

# FDP COMPLEMENTARY PHYSICS

## SEMESTER 1 (CHEMISTRY MAIN)

### AUPY131.2b – ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

#### Unit I (26 hours)

##### Dynamics of rigid bodies (7 hours)

Theorems of M.I with proof-Calculation of M.I of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere-K.E of a rotating body-spinning top.

##### Oscillations and waves (13 hours)

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule Wave motion-general equation of wave motion-plane progressive harmonic wave energy density of a plane progressive wave-intensity of wave and spherical waves-

##### Mechanics of solids (6 hours)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

#### Unit II (10 hours)

##### Surface Tension (5 hours)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces.

##### Viscosity (5 hours)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula-limitations-Ostwald's viscometer-variation of viscosity with temperature-Stokes formula determination of viscosity of a highly viscous liquid by Stokes method.

#### References

1. Mechanics: J.C.Upadhyaya, Ram Prasad & Sons

2. Oscillations & Waves: K.Rama Reddy, S.Bbadami & V.Balasubramaniam (University Press)

## **SEMESTER 2 (CHEMISTRY MAIN)**

### **AUPY231.2b – THERMAL PHYSICS**

**(36 HOURS-2 CREDITS)**

#### **Unit I – Diffusion (4 hours)**

Graham's law of diffusion in liquids-Fick's law-analogy between liquid diffusion and heat conduction-methods of estimating concentrations-determination of coefficient of diffusivity.

#### **Unit II – Transmission of Heat (16hours)**

Thermal conductivity and thermometric conductivity-Lee's disc experiment-Radial flow of heat-cylindrical flow of heat-thermal conductivity of rubber-Weidmann and Franz law (statement only)-Radiation of heat-black body radiation-Kirchoff's laws of heat radiation-absorptive power-emissive power-Stefan's law (no derivation) –energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison solar constant-temperature of sun.

#### **Unit III – Thermodynamics (8 hours)**

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity.Heat engines-carnot's cycle-derivation of efficiency-petrol and diesel engine cycles efficiency in these two cases-second law of thermodynamics-Kelvin and Clausius statements.Phase transition- first order and second order-liquid helium-super fluidity.

#### **Unit IV – Entropy (8 hours)**

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

#### **References**

1. The general Properties of matter: F.H.Newman & V.H.L.Searle
2. Heat & Thermodynamics: N.Subramaniam & Brijlal, S.Chand & Co
3. Heat & Thermodynamics: W.Zemansky, McGraw Hill
4. Heat & Thermodynamics: C.L.Arora.

## SEMESTER 3 (CHEMISTRY MAIN)

### AUPY331.2b – OPTICS, MAGNETISM AND ELECTRICITY

(54 HOURS-3 CREDITS)

#### **Unit I (34 hours)**

##### **Interference (10 hours)**

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength.

##### **Diffraction (10 hours)**

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge Fraunhofer diffraction at a single slit, two slits and N slits. Plane transmission grating determination of wavelength-Resolving power of grating.

##### **Polarisation (8 hours)**

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices-half wave plate and quarter wave plate-elliptically and circularly polarized light-optical activity-Fresnel's theory and applications-polarimeters-determination of specific rotation.

##### **Laser and Fibre Optics (6 hours)**

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

#### **Unit II (20 hours)**

##### **Magnetism (10 hours)**

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism paramagnetism-ferromagnetism-antiferromagnetism. Electron theory of magnetism explanation of ferromagnetism.

##### **Electricity (10 hours)**

EMF induced in a coil rotating in a magnetic field-peak, mean, *rms* and effective values of A.C. Ac circuits-AC through RC, LC, LR and LCR series circuits resonance-sharpness of resonance-power factor and choke coil-transformers.

### References

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – R.Murugeshan, S.Chand & Co Ltd.
3. A text book of B.Sc subsidiary Physics – P.Vivekanandan.

## SEMESTER 4 (CHEMISTRY MAIN)

### AUPY431.2b– ATOMIC PHYSICS, QUANTUM MECHANICS AND ELECTRONICS

(54 HOURS-3 CREDITS)

#### Unit I Atomic physics (12 hours)

Basic features of Bohr atom model-Bohr's correspondence principle-vector atom model-various quantum numbers-magnetic moment of orbital electrons-electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table.

#### Unit II Superconductivity (8 hours)

Properties of superconductors-zero electrical resistance-Meissner effect-critical magnetic field-Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors-applications of superconductors.

#### Unit III Quantum mechanics (12 hours)

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrodinger equation-time dependent and time independent particle in a potential box.

#### Unit IV Spectroscopic Techniques (7 hours)

EM spectrum-UV, Visible, IR, Radio and microwave regions-principle of various spectrometers used in specific regions of EM spectrum-absorption spectroscopy emission spectroscopy-mass spectroscopy-qualitative ideas of ESR & NMR spectrometer.

#### Unit V Electronics (15 hours)

Current-voltage characteristics of a diode-forward and reverse bias-breakdown mechanism of p-n junction diode-zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency. Construction and operation of a bipolar junction transistor-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only).Transistor amplifier-basic features of an amplifier-gain, input and output resistances frequency.response and band width-small signal CE amplifier-circuit and its operation.

### **References**

1. Modern Physics – R.Murugesan, S.Chand & Co. Ltd.
2. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
3. Principles of Electronics – V.K.Mehta.

## **SEMESTER 1 (MATHEMATICS MAIN)**

### **AUPY131.2c – MECHANICS AND PROPERTIES OF MATTER**

**(36 HOURS-2 CREDITS)**

#### **Unit I (28 hours)**

##### **Dynamics of rigid bodies (6 hours)**

Theorems of M.I with proof-Calculation of M.I of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid sphere-K.E of a rotating body. Determination of M.I of a fly wheel (theory and experiment).

##### **Oscillations and waves (15 hours)**

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule.

Wave motion-general equation of wave motion-plane progressive harmonic wave energy density of a plane progressive wave-intensity of wave and spherical waves transverse waves in stretched string-modes of transverse vibrations of strings longitudinal waves in rods and in gases.

**Mechanics of solids (7 hours)**

Bending of beams-bending moment-cantilever-beam supported at its ends and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

**Unit II (8 hours);**

**Surface Tension (5 hours)**

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger's method-equilibrium of a liquid drop over solid and liquid surfaces.

**Viscosity (3 hours)**

Flow of liquid through a capillary tube-derivation of Poiseuille's formula-limitations-Ostwald's viscometer-variation of viscosity with temperature.

**References**

1. Mechanics: J.C.Upadhyaya, Ram Prasad & Sons
2. Oscillations & Waves: K.RamaReddy, S.Bbadami & V.Balasubramaniam (University Press)

**SEMESTER 2 (MATHEMATICS MAIN)**

**AUPY231.2c – HEAT AND THERMODYNAMICS**

**(36 HOURS-2 CREDITS)**

**Unit I – Transmission of Heat (13 hours)**

Thermal conductivity and thermometric conductivity-Lee's disc experiment-Weidmann and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison-solar constant-its determination temperature of sun.

**Unit II – Thermodynamics (13 hours)**

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity. Heat engines-Carnot's cycle-derivation of efficiency-petrol and diesel engine cycles efficiency in these two cases-second law of thermodynamics-Kelvin and Clausius statements.

### **Unit III – Entropy (10 hours)**

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

### **References**

1. Heat & Thermodynamics: N.Subramaniam & Brijlal, S.Chand & Co
2. Heat & Thermodynamics: W.Zemansky, McGraw Hill
3. Heat & Thermodynamics: C.L.Arora.

## **SEMESTER 3 (MATHEMATICS MAIN)**

### **AUPY331.2c – OPTICS, MAGNETISM AND ELECTRICITY**

**(54 HOURS-3 CREDITS)**

### **Unit I (34 hours)**

#### **Interference (12 hours)**

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength and refractive index of liquid.

#### **Diffraction (14 hours)**

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture. Fraunhofer diffraction at a single slit, two slits and N slits. Plane transmission grating-determination of wavelength-Resolving power of grating.

#### **Laser and Fibre Optics (8 hours)**

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

### **Unit II (20 hours)**

**Magnetism (10 hours)**

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism paramagnetism-ferromagnetism-antiferromagnetism. Electron theory of magnetism explanation of ferromagnetism.

**Electricity (10 hours)**

EMF induced in a coil rotating in a magnetic field-peak, mean, *rms* and effective values of A.C. AC circuits-AC through RC, LC, LR and LCR series circuits resonance-sharpness of resonance-power factor and choke coil-transformers.

**References**

5. Brijlal & Subramaniam, A text book of optics –
6. Electricity and Magnetism – R.Murugesan, S.Chand & Co Ltd.
7. A text book of B.Sc subsidiary Physics – P.Vivekanandan.

**SEMESTER 4 (MATHEMATICS MAIN)****AUPY431.2c – MODERN PHYSICS AND ELECTRONICS****(54 HOURS-3 CREDITS)****Unit I****Modern Physics (20 hours)**

Basic features of Bohr atom model-Bohr's correspondence principle-vector atom model-various quantum numbers-magnetic moment of orbital electrons-electron spin- Spin-Orbit coupling-Pauli's exclusion principle-periodic table.Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and packing fraction-nuclear forces-salient features-radioactivity radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity-Nuclear detectors (basic ideas).

**Quantum mechanics (16 hours)**

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability



density-Schrödinger equation-time dependent and time independent particle in a potential box.

## **Unit II (18 hours)**

### **Electronics (10 hours)**

Current-voltage characteristics of a diode-forward and reverse bias-breakdown mechanism of p-n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency. Construction and operation of a bipolar junction transistor-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias,emitter feedback bias, voltage divider bias (qualitative study only).Transistor amplifier-basic features of an amplifier-gain, input and output resistances frequency response and band width-small signal CE amplifier-circuit and its operation

### **Digital Electronics (8 hours)**

Number systems and codes-decimal numbers-binary arithmetic-1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates.Booleen algebra-Booleen operations-logic expressions-laws of Booleen algebra-DeMorgan's theorem-Booleen expression for gate network-simplification of Booleen expression.

### **References**

1. Modern Physics – R.Murugesan, S.Chand & Co. Ltd.
2. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
3. Principles of Electronics – V.K.Mehta.

## **COMPLEMENTARY PRACTICALS (PHYSICS)**

(COMMON FOR ALL COMPLEMENTARY SUBJECTS)

### **AUPY43.2c PI-PRACTICAL**

#### **List of Experiments (Minimum 20 experiments to be done)**

1. Torsion Pendulum- n by torsional oscillations
2. Torsion Pendulum- n and I using equal masses
3. Fly Wheel
4. Cantilever- Young's Modulus by mirror and telescope method
5. Uniform bending- Young's modulus by mirror and telescope method.

6. Symmetric bar pendulum-  $g$  and radius of gyration
7. Surface tension- capillary rise method
8. Coefficient of viscosity- capillary flow method
9. Specific heat-method of mixtures applying Barton's correction
10. Lee's disc- Thermal conductivity of cardboard
11. Melde's string- frequency of tuning fork
12. Method of parallax- optical constants of convex lens using i) mirror and mercury  
ii) mirror and water
13. Method of parallax- refractive index of liquid.
14. Spectrometer-  $A$ ,  $D$  and  $n$
15. Spectrometer- dispersive power of a prism
16. Spectrometer- Grating-normal incidence
17. Deflection and vibration magnetometer-  $M$  and  $Bh$
18. Circular coil- magnetization of a magnet
19. Carey Foster's bridge- Resistivity
20. Potentiometer- Resistivity
21. Potentiometer- Calibration of ammeter
22. Mirror galvanometer- Current and Voltage sensitivity
23. Diode Characteristics (for Ge and Si diodes)
24. Half wave rectifier-Measurement of ripple factor with and without filter capacitor
25. Full wave rectifier- Measurement of ripple factor with and without filter capacitor