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

SYLLABUS FOR S Y B Sc PHYSICS

Effective from Academic Year 2017-2018

Preamble:

Fergusson College is awarded academic autonomy by the UGC beginning the year 2016-17. This autonomy is for a period of six years. We shall be following the semester pattern for academic transactions and the Credit Based Assessment System will be followed for assessment. The curriculum for the graduate programme in Physics is designed to cater to the requirements of the Autonomy and the Credit system following the UGC guidelines.

Physics is one of the oldest branches of natural sciences. It forms the foundation of the scientific process.

The programme is aimed to be more learning centric than teaching centric. The courses are designed so that a student progressively develops a deeper understanding of various aspects of physics.

Physics is learnt more through experimentation than only through classroom sessions. The experiments are designed to develop logical thinking and analytical ability. Reading between lines is important and some open ended experiments, assignments and small projects are designed to develop these skills.

Continuous assessment is an integral part of the credit system. This will help students learn their subjects systematically and thoroughly.

The under graduate programme in Physics is spread over three years with two semesters every year. There will be two theory courses and one laboratory course each semester for the first and the second year. For the third year, there will be six theory courses and three laboratory courses each semester.

Objectives:

1. To explore different areas of physics.
2. To develop theoretical foundation and experimental skills to study various natural phenomena.
3. To train students for in depth study of physics.
4. To encourage students to explore applications of physics in various walks of life.
5. To inculcate research culture by introducing projects at the final year of the course.

Fergusson College (Autonomous), Pune
Faculty of Science
Course structure for B.Sc. (Physics)

Semester	Course Code	Title of the Course	Core / Elective	No. of Credits
I	PHY1101	Mechanics and Properties of matter	CORE-1	2
	PHY1102	Heat and thermodynamics	CORE-2	2
	PHY1103	Practical Course– 1	PCORE-1	2
II	PHY1201	Introduction to Mathematical Physics	CORE-3	2
	PHY1202	Electricity and Magnetism	CORE-4	2
	PHY1203	Practical course II	PCORE-2	2
III	PHY2301	Oscillations, Waves and Sound	CORE-5	3
	PHY2302	Principles and Applications of Optics	CORE-6	3
	PHY2303	Practical course III	PCORE-3	2
IV	PHY2401	Introductory Quantum Physics and Relativity	CORE-7	3
	PHY2402	Measurement Techniques in Physics	CORE-8	3
	PHY2403	Practical course IV	PCORE-4	2
V	PHY3501	Mathematical Methods in Physics	CORE-9	3
	PHY3502	Solid State Physics	CORE-10	3
	PHY3503	Classical Mechanics	CORE-11	3
	PHY3504	Atomic and Molecular Physics	DSE-1	3
	PHY3505	Modelling and Simulations	DSE-2	3
	PHY3506	MATLAB Programming	DSE-2	3
	PHY3507	Astronomy and Astrophysics	DSE-3	3
	PHY3508	Fundamentals of Material Science	DSE-3	3
	PHY3509	Practical Course V	PCORE-5	2
	PHY3510	Practical Course VI	PCORE-6	2
	PHY3511	Practical Course VII: MATLAB Programming	PCORE-7	2
	VPH3501	Video Recording and Playback Systems*	DSE-2	3
	VPH3502	Video Production*	DSE-3	3
	VPH3503	Practical Course V*	PCORE-7	2
VI	PHY3601	Classical Electrodynamics	CORE-12	3
	PHY3602	Quantum Mechanics	CORE-13	3
	PHY3603	Thermodynamics and Statistical Mechanics	CORE-14	3
	PHY3604	Nuclear and Particle Physics	DSE-4	3
	PHY3605	Electronics II	DSE-5	3
	PHY3606	Advanced Electronics	DSE-5	3
	PHY3607	Physics of Nanomaterials	DSE-6	3
	PHY3608	LASERS	DSE-6	3
	PHY3609	Practical Course VIII	PCORE-8	2
	PHY3610	Practical Course IX	PCORE-9	2
	PHY3611	Practical Course X: Project	PCORE-10	2
	VPH3601	Entrepreneurship Development*	DSE-5	3
	VPH3602	Radio Production*	DSE-6	3
	VPH3603	Practical Course VI*	PCORE-9	2
	VPH3604	Practical Course VII: Project*	PCORE-10	2
			TOTAL	

Note: For semester III:

1. *Students not opting Electronics in F. Y. B. Sc. should select* PHY2302.
2. *Students opting Electronics in F. Y. B. Sc. should select* PHY2303.

Note: For semester V:

1. *Students should select any one out of these* PHY3505 *and* PHY 3506 *courses.*
2. *Students should select any one out of these* PHY3507 *and* PHY3508 *courses.*
3. **Students opting for vocational photography at F. Y. B. Sc. and S. Y. B. Sc. should select* VPH3501, VPH3502 and VPH3503.

Note: For semester VI:

1. *Students not opting Electronics in F. Y. B. Sc. should select* PHY3605.
2. *Students opting Electronics in F. Y. B. Sc. should select* PHY3606.
3. *Students should select any one out of these* PHY3607 *and* PHY3608 *courses.*
4. **Students opting for vocational photography at F. Y. B. Sc. and S. Y. B. Sc. should select* VPH3601, VPH3602, VPH3603 and VPH3604.

PAPER CODE: PHY2301 **PAPER –I: OSCILLATIONS, WAVES AND SOUND** **No. of Credits: 3** **No. of Lectures: 48**		
	Title and Contents	**No. of Lectures**
Unit -I	**Module1 :Undamped and damped Oscillations** **Undamped Oscillations** 1.1 Definition of linear and angular S.H.M. 1.2 Differential equation of S.H.M. and its solution (exponential form) 1.3 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method) 1.4Lissajous's figures and its uses, Applications (mechanical, electrical and optical) 1.5 Compound Pendulum, Bar Pendulum, Kater's Pendulum. **Damped oscillation** 1.6 Differential equation of damped harmonic oscillator and its solution, discussion of different cases. 1.7 Logarithmic decrement 1.8 Energy equation of damped oscillations 1.9 Power dissipation 1.10 Quality factor 1.11 Application :LCR series circuit	**12**
Unit -II	**Module 2. Forced Oscillations** 2.1 Forced oscillation with one degree of freedom 2.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation 2.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapour lamp) 2.4 Velocity and Amplitude resonance 2.5 Sharpness of resonance 2.6 Energy of forced oscillations 2.7 Power dissipation 2.8 Quality factor and Bandwidth 2.9 Application of forced oscillations 2.10 Equation of coupled oscillations	**12**
Unit –III	**Module 3. Wave Motion and Doppler effect** 3.1 Differential equations of wave motion in continuous media 3.2 Equations for longitudinal waves and it's solution (one dimension only) 3.3 Equation for transverse waves and its solution (one dimension only) 3.4 Energy density and intensity of a wave 3.5 Discussion of seismic waves 3.6 Electromagnetic Waves. 3.7 Explanation of Doppler effect in sound 3.8 Expression for apparent frequency in different cases. 3.9 Asymmetric nature of Doppler effect in sound 3.10 Doppler effect in light, symmetric nature of Doppler	**12**

	effect in light. 3.11 Applications: Red shift, Violet shift, Radar	
Unit –IV	**Module 4:Sound** 4.1 Definition of sound intensity, loudness, pitch, quality and timber 4.2 Acoustic intensity level measurement 4.3 Acoustic pressure and it's measurement 4.4 Reverberation time and Reverberation of a hall 4.5 Sabine's formula (without derivation) 4.6 Stroboscope	**12**
Reference 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.	

PAPER CODE: PHY2302 **PAPER –II: Principles and Application of Optics** **No. of Credits: 3** **No. of Lectures: 48**		
	Title and Contents	**No. of Lectures**
Unit -I	**Module 1: Geometrical Optics by matrix method** 1.1 Introduction 1.2 Reflection and Translation 1.3 Translation Matrix 1.4 Refraction Matrix 1.5 System Matrix 1.6 Position of image plane 1.7 Magnification 1.8 System of matrix for thick Lens 1.9 System of matrix for thin Lens 1.10 Cardinal points of an optical system 1.11 System matrix for two thin lenses 1.12 Searle's Goniometer	**12**
Unit -II	**Module 2: Interference** 2.1 Phase change on reflection [Stoke's treatment] 2.2 Interference due to thin film i] Uniform thickness: Reflection and Transmission ii] Wedge shaped film: Reflection and Newton's ring 2.3 Colors in thin film 2.4 Principle construction and working of Michelson interferometer 2.5 Applications of Michelson Interferometer i] Determination of thickness of transparent media ii] Resolution of spectral lines iii] Standardization of meters	**12**
Unit –III	**Module 3: Diffraction** 3.1 Definition, difference between interference and diffraction, types of diffraction 3.2 Fresnel's diffraction: i] Diffraction at straight edge and thin wire ii] Diffraction at circular aperture, rectangular aperture and circular disc iii] Zone plate: Derivation of focal length and comparison with converging lens 3.3 Fraunhoffer's Diffraction i] Diffraction through Single slit ,double slit and grating 3.4 Rayleigh criteria for resolution 3.5 Resolving power of telescopes and microscopes 3.6 Dispersive and resolving power of grating	**12**
Unit –IV	**Module 4: Polarization** 4.1Polarization of transverse waves 4.2 Polarization by reflection 4.3 Biot's polariscope 4.4 Brewster's law and Brewster's window	**12**

	4.5 Pile of plates, Malus law 4.6 Double refraction: Huygen's explanation of double refraction in uniaxial crystal 4.7 Nicol prism 4.8 Nature of refraction for different position of optical axis [parallel, Perpendicular, oblique to crystal surface] 4.9 Elliptically and circularly polarized light 4.10 Quarter wave plate 4.11 production and detection of plane, circularly and elliptically polarized light 4.12 Optical Activity: Fresnel's experiment and explanation of rotation 4.13 Polarimeter	
Reference Books:	**1.** Optics, fourth edition, Pearson education, E. Hetch, A. R. Ganesan. **2.** A Text book of Optics, N.Subhramanyam, Brijlal, **3.** M. N. Avadhanulu, S. Chand publication. **4.** Physical Optics by A. K. Ghatak, McMillan, New Delhi. **5.** Fundamentals of Optics, F. A. Jenkins, H. E. White, McGraw- Hill international Edition. **6.** Principles of optics, D. S. Mathur, Gopal Press, Kanpur	

	PAPER CODE: PHY2303 **PAPER –III: PRACTICAL COURSE - III** **No. of Credits: 2** **No. of Experiments: 10**
	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	Absorption coefficient of sound
7	Determination of cardinal points using Searl's Goniometer
8	Measurement of lengths using diffraction pattern
9 & 10	Demo Experiments

PAPER CODE: PHY2401 **PAPER – I: Introductory Quantum Physics and Relativity** **No. of Credits: 3** **No. of Lectures: 48**		
	Title and Contents	**No. of Lectures**
Unit -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	**12**
Unit -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	**12**
Unit –III	**Module3:** Special theory of relativity 3.1Historical 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 3.3 Time dilation, length contraction, simultaneity principle 3.5 Variation of mass with velocity and mass energy equivalence 3.6 Twin paradox	**12**
Unit –IV	**Module 4:** Important Discoveries of Constituents of Atom and Nucleus 4.1 Discovery of i] electron, ii] proton, iii] neutron, iv] neutrino, v] positron, vi] mesons 4.2 Elementary particles: classification	**12**
Reference Books:	**1.** Atomic Physics, J.B. Rajam, S. Chand Publication **2.** Concepts of Modern Physics, Aurther Beiser, Tata McGraw- Hill Education **3.** Introduction to Special Relativity, Robert Resnick, John Wiley and Sons	

PAPER CODE: PHY2402 **PAPER –II: Measurement Techniques in Physics** **No. of Credits: 3** **No. of Lectures: 36**		
	Title and Contents	**No. of Lectures**
Unit -I	**Module 1 :** Mechanics 1.1 Measurement of mass: 1.2 Poison's ratio of rubber 1.3 Measurement of Young's modulus and Modulus of rigidity of wire by Searl's method 1.4 Measurement of surface tension of liquid by i)Wilhelmy's method ii)Fergusson Method iii)Quinke's Method iv)Soap solution method 1.5 Determination of viscosity of liquid by coaxial cylinder method 1.6 Determination of viscosity of gas by flow through a capillary tube **1.7** 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	**12**
Unit -II	**Module 2: Heat and Thermodynamics** 2.1 Determination of specific heat of solid and liquid by cooling method 2.2 Determination of latent heat of fusion of ice, latent heat of vaporization 2.3 Clement and Desorme's experiment for determination of C_p/C_v for air 2.4 Duma's method for determination of vapour density 2.5 Determination of thermal conductivity of rubber and glass tube 2.6 Forbe's method for determining thermal conductivity of a metal bar 2.7 Determination of Joule's equivalent of heat by Callendar and Barne's method 2.8 Determination of Stefan's constant using black body	**12**
Unit -III	**Module 3: Optics** 3.1 Determination of refractive index of a liquid by total internal reflection within a glass prism 3.2 Determination of wavelength of light by Lloyd's single mirror and Fresnel's double mirror 3.3 Determination of Young's Modulus and Poisson's ratio of glass bar by Newton's ring 3.4 Refractive index of air by Rayleigh's refractometer 3.5 Determination of e/m for electron by Normal Zeeman effect using Fabry parrot interferometer 3.6 Determination of resolving power of telescope 3.7 Michelson's method for measuring stellar diameters 3.8 Use of Quarter wave plate	**12**

	3.9 study of rotation of plane of polarization by Lorentz Saccharimeter 3.10 Methods for measurement of velocity of light i) Astronomical Method ii) Kerr Cell Method iii) Rotating mirror method	
Unit –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 permeability by using iron wire specimen and iron sample by using magnetometer and Ballistic galvanometer 4.3 Determination of susceptibility of a solution 4.4 Measurement of electric charge by moving coil Ballistic galvanometer 4.5 Determination of value of high and low resistance using Kelvin ‘s Bridge and by leakage using Ballistic galvanometer method 4.6 Study of variation of resistance with temperature using bridge method 4.7 Comparison of capacities of condensers 4.8 Measurement of self inductance using Anderson bridge 4.9 Measurement of sensitivity of AC bridges using moving coil vibration Galvanometer	**12**
Reference Books:	**1.** Advanced Practical Physics for students, B.L. Worsnop and H.T. Flint, Methuen	

	PAPER CODE: PHY2403 **PAPER –III: PRACTICAL COURSE -IV** **No. of Credits: 2** **No. of Experiments: 10**
	Title of Experiment
1	Use of Computer
2	Transistor characteristics
3	Determination of B_H , B_V and angle of dip by Earth coil
4	Measurement of electric charge by moving coil Ballistic galvanometer
5	Study of half wave and full wave rectifiers
6	study of rotation of plane of polarization by Lorentz Saccharimeter
7	Measurement of Young's modulus and Modulus of rigidity of wire by Searl's method
8	Quarter wave plate
9 & 10	Study visit