Deccan Education Society's

Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

for

S.Y. B. Sc. Physics

With effect from June 2020

Programme Structure

Year	Paper Code	Title of Paper	No. of Credits
S. Y. B. Sc.	**Semester III**		
	PHY2301	Oscillations, Waves and Sound	2
	PHY2302	Principles and Applications of Optics	2
	PHY2303	Practical Practical - III	2
	Semester IV		
	PHY2401	Introductory Quantum Physics and Relativity	2
	PHY2402	Measurement Techniques in Physics	2
	PHY2403	Practical Practical - IV	2

S.Y. B.Sc. Semester III		
Title of the Course and Course Code	**Oscillations, Waves and Sound (PHY 2301)**	**Number of Credits : 02**
Course Outcomes(COs) **On completion of the course, the students will be able to:**		
CO1	Define and describe concepts of undamped, damped and forced oscillations with rigorous mathematical treatment.	
CO2	Exemplify mathematical models for analysis of longitudinal and transverse waves.	
CO3	Solve problems in wave mechanics, Doppler Effect and acoustic measurements.	
CO4	Explain the concept of reverberation of sound and reverberation time.	
CO5	Discriminate between undamped, damped and forced oscillations.	
CO6	Develop mathematical treatment for wave motion in different modes.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Undamped and Damped Oscillations** **Undamped Oscillations** 1.1 Differential equation of S.H.M. and its solution (exponential form) 1.2 Composition of two perpendicular linear S.H.M.s in frequency ratio 1:1 and 1:2 (analytical method) 1.3 Compound Pendulum, Bar Pendulum, Kater's Pendulum. **Damped oscillation** 1.4 Differential equation of damped harmonic oscillator and its solution, Discussion of different cases. 1.5 Logarithmic decrement 1.6 Energy equation of damped oscillations	**09**
II	**Forced Oscillations** 2.1 Differential equation of forced oscillations and its solution (transient and steady state). Amplitude and phase of forced oscillations 2.2 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapour lamp) 2.3 Velocity and Amplitude resonance 2.4 Sharpness of resonance 2.5 Energy equation of forced oscillations	**09**

	2.6 Equation of coupled oscillations	
III	**Wave Motion** 3.1 Differential equations of wave motion in continuous media 3.2 Equations for longitudinal wave and its solution (one dimension only) 3.3 Equation for transverse wave and its solution (one dimension only) 3.4 Energy density and intensity of a wave 3.5 Discussion of seismic waves	**09**
IV	**Doppler effect and Sound** **Doppler effect** 4.1 Explanation of Doppler effect in sound 4.2 Expression for apparent frequency in different cases 4.3 Asymmetric nature of Doppler effect in sound 4.4 Doppler effect in light. Symmetric nature of Doppler effect in light. 4.5 Applications: Red and Blue shift, Radar **Sound** 4.6 Definition of sound intensity, loudness, pitch, quality(timber) 4.7 Reverberation time and Reverberation of a hall 4.8 Sabine's formula (without derivation) 4.9 Stroboscope	**09**

References:

1. Waves and Oscillations, Stephenson
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, S P Puri, Tata McGraw-Hill Publishing co. ltd.
4. A text book of sound, Subramanyam and Brijlal, Vikas Prakashan
5. Sound, Mee, Heinmann, Edition - London.
6. Waves and Oscillations, R. N. Chaudhari, New age international (P) ltd.

Title of the Course and Course Code	Principles and Applications of Optics (PHY 2302)	Number of Credits : 02
Course Outcomes(COs) On completion of the course, the students will be able to:		
CO1	Define terms interference, diffraction and polarization.	
CO2	Articulate concepts of polarization of light, types of polarization, generation of polarized light. Illustrate concepts of Fresnel and Fraunhofer's diffraction.	
CO3	Solve problems based on wavelength and refractive index measurement using Newton's ring, Michelson interferometer for closely spaced wavelength, antireflection coating, resolving power of telescope and grating, Malus law, retarders.	
CO4	Explain the concept of thin film interference for uniform and non-uniform film and their potential applications. Analyze different types of polarized light.	
CO5	Consider different examples of Fresnel and Fraunhofer's diffraction. Compare resolving power of different telescopes.	
CO6	Specify the potential applications of thin film interference and resolving power of grating and telescope.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Interference** 1.1 Phase change on reflection [Stoke's treatment] 1.2 Interference due to thin film i] Uniform thickness: Reflection and Transmission ii] Wedge shaped film: Reflection and Newton's ring 1.3 Colours in thin film 1.4 Principle construction and working of Michelson interferometer 1.5 Applications of Michelson Interferometer i] Determination of thickness of transparent media ii] Resolution of spectral lines iii] Standardization of meters	**09**
II	**Fraunhoffer's Diffraction** 2.1 Definition, Difference between interference and diffraction 2.2 Diffraction through Single slit 2.3 Diffraction at double slit	**09**

	2.4 Diffraction at N- slits 2.5 Diffraction at circular aperture 2.6 Rayleigh criteria for resolution 2.7 Resolving power of telescopes and microscopes 2.8 Dispersive and resolving power of grating	
III	**Fresnel's Diffraction** 3.1 Definition 3.2 Huygens-Fresnel Theory 3.3 Fresnel's assumptions and concept of half period zone 3.4 Zone plate: Derivation of focal length and comparison with converging lens 3.5 Diffraction at straight edge 3.6 Diffraction at circular aperture	**09**
IV	**Polarization** 4.1 Polarization of transverse waves 4.2 Polarization by reflection 4.3 Brewster's law and Brewster's window 4.4 Pile of plates, Malus law 4.5 Double refraction: Huygen's explanation of double refraction in uniaxial crystal 4.6 Nicol prism 4.7 Elliptically and circularly polarized light 4.8 Quarter wave plate, Half wave plate 4.9 production and detection of plane, circularly and elliptically polarized light 4.10 Optical Activity: Fresnel's experiment and explanation of rotation 4.11 Polarimeter	**09**

References:

1. Optics, fourth edition, Pearson education, E. Hetch, A. R. Ganesan.
2. A Text book of Optics, N.Subhramanyam, Brijlal,M. N. Avadhanulu, S. Chand publication.
3. Physical Optics by A. K. Ghatak, McMillan, New Delhi.
4. Fundamentals of Optics, F. A. Jenkins, H. E. White, McGraw- Hill international Edition.

Title of the Course and Course Code	Practical Practical - III (PHY 2303)	Number of Credits : 02
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Define the objectives of a given experiment. Identify various components, devices, instruments and tools for specific applications.	
CO2	Exemplify proper use of tools and testing of measuring instruments. Summarize the observations taken during the experimentation and tabulate the results.	
CO3	Demonstrate handling of tools and instruments used for taking observations	
CO4	Analyze the observed data. Calculate physical quantity as per the aim of experiment.	
CO5	Standardize method to prepare technical report writing for laboratory exercises. Evaluate errors in observed values of physical quantities.	
CO6	Construct circuits from drawings, the block diagrams for a given instrument / equipment. Develop skills of optical levelling, component testing and plotting of graphs with proper scale	

Sr. No.	Title of Experiment
1	Log decrement of oscillator in air and water
2	Study of coupled oscillations using Couple Pendulum
3	'g' by Bar Pendulum
4	Determination of radius of curvature of a lens using Newton's ring
5	Study of Double refraction using prism
6	Determination of 'Y' and 'η' of wire by Searl's method
7	Determination of cardinal points using Searl's Goniometer
8	Determination of wavelength of light and thickness of wire using diffraction pattern
9	Demonstration Experiment 1
10	Demonstration Experiment 2

S.Y. B.Sc. Semester IV		
Title of the Course and Course Code	**Introductory Quantum Physics and Special Theory of Relativity (PHY2401)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall and explain the phenomena like black body radiation, photoelectric effect, Compton effect, diffraction of photons/electrons from one/two slits, pair production etc.	
CO2	Estimate knowledge of theoretical concepts and experimental confirmation of de Broglie hypothesis and other related principles.	
CO3	Demonstrate problems arising due to discrepancies in theories and their inabilities in interpretation of experimental results pertaining to the atomic and nuclear structures which lead to discoveries of elementary particles. Classify the elementary particles.	
CO4	Analyse the concepts of modern physics to matter waves.	
CO5	Consider basic laws of quantum mechanics also serve to set up the mathematical foundations to pursue advanced topics in quantum mechanics and special theory of relativity.	
CO6	Specify postulates of special theory of relativity and rewrite it with respect to space, time, and mass etc.	

Unit. No.	Title and Contents	No. of Lectures
I	**Particle Nature of Wave** 1.1 Black Body Radiation: i] Spectral energy density at various temperatures, ii] Stefan's 4^{th} power law iii] Ray Leigh Jeans law iv] Wein's displacements Law, Plank's law 1.2 Photoelectric Effect: - i]Experimental observation ii] Einstein's explanation photoelectric current and retarding potential (estimation of Plank's constant and work function) 1.3 X-ray and X-ray Diffraction: - Discovery of X-ray, Production and Diffraction 1.4 Compton Effect: - Experimental demonstration of effect	**09**

	(Derivation of wavelength shift) 1.5 Pair Production Annihilation	
II	**Wave nature of particle** 2.1 de Broglie Hypothesis: Concept of matter waves, de Broglie wavelength 2.2 Experimental confirmation of de Broglie Hypothesis i) Davisson Germer experiment ii) G P Thompson Experiment 2.3 Heisenberg uncertainty principle 2.4 Electron Microscope Principle and construction :Scanning Electron Microscope	**09**
III	**Special theory of relativity** 3.1 Historical background: Concept of absoluteness of space, time simultaneity and absolute motion, Michelson Morley experiment, Lorentz-Fitzgerald Transformation 3.2 Postulates of special theory of relativity 3.3 Lorentz transformation: Derivation 3.4 Time dilation, length contraction, simultaneity principle 3.5 Variation of mass with velocity and mass energy equivalence 3.6 Twin paradox	**09**
IV	**Important Discoveries of Constituents of Atom and Nucleus** 4.1 Discovery of electron 4.2 Discovery of proton 4.3 Discovery of neutron 4.4 Discovery of neutrino 4.5 Discovery of positron 4.6 Discovery of mesons 4.7 Classification of elementary particles	**09**

References:

1. Atomic Physics, J.B. Rajam, S. Chand Publication
2. Atomic Physics, S.N. Ghoshal
3. Concepts of Modern Physics, AurtherBeiser, Tata McGraw- Hill Education
4. Introduction to Special Relativity, Robert Resnick, John Wiley and Sons.

Title of the Course and Course Code	Measurement Techniques in Physics (PHY2402)	Number of Credits: 02
Course Outcomes (Cos) **On completion of the course, the students will be able to:**		
CO1	Identify the physical quantities to be measured in the groups of mechanics, properties of matter, optics, electricity, magnetism, heat, and thermodynamics.	
CO2	Explain the theory behind each experiment to measure the given parameter.	
CO3	Use different instruments, devices, systems for organizing the experiments and recording the readings.	
CO4	Arrange the apparatus to perform the experiment.	
CO5	Determine the values of physical constants and values of parameters from the experimental data.	
CO6	Compile the data and verify the results obtained.	

Unit No.	Title of Unit and Contents	No. of Lectures
I	**Mechanics** 1.1 Measurement of mass: 1.2 Poison's ratio of rubber 1.3 Measurement of surface tension of liquid by i)Wilhelmy's method ii) Fergusson Method iii)Quinke's Method iv)Soap solution method 1.4 Error analysis: definition of error and accuracy in measurement, order of accuracy, types and causes of errors, estimation of errors, Average error, rms error, probable error, practical determination of error	**09**

II	**Heat and Thermodynamics** 2.1 Determination of specific heat of solid and liquid by cooling method 2.2 Clement and Desorme's experiment for determination of C_p/C_v for air 2.3 Determination of thermal conductivity of rubber and glass tube 2.4 Forbe's method for determining thermal conductivity of ametal bar 2.5 Determination of Joule's equivalent of heat by Callendar and Barne's method 2.6 Determination of Stefan's constant using black body	**09**
III	**Optics** 3.1 Determination of wavelength of light by Lloyd's single mirror and Fresnel's double mirror 3.2 Determination of Young's Modulus and Poisson's ratio of glass bar by Newton's ring 3.3 Determination of resolving power of telescope 3.4 Michelson's method for measuring stellar diameters 3.5 study of rotation of plane of polarization by Lorentz Saccharimeter 3.6 Methods for measurement of velocity of light i) Astronomical Method ii) Kerr Cell Method iii) Rotating mirror method	**09**
IV	**Electricity and Magnetism** 4.1 Determination of B_H, BV and angle of dip by Earth coil 4.2 Determination of susceptibility of a solution 4.3 Measurement of electric charge by moving coil Ballistic galvanometer 4.4 Determination of value of high and low resistance using Kelvin 's Bridge and by leakage using Ballistic galvanometer method 4.5 Study of variation of resistance with temperature using bridge method 4.6 Measurement of self-inductance using Anderson bridge.	**09**

Refernces:

1. Advanced Practical Physics for students, B.L. Worsnop and H.T. Flint,Methuen
2. Elements of Properties of Matter, D. S. Mathur

Title of the Course and Course Code	Physics Practical IV - (PHY 2403)	Number of Credits: 02
Course Outcomes (Cos) **On completion of the course, the students will be able to:**		
CO1	Define the objectives of a given experiment. Identify Various components, devices, instruments, and tools for specific applications.	
CO2	Exemplify proper use of tools and testing of measuring instruments. Summarize the observations taken during the experimentation and tabulate the results.	
CO3	Demonstrate handling of tools and instruments used for taking observations. Use computer software for data generation and plotting	
CO4	Analyze the observed data, calculate physical quantity as per the aim of experiment.	
CO5	Standardize method to prepare technical report writing for laboratory exercises. Evaluate errors in observed values of physical quantities.	
CO6	Construct circuits from drawings, block diagrams for a given instrument / equipment. Develop skills of optical levelling, component testing and plotting of graphs with proper scale.	

Sr. No.	Title of Experiment
1	Use of Computer
2	Transistor characteristic
3	UJT characteristics
4	Zener Stabilized Power Supply
5	Dispersive power of grating
6	Study of half wave and full wave rectifier
7	Specific rotation of cane sugar by half shade polarimeter
8	Determination of B_H by tangent galvanometer
9 and 10	Study visit