenons. • Understand various natural phenomenons which is happening in their surroundings. • Explain the relationship in between various optical phenomenon	

1	**Interference**: Light waves, superposition of waves, interference, theory of interference, techniques of obtaining interference, (i) Interference in thin films (ii) Newton's rings. Applications of thin film interference; Newton's ring (measurement of wavelength and refractive index) SBA: 14.2, 14.3, 14.4, 14.41, 14.8, 15.2, 152.1, 15.2.2, 15.2.3, 15.2.4, 15.6, 15.6.1, 15.6.2, 15.6.3, 15.6.4, 15.6.7 **Polarization**: Introduction, type of polarization, polarization by reflection, Brewster's law, polarization by double refraction, the phenomenon of double refraction, Theory of λ/2 and λ/4 plates. SBA: 20.1, 20.2, 20.3, 20.4, 20.5, 20.6.1, 20.6.1.1, 20.6.5, 20.11, 20.11.3	
UNIT 2	**Diffraction:**	**No, of lectures : 12**
2	Learning Objective— This Course Enables the Learner to ➢ Study and develop the Bohr theory of the hydrogen atom. ➢ Recognize the difference between constructive and destructive interference, and between interference and diffraction Learning outcomes--- After successful completion of this course a Learner will be able to: ▪ Calculate fringe width. ▪ Recognize the difference between constructive and destructive interference, and between interference and diffraction	
2	**Fresnel's diffraction**: Introduction, Huygen's-Fresnel's theory, Fresnel's assumptions, rectilinear propagation of light, distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, diffraction due to straight edge, position of maximum and minimum intensity, intensity at a point inside a geometrical shadow, **Fraunhoffer diffraction:** Introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to single slit, Fraunhoffer diffraction at N slit, Plane diffraction grating, theory of plane transmission grating, width of principal maxima, prism and grating spectra. SBA: 17.1, 17.2, 17.3, 17.4 17.6, 17.7, 17.10, 17.10.1, 17.10.2, 18.1, 18.2, 18.2.1, 18.2.2, 18.4, 18.4., 18.6, 18.7, 18.7.1, 18.7.2, 18.7.8 (I to VI)	
UNIT	**Interferometer**	**No. Of lectures**

3		**12**
3	Learning Objective & outcomes. This Course Enables the Learner to demonstrate the following outcomes: • Identify the main components of a Michelson interferometer and their relative positions in the device • Draw the paths that light follows through a Michelson interferometer. • Define and identify interference pattern and explain how an interference pattern forms in an interferometer. • Describe what will happen to the interference pattern when a mirror is moved.	
	(i) **Michelson Interferometer**: Principle, construction, working, circular fringes, localised fringes, Visibility of fringes. Applications of Michelson interferometer: b. Measurement of wavelength c. Determination of the difference in wavelengths of two waves d. Thickness of thin transparent sheet. e. Measurement of Gravitational waves. (ii) **Fabry-Perot interferometer** and etalon: Formation of fringes, determination of wavelength, Measurement of difference in wavelength. SBA: 15.7, 15.7.1 to 15.7., 15.8, 15.8.1 o 15.8.3, 15.12, 15.12.1 to 15.12.3 (iii) **Resolving Power**: introduction, Raleigh's criterion, resolving power of optical instruments, criterion for resolution according to Lord Rayleigh's, resolving power of telescope, resolving power of a prism, resolving power of a plane transmission grating. SBA: 19.1, 19.2, 19.5, 19.6, 19.7, 19.11, 19.12.	

References:

1 SBA: Subramanyam, Brij Lal, Avadhanulu A text book of Optics –– S. Chand & Co. Multicoloured Ed. 2007.

2. Optics – Ajay Ghatak (3rd Ed) Mc. Graw Hill Co.

S.Y. B. Sc. (PHYSICS) SEMESTER IV

Course – II

COURSE TITLE: Electricity and Magnetism

COURSE CODE: 19US4PH2

[CREDITS - 02]

Learning Outcomes:

On successful completion of this course students will be able to:

- Understand the basic mathematical physics concepts and applications of them in physical situations
- Understand the basic laws of electrostatics and magneto statics and applications of them and be able to perform calculations using them. Course Outcome:
- Understand how to do vector calculations including: vector addition,cross products, dot (scalar) products.
- Use correct SI units for all quantities studied
- Define electric field (E) & Define charge density (λ,σ,ρ)
- Understand the difference between electric potential energy (U) & electric potential
- Understand the motion of charged particle in electric & magnetic field

UNIT 1	**Vector Analysis**	**No of l 12**
	Learning Objective— This Course Enables the Learner to ▪ Study and develop the Bohr theory of the hydrogen atom . ▪ Enable the participants to use the three fundamental theorems of the vector analysis, viz. Gauss', Green's and Stokes' theorems Learning outcomes--- After successful completion of this course a Learner will be able to: ▪ Apply basic techniques, results and concepts to solve prescribed exercises, ▪ Give arguments for the steps in the solution of the exercises.	

1	Triple products, the ∇ operator, the gradient, divergence and the curl, product rules. The fundamental theorem of gradient divergence and curl, spherical polar coordinates, one dimensional and three dimensional Dirac- delta function. Integration of vectors: line integral, surface integral, volume integral of vector field. Gauss-divergence theorem and Stokes theorem of vectors (statement only). DG: 1.1.3, 1.2.2 TO 1.2.6, 1.3.3, 1.3.4, 1.3.5, 1.4.1, 1.4.2, 1.5.2, 1.5.3. HD: 5.40,5.41,5.42	
UNIT 2	Electrostatics & Magnetostatics	No. of lectures 12
2	Learning Objective— This Course Enables the Learner to • introduce the basic mathematical concepts related to electromagnetic vector fields. • To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications. • To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications. • To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines. Course Outcome --- After successful completion of this course a Learner will be able to: • Understand the basic mathematical concepts related to electromagnetic vector fields. • Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density. • Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density	

2	1. The Electrical Field: Introduction, Coulomb's Law, The Electrical Field, Continuous charge distribution, electric potential, introduction to potential, comments on potential, the potential of a localized charge distribution. 2. Work And Energy In Electrostatics: The work done in moving a charge, the energy of a point charge distribution, the energy of continuous charge distribution. 3. Magnetostatics: The Biot-Savart law, applications of Biot-Savart law, Magnetic field due to a current carrying straight wire, circular loop, Helmholtz coils and solenoid. Ampere's law DG: 1) 2.4.1 TO 2.4.4 CR: 2) 8.7, 8.8	
UNIT 3	Charged particle dynamics	NO OF LECTURES 12
3	Learning Objective— This Course Enables the Learner to ➢ Compare the effects of the electric and the magnetic fields on the charged particle Learning outcomes--- After successful completion of this course a Learner will be able to: ▪ Motion of charged particle in electric field ▪ Motion of charged particle in various magnetic field ▪ Working of cyclatron	
3	Kinetic energy of a charged particle in an electric field, motion of a charged particle in a constant electric field, Charged particle in an alternating electric field, Thomsons parabolas and positive ray analysis. Force on a charged in a magnetic field. Charged particle in a uniform and constant magnetic field, The Cyclotron. Velocity selector Motion of a charged particle in combined electric and magnetic field: Case I: Parallel electric and magnetic field Case II: Crossed electric and magnetic field, Bainbridge mass spectrometer. HP: 13.1, 13.2, 13.3, 13.4, 13.5,13.5.1,13.6, 13.6.1 *[Note: A good number of numerical examples are expected to be covered during the prescribed lectures.]*	

References:

1. HP :HS. Hans and S. P. Puri Mechanics Tata Mc. GrawHill (2nd Ed.)

2. DG : David J. Griffiths Introduction to Electrodynamics –Prentice Hall India (EEE) 3rd Ed.
3. CR: D. Chattopadhyay and P. C. Rakshit Electricity and Magnetism - Books and allied (P) Ltd. Reprint 2000 (4th Edition.)
4. R.H: K.F.Riley, M.V.Hobson & S.J.Bence Mathematical methods for Physics & Engineering (3rd Edition)- Cambridge University Press.
5. HD: H.K Dass- S Chandand Mathematical Physics- Company LTD

UNIT-I: Z. Capri and P. V. Panat Introduction to Electrodynamics, (Narosa Pub. House)

UNIT–II: Brij Lal, Subramanyam , Jivan Sesan, Mechanics and Electrodynamics, (S. Chand) (Revised & Enlarged ED. 2005)

S.Y. B. Sc. (PHYSICS) SEMESTER IV
Course – III

COURSE TITLE: QUANTUM PHYSICS

COURSE CODE: 19US4PH3

[CREDITS - 02]

Learning Outcomes :

On successful completion of this course students will be able to :

1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.

2) Demonstrate quantitative problem solving skills in all the topics covered.

UNIT 1	**The Schrodinger wave equation**:	NO OF LECTURES 12
1	Background Reading (Review): Matter waves-De Broglie hypothesis, Wave particle duality, Concept of wave packet, phase velocity, group velocity,Heisenberg's uncertainty principle, **The Schrodinger wave equation**: Concept of wave function, Born interpretation of wave function. ,Concepts of operator in quantum mechanics examples – position, momentum and energy operators. ,Eigenvalue equations, expectation values of operators. , Schrodinger equation. ,Postulates of Quantum Mechanics. , Time dependent and time independent (Steady State) Schrodinger equation, Stationary State.	

	Superposition principle. Equation of continuity and its physical significance.	
UNIT 2	**Applications of Schrodinger steady state equation**	**NO OF LECTURES 12**
2	Learning Objective— This Course Enables the Learner to • Through understanding the behavior of quantum particle encountering a i) barrier, ii) potential, the student gets exposed to solving non-relativistic hydrogen atom, for its spectrum and eigenfunctions Learning outcomes--- After successful completion of this course a Learner will be able to: • In the laboratory course, with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three dimensional potentials.	
2	Free particle. ,Particle in infinitely deep potential well (one - dimension). Step potential. Particle in three dimension rigid box, degeneracy of energy state.	
UNIT 3	**Applications of Schrodinger steady state equation –II**	**NO OF LECTURES 12**
3	Learning Objective— This Course Enables the Learner to ▪ This course shall develop an understanding of how to model a given problem such as particle in a box, hydrogen atom, hydrogen atom in electric fields. ▪ These skills will help in understanding the different Quantum Systems in atomic and nuclear physics.	
3	Potential barrier (Finite height and width) ,penetration and tunneling effect (derivation of approximate transmission probability) , Theory of alpha particle decay from radioactive nucleus. Harmonic oscillator (one-dimension), correspondence principle. [Note: A good number of numerical examples are expected to be covered during the prescribed lectures].	

References:

- A. Beiser (6th Ed.) Concepts of Modern Physics –Tata McGraw Hill.
- S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.Quantum Mechanics

- R. Eisberg and R. Resnik Nuclei and particles. - Published by Wiley.
- D. Griffiths Introduction to Quantum Mechanics. - Published by Prentice Hall.
- Ghatak and Lokanathan Quantum Mechanics. - Published by Mc. Millan.
- Quantum Mechanics. -. By L. I. Schiff
- Powell and Crasemann, Quantum Mechanics. - Wesley Pub. Co.

Evaluation Pattern: Theory

For each course I, II ,III

External Evaluation – Semester End Examination (60 M)- Duration : 2 hours

Paper Pattern

Question No	Module	Marks with Option	Marks without Option
Q.1 (A) Attempt any One/Two (B) Attempt Three/Four	1	08 12	16 16
Q.2 (A) Attempt any One/Two (B) Attempt Three/Four	2	08 12	16 16
Q.3 (A) Attempt any One/Two (B) Attempt Three/Four	3	08 12	16 16

Internal Evaluation - (40 M)

Evaluation type	Marks
Class Test /online class test	30
Assignment Poster presentation field visit report simple project **OR**	10
Project +presentation+ report writing+ Viva **OR**	40
Chapter review +presentation+ report writing +Viva	40

SEMESTER II - Practicals

Course-I & II& III

COURSE CODE: ----19US4PHP1/2/3

Instructions:

i) All the measurements and readings should be written with proper units in SI system only

ii) After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination

iii) While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skill and procedure, graph, calculation and result.

iv) Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Leaning Outcome: On successful completion of this course students will be able to:

i) To demonstrate their practical skills.

ii) To understand and practice the skills while doing physics practical.

iii) To understand the use of apparatus and their use without fear.

iv) To correlate their physics theory concepts through practical.

v) Understand the concepts of errors and their estimation.

Experiments GROUP I	GROUP II	GROUP III	No. of Credit	Number of hours

			s	
• Determination of Cauchy's constant. • Cylindrical obstacle: determination of wavelength. • Resolving power of telescope. • Brewster's Law. • Newton's Rings(Determine wavelength of Na source) • Single slit Diffraction using spectrometer. • Lycopodiumpowder	I. LCR transients. II. Passive Low pass filter./High pass filter III. C_1/C_2 by de Sauty's Method IV. Figure of merit of a mirror galvanometer V. Superposion Theorem. VI. LCR Parallel resonance. VII. Determination of absolute Capacity by BG	• Study of RS Flip Flop. • Op amp comparator • Op amp – Differentiator • G by Shunting. • Op amp Integrator • First order active filters	2	3 hours/experiment

Demonstration experiments

1. 1. Laser experiments : straight edge, single slit, ruler grating
2. Optical fiber : transmission of signal
3. Concept of beats
4. Coupled oscillations and resonance
5. Wave form generator using Op-amp
6. PC simulations: graph, curve fitting etc.
7. Straight edge Fresnel diffraction
8. Double refraction

REFERENCES

1. D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Advanced course in Practical Physics Book& Allied Pvt. Ltd.
2. – Harnam Singh S. BSc Practical Physics Chand & Co. Ltd. – 2001
3. Samir Kumar Ghosh A Text book of advanced Practical Physics –, New Central Book Agency –(3rd edition)
4. CL Arora (1st Edition) B Sc. Practical Physics –– 2001 S. Chand & Co. Ltd.
5. CL Squires – (3rd Edition) Practical Physics –Cambridge University Press.
6. D C Tayal University Practical Physics –. Himalaya Publication.
7. Worsnop & Flint.Advanced Practical Physics –Main Reference: Manual provided by Department of Physics

Practical

There will be no internal assessment for practical.

For practical examination the learner will be examined in **three experiments** (one from each
Group. Minimum **3** from each group and in all minimum **12** experiments and 4 Demo experiments are required to be completed and reported in journal compulsorily.

The learner be evaluated at the time of viva voce on the basis of regular experiments and demonstration experiments.

A learner will be allowed to appear for the semester end practical examination only if he /she submits a Certified journal at the time of practical examination or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Physics as per the minimum requirement.

The duration of the practical examination will be three hours per experiment. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics