



Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

for

F. Y. B. Sc. Physics

With effect from June 2019

Programme structure

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	Physics Practical - I	PCORE-1	2
II	PHY1201	Introduction to Mathematical Physics	CORE-3	2
	PHY1202	Electricity and Magnetism	CORE-4	2
	PHY1203	Physics Practical - 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
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: PHY1101
PAPER – I: MECHANICS AND PROPERTIES OF MATTER
No. of Credits: 2

	Title and Contents	No. of Lectures
Unit -I	<p>Moment of Inertia Moment of Inertia: Definition of MI, Radius of gyration, Statement of parallel and perpendicular axis theorems. Derivation of MI of: i) Circular Ring, ii) Circular Disc, iii) Annular Ring, iv) Spherical shell & solid sphere, v) Hollow cylinder & Solid cylinder, vi) Flywheel, axle & its Applications, vii) Spring Gyroscope: Principle, construction, working and applications</p>	10
Unit -II	<p>Gravitation: Newton's law of gravitation, Gravitational force, Gravitational field and Gravitational potential, Gravitational potential energy of a multi-particle system, uniform solid sphere and galaxy, Central force, Kepler's laws of planetary motion</p>	8
Unit -III	<p>Elasticity: Basic concepts of elasticity, Hook's law, three types of elastic moduli, Poisson's ratio, Relationship between Y, k, Δ. Bending of beam, bending moment, cantilever load at free end, loaded uniformly, due to its own weight. Determination of Y by bending of a uniformly loaded beam. Determination of elastic constant using Searle's method</p>	8
Unit -IV	<p>Fluid Mechanics: Laminar and viscous flow, viscosity, Coefficient of viscosity, Streamline flow and Turbulent flow (Tubular flow), Equation of continuity of flow, Energy of fluid. Bernoulli's theorem (Steady flow), Euler's equation. Applications of Bernoulli's theorem: Venturi meter, Pitot tube, Aerofoil, Bunsen burner, Atomizer, Spinning of a ball. Critical velocity and Reynold's number</p>	10
Reference Books:	<ol style="list-style-type: none"> 1. University Physics: Sears and Zeemansky, XIIth edition, Pearson Education 2. Physics: Volume I, Resnick/Halliday/Krane John Wiley & Sons (Sea) pvt ltd. 4th edition. 3. Properties of Matter: D. S. Mathur, Shamlal Charitable Trust New Delhi 4. Mechanics: D. S. Mathur, S. Chand and Company New Delhi. 5. Concepts of Physics, Vol I: H. C. Varma, Bharati Bhavan Publishers 	

PAPER CODE: PHY1102
PAPER – II: HEAT AND THERMODYNAMICS
No. of Credits: 2

	Title and Contents	No. of Lectures
Unit -I	Concepts of Thermodynamics: Thermodynamic state of a system and zeroth law of thermodynamics, Thermodynamic Equilibrium, Adiabatic and isothermal changes, Work done during isothermal changes, Adiabatic relations for perfect gas, Work done during adiabatic change, Indicator Diagram, First law of Thermodynamics, Reversible and Irreversible processes	8
Unit -II	Applied Thermodynamics: Conversion of heat into work and its converse, Carnot's cycle and Carnot's heat engine and its efficiency, Second law of Thermodynamics, Concept of entropy, TemperatureEntropy diagram, T-dS Equation, Clausius-Clapeyron latent heat equations	8
Unit –III	Heat Transfer Mechanisms: Heat Engines (Otto cycle and its efficiency, Diesel cycle and its efficiency), Refrigerators (General principle and coefficient of performance of refrigerator, The Carnot refrigerator, Simple structure of vapour compression refrigerator), Air conditioning principle and its applications	8
Unit –IV	Equation of state: Equations of state, Andrew's experiment, Amagat's experiment, Van der Waals' equation of state, Critical constants, Reduced equation of state, Joule-Thomson porous plug experiment	8
Unit –V	Thermometry: Temperature Scales (Centigrade, Fahrenheit and Kelvin scale), Principle, construction and working of following thermometers (Liquid and gas thermometers, Resistive type thermometers, Thermocouple as thermometer, Pyrometers)	4
Reference Books:	<ol style="list-style-type: none"> 1. Physics: Volume I, Resnick/Halliday/Krane John Wiley & Sons (Sea) pvt ltd 2. Sears and Zemansky's University Physics, 12th Edition, H. D. Young,R. A. Freedman,A. L. Ford,F. W. Sears, Pearson Education 3. Concept of Physics Vol I: H. C. Verma, Bharati Bhavan Publishers 4. Heat and thermodynamics: Singhal, Agarwal and Prakash. 5. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi 	

PAPER CODE: PHY1103
PAPER – III: PHYSICS PRACTICAL - I
No. of Credits: 2

	Title of Experiment
1	Measurement of least count of various instruments
2	Moment of Inertia of a disc by torsional oscillations
3	Viscosity by flow through a capillary tube by Poiseuille's method
4	'Y' by bending
5	Plotting of graph and analysis
6	Moment of inertia of a flywheel
7	Calibration of thermocouple
8	Thermal conductivity by Lee's method
9	Demo experiment I
10	Demo experiment II

PAPER CODE: PHY1201
PAPER – I: INTRODUCTION TO MATHEMATICAL PHYSICS
No. of Credits: 2

	Title and Contents	No. of Lectures
Unit -I	Complex Numbers: Introduction to Complex Numbers, Algebra of Complex Numbers, Argand diagram, Algebra of complex numbers using Argand Diagram, Rectangular, polar and exponential forms of complex Numbers, DeMoivre's theorem (statement only), Trigonometric, hyperbolic and exponential functions, Powers, roots and log of complex numbers, Application of complex numbers to determine velocity and acceleration in curved motion. <i>Problems</i>	10
Unit -II	Vector Analysis: Differentiation of vectors with respect to scalars, Scalar and vector fields, Vector differential operators, Gradient of scalar field and its physical significance, Curl of vector field and its physical significance, Vector integrals (line, surface and volume integral with their examples), Statements of Gauss divergence theorem and Stoke's theorem. Vector identities: a) $\nabla \times \nabla \phi = 0$ b) $\nabla \cdot (\nabla \times V) = 0$ c) $\nabla \cdot (\nabla \phi) = \nabla^2 \phi$ d) $\nabla \cdot (\phi A) = \nabla \phi \cdot A + \phi (\nabla \cdot A)$ e) $\nabla \times (\phi A) = \phi (\nabla \times A) + (\nabla \phi) \times A$ f) $\nabla (A \times B) = B \cdot (\nabla \times A) - A \cdot (\nabla \times B)$	8
Unit – III	Partial Differentiation: Definition of partial differentiation, Successive differentiation, Total differentiation, Exact differential, Chain rule, Theorems of differentiation, Change of variables from Cartesian to polar co-ordinates, Implicit and explicit functions, Conditions for maxima and minima (without proof) <i>Problems</i>	8
Unit – IV	Applications of differential equations: First order differential equations: Growth and decay (Charging and discharging in CR Circuit, LR circuit, Radioactive decay, Population problems), Temperature Problems (Cooling of a body), Falling Body Problems (Equation of Motion for velocity and position of the body when all resistance is proportional to velocity of body) Second order differential equations: Simple Harmonic Oscillator, LCR Circuit, Buoyancy	10
Reference Books:	1. Mathematical Physics , B. D. Gupta, Pragati Prakashan, Meerut 2. Mathematical Methods in Physical Science , Mary L. Boas, Wiley Publications 3. Schaum's Outline of Vector Analysis , Murray R. Spiegel, McGraw Hill Professional 4. Theory And Problems Of Differential Equations (Schaum's Outline Series) , Bronson, Tata McGraw-Hill Education	

PAPER CODE: PHY1202 PAPER – II: ELECTRICITY AND MAGNETISM No. of Credits: 2 No. of Lectures: 36		
	Title and Contents	No. of Lectures
Unit -I	Dielectrics: Polarization of matter (Atomic view, Induced charges, Free charges and bound charges), Polarization charges and dipole moment, Electric susceptibility and polarization vector, Electric displacement and examples, Gauss's law in dielectrics, Boundary conditions at dielectric surface	10
Unit -II	D C circuits: Growth and decay of current in R-L circuit, Growth and decay of current in L-C circuit, L-R-C series circuit	6
Unit -III	A C circuits: Phasors, Resistance and Reactance, L-R-C series circuit, Power in AC circuit, Resonance in AC circuit,	10
Unit –IV	Magnetism in matter: Ampere's circuit law and it's applications, Gauss law for magnetism, Magnetic Materials (Ferro magnetic, Paramagnetic, diamagnetic), Cause of magnetization (Spin magnetic moment and orbital magnetic moment, Bohr magneton), Concepts of H, B, M, χ, \square, Relation between B, H, M , Hysteresis	10
Reference Books:	1. Fundamentals of electricity and Magnetism , Arthur Kip, McGraw-Hill 2. Sears and Zemansky's University Physics, 12th Edition , H. D. Young, R. A. Freedman, A. L. Ford, F. W. Sears, Pearson Education	

PAPER CODE: PHY1203 PAPER – III: PHYSICS PRACTICAL - II No. of Credits: 2 No. of Experiments: 10	
	Title of Experiment
1	Determination of frequency of A. C.
2	Study of LCR circuit
3	Verification of circuit theorems
4	Study and calibration of spectrometer
5	Charging, discharging of capacitor
6	L-R circuit: Vector diagram and power factor
7	Diode characteristics
8	Temperature coefficient of resistance
9 & 10	Study visit