Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE

Syllabus

for

S. Y. B. Sc. (Physics)

[Pattern 2019]

(B.Sc. Semester-III and Semester-IV)

From Academic Year

2020-21

Deccan Education Society's
Fergusson College (Autonomous), Pune

S.Y.B.Sc. Physics (Pattern 2019)

From academic year 2020-21

Particulars	Name of Paper	Paper Code	Title of Paper	No. of Credits
S.Y. B.Sc. Semester III	Theory Paper - 1	PHY2301	Oscillations, Waves and Sound	2
	Theory Paper - 2	PHY2302	Principles and Application of Optics	2
	Practical Paper - 1	PHY2303	Practical Course - III	2
S.Y. B.Sc. Semester IV	Theory Paper - 3	PHY2401	Introductory Quantum Physics and Special Theory of Relativity	2
	Theory Paper - 4	PHY2402	Measurement Techniques in Physics	2
	Practical Paper - 2	PHY2403	Practical Course - IV	2

S.Y. B.Sc. Semester III

Subject Physics Paper -I (PHY2301): Oscillations, Waves and Sound
[Credits-2]

Course Outcomes
On successful completion of the course, the students will be able to

CO1 Develop mathematical treatment for wave motion in different modes.

CO2 Understand the concepts related to energy in oscillations.

CO3 Solve problems in wave mechanics.

CO4 Apply their knowledge in calculating red and blue shift and also in acoustics.

Unit	Details	Lectures
I	**Module1: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.sin 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	**Module 2. 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 2.6 Equation of coupled oscillations	**[09]**
III	**Module 3. Wave Motion** 3.1 Differential equations of wave motion in continuous media 3.2 Equations for longitudinal wave and it's 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	**Module 4: Doppler effect and Sound** **Doppler effect** 4.1 Explanation of Doppler effect in sound	**[09]**

	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 Dopplereffect 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	

Books-

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.

S.Y. B.Sc. Semester III

Subject Physics Paper -II (PHY2302): Principles and Application of Optics
[Credits-2]

Course Outcomes
At the end of this course, students will be able to

CO1 The course will provide the student a thorough fundamental knowledge of optical phenomena which includes interference, diffraction and polarization.

CO2 The student will be able to analyse and understand interference due to thin films and its applications.

CO3 The student will get acquainted with Fresnel's and Fraunhofer's diffraction and will be able to analyse intensity variation of diffracted light in each case.

CO4 The student will get a thorough knowledge of the polarization of light, types of polarization, generation and applications of polarized light.

Unit	Details	Lectures
I	**Module 1: 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	**Module 2: Fraunhoffer's Diffraction** 2.1Definition , Difference between interference and diffraction 2.2 Diffraction through Single slit 2.3 Diffraction at double slit 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	**[09]**
III	**Module 3: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	**[09]**

	3.5 Diffraction at straight edge 3.6 Diffraction at circular aperture	
IV	**Module 4: Polarization** 4.1Polarization of transverse waves 4.2 Polarization by reflection 4.3 Brewster's law and Brewster's window 4.4 Pile of plates, Malus law 4.5Double 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]**

Books-

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.

S.Y. B.Sc. Semester III

Subject Physics Paper -III (PHY2303): Practical Course - III

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

CO1 Apply knowledge of principles of optics to understand phenomena of interference, diffraction and double refraction.

CO2 Apply geometrical optics to find cardinal points of lens system.

CO3 Understand damped oscillations, compound pendulum and coupled pendulum

List of practicals (Compulsory 10 + 2 Activity)

Sr. No.	Title of Experiment
1	Study of damped oscillations in water
2	Log decrement of oscillator in air
3	Study of coupled oscillations using Couple Pendulum
4	'g' by Bar Pendulum
5	Determination of radius of curvature of a lens using Newton's ring
6	Study of Double refraction using prism
7	Determination of Young's modulus of wire by Searl's method
8	Determination of modulus of rigidity of wire by Searl's method
9	Determination of cardinal points using Searl's Goniometer
10	Measurement of lengths using diffraction pattern
11 & 12	Demo Experiments

S.Y. B.Sc. Semester IV

Subject Physics Paper -1
(PHY2401): Introductory Quantum Physics and Special Theory of Relativity
[Credits-2]

Course Outcomes
At the end of this course, students will be able to

CO1 Understand phenomena like black body radiation, photoelectric effect, Compton effect etc.

CO2 Acquire knowledge of theoretical concepts and experimental confirmation of de Broglie hypothesis and other related principles.

CO3 Apply postulates of special theory of relativity with respect to space, time and mass etc.

CO4 Appreciate 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.

Unit	Details	Lectures
I	**Module 1: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 (Derivation of wavelength shift) 1.5 Pair Production Annihilation	**[09]**
II	**Module 2: 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	**Module3: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	**Module 4: 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]**

Books-

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.

S.Y. B.Sc. Semester IV

Subject Physics Paper -II (PHY2402): Measurement Techniques in Physics
[Credits-2]

Course Outcomes
At the end of this course, students will be able to

CO1 Design the experiment and the observation tables.

CO2 Enlist the precautions for minimizing the errors and estimate the errors.

CO3 Develop various techniques for the measurement of various physical quantities.

CO4 Understand and apply the techniques of graphical analysis of the experimental data.

Unit	Details	Lectures
I	**Module 1 :Mechanics** 1.1Measurement of mass: 1.2Poison's ratio of rubber 1.3Measurement of surface tension of liquid by i)Wilhelmy's method ii)Fergusson Method iii)Quinke's Method iv)Soap solution method 1.4Error 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	**[12]**
II	**Module 2: 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 glasstube 2.4Forbe'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	**[12]**
III	**Module 3: 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	**[12]**

	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	
IV	**Module 4: Electricity and Magnetism** 4.1 Determination of B_H , B_V 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	

Books-

1. Advanced Practical Physics for students, B.L. Worsnop and H.T. Flint,Methuen

2. Elements of Properties of Matter , D. S. Mathur

S.Y. B.Sc. Semester IV

Subject Physics Paper -III (PHY2403): Practical Course –IV

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

CO1 Design circuits for measurement of various electrical quantities.

CO2 Generate data and plot of various functions using computer software.

CO3 Set the apparatus for optical and magnetic measurements.

List of practicals (Compulsory 10 + 2 Activity)

Sr. No.	Title of Experiment
1	Plotting of Trigonometric functions
2	Polar plot for dipole potential
3	Transistor characteristics
4	UJT characteristics
5	Regulated power supply using Zener diode
6	Dispersive power of grating
7	Study of half wave rectifier
8	Study of full wave rectifier with and without filter
9	study of rotation of plane of polarization by Lorentz Saccharimeter
10	Determination of B_H using tangent galvanometer
11 & 12	Study visit