PHYSICS COMPLEMENTARY COURSE STRUCTURE

Total Credits: 12 (Internal: 20%; External: 80%)

Semester	*Code No*	*Course Title*	*Hours/ Week*	*Total Hours*	*Credit*	*Marks*
1	PHY1C01	Complementary Course I: Properties of matter and Thermodynamics	2	36	2	75
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
2	PHY2C02	Complementary Course II: Optics ,Laser, Electronics	2	36	2	75
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
3	PHY3C03	Complementary Course III: Mechanics, Relativity, Waves and Oscillations	3	54	2	75
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
4	PHY4C04	Complementary Course IV: Electricity ,Magnetism and Nuclear Physics	3	54	2	75
	PHY4C05	Complementary Course V: PHYSICS Practical	2	36	4*	100
Total					**12**	**400**

* Examination will be held at the end of 4th semester

COMPLEMENTARY COURSE THEORY: EVALUATION SCHEME

The evaluation scheme for each course contains two parts: *viz.,* internal evaluation and external evaluation. Maximum marks from each unit are prescribed in the syllabus.

1. INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The colleges shall send only the marks obtained for internal examination to the university.

Table 1: Components of Evaluation

Sl. No.	*Components*	Marks for 2/3 credits papers
1	Class room participation based on attendance	3
2	Test paper: I	6
3	Assignment	3
4	Seminar/ Viva	3
Total Marks		15

Table 2: Pattern of Test Papers

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
2 Hours	Short answer	12	10-12	2	20
	Paragraph/problem	7	6-7	5	30
	Essay	2	1	10	10
*Total Marks**					60

*90% and above = 6, 80 to below 90% = 5.5, 70 to below 80% = 5, 60 to below 70% = 4.5, 50 to below 60% = 4, 40 to below 50% = 3.5, 35 to below 40% = 3, 25 to below 30% = 2.5,15 to below 20=2, less than 15 = 0

2. EXTERNAL EVALUATION

External evaluation carries 80% marks. University examinations will be conducted at the end of each semester.

Table 1: Pattern of Question Papers

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
2 Hours	Short answer	12	10-12	2	20
	Paragraph/problem	7	6-7	5	30
	Essay	2	1	10	10
Total Marks					60

Practical Evaluation (Complementary)

Internal		External	
Record	4	Record with 20 experimrnts. Max. ½ mark for one expt.	10
Regularity	4	Formulae, Theory, Principle	22
Attendance	4	Adjustments, setting	14
Test I	4	Tabulation & Observation	20
Test II	4	Calculation, graph, result, unit	10
		Viva	4
Total	**20**	**Total**	**80**

B.Sc. PHYSICS

COMPLEMENTARY COURSES SYLLABUS

(For B. Sc Programme in Mathematics, Chemistry etc)

Semester 1 | Complementary course-I

PHY1C01: Properties of matter & Thermodynamics

36 Hours (Credit - 2)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Understand the basic principles of elasticity	U	C	9
CO2	Understand the concepts of surface tension	U	C	5
CO3	Understand the aspects of viscosity	U	C	4
CO4	Understand the basic principles of thermodynamics	U	C	18

Unit 1 Elasticity. 9 Hrs

Elastic modulii. (Elementary ideas)- Work done per unit volume - Poisson's ratio and theoretical limits - relation between various elastic constants(Derivation not required)- Twisting couple on a cylinder(Derivation not required)- Torsion pendulum-Determination of rigidity modulus of a wire-Bending of beams-bending moment- I-form girders- Cantilever loaded at the free end – Loaded uniformly (Derivation required)

Unit 2 Surface Tension & Viscosity. 9 Hrs

Surface tension (Elementary ideas)-Excess pressure inside a liquid drop and bubble (Effect of electrostatic pressure on a bubble-change in radius)-Work done in blowing the bubble (problem based on the formation of bigger drop by a number of smaller drops)

Viscosity-Coefficient of viscosity-Derivation of poiseuille's equation, stokes equation-Determination of viscosity by Poiseuille's method and stokes method-Brownian motion – Viscosity of gases

Unit 3 Thermodynamics 18 Hrs

Thermodynamic processes –Indicator diagram (P-V diagram, P-T diagram, T-V diagram, T-S diagram)- Work done in Quasi static process-Work done in Isothermal, Adiabatic, Isochoric, Isobaric processes-First law of thermodynamics-Application to heat capacities- Second law of thermodynamics- Carnot's engine - Derivation of efficiency using Carnot's cycle-Carnot's theorem and its proof- Carnot's refrigerator(coefficient of performance)-

Entropy- Change of entropy in a carnot's cycle, reversible cycle , irreversible cycleprinciple of increase of entropy- Entropy and available energy- entropy and disorder - Clausius-Clapyron equation(Derivation not required)-Effect of pressure on melting point and boiling point.

Text for study

1. Properties of matter-D. S. Mathur
2. Properties of matter-JC Upadhaya
3. Heat and Thermo dynamics- Brijlal and Subrahmanyam

Books for reference

1.. Heat and Thermo dynamics- D S Mathur
2. Heat and Thermodynamics - Zemansky
3. Physics- Resnick and Halliday
4. Thermodynamics- Brijlal and Subrahmanyam

Mark distribution for setting Question paper.

Unit/ chapter	**Title**	**Marks**
1	Elasticity	20
2	Surface Tension & Viscosity	20
3	Thermodynamics	39
*Total Marks **		79

*****Total marks include that for choice of questions in sections A, B and C in the question paper.

Semester 2 | Complementary Course II
PHY2C02: Optics, Laser & Electronics
36 Hours (Credit - 2)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Understand the basic concepts of interference and diffraction	U	C	16
CO2	Understand the concepts of polarization	U	C	6
CO3	Understand the fundamentals of electronics	U	C	10
CO4	Understand the important principles of laser physics	U	C	4

Unit 1 Interference **8 Hrs**

Superposition of two sinusoidal waves (resultant amplitude and intensity)., constructive and destructive interference- Fresnel's two mirror arrangement - Interference by a plane film- colours of thin films- Newton's rings (Reflected system)-Determination of wavelength

Unit 2 Diffraction **8 Hrs**

Fresnel and Fraunhoffer class of diffraction Fraunhofer single slit diffraction pattern- Intensity distribution (qualitative ideas only)- plane diffraction Grating-resolving power and dispersive power. Experiment with grating

Unit 3 Polarisation **6 Hrs**

Elementary idea- Brewster' law- Double refraction- positive and negative crystals- Quarter and half wave plate- production of plane, elliptically and circularly polarized light- optical activity

Unit 4 Electronics **10 Hrs**

Half wave, Full wave and bridge rectifier circuits- Efficiency & ripple factor- Filter circuits (capacitor filter and π filters) – Zener diode characteristics- Voltage stabilization Transistors- CB, CE, CC Configurations- CE (only) characteristics- Current amplification factors - relation connecting α , β and γ – CE Amplifier- frequency response- band width Basic principle of feedback, concept of an oscillator circuit, Logic gates- Universal gates- De- Morgan's theorem – Exclusive OR gate

Unit 5 Laser physics **4 Hrs**

Induced absorption- spontaneous emission and stimulated emission- population inversion Principle of Laser-Types of laser- Ruby laser, Helium Neon laser

Text for study:

1. Optics - Brijlal & Subramanian

2. Principles of Electronics-VK Mehta

Books for reference

1. Optics- Ajay Ghatak

2. Optics – Brijlal &Subramaniam

3. Laser fundamentals – Silfrast

4. Lasers – theory & applications- Thyagarajan & Ghatak

Mark distribution for setting Question paper.

Unit/ chapter	**Title**	**Marks**
1	Interference	18
2	Diffraction	18
3	Polarisation	13
4	Electronics	21
5	Laser Physics	9
Total Marks *		79

*****Total marks include that for choice of questions in sections A, B and C in the question paper.

Semester 3 | Complementary Course III
PHY3C03: Mechanics, Relativity, Waves and Oscillations
54 Hours (Credit - 3)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Understand the basic ideas of frames of reference and the principles of conservation of energy and momentum	U	C	22
CO2	Understand the concepts of relativity	U	C	12
CO3	Understand the basic ideas of oscillations and waves	U	C	10
CO4	Understand the basic ideas of modern physics	U	C	10

Unit 1 Frames of reference. 8 Hrs

Inertial frame of reference-Galilean transformation equations and Invariance- Non inertial frames-Centrifugal force and Coriolis force

Unit 2. Conservation of Energy and Momentum 14 Hrs

Conservation of energy of a particle –Energy function- Potential energy curve- Conservative and Non conservative forces- Conservation of Linear momentum-Center of mass frame of reference-Rockets- motion under central force- Conservation of angular momentum (Illustrate suitable example)

Unit 3 Relativity 12 Hrs

Postulates of special theory-Michelson Morley experiment-Lorentz transformation equations-Length contraction-Time dilation- Twin paradox- variation of mass with velocity-Mass energy relation- momentum energy relation

Unit 4 Oscillation and Waves 10 Hrs

Simple harmonic motion (Elementary idea) - equation –examples like oscillation of simple pendulum, loaded spring-An harmonic oscillator-Damped harmonic oscillator. Wave motion-Equation for plane progressive wave-Energy density- Pressure variations of
plane waves.

Unit 5 Introduction to Modern Physics 10 Hrs

Electromagnetic waves -Black body radiation, UV catastrophe(Qualitative ideas), Photoelectric effect, wave-particle duality, de Broglie hypothesis, Uncertainty Principle, Energy and momentum

operators, Schrödinger's time dependent and time independent equations(elementary ideas only), Eigen values and eigen functions .

Text for Study:

1. Mechanics:J C Upadhyaya
2. Modern Physics-Arthur Beiser

Books for reference-

1. Special theory of relativity- Resnick
2. Waves, Mechanics & Oscillations- S B Puri

Mark distribution for setting Question paper.

Unit/ chapter	Title	Marks
1	Frames of reference.	12
2	Conservation of Energy and Momentum	19
3	Relativity	18
4	Oscillation and Waves	15
5	Introduction to Modern Physics	15
*Total Marks **		79

*****Total marks include that for choice of questions in sections A, B and C in the question paper.

Semester 4 | Complementary Course IV
PHY4C04: Electricity, Magnetism and Nuclear physics
54 Hours (Credit - 3)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Understand the basic ideas of static and current electricity	U	C	20
CO2	Understand the concepts of magnetism	U	C	12
CO3	Describe the fundamental concepts of nuclear physics	U	C	12
CO4	Understand the basic ideas of cosmic rays and elementary particles	U	C	10

Unit 1 Electrostatics **10 Hrs**

Coulomb's law between charges- Electric field- field lines- Electric potential-Gauss's law and applications of Gauss's law to find field due to plane sheets of charge- Electrostatic shielding (Illustrate practical application) –Dielectrics- capacitors: A parallel plate capacitor, Energy of a capacitor, capacitance of cylindrical and spherical capacitors. Capacitance of a parallel plate capacitor- partially filled with dielectric and when completely filled with dielectric.

Unit 2 Current electricity **10 Hrs**

Drift velocity of charges- electric resistance- superconductivity (basic ideas)- Galvanometer- conversion of galvanometer in to Voltmeter and ammeter – potentiometer – determination of resistance- carey fosters bridge- temperature coefficient of resistance.

Unit 3 Magnetism **12 Hrs**

Earths magnetism- magnetic elements- Dia magnets-paramagnets and ferromagnets, Hysteresis. Magnetic moment-Deflection magnetometer-Tan A, Tan B and Tan C- Searles vibration magnetometer- Tangent galvanometer.

Unit 4 Nuclear physics **12 Hrs**

Nucleus and its properties- nuclear force- stability of nucleus- binding energy- nuclear fission- fusion- reactors- Nuclear bomb, Hydrogen bomb- Radio activity- α ,β and γ radiations- half life and mean life- C_{14} dating- Effects of radiation- Nuclear waste disposal Particle accelerators- Linear accelerator- cyclotron

Unit 5 Cosmic rays and Elementary particles **10 Hrs**

Cosmic rays (primary and secondary)- cosmic ray showers- Elementary particles-Classifications- Leptons- Hadrons - Higgs boson- L H C- Origin of universe.

Books for study

1. Electricity and Magnetism-Murugesan
2. Nuclear Physics-D C Tayal

Reference books

1. Introduction to Electrodynamics-David J Griffith
2. Electricity and Magnetism – Arthur F Kip
3. Concepts of Modern physics – Arthur Beiser
4. Nuclear physics – Irvin Kaplan

Mark distribution for setting Question paper.

Unit/ chapter	**Title**	**Marks**
1	Electrostatics	15
2	Current electricity	15
3	Magnetism	17
4	Nuclear physics	17
5	Cosmic rays and Elementary particles	15
*Total Marks **		79

*****Total marks include that for choice of questions in sections A, B and C in the question paper.

LAB PROGRAMME FOR COMPLEMENTARY COURSES

(Lab examination will be conducted at the end of 4th semester)

The minimum number of experiments for appearing examination is **75% of total 24 experiments** in the syllabus. Basic theory of the experiment must be shown at the time of Examination. **Students must submit a certified fair record at the time of Examination.** Number of Questions per session for the practical Examination shall be 8, and a minimum of 6 questions in the Question paper shall be set for the Examination at the centre.

Semester 1 to 4 | Complementary Course V

PHY4C05: PHYSICS PRACTICALS I

36 Hours in each semester × 4 (Credit - 5)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Apply and illustrate the concepts of properties of matter through experiments	Ap	P	36
CO2	Apply and illustrate the concepts of electricity and magnetism through experiments	Ap	P	36
CO3	Apply and illustrate the concepts of optics through experiments	Ap	P	36
CO4	Apply and illustrate the principles of electronics through experiments	Ap	P	36

List of Experiments

1. Characteristics of Diode and Zener diode
2. Liquid lens- Refractive index of liquid and glass
3. Torsion pendulum- Rigidity modulus
4. Spectrometer- Refractive index of the material of prism
5. Deflection Magnetometer- Moment of a magnet (Tan-A & Tan - B positions)
6. Potentiometer-Measurement of resistance
7. Young's modulus – Uniform bending –using optic lever
8. Static torsion – Rigidity modulus
9. Spectrometer- Grating- Normal incidence
10. Melde's string- Frequency of fork (Transverse and Longitudinal mode)- (Mass determination by equal oscillation method / digital balance)

11. Half wave rectifier and Full wave rectifier

12. Field along the axis of a circular coil

13. Deflection Magnetometer- Moment of a magnet (Tan-C)

14. Potentiometer- Conversion of Galvanometer in to voltmeter –calibration by standard voltmeter

15. Viscosity of liquid- Capillary flow- Variable pressure head method (Mass determination by equal oscillation method / digital balance)

16. Logic gates – Verification of truth table

17. Carey Fosters bridge- Resistivity of the material of wire

18. Surface Tension-Capillary rise method - Radius by microscope.

19. Young's modulus of a cantilever- Pin and microscope method

20. Potentiometer-Calibration of low range voltmeter

21. Moment of inertia of fly wheel

22. Tangent galvanometer – Reduction factor

23. Searle's vibration magneto meter – Comparison of moments

24. Newton's rings- Wavelength of sodium light

Books of Study:

1. Electronics lab manual- K A Navas (vol 1 &2)
2. B.Sc Practical Physics- C L Arora

Reference book:

3. Practical Physics- S L Gupta & V Kumar