PHYSICS: SEMESTER-I

Revised Syllabus (2015-17)

PH 115 - Mechanics, Heat and Thermodynamics

Total hours: 60

1. Newton's laws of motion:

Review of Newton's laws of motion Frames of reference, two frames moving with constant relative velocity, two frames moving with constant relative acceleration, Pseudo forces. Free body diagrams- Problems with (i) two masses connected by string hanging over a frictionless pulley (ii) masses in contact and masses connected by strings (iii) two masses connected by a string passing over a frictionless pulley fixed at the edge of horizontal plane (iv) Motion along inclined plane, Problems. **(8 hours)**

2. Centre of mass, linear momentum & collisions:

Centre of Mass, Centre of mass of rigid bodies, Motion of the centre of mass, Linear momentum and its conservation principle, Rocket propulsion, Collision, Elastic collision in one dimension, Perfectly inelastic collision in one dimension, Elastic collision in two dimensions – with respect to lab frame of reference and center of mass frame of reference. Problems. **(7 hours)**

3. Work and energy:

Work, Kinetic energy, Work energy theorem, Calculation of work done- constant force, spring force and force perpendicular to velocity, Work energy theorem for a system of particles, Conservative and Non-conservative forces, potential energy and principle of conservation of energy. Problems. **(4 hours)**

4. Circular motion:

Motion in plane- angular variables, radial and transverse components of velocity and acceleration, circular motion, centrifugal force, coriolis force, Problems. **(3 hours)**

5. Rotational dynamics of rigid bodies:

Rotation of a rigid body about a given fixed line, kinematics, rotational dynamics, Torque of a force about the axis of rotation, angular momentum, conservation of angular momentum, Kinetic energy of a rigid body rotating about a given axis, Power delivered and work done by a torque, Calculation of moment of inertia of rod, rectangular plate, circular plate, solid cylinder and solid sphere. Theorem of parallel axis and theorem of perpendicular axis. Euler equations, Problems. **(8 hours)**

6. Kinetic theory of gases:

Assumptions of kinetic theory of gases, Deduction of the pressure of an ideal gas, Deductions of Boyle's law, Charles' law and Avagadro's law from kinetic theory, Maxwell's velocity and

speed distribution(graph and interpretation without derivation), Definition and expressions for rms, mean and most-probable velocity. Degrees of freedom, Principle of equipartition of energy. Mean free path (derivation). Transport phenomenon – derivation of coefficient of viscosity and thermal conductivity. Problems. **(9 hours)**

7. Thermodynamics:

Zeroth law, First law of thermodynamics, Concept of internal energy, Different types of thermodynamic processes – isothermal, adiabatic, isobaric and isochoric. Derivation of PV^{γ}=constant. Work done during isothermal and adiabatic changes. Carnot cycle- efficiency-reversibility-refrigerator. Clausius – Clayperon's equation. Carnot's theorem (no proof only statement and explanation). Concept of absolute zero, Entropy and second law thermodynamics. Principle of increase of entropy in solving problems (no derivations) Statement of Clausius inequality, T – S diagram and its use to find the efficiency of Carnot cycle. Third law of thermodynamics. Problems. **(10 hours)**

8. Thermodynamic potentials:

Internal energy, enthalpy, Helmholtz free energy, Gibbs free energy and their significance, Maxwell's thermodynamic relations from thermodynamic potentials and their significance. Applications of Maxwell's thermodynamic relation- nature of variation of internal energy with volume, difference between the specific heat capacities for ideal gases and real gases. Problems.

(4 hours)

9. Real gases and liquefaction of gases:

Andrews' experiment on Carbon dioxide-isothermal curves of real gases, Van der Waals' equation, critical constants (definition and derivation),Joule's porous plug experiment (with theory), Linde's process, and adiabatic de-magnetization Problems.

(7 hours)

References:

1. University Physics - F. W. Sears and Zemansky and H. D. Young- Narosa Publications –New Delhi.
2. Fundamentals of Physics, 6th Edn. – Resnick, Halliday and Walker-Asian Books Pvt Ltd New Delhi 5th Edition.
3. Feyman lectures on physics - Vol I –Narosa Publications-New Delhi.
4. Elements of Properties of Matter- D. S. Mathur-Shamlal Charitable Trust,New Delhi
5. Mechanics-Berkele Physics Course Vol. I-Mittal , Knight& Rudermann,TMH Delhi,1981
6. Properties of Matter-Brijlal & Subramanyam, S Chand & Co,
7. Heat and Thermodynamics - J. B. Rajam.
8. Heat and Thermodynamics – D. S. Mathur – S Chand & Co, New Delhi 5th Edition (2004).
9. Teach yourself Thermodynamics- Bharathibavan Publication
10. Heat Thermodynamics and Statistical Physics – Brijlal Subramanyam & P.S.Hemne, S Chand & Co.
11. Mechanics-J.C Upadhyaya, Ramprasad & Co, Agra
12. Mechanics & Thermodynamics- G Basavaraju & Dipan Ghosh,TMH Publishing Ltd , New Delhi
13. Concepts of Physics Vol.I & Vol.II -H.C.Verma.Bharathibavan Publication. New Delhi

PH1P1 Practical

List of experiments:

1. Measuring instruments – Vernier calipers, Screw Gauge and Traveling Microscope with error calculation
2. Inclined plane- Determination of Coefficient of static, kinetic and rolling friction.
3. Verification of Principle of Conservation of energy.
4. Determination of Moment of inertia of an irregular body.
5. Verification of Parallel and perpendicular axes theorem.
6. Determination of Moment of inertia of a flywheel.
7. Coupled oscillators- Determination of Period for normal modes & Frequency of energy transfer.

8. Determination of Specific heat of water using Joule's calorimeter.
9. Determination of Thermal conductivity of rubber
10. Determination of Thermal conductivity of a bad conductor.
11. Dice experiment – to study statistical nature of results.

NOTE: A minimum of NINE (9) experiments must be performed.

PHYSICS - SEMESTER-II

Revised Syllabus (2015-17)

PH215 - Properties of Matter, Waves and Radiation

Total hours: 60

1. **Elasticity:**

Rigid bodies and elastic bodies, Concept of stress and strain, Hooke's law, Stress- Strain diagrams, Elastic limit, Elastic moduli- Young's modulus, rigidity modulus and bulk modulus (mention of relation between them), Poisson's ratio- its limiting values, Work done in stretching a wire-derivation, Bending of beams- Concept of neutral axis, Bending moment- derivation, Theory of single cantilever. I- section girders. Torsional Oscillations- Derivation of time period of Torsional oscillations. Problems.

(10 hours)

2. Physics of fluids:

Molecular interpretation of surface tension, Molecular forces in liquids and liquid surfaces- Adhesive and cohesive forces, Mention of sphere of influence, Surface tension of a stretched membrane. Surface energy- definition and derivation of surface energy, Surface tension- angle of contact and wetting- Pressure difference across a curved surface- derivation for the pressure difference, Interfacial tension- vanishing of surface tension at the critical point. Surface tension by drop weight method with theory, Factors affecting surface tension. Streamline and turbulent flow, Critical velocity, Reynold's number, Bernoulli's equation (qualitative), Derivation of Poiseulle's equation, Stokes law, Terminal velocity, Co-efficient of viscosity by Stokes's method. Factors affecting viscosity , Problems.

(10 hours)

3.Gravitation:

Newton's laws of gravitation, Gravitational potential energy, Gravitational potential. Calculations of gravitational potential-Spherical shell and solid sphere, Gravitational field, Relation between field and potential, Escape velocity- derivation, Orbital velocity and its expression. Kepler's laws of planetary motion (derivation of III law from Newton's law of gravitation), Launching of artificial satellites, Geostationary and Geosynchronous satellites (qualitative). Inertial and gravitational mass. Problems.

(10 hours)

4. Simple harmonic motion:

Simple harmonic motion, Simple harmonic motion as a projection of circular motion, Equation

of motion of SHM, Energy conservation in SHM, Angular SHM, Simple pendulum as a linear harmonic oscillator, Torsional pendulum, Bar pendulum-expression for time period & Concept of equivalent length, Composition of two SHM's (Conditions for maxima and minima), Lissajou's figures, Equation of motion of Damped harmonic oscillation and Forced oscillation with solution (Qualitative)- critical damping under damping and over damping,. Problems.

(12 hours)

5. Wave motion:

Wave motion, Wave pulse on a string, Sine wave traveling on a string, Velocity of wave on a string, Energy transmitted by a wave, Intensity and Power transmitted by a sine wave, Superposition of waves, Concept of group velocity (derivation of Vg=dw/dk), Phase velocity and the relation between them, Standing waves, Fourier theorem, Fourier series, Evaluation of the Fourier coefficients, Fourier analysis of a square wave. Problems

(10 hours)

6. Radiation:

Black body radiation, Characteristics of black body spectrum, Planck's law with derivation, Deduction of Wien's displacement law & Rayleigh-Jean's law from Planck's law, Stefan's law, Stefan-Boltzmann law, Radiation pressure (qualitative), Solar constant, Surface temperature of sun, Problems.

(8 hours)

References:

1. University Physics - F. W. Sears and Zemansky and H. D. Young- Narosa Publications –New Delhi.
2. Fundamentals of Physics, 6th Edn. – Resnick, Halliday and Walker-Asian Books Pvt Ltd New Delhi 5th Edition.
3. Feyman lectures on physics - Vol I –Narosa Publications-New Delhi.
4. Elements of Properties of Matter- D. S. Mathur-Shamlal Charitable Trust,New Delhi
5. Mechanics-Berkelee Physics Course Vol. I-Mittal , Knight& Rudermann,TMH Delhi,1981
6. Oscillation and waves-DPKhadelwal, Himalaya publishing house.
7. Properties of Matter-Brijlal & Subramanyam, S Chand & Co,
8. Oscillation and waves – Brijlal & Subramanyam, S Chand & Co.
9. Heat and Thermodynamics – D. S. Mathur – S Chand & Co, New Delhi 5th Edition (2004).
10. Teach yourself Thermodynamics- Bharathibavan Publication

11. Heat Thermodynamics and Statistical Physics – Brijlal Subramanyam & P.S.Hemne, S Chand & Co.
12. Mechanics-J.C Upadhyaya, Ramprasad & Co, Agra
13. Mechanics & Thermodynamics- G Basavaraju & Dipan Ghosh,TMH Publishing Ltd , New Delhi
14.Concepts of Physics Vol.I & Vol.II -H.C.Verma.Bharathibavan Publication. New Delhi

PH2P1 Practical

List of experiments:

1. Determination of Young's modulus- by single cantilever
2. Determination of modulii of elasticity using Searle's double bar
3. Determination of acceleration due to gravity using Spring –mass oscillator
4. Determination of rigidity modulus by dynamic method
5. Determination of acceleration due to gravity using bar pendulum
6. Determination of Viscosity of a liquid by Stoke's method
7. Determination of Specific heat of a Liquid by Newton's law of cooling.
8. Determination of Surface tension of a liquid & Interfacial tension between two liquids.
9. Determination of Emissivity of a surface by Lee's disc method.
10. Fourier analysis
11. Determination of Stefan's constant by emissivity method.

NOTE: A minimum of NINE (9) experiments must be performed.

PHYSICS - SEMESTER – III

Revised under Choice Based Credit System Scheme (2016-18)

PH315: Electromagnetism, Sound and Physical Optics

Total hours: 60

1. Vector calculus

Differential Calculus: Gradient of a scalar field, geometrical and Physical Interpretation, Del operator, divergence and curl of a vector, Product rule of del operator and second derivatives.

Integral Calculus: Line integral-- Conservative nature of electrostatic field, Surface and volume integrals, Flux over a vector field, Gauss's divergence Theorem and Stoke's curl theorem (only explanation) Problems**.** **(4 hours)**

2. Electrostatics

Coulomb's law, electric field and electric potential, Derivation of $E = -\nabla V$, Gauss's law in integral and differential form, Poisson's equation and Laplace's equation, force on the surface of a charged conductor, electric pressure, and energy density. Electric dipole - electric potential and field at any point due to a dipole, torque on a dipole in a uniform electric field and its energy. Capacitors equivalent capacitance in series and parallel (No derivation), capacitor, partially filled with dielectric, energy stored in a capacitor. Energy loss due to sharing of charges (no derivation) Problems. **(7 hours)**

3. Magnetostatics

Magnetic flux and flux density $\vec{B}$, Lorentz force (qualitative), torque on a current loop in a magnetic field, equivalence of a current loop and a magnetic dipole, magnetic dipole moment. Magnetic force on a moving charge, force on a current carrying conductor (no derivation).

Biot-Savart's law, Expression for magnetic field due to current in a long straight conductor of finite length and a special case for infinite length. Field due to current along the axis of solenoid, Ampere's circuital law - statement and its application to infinite straight conductor carrying current. Problems. **(6 hours)**

4. Electromagnetic Induction

Faraday's laws of electromagnetic induction, derivation of $e = (-d\Phi/dt)$, energy stored in an inductor, self induction - self-inductance of a long solenoid, energy density in magnetic field, mutual induction - Expression for mutual inductance between two coils. Eddy currents and its applications - electromagnetic damping, electric brake and induction motor. Problems.

(6 hours)

5. Maxwell's field equations

Concept of displacement current, equation of continuity, setting up of Maxwell's equations, physical significance, derivation of e.m wave equation, velocity of e.m. wave, propagation of e.m waves in dielectric medium, relation between electric and magnetic vectors – transverse nature, phase relation between electric and magnetic vectors, Poynting vector and energy density of e.m waves (no derivation), Skin effect. Problems. **(7 hours)**

6. Sound

Characteristics of sound, Derivation of Newton's formula for the velocity of sound -Laplace correction (derivations), effect of pressure, temperature and humidity on the velocity of sound, velocity of sound in a thin rod (derivation), Kundt's tube experiment with theory. Problems**.** **(6 hours)**

Physical Optics:

7. Interference

Huygens' principle and construction of wave front. Theory of interference- conditions for sustained interference. Young's double slit experiment, expression for fringe width, concept of virtual sources – Fresnel's Biprism, distance between two virtual source by shift method. shift in the fringe pattern by the introduction of a thin film in the path of interfering beam,

Interference in thin film - reflected system, theory of interference at an air wedge and Newton's rings. Problems. **(8 hours)**

8. Diffraction

Introduction, Fresnel and Fraunhofer diffraction, Fresnel half period zones-rectilinear propagation of light, Zone plate – construction and theory, comparison of a zone plate with a convex lens. Fraunhofer diffraction - single slit (qualitative), theory of plane diffraction grating - normal incidence and oblique incidence, dispersive power of a grating, Rayleigh's Criterion for resolution, resolving power of grating (no derivation). Problems. **(8 hours)**

9. Polarization

Review of Polarization of light, methods of polarization, plane of polarization, Polarization by reflection-Brewster's law, Malus law with proof ($I_\theta = I_o \cos^2\theta$), Huygen's theory of double refraction in uniaxial crystals, Polariods. Theory of retarding plate, quarter wave plate and half wave plate. Production and detection of plane, circularly and elliptically polarized light, Optical activity, specific rotation, Fresnel's theory of optical rotation. Problems.

(8 hours)

References

1. Introduction to Electrodynamics by David J Griffith. Prentice-Hall of India Pvt. Ltd. 3rd edition, 2008.
2. F.W. Sears and M.W. Zemansky, University physics 10th edition. Addison Wesley publishing Co. 1999.
3. Electricity and magnetism with electronics by K.K. Tiwari. S. Chand and Co. Ltd. 1995.
4. Electricity and Magnetism – Berkley series. Vol.2, 1986.
5. Electricity and Magnetism by Murugeshan. S. Chand and Co. Ltd.2008.
6. Optics and Spectroscopy by Murugeshan S. Chand and Co. Ltd.2010.
7. Optics by D.N. Vasudeva. . S. Chand and Co. Ltd.
8. Optics by Ajoy Ghatak and Thyagarajan. Tata-McGraw-Hill Education. Private Limited 4th edition. 2006
9. Optics by Khanna and Gulati. S. Chand and Co. Ltd. 1985.
10. Optics by Brijlal and Subramanyam. S. Chand and Co. Ltd. 2012.
11. Sound by Brijlal and Subramanyam. S. Chand and Co. Ltd.2005.
12. Electromagnetics by B.B. Laud. New age International (P) Ltd. 2011
13. Feynman Series Vol. II, Narosa Publishing House.2010

PH3P1 Practical

List of Experiments:

1. Volume Resonator- determination of unknown frequency of a tuning fork
2. Sonometer-determination of frequency of an A.C
3. Air wedge -determination of thickness of a wire
4. Newton's rings-determination of radius of curvature of a plano-convex lens
5. Diffraction grating-determination of wavelengths of spectral lines in **minimum**

deviation position

6. Diffraction grating-determination of wavelengths of spectral lines in **normal incidence position**
7. Helholtz Tangent Galvanometer-determination of K & B_H
8. de-Sauty's bridge-verification of laws of combination of capacitors.
9. Melde's apparatus – Frequency of vibrating metallic strip.

PHYSICS - SEMESTER – IV

Revised under Choice Based Credit System Scheme (2016-18)

PH415: Optics, Electricity and Semiconductor Diodes

Total hours: 30

Optics:

1. Laser

General principles - Spontaneous and induced emissions, Production of Lasers- Optical pumping, lasing and active systems. Condition for laser action - population inversion, metastable states, spatial and temporal coherence, Einstein's coefficients A and B (derivation), Ruby laser, He-Ne lasers, properties and uses of lasers, Problems. **(7 hours)**

2. Fibre optics

Principle, construction of optical fibre (general description) , Expressions for acceptance angle and numerical aperture, Fractional index change (Δ) and relation between NA and Δ Modes of propagation V-number, Types of optical fibres (w.r.t refractive index) -single mode and step index multi mode and graded index multimode fibre. Fibre optics communication system (block diagram)-advantages and limitations, Problems.

(6 hours)

3. Transient currents

Growth and decay of currents in LR, CR, LC circuits and series LCR circuit (qualitative), Problems. **(4 hours)**

4. Alternating currents

LCR series and parallel circuits (L & R in series and in parallel to C) using phasor diagrams, applications in tuning circuits, resonance, sharpness of resonance, Q-factor, band width, expression for the power in an AC circuit, power factor, choke & its use in

household electric fittings, wattless current, Problems. **(6 hours)**

5. Semiconductor diodes

Intrinsic and extrinsic semiconductors (p-type and n-type), p-n junction, Rectifiers - half wave and full wave (centre tapped and bridge) with input and output waveforms, expression for ripple factor and efficiency (derivation). Zener diode-characteristics and application as a regulator-load and line regulation. Problems. **(7hours)**

References

1. Physical optics Ajoy Ghatak and Thyagarajan. Cambridge University press.1989.
2. Electricity and magnetism with electronics by K.K. Tiwari. S.Chand and Co. Ltd.2005.
3. F.W. Sears and M.W. Zemansky, University physics 10th edition. Addison Wesley publishing Co. 1999.
4. Fundamentals of electricity and magnetism by Duggal B.D. & Chabbra. Vishal publishing Ltd. 2005.
5. Introduction to optics III edition by Frank L.Pedrotti S.J. et.al. Prentice-Hall of India Pvt.Ltd. 2006.
6. Electricity and Magnetism by R. Murugeshan, S.Chand and Co. Ltd.1995.
7. Optics and Spectroscopy by Murugeshan. S.Chand and Co. Ltd. 2010.
8. Optics by Khanna and Gulati. S.Chand and Co. Ltd. 1985.
9. Current Electricity by Sehgal, Chopra and Sehgal. .S.Chand and Co. Ltd.
10. Basic Electronics by B.L.Theraja, S.Chand and Co. Ltd. 2008.
11. Electronic devices and circuit theory – Robert Boylsted
12. Electronic principles – A.P Malvino

PH4P1 Practical

List of experiments

1. Series resonanceLCR circuit-determination of resonant frequency, inductance &Q-factor
2. Parallel resonance LCR circuit- determination of resonant frequency & inductance

3. Black Box-dentification of circuit elements & determination of their values
4. Combination of lenses-determination of focal length for different separations of lenses.
5. Half wave and Full Wave rectifiers- determination of ripple factor and percentage of regulation with and without filters
6. Zener diode characteristics –study of characteristics, line and voltage regulation
7. Brewster's law-verification and determination of refractive index
8. Maxwell's Impedance Bridge-determination of inductance of a coil
9. Polarimeter-determination of specific rotation of sugar

PHYSICS - OPEN ELECTIVE - I

Choice Based Credit System Course (2016-18)

The Universe and Me

Resource person: Prof. Joselin Jose, Dept. of Physics, St. Joseph's college

The objective of the course:

1. What distinguishes the methods of science from other human activities?
2. To understand and appreciate the universe which eventually helps us to think about who you are and where you and the human race are going?
3. What astronomy can tell us about our place in the universe? (How was the universe created? Where did the earth, moon and the sun come from? What are the stars and the planets made of? How do we fit in? What is our place in the universe?)

Syllabus

1. Introduction to Astronomy

The changing perceptions of the universe – Geocentric, heliocentric and the present day perceptions of the universe.Solar System – Solar system and its origin.Sun and Sun like stars – properties, stellar classification, the birth, death and resurrection of the stars.Galaxies – The Milky Way Galaxy, classification of galaxies.

(15 hours)

2. Windows to the Universe
Electromagnetic spectrum – Optical, radio, UV, micro, IR, X-ray and gamma ray astronomy.Visible windows – Optical astronomy, optical telescopes, functions of telescopes.Invisible windows – Radio-astronomy, radio-telescope, advantages and disadvantages.

(10 hours)

3. Cosmology
The Origin and Evolution of the Universe – The Expanding Universe, Hubble's Law, Age of the Universe, Big Bang Theory, CMBR, Dark energy and the accelerating universe.

(5 hours)

Reference: 1. Universe, Roger A. Freedman and William J. Kaufmann III, W. H. Freeman and company, New York
2. Astronomy: The Evolving Universe, Michael Zeilik, Cambridge University Press.

PHYSICS - OPEN ELECTIVE - II
Choice Based Credit System Course (2016-18)
Logic and Its Application in the Ascent of Physics

Resource Person: Dr. Rabbi Akkiba Angiras, Dept. of Physics, St. Joseph's College
Expected participants: Students from Statistics, Biological Sciences and Economics
Expected number of Students: Maximum of 20 students

Objectives of the Course: 1) Help the students getting over the fear of asking questions and arguing.
2) Act as a primer for the students that will help them in understanding concepts taught in their respective courses.
3) Help the students understand scientific method.

Syllabus

Logic: Deductive, Inductive logic, Identification of an argument, Identifying fallacies, Definition of definition, Symbolic Logic, Scientific Method, Application to Physics, Economics, Language

Epistemology of Physics: Ideas from Rene Descartes, Fransis Bacon, David Hume, Karl Popper, Berkeley, Ludwig Wittingstein, Influence of these philosophers on Newton, Maxwell and Einstein **(10 hours)**

Mathematical Primer: Ideas of functions, calculus, statistical analysis, introduction to Python, writing Python codes to plot a function, statistics and numerical analysis etc. **(10 hours)**

Observations, Making Models: Devising a simple experiment (either from Physics, Astrophysics, Economics. Internet resources could be used) taking measurements, understanding sources of errors, making a model, making a prediction **(5 hours)**

Developing a demonstration experiment **(5 hours)**

Resource Books:

1) Introduction to Logic- Irving Copi, Pearsons (14th Edition), 2013
2) Theory of Knowledge: A Contemporary Introduction to the theory of Knowledge – Robert Audi, Routledge Publishers, 2005
3) Introduction to Computation and Programming Using Python – Guttag John, PHI, 2014
4) Data Reduction and Error Analysis for Physical Sciences – Philip Bevington and Keith Robinson, McGraw-Hill Higher Education, 2005

Mode of Evaluation: Class participation, Presentation, One Test (Can vary with the nature of students).

PHYSICS - OPEN ELECTIVE - III
Choice Based Credit System Course (2016-18)
Wonders of Physics

Resource Person: Prof. Ricky Wilfred G, Department of Physics, St. Joseph's College

Objective of the course:

i) To induce a sense of wonder and awe among the students when they look at the world around them.

ii) To rationalize the thoughts and build a bridge between the science that they study in the course and its application in their daily life.

Total hours: 30

Syllabus

1. Science: A wonder of reality

Introduction, Aristotelian science, Science - tracing back its origin, what is physics, why physics, the three fundamental entities of reality – Space, time and matter.

(3 hours)

2. Space

a) Universe by design: From backyard to the big bang – A brief history of cosmology; world-views in science and cosmological models, twentieth century cosmology, more recent developments in cosmology, tools for explaining the universe, the big bang model, fine-tuned

universe, the law of cause and effect, A pale blue dot but a privileged planet.

b) Frontiers of Astronomy: From dawn to dusk, exploring the night sky, recent discoveries in the solar system, other worlds, cosmological distance and measurements, death of massive stars – supernova and black holes **(8 hours)**

3. Time

a) A Physical quantity: The International System (SI) of measurement for physical quantities, The unit of time, Measuring time with atomic clocks, Determining position with the aid of precise time measurements, Shortest and longest time-span, Time constants and periods, Time constants and oscillation periods in physics, Time in astronomy, Time in biological systems, Other aspects of physical time.

b) An anthropological quantity: Introduction, Attributes of time, application of information science in interpreting time, the five levels of time, eternity, ideas of eternity among people, sense of eternity among people. **(5 hours)**

3. Matter

Properties of matter, Matter and energy, wave particle duality, logic and physics, materialism, the equation of life and death, Erwin Schrödinger and the birth of information science.

(6 hours)

4. Love of Physics

Powers of ten, from nucleus to deep space; measurements, uncertainties and stars, bodies in motion, the rainbow, harmonies of strings and winds, wonders of electricity, mysteries of magnetism, energy conservation, physical phenomena in living systems, inventions that conquered the world, discoveries that revolutionized the world, physics in our daily life.

(8 hours)

PHYSICS - SEMESTER-V

(Revised syllabus 2017-19)

PH 5115: Electronics and Relativity

Total Hours: 45

1. Bipolar Junction Transistor:

Construction and basic action, Configurations (Common base, common emitter and Common collector).Definition of α, β and their relations. Comparison between CB, CE, CC mode. Input, output and transfer characteristics of CE and CB configurations. Leakage current in transistors-CE mode, thermal runaway. Biasing methods – base biasing and voltage divider biasing. DC load line, operating point (Q point). Transistor as a switch. Transistor as an amplifier: CE and CC amplifier, working and frequency response. Problems. **(10 hours)**

2. Field Effect Transistor:

Construction and working, Static Characteristics, Shockley's equation. FET parameters. FET amplifiers. MOSFET - Types of MOSFET- Depletion and enhancement mode (Construction, Drain characteristic and transfer characteristic). Problems **(5 hours)**

3. Operational Amplifiers and Oscillators:

Operational Amplifier: characteristics of an ideal opamp. CMRR, slew rate. Concept of virtual ground. Inverting and non-inverting operation amplifiers, expression for gain. Operational amplifier as adder, subtractor, integrator differentiator and comparator. Concept of positive and negative feedback. Barkhausen criterion for an oscillator. RC and LC oscillations. RC oscillator: Phase shift oscillator, Wienbridge oscillator. LC oscillator: Hartley and Colpitt oscillators. Expression for frequency (no derivation). Problems **(10 hours)**

4. Digital Electronics:

Logic gates - AND, OR and NOT - circuit symbols, Circuit using diodes and transistors- truth tables. Boolean algebra, Boolean equations. De-Morgan's theorem, NOR and NAND gates, NAND gate as Universal gate. EXOR - gate, Half and Full adder. Problems. **(5 hours)**

5. Relativity:

Review of frames of reference-Inertial and non inertial frames. Galilean transformation equation principle of Galilean relativity. Michelson-Morley experiment-significance of negative result postulates of special theory of relativity. Derivations of Lorentz transformation equations Applications-1. Length contraction, 2. Time dilation. Illustration with "twin paradox" and "life time of a μ meson" Simultaneity in relativity, velocity transformation equations, Velocity addition theorem, Variation of mass with velocity, Relativistic momentum, Mass-energy and momentum-energy, relativistic force examples-annihilation of matter, pair production. Problems **(15 hours)**

References:

1. Principles of electronics- A.P.Malvino (Mc Graw-Hill Pub.)
2. Electronic devices and circuits- Millman and Halkias (Mc Graw-Hill Pub.)
3. Digital electronics –Malvino and Leach (Mc Graw-Hill pub)
4. OP AMP and linear integrated circuits-Gayakwad (Pearson Education)
5. Basic electronics – B.L.Theraja (S. Chand& Company Ltd)
6. Applied electronics- R.S.Sedha (S. Chand & Company Ltd-first edition 1990)
7. Principles of electronics –V.k. Mehta & Rohit Mehta (S. Chand & Company Ltd)
8. General Relativity – Griffith(Cambridge University Press)
9. Introduction to special Relativity – Robert Resnick(Wiley eastern Ltd)
10. Concepts of Modern physics – Arthur Beiser (Tata Mc Graw-Hill Pub.)

PH5P1 Practical

List of Experiments:

1. Transistor characteristics.

2. CE amplifier
3. CC amplifier
4. FET characteristics
5. FET amplifier
6. Op AMP –Inverting & Non-inverting amplifiers
7. Phase shift oscillator
8. Wien bridge oscillator
9. Logic gates using diodes & IC
10. Transistor as a switch.
11. Half adder & full adder

PHYSICS -SEMESTER-V

(Revised syllabus 2017-19)

PH 5215: Quantum Mechanics, Atomic and Molecular Physics

Total Hours: 45

Problems to be worked out in all chapters.

1. Basic quantum mechanics

Failure of Classical Physics - black body radiation, photo electric effect and specific heat of metals. Brief explanation based on quantum theory. de-Broglie's hypothesis, expression for de-Broglie wavelength-different forms, both relativistic and non-relativistic, Davisson and Germer's experiment, G.P.Thomson's experiment and their significance. Phase velocity, group velocity, concept of wave packets, de- Broglie wavelength applied to Bohr atom.

Uncertainty principle in terms of momentum & position- different forms, explanation of natural broadening of spectral lines. Diffraction of electrons at a single slit. **(12 hours)**

2. Schrodinger's equation

Concept of Wave function- setting up of Schrodinger's equation - time dependant and time independent. Max Born's interpretation of wave function, probability density, operators- Hermitian operator, commutation relations and its physical interpretations, expectation values of dynamical quantities. **(8 hours)**

3. Application of Schordinger's equation

Infinite potential well in one dimension, Extension to three dimension – degeneracy. Equation of continuity, probability current density. Step potential in one dimension – reflection and transmission coefficients (with derivation), Experimental evidence of tunneling effects- tunnel diode, alpha decay (qualitative). Harmonic Oscillator - expression for energy and zero point energy. Hydrogen atom (qualitative), mentioning of quantum numbers, n and l, m_l and s. **(10 hours)**

Atomic and Molecular Physics

4 Atomic Physics:

Review of Bohr's theory of hydrogen atom, Sommerfeld's modification of Bohr's atomic model (qualitative). Vector atom model – Spatial quantization, electron spin, Quantum nos. associated with the vector atom model, Spectral terms and their notations. Coupling schemes - L-S coupling, J-J coupling. Pauli's exclusion principle, Magnetic dipole moment due to orbital motion of an electron, Magnetic dipole moment due to spin, Stern-Gerlach experiment, Larmor's theorem, experimental study of Zeeman effect, Quantum theory of Normal Zeeman effect and Anomalous Zeeman effect, sodium D-line.

Paschen Back effect, Stark effect. (qualitative). **(10 hours)**

5. Molecular Physics:

Pure rotational motion – Diatomic molecule as a rigid rotator, Rotational Spectrum-selection rule. Pure vibrational spectrum-expression for energy-selection rule. Rotational – vibrational spectrum selection rules. Scattering of light, Rayleigh's scattering. Raman effect experimental study, quantum mechanical explanation and applications. **(5 hours)**

References

1. Concepts of Modern Physics by Arthur Beiser, Tata McGraw Hill (2008)
2. Quantum mechanics by Berkley series. Vol II Chapter I
3. Qauntum mechanics by Schaum's series Tata McGraw Hill.

4. Quantum mechanics by Eugene Merzbacher, Wiley International (1998)
5. Quantum mechanics by Albert Messiah Vol IDover Publication (1999)
6. Introduction to quantum mechanics by David J Giffiths, 2nd edition, Pearson Education(2005)
7. Quantum mechanics by Dr. Gupta, Dr. Kumar, Dr. H.V.Sharma and Dr. R.C. Sharma, Jaiprakash Nath and Co (2009)
8. Modern quantum mechanics by J.J.Sakurai, Pearson Education (2000)
9. Wave mechanics by N.F.Mott and Sneddon, Dover publication (2000)
10. Modern Physics– Murugeshan, Kiruthiga Sivaprasath, S.Chand and Co. Ltd.
11. The Feynmann lectures, Vol III (1965)
12. Introduction to Atomic spectra by H.E. White, McGraw Hill Company (1934)
13. Modern Physics – Richtmyer, Kennard and Cooper, Tata McGraw Hill (2000)
14. Molecular Physics – Gerhard Herzberg
15. Optics – Ajoy Ghatak. McGraw Hill Company (2009)

PH5P2 Practical

List of Experiments

1. Wave length of Laser
2. Ionisation potential of Xenon
3. Analysis of rotational spectrum of N_2
4. Analysis of rotational, vibrational spectra of HBr
5. e/m by Thomson's method
6. Planck's constant determination
7. Determination of Rydberg's constant using Hydrogen spectrum
8. Determination of fine structure constant
9. Application of CRO in the study of Lissajous figures, calculation of rms voltage and calculation of frequency of AC
10. Quantum Harmonic Oscillator – Computational method
11. Absorption spectrum of $KMno_4$

PHYSICS -SEMESTER – VI

(Revised syllabus 2017-19)

PH6115: Solid State and Statistical Physics

Total Hours: 45

1. Crystal Structure:

Crystalline and amorphous solid, space lattice, primitive and unit cell, Seven crystal system and Bravais lattices. Characteristics of unit cell – atomic radius, Co-ordination number, volume, density, packing fraction. Symmetry Elements in crystals –The Twenty three symmetry elements in a cubic crystal. Miller indices, Inter – planar spacing. Problems. **(6hours)**

2. X-rays:
Properties of x-rays, Production of x-rays - Coolidge tube, Continuous and Characteristic x-rays. Mosley's law. Scattering of x-rays-Compton effect. Bragg's law of x-ray diffraction. Analysis of crystal structure by Powder method. Problems **(6 hours)**

3. Properties of Metals
Drude and Lorentz classical theory, Expression for electrical conductivity, Ohm's law, Thermal conductivity, Wiedmann-Franz law. Specific heat of metals- Dulong and Petit's law - Einstein theory - Debye's theory. Problems **(6 hours)**

4. Band theory of solids
Formation of energy bands in solids. -Distinction between metals, insulators and semiconductors. Intrinsic - concept of holes, concept of effective mass. Carrier concentration in an Intrinsic semiconductor- density of free electrons in conduction band-density of holes in valence band. Conductivity in intrinsic semiconductor. Extrinsic semiconductors-impurity states energy band diagram and Fermi level. Hall effect in metals and semiconductors. Solar cells, photoconductivity, light dependent resistors, light emitting diode. Problems **(8 hours)**

5. Superconductivity-Introduction, experimental facts-zero resistivity, critical field, Meissner effect, persistent currents, superconducting magnets, magnetic levitation, isotopic effect. Type I and Type II superconductors- Cooper pairs, BCS theory (qualitative), Josephson Effect (qualitative). Problems. **(4 hours)**

6. STATISTICAL PHYSICS
Introduction- basic concepts- phase space, microstate, macrostate, thermodynamic probability. Maxwell Boltzmann statistics- basic postulates, distribution function, Maxwell distribution of molecular velocities, application to width of spectral lines (Doppler broadening). Bose Einstein statistics – postulates, distribution function, Fermi-Dirac statistics, Fermi distribution function, Density of states, Expression for total Fermi energy and average energy zero Kelvin and above zero Kelvin temperatures. Problems. **(15 hours)**

References:

1. Introduction to Solid State Physics, 5th Edition -C.Kittel.
2. Introduction to Solids -L.V.Azaroff.
3. Fundamentals of Solid State Physics –A.J.Dekkar.
4. Solid State Physics- S.O. Pillai.
5. Thermodynamics and Statistical Physics- Singhal, Agarwal.
6. Stastistical Physics-Reif.
7. Stastistical Mechanics-Agarwal and Eisner.

PH6P1 Practical

List of Experiments

1. Energy gap of a semicoductor
2. Fermi energy of a Copper.
3. LDR – Characteristics.
4. Planck's constant using LED.
5. Analysis of X-ray Photograph.
6. Gaussian distribution – using radioactive source.
7. Diode as a temperature sensor.
8. Solar cell – Fill factor.
9. Solar cell – Inverse square law.
10. Determination of dielectric constant.
11. Determination of resistivity by Four probe method

PHYSICS - SEMESTER – VI

(Revised syllabus 2017-19)

PH6215: Astronomy, Astrophysics and Nuclear Physics

Total hours: 45

Astronomy& Astrophysics:

1. Introduction to Astronomy

Electromagnetic spectrum- transmission of radiation through the atmosphere. Windows to the universe-optical astronomy, infrared astronomy, ultraviolet astronomy, radio

astronomy, x-ray and gamma ray astronomy (history, wavelength/frequency, astronomical sources).Problems. **(2 hours)**

2. Observational Techniques

Optical telescopes- refraction telescope, reflection telescope- Newtonian and Cassegrain telescope, properties of telescope- f-ratio, light gathering power, resolving power, magnifying power. Problems**.** **(3 hours)**

3. Physical properties of sun like stars

Luminosity, apparent brightness, magnitude scale, apparent, absolute and bolometric magnitude, distance modulus equation, effective temperature of a star, the relationship of temperature with the color of a star, size of a star, units of distance, trigonometric parallax method to find the distance of nearby stars. Problems.

The Sun-core, radiative zone, convective zone, the atmosphere of sun- photosphere, chromosphere, corona. Surface activities of the sun- sun spot, solar flare and solar wind .Problems. **(6 hours)**

4. Astrophysics of sun like stars

Ideal gas equation of the state of the star, gravitational binding energy of the star, Virial theorem and total energy of the star, the mean particle energy, the mean temperature and mean pressure of a star, internal structure of the stars- the equation of hydrostatic equilibrium, thermal equilibrium(qualitative), calculation of the life time of sun, energy generation in the center of the star, photon random walk, photon diffusion time, mass-luminosity relation. Problems **(9 hours)**

5. Evolution of sun like stars

HR diagram, main sequence stars, evolution of stars, the end states of stars, equation of state of a degenerate star- white dwarf, physical properties , the Chandrasekhar limit (qualitative), supernova, neutron star, physical properties, pulsars , basic physics of black hole- Shwarzschild radius. Problems**.** **(5 hours)**

6. The Milky way Galaxy and the galaxies beyond

The Milky way galaxy, over all structure of the galaxy, galaxies beyond milky way-the classification of galaxies, the rotation of galaxies, the dark matter in galaxies, the expansion of the universe, red shift of galaxies, Hubble's law, calculation of the age of the universe, The Big bang cosmology, cosmic microwave back ground radiation. Problems. **(5 hours)**

Nuclear Physics:

1. Nuclear decay

Radioactive decay- the decay law, half life, mean life and decay constant (No derivation), Units of radioactivity, Theory of successive disintegration- secular and transient equilibrium, radioactive series Alpha decay- potential barrier, Gamow's theory of alpha decay (qualitative), alpha particle disintegration energy, alpha ray spectra, Geiger- Nuttal's law &

its importance. Beta decay-beta ray spectra, Pauli's neutrino hypothesis. Problems **(5 hours)**

2. Nuclear properties and nuclear reactions

Properties of the nucleus-charge, size, density, mass, packing fraction, binding energy binding energy curve, nuclear fission and fusion, nuclear spin, nuclear magnetic moment, quadrupole moment, characteristics of nuclear force Nuclear reactions-conservation laws, Q - value equation and threshold energy. Problems. **(4 hours)**

3. **Particle accelerators and detectors**

Cyclotron,electron synchrotron, proportional counter, GM counter, Problems **(4 hours)**

4. Elementary particles

Classification, basic interactions in nature, conservation laws (Qualitative).Quarks. **(2 hours)**

References

1. The Physical universe (1982) Shu F.H University Science books
2. Introductory Astronomy and Astrophysics 4th edn 1998 by Micheal Zeilik & Stephen A.Gregory
3. Astrophysics- a modern perspective by K.S Krishna swamy
4. An introduction to modern astrophysics 2nd edn by Bradly W. Carroll & Dale A. Ostlie
5. Nuclear Physics by Irving Kaplan
6. Concepts of nuclear Physics by Cohen
7. Nuclear Physics by S.B. Patel

PH6P2 – Practical

List of experiments

1. Stellar Parallax
2. Stellar Spectra
3. Stellar Classification
4. H-R diagram
5. Resolving Power of a Telescope
6. Solar rotation periods
7. Hubble's Constant
8. Study of Pulsars
9. GM Characteristics
10. Inverse square law using G-M Counter.