Revised CBSE syllabus

SEMESTER I

PAPER 101 (Theory: 60 Lectures)Mechanics and Special Theory of Relativity
(Credits: Theory-O4, Practicals-02)(Theory: 60 Lectures)

Unit-1 Laws of Motion: Frames of reference. Newton's Laws of motion-Newton's I Law explanation with illustration, concept of inertial mass, Newton's II Law, Newton's II law in accelerated frame of reference, gravitational force, weight of a body. Newton's III Law, explanation with illustration, applying Newton's laws to solve problem by using free body diagrams, dynamics of a system of particles. Newton's II law for system of particles. Centre of mass, F,r"1:Maro. -Problems. (09 Lectures)

Momentum and Energy: Review of linear momentum, work, energy and conservation laws.System with varying mass, motion of rockets. Velocity and acceleration of single stage rocket, multistage rockets (qualitative), contribution and achievements of India in rocket technology (Qualitative)-Problems. (06 Lectures)

Unit-2

Rotational Motion: Review of angular velocity, angular momentum and torque, MI of a body, radius of gyration, Conservation of angular momentum. Parallel and Perpendicular axes theorems with proof (two-dimensions only). Calculation of MI of a ring, circular disk and solid cylinder. -Problems, (05 Lectures)

Gravitation: Newton's Law of Gravitation. Gravitational potential and field intensity due to spherical distribution of matter (Solid sphere only). Motion of a particle in a central force field (qualitative). Kepler's Laws (statements & proof . Satellite in circular orbit, Expression for Orbital velocity, Escape velocity. Geosynchronous orbit. Weightlessness (qualitative).Basic idea of global positioning system (GPS).-Problems(10 Lectures)

Unit-3 Oscillations: Review of oscillations, simple harmonic motion, Differential equation of SHM and its solutions, kinetic and potential energy, total energy (derivation). Compound pendulum as an example of SHM (expression for period), Damped oscillations (Qualitative). –Problems (05 Lectures)

Elasticity: Introduction, Hooke's law - Stress-strain diagram - Elastic modulii-Relation between elastic constants (proof) - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants. Bending of beams, Expression for bending moment, Single cantilever with theory, Determination of Rigidity modulus by static torsion and dynamic methods with theory.-Problems (10 Lectures)

Unit-4

Special Theory of Relativity: Inertial and non-inertial frames, Principle of Galilean relativity; idea of Galelian transformation equations (the concept of /=t',a:a',F:F').Michelson- Morley experiment with a brief background, significance of its negative results, Postulates of special theory of relativity, Derivation of Lorentz transformation equations. Proper length, Lorentz-Fitzgerald length contraction, proper time, time dilation, illustrations lifetime of p- mesons and twin paradox. Simultaneity in relativity. Velocity transformation equations, Relativistic addition of velocity (velocity addition theorem). Variation of mass with velocity, Mass-energy and momentum-energy relations. -Problems (15 Lectures)

Reference Books:

I. Undergraduate Physics Vol-I, Mechanics and Special Theory of Relativity, Niruta Publications, Bangalore.
2. University Physics. FW Sears, MW Zemansky and HD Youngl3/e, 1986. AddisonWesley

3. Mechanics Berkeley Physics course,v.l: Charles Kittel, et. Al. 2007, Tata McGrawHill
4. Physics - Resnick, Halliday & Walker 91e,2010, Wiley
5. Engineering Mechanics, BasudebBhattacharya, 2nd edn., 2015, Oxford University Press
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole
7. Elements of Properties of Matter-D,S.Mathur, Shamala Charitable trust, New Delhi.

Practical: PAPER 102

1. Measurements of length & diameter using Vernier calipers, screw gauge and travelling microscope.
2. To determine the Young's Modulus by single cantilever.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus by Stretching.
5. To determine the Modulus of Rigidity of a wire by dynamic method.
' 6. To determine the Elastic Constants of a Wire by Searle's method.
7, To determine g by Bar Pendulum.
8. Verification of law of conservation of momentum and energy.
9. To verify perpendicular axes theorem.
10. To verify parallel axes theorem,
1 1. To study the oscillation of a spring and calculate (a) Spring Constant (b) Value of g.
12. To determine the Rigidity Modulus by Static torsion method.
(A Minimum of eight experiments should be performed.)

SEMESTER _II
PAPER 201
Electrostatics, Electromagnetism and current Electricity
(Credits: Thoery-04, practicals-02)
Theory: 60 Lectures

Unit I: Vectors: Review of vector algebra (Scalar and Vector product), gradient, divergence, curl and their physical significance. Vector Integration (qualitative) - Line, surface and volume integrals of vector fields. Gauss-divergence theorem and Stokes theorem of vectors (statements only),

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem in electrostatics. Applications of Gauss theorem: Electric field due to point charge, infinite line of charge ,uniformly charged solid sphere. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged solid sphere. Expression for capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser. Energy stored in capacitor. Dielectric medium, polarisation, displacement vector (qualitative).-Problems. (15 Lectures)

UNIT II:

Magneto-statics: Biot- Savart's law & its applications- magnetic field due to straight conductor of finite length (infinite length as a special case), Derivation of Expressions for magnetic field at the center of a circular coil and solenoid carrying current. Definitions of divergence and curl of magnetic field. Ampere's circuital law and its application to determination of magnetic field on the axis of the solenoid. -problems.

Magnetic Fields and Force: mention the expression for motion of a charged particle in a magnetic field, derivation of expression for magnetic force on a current carrying conductor. Torque acting on a current loop, Construction and theory of Ballistic Galvanometer,

Concept of dead beat. Determination of high resistance by leakage method with theory.- Problems. **Electromagnetic Induction: Review** 10 Lectures
coil experiments)- Faradays' laws and of electromagnetic induction (coil-magnet and coil-Lenz's law of electromagnetic induction, Definition for self and mutual inductance, Expression for L of single coil, Expression for M of two coils and Energy stored in an inductor. Eddy currents and applications-Electromagnetic damping, induction furnace. Induction motor, electric breaks and speedometers (qualitative).Problems. (5 Lectures)

UNIT III:

Magnetic properties of materials: Brief explanation of Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Properties of para- dia- and ferro-magnetic materials. Derivation for paramagnetic susceptibility-Curie law. Hysteresis curve and its significance. -Problems.
(5 Lectures)

Maxwell's equations and Electromagnetic wave propagation: Expression for equation of continuity of current, Derivation of Maxwell's equations (four equations), Maxwell's correction to Ampere's law, Displacement current, Expression for velocity electromagnetic wave through vacuum and isotropic dielectric medium, transverse nature of EM waves(proof), energy density equally in an electromagnetic field,. Poynting theorem and pointing vector (qualitative)-Problems.(10 Lectures)

UNIT IV:**Transient Currents:** Theory of CR circuit (charging and discharging)-LR circuit (growth and decay) -LCR circuit (discharging). -Problems.

Alternating Currents: Review of basic definitions, series LCR circuit - Impedance by using j operator, series resonance, 'Q' factor and band width, parallel LCR circurt (qualitative). -Problems. (9 Lectures)

Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem and maximum power transfer theorem.- Problems. (6 Lectures)

Reference Books:

1-. Undergraduate Physics Vol-II, Electrostatics and Magnetism, Niruta Publications,Bangalore.
2. Electricity and Magnetism, Edward M,Purcell.
3, Electricity and Magnetism, J.H. Fewkes& J. yarwood. Vol.I
4. Electricity and Magnetism, D CTayal
5. University Physics, Ronald LaneReese
5. Introduction to Electrodynamics, D. J. Griffi ths
7. Electrical Networks, B. L.Theraja
8. Electricity and Magnetism, K, K,Tiwari.

Practical: PAPER 202

l. To determination of constants of Ballistic Galvanometer.
2. To determine the capacitances and verify the laws of capacitances using DeSauty's bridge.
3' To determine the time constant during charging and discharging of a capacitor.
4- To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Band width(c) Quality Factor (d) self-inductance of a coil,
5. To study a parallel LCR circuit and determine its (a)Anti- resonant frequency (b)Band width (c) Quality factor e (d) self-inductance of a coil.
6. To determine a Low Resistance by Carey Foster’s Bridge.
7. To verify the Thevenin's Theorem.
8- To verify the Superposition theorem.
9. To determine Self-inductance of a given coil by using Anderson,s Bridge.

10. To determine L and c for two different values by equal voltage method.
11. Ballistic Galvanometer: Determine a high resistance by Leakage Method.
12. Maximum Power Transfer Theorem
13. To verify the Norton theorem.
(A Minimum of Eight experiment should be performed.)

SEMESTER III PAPER 301
Thermal Physics, Radiation and Optics I
(Credits: Theory-O4, Practicals-02)
UNIT I: Kinetic Theory of Gases
Review of kinetic theory of gases (qualitative), Maxwell's law of distribution of velocities(qualitative) and its experimental verification (Stern's Experiment), Average, r.m.s. and most probable velocity (derivations using Maxwell's law of distribution of velocity). Degrees of freedom and law of equi partition of energy with proof and mention its applications to find ratio of specific heats for mono; di- and tri atomic gas molecules. Mean free path (derivation)Mention Boltzmann-Maxwell's expressions for mean free path, Transport phenomena -Viscosity, conductivity, diffusion, Expression for q, r and D (derivations) and relation between them. Brownian motion, Einstein's explanation (qualitative), Vertical distribution of Brownian particles, Evaluation of Avo gadro number. -Problems. (15 Lectures)

UNIT II: Thermodynamics
Review of laws of thermodynamics, different processes, Heat engines: Carnot's engine (qualitative), Otto engine, Otto cycle: Expression for efficiency, Diesel engine, Diesel cycle: Expression for efficiency and Carnot's theorem (statement and proof). Entropy: Concept of entropy, Change in entropy in reversible and irreversible processes, Entropy-temperature diagram and its significance. Thermodynamic potentials: Internal energy, Enthalpy ,Helmholtz free energy and Gibbs free energy and their significance. Condition for equilibrium of phases in terms of Gibbs potential. Maxwell's relations: Derivation of Maxwell's relations, Applications, - l) Clausius- Clapeyron's equation, 2) Mayer's equations (specific heat of saturated vapours), TdS equations (energy equations). –Problerns (15 Lectures)

UNIT-3: Low Temperature Physics and Radiation
Production of low pressure: Exhaust pump and its characteristics, Exhaust pressure, Degree of vacuum attainable, Speed of pump (Gaede and Langmuir equations). Diffusion pump principle, construction and working.
Production of low temperature: Joule Thomson effect, Porous plug experiment with theory, Thermo dynamical analysis of Joule Thomson effect, discussion of J-T coefficient for ideal and real gases. Temperature of inversion. -Problems.
Radiation: Review of black body radiation, Kirchoff s laws of radiation (derivation).Energy density and Radiation pressure (qualitative), Stefan's law and its derivation using radiation pressure. Black body radiation spectrum, Planck's law of radiation and its
derivation, Deduce Wien's displacement law and Rayleigh-Jean's law from Planck's law. Determination of Solar constant using pyrheliometer and estimation of temperature of the Sun -Problems (15 Lectures)
UNIT IV: Optics I
Huygen's wave theory: Huygens Principle, Wave front and its types.
interference of light: Coherent sources, Production of coherent sources by

1) Division of wave front- Young's Double Slit experiment (qualitative) Fringe shift due to introduction of a thin film. Lloyd's Miror (qualitative). Phase change on reflection: Stoke's treatment. Fresnel's Bi-prism- construction, working and determination of wavelength,. -Problems.

2) Division of amplitude: Interference in thin Films: Interference due to reflected light in parallel films-theory, interference due to transmitted light in parallel films (qualitative),wedge-shaped films. Theory of Air wedge. Fringes of equal inclination-Haidinger Fringes(qualitative); Fringes of equal thickness- Fizeau Fringes (qualitative). Theory of Newton's Rings ,Problems.

Michelson's Interferometer: Principle, Construction, determination of wavelength, andwavelength difference. -Problems. (15 Lectures)

Reference Books:

1. Undergarduate Physics, Vol-I[, Thermal Physics, radiation and optics, Niruta Publications,Bangalore.
2. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, lgg3,TataMcGraw-Hill.
3. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969,Indian press.
4. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications,
5, Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
8. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
9. Heat and thermodynamics, Subramanyam and Brijlal.

Practical: PAPER 302

l. To determine mechanical equivalent of heat by electrical method.
2. Measurement of Planck's law using blackbody radiation.
3, Verification of Stefan's law.
4. To determine the thermal conductivity of copper by Searle's apparatus.
5. To determine specific of a liquid by Newton's law of cooling.
6. To determine the thermal conductivity of bad conductor by Lee and Charlton's disc method.
L To determine the temperature coefficient of resistance of aluminum/copper wire.
8. To study the variation of thermo-emf across two junctions of a thermocouple with temperatue.
9 . To determine the dispersive power of the material of a given prism using mercury light.
10. To determine the value of Cauchy's constants of a material of a prism.
I I . To determine the radius of curvature of a Plano-convex lens using Newton's rings.
12. To determine the thickness of a material by air wedge.

(A Minimum of eight experiments should be performed.)

Reference Books:

l. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, AsiaPublishing House.
Z. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, I lth Edition,2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal,I 985, Vani Publication Oleay,

Semester IV
PAPER 401
Waves, Optics-Il and Statistical Physics.
(Credits: Theory-O4, Practicals-02)Theory: 06 Lectures
Unit I:
Superposition of Two Collinear Harmonic Oscillations: - Linear and Superposition Principle. Superposition of oscillations with (l) equal frequencies and (2) <different frequencies (Beats).- Problems
Superposition of Two Perpendicular Harmonic Oscillations: - Graphical and analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses. Wave motion: Transverse waves on a string. Progressive and standing waves on a string. Normal modes of vibrating string. Group Velocity, Phase velocity, wave Intensity.- Problems (15 Lectures)
Unit II:
Sound: Simple Harmonic Motion (qualitative) - Forced vibrations, Resonance (solution of equation of motion) - Fourier's Theorem, Application to saw tooth wave, Intensity and loudness of sound, decibels, Intensity levels-Musical notes-Musical scale. Acoustics of buildings: Reverberation and Time of reverberation, Absorption co-efficient, Sabine's formula-measurements of reverberation time with theory, Acoustic aspects of halls and Auditoria.- Problems (06 Lectures)
Fluids: -Review of Surface Tension: Syn clastic and anticlastic surfaces - Excess pressure- Application to spherical, cylindrical drops and bubbles (derivations), Jaeger's method to determine surface tension- theory and experiment, variation of surface tension with temperature, Viscosity: Review of viscosity-Rate of flow of liquid in capillary tube-Poiseuille's formula (derivation)-Determination of coefficient of viscosity of a liquid by Poiseuille's method. Variation of viscosity of a liquid with temoerature. lubrication and lubricants (qualitative). -Problems (09 Lectures)
Unit III:
Diffraction- Fresnel Diffraction: Half-period Zones, Zone Plate, Fresnel diffraction pattern at straight edge, single slit using half period Zone analysis. -Problems.
Ultra violet Fraunhofer diffraction: Single slit; Double slit and Diffraction Grating with theory.Problems. (09 Lectures)
Polarization: - Transverse nature of light, methods of production of plane polarized light (qualitative), Plane, circularly and elliptically polarized light, quarter wave plate and half wave plate, production and detection of plane, circular and elliptically polarized light. Optical activity- Fresnel's explanation and theory. Specific Rotation- Polarimeter-construction and working. -Problems (06 Lectures)

Unit IV:
statistical Mechanics:- Phase Space, Macro state and microstate, Entropy and thermodynamic probability, Classical statistics-Maxwell-Boltzmann distribution law, Maxwell-Boltzmann law of Distribution of velocity, Quantum statistics- Fermi- Dirac distribution law, Fermi sphere and Fermi energy, Fermi gas. Bose Einstein distribution law. Bose's derivation of Planck's law, Rayleigh-jeans law, Wien's law, Comparison of Statistical distribution laws. -Problems
Reference Books:
(15 Lectures)
l. Undergraduate Physics, Vol-IV, Optics and Statistical mechanics, Niruta Publications,Bangalore.
2. Principles of Optics- B.K Mathur

3, Laser and Optics - A.K Ghatak
4. Optics- Brijilal and Subramanium
5: Properties of matter- Brijilal and Subramanium
6. Elements of properties of matter- D.S Mattur
1. Optics- Jenkins and white, Mc grow Hills
8. Statistical mechanics- Agarwal and Eisner
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Practical: PAPER 402

1. To Study the motion of coupled oscillators,
2. To determine the frequency of an electrically maintained tuning fork by Melde's Experiment
3. To determine the unknown frequency of given tuning fork using Helmholtz resonator.
4. To determine the co efficient of viscosity of liquid by Stoke's method
5. To determine the wavelength of LASER light using diffraction at a single slit
6. To determine wavelength of Mercury lines using plane diffraction grating
7 . To determine wavelength of sodium lines using Fresnel Biprism.
8. To determine the surface tension of water and interfacial tension between water and kerosene by drop weight method.
9. To determine the resolving power of a telescope.
10. To determine the specific rotation of sugar solution using polarimeter.
11. To determine the surface tension by Jaeger's method.
12.To measure the intensity using Photo sensor and LASER in Diffraction Patterns of single
and double Slits.
13. To determine the Resolving Power of a Plane Diffraction Grating.
14. To determine the Refractive lndex of the Material of a given Prism using Sodium Light.
(A Minimum of eight experiments should be performed.)

Reference Books:

I. Advanced Practical Physics for students,B.L Flint and H T Worsnop, 1971, Asiapublishing house.
2. Advanced level physics practicals, Michael Nelson and Jon M. Ogborn,Fourth Edition, Reprinted 1 985,Heinemann educational publishers.
3. A Textbook of practical Physics, Indu Prakash and Ramakrishna,ll Edition,20ll,Kithab Mahal. New Delhi.
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Semester V

PAPER 501

Semiconductor Devices, Digital Electronics, LASER and Fiber optics
(Credits: Theory-03, Practicals-l.5)
Theory: 45 Lectures

UNIT I: Semiconductor Devices and Amplifiers:

Semiconductor Diodes: p-type and n-type semiconductors. Barrier Formation in PN junction Diode. Principle and Working of (1) LED's (2) LDR (3) Solar cell.Bi polar Junction transistors: Review of Transistor, n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cut-off, and Saturation regions. Current gains c and B. Relations between o and B. Transistor biasing - DC load line analysis and Q-point. h-parameters, Hybrid Equivalent Circuit of a CE amplifier. Expression for Input impedance, Output admittance, Current gain, Voltage gain, and Power Gain using h - parameter.

-Problems.(15 Lectures)

UNIT II: Digital Electronics

Difference between Analog and Digital Circuits. Numbers system-. Binary, Decimal, Octal and Hexadecimal and conversions. AND, OR Gates (Realization using Diodes) and NOT Gate (Realization using Transistors). NAND, NoR, XoR and XNOR Gates. (Truth Table,
Binary Graphical representation of Input & Output). De-Morgan's Theorems. Boolean Laws. Simplification of Logic Circuits using Boolean Algebra. NAND and NOR Gates as Universal Gates. Fundamental Products. Min terms and Max terms. Conversion of a Truth Table into
an Equivalent Logic circuit by (1) Sum of products method and(z) Karnaugh Map.-Problems. (09 Lectures)

Binary Addition, Binary Subtraction using 2's compliment Method, Half Adder and Full Adder, Half Subtractor and Full Subtractor. Problems, (04 Lectures)

Introduction to CRO: Block Diagram of CRO. Application of CRO: (l) study of Waveform, (2) Measurement of Voltage, Frequency and Phase Difference. (02 Lectures)

Unit-III: LASER

General Principles-Spontaneous and stimulated emissions- Condition for laser action active medium, Population inversion, Optical pumping, resonance cavity. Derivation of Einstein's constants A & B. Purity of a spectral line, temporal and spatial coherence. Ruby laser -t4 lP;t11 r:e construction and working, He-Ne Laser - construction and working, pulsed and tunable lasers (qualitative). mention applications of lasers. -Problems. Holography: Elementary hologram, applications.

(07 Lectures) ideas of holography-principle, theory, production and analysis of
(02 Lectures)

Fiber optics: Optical fiber-principle, classification, Construction and Working of Multimode step index optical fiber, glass fiber, Coherent bundle; Numerical apertuure of optical fibre (derivation); Acceptance angle (derivation). Attenuation in Multimode optical fibers;, RayDispersion in multi-mode step index fibers -Problems. (06 Lectures)

Reference Books:-

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata McGraw Hill.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 20I2,Tata Mc-Graw Hill.
3. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,l990, PHI Learning
4. Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7thEd.,z0ll,TataMcGraw Hill
5. Fnndamentals of Digital Circuits, A. Anand Kutnar, 2nd Edition , 2009 , PHI Learning Pvt.Ltd.
6. Digital fundamentals, T. L. Floyd, Pearson publishers.
7. Optics, Ajoy Ghatak, Tata Mc Graw Hill,4'h Edition.
8. An Introduction to LASERS- Theory & Applications, M N Avadhanulu, S Chand & Co.[2001]
g. Optical Fiber Communication, Gerd Keiser, Mcgraw Hill,3"l Edition,[2000]
10. Fiber optics communication, D C Agarwal, Wheeler Publications,2"d Edition15lPagtt---

Practical: PAPER 502

1. To measure (a) Voltage (b) Frequency of a periodic waveform & (c) unknown frequency by Lissajous patterns using CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To study the working of the Half-adder and Full-adder.

4. To determine the ideality factor, drift current and reverse saturation current of a semiconductor diode.
5,, To determine the energy gap of semiconductor (thermistor).
6. To study the characteristics of a Transistor in CE configuration and calculation of h-parameters.
7. To study the frequency response of R-C coupled CE amplifier'
8. LED characteristics and determination of Planck's constant (Minimum four colours)
g. LDR characteristics - measurement of material constant, saturation resistance and dark resistance.
10. Transistor as a switch and an active devise.
11. Solar cell characteristics- Open Circuit voltage, Short circuit current and efficiency/fill factor.
12. Regulated power supply using IC-7805.
13. To study the Frequency response of an emitter follower
' (A Minimum of Eight Experiments must be performed')
Reference Books:
1. Basic Electronics: A text lab manual, P.B. Zbat, A.P. Malvino, M.A. Miller, L994,Mc-GrawHill.
2. Electronics: Fundamentals and Applications, J,D. Ryder, 2004, Prentice Hall,
3. OP-Amps and I inear Integrated Circuit, R. A. Gayakwad,4th edition, 2000, PrenticeHall.
4. Electronic Principle, Albert Malvino,2008, Tata Mc-Graw Hill
5. Digital electronics-R.P. Jain16 lPage

SEMESTER_VI
PAPER 503
Quantum Mechanics - I, Astrophysics and Nuclear Physics - I
(Credits: Thoery-03, practicals-l.5)
Theory: 45 Lectures
Unit - I: Quantum Mechanics - I
Development of quantum mechanics: Introduction to quantum mechanics. Planck's quantum theory. Failure of classical physics to explain the phenomena such as stability of an atom, atomic spectra, black body radiation, photoelectric effect, Compton effect and specific heat of solids. Explanation of the above effects based on quantum mechanics. - Problems, (05 Lectures)
Wave - Particle duality and Uncertainty Principle: de Broglie's hypothesis of matter waves. de Broglie's wave equation (de Broglie's wavelength 2 in terms of momentum, energy, potential difference and temperature). Thomson's experiment. Davisson and Germer's experiment - normal incidence method. Concept of wave packet, Phase velocity, particle velocity and Group velocity. Relation between group velocity and phase velocity.
Bohr's quantum condition and matter waves. Heisenberg's uncertainty principle - different forms. Gamma ray microscope experiment. Application to Non - existence of electron in nucleus. -Problems (10 Lectures)
Unit - II: Astrophysics
Parallax and stellar distances: Units of stellar distances - Definition of parsec (pc),astronomical unit (AU), light year (ly) and their relations. Helio-centric parallax – Relation between distance and parallax of a star. Luminosity of stars: Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude. Distance -

modulus relationship. Distinction between visual and bolometric magnitudes. Radius of a star. –Problems (04 Lectures)

Stellar classification: E. C. Pickering classification and Yerke's luminosity classification .H-R diagram, main sequence stars and their general characteristics .Pressure and Temperature of a Star: Expression for core pressure of a star based on the linear density model of a star. Determination of Surface or effective temperature of a star by Wien's displacement law. Color of a star. Expressions for core temperature and average temperature of a star based on the linear density model of a star. tTlgagt Photon diffusion time: Photon diffusion time (qualitative), Mass - Luminosity relationship and expression for lifetime of a star. Source of Energy of Stars; Expression for Gravitational potential energy or self energy of a star. Statement and explanation of Virial theorem. Nuclear energy of a star (qualitative). -Problems. (07 Lectures)

Evolution of Stars: Stages of star formation - (GMC – Proto star - T-Tauri), main sequence stars and red giant. Chandrashekar limit (qualitative). Formation of White dwarfs, Neutron stars, Pulsars and Black holes. Schwarzschild radius, event horizon and singularity (qualitative). Supernova explosion and its types. Sun spots and their effect on earth(qualitative). -Problems (04 lectures)

Unit III:

Nuclear Physics: Rutherford's experiment of alpha particle scattering, derivation of Rutherford scattering formula (assuming the path of the alpha particle to be a hyperbola).General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. -Problems. Nuclear models: Liquid drop model, semi-empirical binding energy or mass formula, Fermi gas model, nucleonic potential well according to Fermi gas model, Shel1 model, basic assumptions of shell model - evidence for shell model- magic numbers.-Problems' (15 Lectures)

Reference Books:

1. Quantum Mechanics S.P Singh. M.K. Bagde and Kamal Singh. S. Chand & Company,New Delhi.
2. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
3. The Great Universe - G K Sasidharan ,S Chand' 2008
4. Modern Physics, R Murugashen.
5. An Introduction to Astrophysics- BaidyanathaBasu, Prentice hall of India pvt.Ltd. 2004
6. Astrophysics - A Modern perspective - K.S. Krishna swamy , New age International Publishers tSlfagta
7. Astrophysics stars and galaxies, K. D. Abhyankar, University press (India Ltd.)
8. Astrophysics for astrophysicists, Arnab Rai Choudhuri, Cambridge University Press.
9, Atomic and Nuclear Physics - S N Ghoshal
10. Nuclear Physics - D C Tayal,
11. College Physics - Dr N Sundarajan

Practicals- Paper 504

1. To determine the Planck's constant using photocell.
2. Characteristics of Photo emissive cell.
3. To determine the value of e/m by Thomson's method.
4. Parallax Method - Distance of objects using trigonometric parallax.
5. H.R Diagram & the physical properties of stars.
6. Analysis of stellar spectra.

7. Analysis of sunspot photographs & solar rotation period.
8. Mass luminosity curve - Estimation of mass of a star.
9. Mass of binary stars.
10. Spectral response ofa Selenium photocell,
I I . Determination of binding energy of nucleus.
12. Determination of the size of arupee coin.
(A Minimum of eight experiments should be performed.)
Reference Books:
L Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1 985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, llth Edition,20ll, Kitab Mahal, New Delhi.
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SEMESTER VI
PAPER 601
Quantum Mechanics-Il, Atomic Spectra and Operational Amplilier
(Credits: Theory-03, Practicals-l.5) Theory: 45 Lectures
UNIT I:
Quantum Mechanics II: The concept of wave function, physical significance of wave function, Development of time Dependent and Time independent Schrodinger's wave equations, Max Born's interpretation of wave function. Normalization and expectation values, Quantum Mechanical Operators, Eigen values and Eigen Functions. Applications of Schrödinger's Equation- Free particle, particle in l-Dimensional box-derivation of Eigen values and Eigen Functions- extension to three dimensional box; Development of Schrodinger's Equation for one dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom mention Eigen function and Eigen value for ground state.
-Problems. (15 Lectures)
UNIT II:
Atomic Spectra Review of Bohr's theory of Hydrogen atom-Mention the expression for total energy, wave number and Rydberg constant. Variation of Rydberg constant with nuclear mass. Somerfield's modification of Bohr atomic model (qualitative).Excitation and Ionization potentials. Frank-Hertz experiment. -Problems. (5 Lectures)
Vector Model of the Atom: Concept of Spatial quantization and Spinning of Electron. Different quantum numbers associated with the vector atom model. Spectral terms and their notations. Selection rules,Coupling Schemes L-S & J-J Coupling (multi-electron system). Pauli's Exclusion principle .Expression for Maximum number of electrons in an orbit. Spectra of Alkali elements(Sodium-D lines). Larmor precession (derivation), Bohr magneton, Stern-Gerlach experiment, (Experiment and theory). Zeeman effect, experimental study of Zeeman effect, Zeeman shift, Classical explanation of normal Zeeman effect. Quantum theory of Normal and Anomalous Zeeman effect. Paschen-Back effect and Stark effect (qualitative) (10 Lectures)2Ollla'E"11
UNIT III:
Integrated Circuits:
Monolithic IC- Basic production process-Description of Discrete IC (transistor, diodes ,resistors& capacitors)-techniques of manufacturing thin film and thick film IC (any one basic process), limitations of IC's. (2 Lectures)

Operational Amplifier: Block diagram of an Op-Amp, Characteristics of Ideal and practical op-Amp(IC-741),Open loop and closed loop gain, CMRR, Slew rate, concept of virtual ground, application of op-Amp -(i)inverting and non-inverting amplifiers (ii) Adder (ii) Subtractor (iv)Differentiator (v) Integrator- (expressions for output voltage). Instrumentation Amplifier (qualitative). -Problems. (8 Lectures)

Oscillators: Concept of feedback, feedback principles, Oscillator circuits, types of feedback,types of negative feedback, mention the expression for voltage gain in positive feedback, Barkhausen's criterion, RC-Oscillators- phase-shift oscillator and Wein bridge oscillator using Op-Amp.- Problems (5 Lectures)

Reference books:

1. Principle of electronics,Malvino.
2. Operational Amplifier, RamakanthGayakwad.
3. Operational Amplifier with Linear Integrated Circuits, William D Stanley.
4, Electronic Devices and circuit theory, Robert Boylestead and Louis Nashelsky.
5. Quantum Mechanics, B H Bransden and CJ Joachain.
6. Modern Physics, R Murugashen.
7. Fundamental of Electronics, B Basavaraju and P Sadashivaiah.
B. Electronic Fundamentals and Applications (Eleventh Edition).-D Chattopadyya,PC Rakshith.
9, Quantum Mechanics, Basavaraj.

Practical: PAPER 602

t. Measurement of Op-amp parameters: open loop gain, input impedance, output impedance, input offset voltage, CMRR and slew rate.
2, Low Pass filter using op-amp.
3. High pass filter using op-amp.
4. To sfudy Op-Amp inverting and non-inverting arnplifiers.
2ll*agt
5. To investigate the use of an op-amp as a Differentiator'
6. To investigate the use of an op-amp as a Integtator.
7. To determine gain bandwidth product of an Op-Amp.
8. To Design a Wein bridge oscillator using an op-Amp'
9. Op-Amp Summer (Adder) and subtractor'
10. Phase-Shift Oscillator using Op-Amp.
11. Somerfield Fine Structure constant 'o' by measuring fine structure separation of Nadoublets.
12. Study of solar spectrum-Fraunhofer lines and determination of Redberg constant.
13. Ionization Potential of Xenon.

(A Minimum of Eight Experiments must be performed.)

Reference:

1. IGNO, Practical Physics Manual'
2" Saraf, Experiment in Physics, Vikas Publication.
3. S P Singh, Advanced Practical Physics'
4. Guptha and Kumar, Practical Physics.
5. Misra and Misra, Physics Lab Manual 22lPa'**

SEMESTER VI PAPER 603 Solid State' Molecular Physics and Nuclear Physics – II (Credits: Theory-03, Practicals-1.5) TheorY: 45 Lectures

Unit I:Free electron theory of metals: Classical free electron theory, Drude-Lorentz theory - Expression for electrical conductivity, Thermal conductivity, weidman-Franz's law. Density of states for free electrons (Definition and Derivation of expression) Fermi energy(qualitative). Hall Effect in semiconductors and its impofiance'

-Problems (06 Lectures)

Crystal Structure: Introduction to X-ray and Crystallography (qualitative)- Crystal system' crystal structure- The concept of Lattice, Unit cell. Bravais Lattice-symmetry elements-Lattice plane and Miller indices; Braggs law. Reciprocal Lattice' Spacing between lattice planes of cubic crystals (Simple cubic). -Problems' (5 Lectures)

Molecular Physics: Pure rotational motion, spectrum and selection rules; vibrational motion ,vibrational spectrum and selection rules; Rotation-Vibration spectrum; Scattering of light-Tyndall scattering, Rayleigh scattering and Raman scattering' Experimental study of Raman effect, Quantum theory of Raman effect -Applications. Problems (05 Lectures)

Unit II:

Radioactivity:

a) Alpha decay- Basics of a- <decay process, range of a- particles, alpha particle spectra ,long range and short range, Gamow's theory of u-decay, Geiger's law, Geiger-Nuttal law'

b) p- decay - energy kinematics for B -decay -equation for Q value, positive and negative B decay electron capture, origin of line and continuous spectrum, Pauli's neutrino theory of B- decay.

c) Gamma decay -Gamma rays emission and kinematics, internal conversion.-Problems.(08 Lectures)

Nuclear Detectors: Estimation of electric field and Mobility of particle in nuclear detectors' Ionisation chamber- G M counter, Basic principle of Scintillation Counter, Photo multiplier tube- Construction, semiconductor detector (Si & Ge) for charge particle and photon (y-ray)-concept of charge and mobility - advantages and disadvantages.-Problems' (07 Lectures) 231? a r.t t

UNIT III : Nuclear Reactions and Particle Physics

Nuclear Reactions : Types of reactions, Conservation laws in nuclear reactions with examples, derivation of Q -value for reactions using the energy-momentum conservation, exoergic and endoergic reactions, threshold energy, reaction rate, reaction cross - section, concept of direct and compound reactions, resonance reaction; - Problems.

(8 Lectures)

Elementary Particles i Classification of elementary particles, Fundamental interactions (Gravitational, Electromagnetic, Weak, strong - range, relative strength particle interactions for each); Symmetries and Conservation Laws (momentum, energy charge, parity, lepton number, baryon number, iso spin, strangeness and charm);Concept of Quark Model, Color quantum number and gluons;

(7 Lectures)

Reference Books

1. Solid State Physics - S O Pillai
2. Modem Physics by Brijlal Subramanium
3. Modem Physics - S N Ghoshal
4. Atomic and Nuclear Physics - S N Ghoshal
5. NuclearPhysics-D C Tayal,
6. College Physics - Dr N Sundarajan
l. Modern Physics - Basavaraj B and P Sadashiv
8. Elementary Solid State Physics - J P Srivastava

9. Solid State Physics - F W Ashcroft and A D Mermin- Saunders College
10. Modern Physics - R A Serway, C J Moses and C A Moyer.
I l. Introductory nuclear Physics -Kenneth S. Krane
Practical: Paper 604
1. Characteristics of GM Counter.
2. Verification of Inverse square law using GM Counter.
3. Determination of mass absorption coefficient of Aluminum foil.
4. Analysis of X-ray diffraction pattern obtained by powder method.
5. Determination of Fermi energy of Copper.
6. Experiments with dies to verify half life.
7. Determination of resistivity of a material by Four Probe method.
8. Half - life of Kqo. 24 lPage
9. Determination of Hall coefficient.
10. Analysis of rotational spectrum of N2 (Raman Spectrum)'
I L Analysis of rotational -vibrational Spectrum of Diatomic molecule.(HBr)
12. Analysis of Band spectra.
13. Nuclear counting statistics.
(A Minimum of Eight Experiments must be performed.)
Reference Books:
1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition,reprinted I 985, Heinemann Educational Publishers

OPEN ELECTM IN PHYSICS (IV Semester Students)

Fundamentals of Physics
(Credits: 02) 30 Lectures
Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier caliper, Screw gauge and their utility. Measure the dimension of a solid block volume of cylindrical beaker/glass, diameter of a thjn wire, thickness of metal sheet, etc.
(05 Lectures)
Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. (10 Lectures)
Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law.Series,parallel, and series-parallel combinations. AC Electricity and DC Electricity, Familiarization with multimeter, voltmeter and ammeter.
(05 Lectures)
Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources (5 Lectures)Basics of Atomic and Nuclear Physics: Basic concept of atomic strllctllre; X rays characteristic and production; The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive
decay, Mean life and half-life, basic concept of alpha, beta and gamma decay, fission and fusion reactions . (05 Lectures)