KUVEMPU UNIVERSITY

Jnanasahyadri, Shankaraghatta

PHYSICS

THREE YEAR B.Sc., DEGREE COURSE SYLLABUS

(Semester Scheme)

TO BE IMPLEMENTED FROM– JUNE 2014

Scheme of Examination

SEMESTER	THEORY				INTERNAL ASSESSMENT (I.A)	PRACTICAL		
	PAPER	PAPER CODE	TIME	MAX. MARKS	MAX. MARKS	PAPER	TIME	MAX. MARKS
I	I	SSA215	3 Hours	50	10	I	3Hours	40
II	II	SSB215	3 Hours	50	10	II	3Hours	40
III	III	SSC215	3 Hours	50	10	III	3Hours	40
IV	IV	SSD215	3 Hours	50	10	IV	3Hours	40
V	V	SSE215	3 Hours	50	20	V	3 Hours	40
	VI	SSE216	3 Hours	50		VI (dissertation)	3 Hours	40
VI	VII	SSF215	3 Hours	50	20	VII	3 Hours	40
	VIII	SSF216	3 Hours	50		VIII	3 Hours	40

Question paper Pattern
PAPER: I to VI semesters (all papers)

Section A

- **To be answered in brief.**
- **Short answer questions.**
- **Questions are to be set on the concept of the subject.**
- **Small relevant problems may be included.**
- **Each question carries 2 Marks.**
- **7 questions are to be answered out of 9 questions given.**

Section B:

- **Long answer type questions –To be answered with detailed explanation, analysis, mathematical derivation etc.,**
- **Each question carries 4 Marks.**
- **6 questions are to be answered out of 8 questions given.**

Section C:

- **Problems.**
- **Each problem carries 3 marks – includes both numerical and theoretical problems.**
- **4 questions are to be answered out of 6 questions given.**

Practical Examination:

***Submission of duly certified record book in the examination is compulsory. The candidate who has not submitted the record book is not eligible to take the practical examination*.**

Maximum Marks for doing Examination	**:**	**30**
Maximum Marks for Practical Record Book	**:**	**05**
Maximum Marks for Viva-Voce	**:**	**05**
Grand total	**:**	**40**

Dissertation or Minor Project

The students have to submit the duly certified report at the examination.

Maximum Marks for Subject Content	**:**	**20**
Maximum Marks for presentation	**:**	**10**
Maximum Marks for Viva-Voce	**:**	**10**
Grand total	**:**	**40**

PHYSICS SYLLABUS

FIRST SEMESTER (PAPER-I)

MECHANICS, GRAVITATION, ROTATIONAL MOTION AND PROPERTIES OF MATTER

(4 hours of lecture per week) **60 Hours**

1. INTRODUCTION:

Physics- nature, scope and importance as fundamental science. Interconnection between physics and technology. Impact of physics and technology on society. 2 Hrs

2. *PLANAR MOTION*:

Review of vector algebra- vector addition, multiplication by a scalar, Scalar and Vector product. Derivative of a rotation of vector of a constant magnitude. Review of polar coordinates, radial and transverse components of velocity and acceleration – application to uniform circular motion, centripetal force, areal velocity (derivation). 4 Hrs

3. FRAMES OF REFERENCE:

Concept of point mass, Newton's law of motion. Frames in uniform motion – Galilean transformation – Inertial frames – Galilean principle of relativity (explanation using various examples).

***Noninertial frames* – Accelerated frames (uniform acceleration) – Invalidity of Newton's laws – concept of pseudo forces – examples (for – ma*). Measurement of acceleration using plumb line (explanation with necessary derivation). Rotating frames of reference – expression $(- d/dt)_{fixed} = (- d/dt)_{rotating} + \omega x$. (no derivation) force in fixed frame(derivation). Centrifugal and Coriolis forces. Discussion of the earth as an inertial frame – Foucault pendulum, direction of the cyclones. Weightlessness. Centrifugal force as a pseudo force using a conical pendulum. 10 Hrs**

4. FORCE AND MOTION:

Spring - mass system, projectile with linear resistance, Free body diagram (example – simple pendulum), Frictional forces (origin- static and kinetic). Central forces – characteristics of central motion. 3 Hrs

***5. SYSTEMS OF PARTICLES*:**

Newton's laws for a system of particles – centre of mass (definition) – External and internal forces – results about total momentum and motion of CM, Conservation of linear momentum – impulsive motion. Rocket motion – expression for instantaneous and final velocities – effect of earth's gravity – multi stage rockets – brief account of Indian rockets.

***Angular momentum* – relation between the torque and momentum, theorems on total angular momentum about CM. conservation of angular momentum - examples.**

Work done by a variable force, work – energy theorem – conservative force fields, potential energy - conservation of energy, examples – oscillation of a loaded spiral spring Atwood machine (calculation of acceleration using conservation of energy).

***Collisions:* Elastic and inelastic collisions – elastic head on collision – oblique collision of identical masses in a plane. 11 Hrs**

6.GRAVITATION, PLANETARY AND SATALLITE MOTION:

Newton's law of gravity in vector form. Gravitational potential and field for spherical mass distributions – shell and solid sphere (derivation). *Kepler's laws* – statements and derivation, conditions for different orbits, brief account on physics of tides. *Elements of satellite motion* – orbital velocity, conditions for geosynchronous satellites, escape velocity, launching of a satellite. 8 Hrs

7. MOMENT OF INERTIA:

Concept of a rigid body. Definition – Theorems on moment of inertia. Derivations of M.I.for a rectangular plate, circular disc, cylinder and sphere about different axes. 2 Hrs

***8. ROTATIONAL MOTION*: Equation of motion for rotational motion, K.E of a rotating body, motion of a cylinder rolling down an inclined plane – expression for velocity and energy. Theory of a compound pendulum – time period. Precessional motion – top and gyroscope. Brief account on rotation of the earth.**

5 Hrs

***9. ELASTICITY*: Stress and strain – elastic limits – Hooke's law – molecular origin –Elastic constants for an isotropic solid, their inter relation, torsion of a cylinder –couple, torsional pendulum. Bending of a beam, Single cantilever (theory). 7 Hrs**

10.VISCOSITY:

Viscosity Streamline and turbulent motion, equation of continuity, coefficient of viscosity, critical velocity, Reynold's number, Poiseuille's equation, Stokes law (only statement), terminal velocity, Bernoulli's theorem and applications, Newtonian and non- Newtonian fluids – an elementary idea. - Variations of viscosity of a liquid with temperature, lubrication. Viscoelasticity, Magneto and electrorheological fluids – working mechanisms and their smart application. 3 Hrs

11. SURFACE TENSION:

Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature – (Jaegar's method). Applications. 3 Hrs

12. KINEMATICS OF MOVING LIQUIDS:

Equations of continuity, Euler's equation, potential energy, Bernoulli's theorem –applications. 2 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

REFERENCES:

1) **Berkeley course in physics – vol I**
2) **Classical mechanics – Takwale.**
3) **Classical mechanics – K.N.Srinivas Rao.**
4) **Fundamentals of physics – Halliday, Resnick and Walker- sixth edition.**
5) **Mechanics – D.S.Mathur.**
6) **Properties of matter – D.S.Mathur.**
7) **Newtonian mechanics – A.P. French.**

PRACTICALS –I

(One experiment per week to be conducted in 3 hours duration)

1) **Bar pendulum – g and k by h-T and h^2- hT^2 graph.**
2) **Spiral spring – force constant, g and unknown mass by graphical method.**
3) **Fly wheel – M.I, mass and density of fly wheel.**
4) **'q' by Stretching – graphical method.**
5) **'q' by uniform bending – graphical method.**
6) **Surface tension by capillary rise method.**
7) **Surface tension and angle of contact by Quinke's method.**
8) **Surface tension and interfacial tension by drop weight method.**
9) **Viscosity of water by capillary flow method.**
10) **Viscosity of oil by Stoke's method.**
11) **Specific heat by cooling – graphical method.**
12) **Perpendicular axis theorem using torsion pendulum.**
13) **Bulk modulus of rubber.**
14) **Conservation of energy- using inclined plane.**
15) **Determination of elastic modulii, poisson's ratio and acceleration due to gravity 'g'.**
16) **To study kinematics of Atwood's machine and hence to determine the value of 'g'**

NOTE:

1. **Suitable and relevant experiments may be included.**
2. **Experiments mentioned in I and II semester may be redistributed depending upon the facilities available in the laboratory.**
3. **Minimum of 8 experiments should be done in each practical.**
4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments.**

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SECOND SEMESTER (PAPER- II)

HEAT & THERMODYNAMICS, RADIATION, WAVES, OSCILLATIONS & SOUND.

(4 hours of lecture per week)

60 Hours

***1.THERMODYNAMICS*:**

Review of isothermal and adiabatic processes, Equation of state of a gas in adiabatic processes (derivation). Relation between P,V and T. Slopes of Isothermal and adiabatics. Relation between Isothermal and adiabatic elasticities. P-V diagram. Carnot cycle: Expression for efficiency (no derivation). Second law of thermodynamics : Kelvin and Clausius statements. Applications of Second law of Thermodynamics .Carnot theorem-Statement and proof. Thermodynamic scale of temperature. Clausius-Clayperon equation (derivation)- It's application for Melting point and boiling points. 12 Hrs

2. ENTROPY:

Concept of entropy, entropy changes in reversible and irreversible processes with examples. T-S diagrams, example of carnot's cycle. Change in entropy during change of state, entropy disorder, heat death. Entropy and second law of thermodynamics. The applications of entropy. Third law of thermodynamics - statement only.

Thermodynamic Potentials : Extensive and intensive thermodynamic variables. Thermodynamic Potentials U, H, F and G. Their definitions, properties and applications. Maxwell Thermodynamic relations Derivations and applications [1] Values of Cp-Cv, [2] Clausius-Clayperon Equation, [3] TdS equation [4] Change of temperature during an adiabatic process. 8 Hrs

3. KINETIC THEORY OF GASES:

Maxwell's law of distribution of velocities (statement and expression). Expression for mean free path. Degrees of freedom, law of equipartition of energy (statement and derivation) Calculation of value of γ for monoatomic and diatomic gases. 4 Hrs

4. REAL GASES :

Vanderwal's equation of state – isotherms of a real gas, expression for critical temperature, volume and pressure. Liquefaction of gases – porous plug experiment with theory – derivation of expression for temperature of inversion. Principle of adiabatic demagnetization. J-T Cooling(using Maxwell relation) 6 hrs

5. RADIATION: **Distribution of energy in the spectrum of a black body. Wein's displacement law, Wein's law of radiation, Rayleigh- Jeans law. Planck's law of radiation and derivation from the concept of harmonic oscillators – deduction of Wein's law, Wein's displacement law, Rayleigh – Jeans law, and Stefan's law from Planck's law of radiation. Solar constant – temperature of the sun from solar constant. Radiation pressure (definition) 9 Hrs**

6. OSCILLATIONS:

Review of simple harmonic motion, expression for frequency from the equation f α –x (derivation). Equation for damped simple harmonic oscillator. Theory of forced vibrations and resonance – mechanical and electrical examples of resonance (Helmholtz resonator and sonometer). Superposition of S.H.M.s, theory of Lissojous figures. 7 Hrs

7. WAVES:

Characteristics of wave motion - derivation of general equation of one dimensional progressive wave – differential equation of a wave – complex representation of a wave. Phase of a wave, wave front, expression for intensity of progressive wave. Wave groups – phase velocity and group velocity – relation between them. Brief discussion of different types of waves (mechanical waves, seismic waves , water waves and matter waves). 7 Hrs

8. SOUND:

Velocity of longitudinal waves in a gas. Newton's formula, derivation. Laplace correction – variation of pressure in a sound wave. Theory of beats. Expression for velocity of transverse waves in a stretched string, derivation. Theory of stationary waves(theory) 7 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

REFERENCES :

1) **Heat - D.S. Mathur.**
2) **Heat and thermodynamics - Brijlal and Subramanyam.**
3) **Physics volume – I - Halliday and Resnik.**
4) **Berkely course in Physics - volume – I.**
5) **Sound - Khanna and Bedi.**
6) **Refresher course in Physics volume – II - C.L. Arora.**
7) **University Physics – Sears and Zemansky.**
8) **Physics of waves and oscillation - Bajaj.**
9) **Fundamentals of Physics - Halliday and Resnik.**
10) **Heat - G.K.Nokes.**
11) **Treatise on heat – Saha and Srivatsava.**

PRACTICALS –II

(One experiment per week to be conducted in 3 hours duration)

1) **q' by Single Cantilever - graphical method.**
2) **'q' by Koenig's method - graphical method.**
3) **Torsion pendulum – M.I of irregular body and rigidity modulus.**
4) **Parallel axes theorem – using bar pendulum.**
5) **Static torsion - rigidity modulus - graphical method.**
6) **Frequency of A.C by sonometer - graphical method.**
7) **Helmholtz resonator – Velocity of sound.**
8) **Platinum resistance thermometer- determination of unknown temperature.**
9) **Stefan's – Boltzmann's law – verification using meter bridge.**
10) **Thermal conductivity of a good conductor –Searle's method.**
11) **Thermal conductivity of a bad conductor – Lees and Charlton's method.**
12) **Searle's double bar – q, n,k and Q .**
13) **Interference of sound waves – Quinke's method - Velocity of sound**
14) **'q' by cantilever oscillation – graphical method.**

NOTE:

1. **Suitable and relevant experiments may be included.**
2. **Experiments mentioned in I and II semester may be redistributed depending upon the facilities available in the laboratory.**
3. **Minimum of 8 experiments should be done in each practical.**
4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments.**

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THIRD SEMESTER (PAPER- III)

OPTICS AND ELECTROSTATICS

(4 hours of lecture per week)

60 Hours

1.GEOMETRICAL OPTICS:

Optical path, Fermat's principle – statement, time taken for maximum and minimum path. Derivation of Snell's law refraction using Fermat's principle.

***Cardinal points*:**

Mention of Gauss sign conventions. Meaning of thick lens. Definition of cardinal points – focal points, principal points and nodal points and corresponding planes. Combination of two thin converging lenses not in contact as an example of combination of two optical systems.

***Defects of lenses*:**

***Abberations* – types, chromatic aberration. Achromatisation of two thin lenses not in contact (derivation). Mention of condition for two thin lenses in contact. Monochromatic aberrations – mention of five types and brief explanation – problems. 8 Hrs**

2.OPTICAL INSTRUMENTS:

Eye-pieces, Huygen's and Ramsden's eye-pieces - construction, expression for focal length (derivation), correction for aberrations, position of principal and focal plane (no derivation). Comparison.. 3 hrs

***3.WAVE THEORY OF LIGHT*:**

Wave front, Huygen's principle, explanation of advance of wave front using concept of secondary waves. Refractive index in terms of velocity. Experimental confirmation. Derivation of lens makers formula in the case of double convex lens using spherical wave front. 3 Hrs

***4.INTERFERENCE OF LIGHT*:**

Review of Young's double slit experiment, coherent sources, conditions for interference. Biprism -explanation, expression for fringe width. Explanation of measurement of distance between two coherent sources ($d=\sqrt{d_1 d_2}$). Lloyd's mirror- explanation. Interference in thin films – reflected system – derivation, transmitted system (qualitative). Complimentary nature of the two patterns. Interference due to an air wedge- expression for band width (or wavelength) – derivation. Theory of Newton's rings – reflected system, determination of wavelength and refractive index of a liquid- theory, problems.

Michelsons interferometer – construction and working, formation of interference pattern, Condition for circular, straight fringes, mention of fringes of equal inclination(Haidingers fringes) and thickness. Applications - determination of wavelength λ and difference in wavelength dλ - Problems. Interference filters. 11 Hrs

***5.DIFFRACTION OF LIGHT*:**

Introduction, Fresnel's half period zones, expression for radii- (derivation) – Explanation of rectilinear propagation of light. Origin of diffraction effects, dimension of obstacles compared to wavelength on diffraction. Zone plate – principle, explanation (qualitative). Expression for focal length, comparison of zone plate and convex lens. Types of diffraction phenomena. Fresnel's diffraction at a straight edge–positions of maxima and minima, expressions (derivation), graphical representation of variation of intensity in the diffraction pattern. Diffraction at a straight wire(qualitative). Plane transmission grating – normal and oblique incidence (derivation). Dispersive and resolving power of a grating (qualitative) comparison of grating and prism spectra. Problems. 11 Hrs

6.POLARISATION OF LIGHT:

Double refraction in a uniaxial crystal. Optic axis. Mention of biaxial crystals. Principal refractive indices – Huygen's construction for O and E wave fronts in the case of optic axis in the plane of incidence and parallel to crystal surface – oblique and normal incidence (in detail). Retarding plates – production with theory, expression for the thickness of quarter and half wave plates – problems. Production and detection of linearly, circularly and elliptically polarized light. Optical activity- Fresnel's theory. Kerr and Faraday effect. 8 Hrs

ELECTROSTATICS:

7. SCALAR AND VECTOR FIELDS:

Concept of scalar and vector fields: Del operator – gradient of scalar function – physical significance. Divergence and curl of a vector function - physical significance with examples, problems. Laplacian operator- line, surface and volume integrals of a vector function, examples. Gauss divergence theorem, Stokes theorem and their physical meaning (no derivation). Proof of curl grad $\phi = 0$ and div curl A = 0. 4 Hrs

8. ELECTRIC FIELD AND POTENTIAL : **Coulomb's law. Conservation and quantization of charges. Electric field due to discrete and continuous distribution of charges- concept of multipoles. Electric field lines and flux.**

Expression for flux. Gauss's law (differential and integral form) Application to deduce the expression for the field near acharged conductor and force per unit area of its surface (derivation of both). Coulomb's law from Gauss law (derivation).

The Electric Potential*:* Conservative nature of electric field. Electric field as the negative gradient of potential. Proof of E = - grad ϕ. Mention of Poisson and Laplace equations, uniqueness theorem (statement).

Work and Energy in Electrostatics: Potential energy. The energy of a continuous charge distribution. (no derivation). Energy density in an electrostatic field, derivation from the example of a parallel capacitor. Loss of energy due to sharing of charges between two conductors. 5 Hrs

9.ELECTRIC DIPOLE:

Concept of dipole, physical examples (polar molecules). Equation for Potential and field due to a dipole derivation) in polar coordinates. Electric field in a dielectric medium , electric polarization. Types of polarization, Lorentz local field (derivation) Relation between D and P. $D= \epsilon_o E + P$. Definition and meaning of dielectric susceptibility. Brief account of_para and ferro electric materials.Clausius – mossotti equation. Concept of electrical images- Application to a point charge near the surface of a conducting plane. 7 Hrs

REFERENCES:

1) **Optics- Brijlal and Subramayam**
2) **Optics and Atomic physics – D.P Khandelwal.**
3) **Optics and Atomic physics – Satya prakash**
4) **Electricity and Magnetism – K.K. Tiwari**
5) **Physics Volume II – Halliday and Resnick**
6) **Optics – R. Murughesan**
7) **Electricity and Magnetism - Brijlal and Subramayam**
8) **Optics – Ajoy Ghatak**
9) **Fundamentals of Physics – Jenkins and White**
10) **Electricity and Magnetism – D.N Vasudeva**
11) **Berkely Physics course – Volume –II**

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PRACTICALS –III

(One experiment per week to be conducted in 3 hours duration)

1) **Interference at an air wedge – determination of thickness.**
2) **Newton's rings – determination of radius of curvature.**
3) **Biprism – determination of wavelength.**
4) **Diffraction at a straight wire - determination of diameter.**
5) **Diffraction grating – minimum deviation method- mercury spectrum.**
6) **Polarimeter – Specific rotation of sugar.**
7) **Resolving power of a telescope.**
8) **Resolving power of a grating.**
9) **Diffraction at a straight edge - determination of wavelength.**
10) **L-B photometer – inverse square law & absorption coefficient of glass plate.**
11) **Charging and discharging of a capacitor- calculation of energy dissipation.**
12) **deSauty's bridge – verification of law combination of capacitances.**
13) **Impedance of series R-C circuit - determination of frequency of A.C graphical method.**

NOTE:

1. **Suitable and relevant experiments may be included.**
2. **Experiments mentioned in III and IV semester may be redistributed depending upon the facilities available in the laboratory.**
3. **Minimum of 8 experiments should be done in each practical.**
4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments.**

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IV SEMESTER (PAPER IV)

ELECTRICITY AND ELECTROMAGNETIC THEORY

(4 hours of lecture per week)

60 Hours

1. TRANSCIENT CURRENTS:

Brief discussion of L, C and R. Growth and decay of current in a series L-R circuit fed with direct emf. Derivation of expression for current in each case – graphical representation, explanation of time constant.

Charging and discharging of a capacitor through a resistance – derivation of expression for charge variation in a R-C circuit, mention of expression for voltage and current variation – explanation of time constant in each case.

Series L-C-R circuit fed with direct emf – qualitative discussion- mention of expression for transient charge, condition for oscillation and expression for frequency(no derivation). problems 6 Hrs

2. ALTERNATING CURRENTS:

Types of AC (sinusoidal and nonsinusoidal) – derivation of expression for mean and RMS values of sinusoidal AC and relation between them. Complex representation of AC using j- operator, phase factor ($\omega t - \theta$). Response of L-C-R circuits fed with alternating emf – derivation of expressions for current and impedance in each case (using j- notation), phase relation between current and applied emf in each case.

Series resonance – discussion from the expression for current , explanation of half power frequency, band width and quality factor, expression for quality factor in terms of f_1 and f_2 & L and C, significance of Q – factor, effect of resistance, frequency and quality factor. Variation of voltage with frequency of source across L and C in a series LCR circuit. Voltage magnification.

Parallel resonance (LR in parallel with C) expression for current and impedance(no derivation). Comparison between series and parallel resonance. Power in an AC circuit- derivation of expression for average power, power factor and its significance. Skin effect (qualitative). Comparison of A C and D C w.r.t characteristics and applications. Problems 11 Hrs

***3. NETWORK ANALYSIS*:**

Mesh current method of circuit analysis. Thevenin's and Norton's theorems – DC and AC statements – explanation using DC circuits, problems involving both DC and AC circuits. Maximum power transfer theorem – AC and DC statements, proof for DC circuit, problems with DC circuits. Problems 7 Hrs

4. FREQUENCY FILTETS:

High pass and low pass filters – derivation for expression for cut-off frequency in each case. Band pass and band stop filters- working using circuits (qualitative discussion). Application of frequency filters. 2 Hrs

5. RECTIFIERS:

Half wave rectifier –construction and working , full wave rectifier - construction and working using two diodes – Derivation of expression for ripple factor and efficiency. Bridge rectifier (qualitative discussion).Role of filters in rectifiers – C,L and π section filters(qualitative). Zener diode- construction and working – V-I characteristics- meaning of zener breakdown. Regulated power supply -Construction and working using zener diode-voltage regulation in case of a) input variation (detail) and b) load variation (qualitative). Bleeder resistance –action. Problems. 7 Hrs

6. ELECTRICAL MEASUREMENTS:

Ballistic Galvanometer – construction and theory of B.G. Charge sensitivity – origin of damping and damping correction. Logarithmic decrement, expression for decrement. (derivation). Principles of experiments to determine capacitance by absolute method and high resistance by leakage. Mention of applications of BG.

Cathode ray oscilloscope – construction of CR tube – block diagram of CRO- brief explanation of function of each block. Time – base with simple circuit – uses of CRO. Measurement of voltage and frequency (using time base and Lissajous figures. Watt meter – watt hour meter. 10 Hrs

7.ELECTROMAGNETISM:

Explanation of magnetic field as that produces force on a moving charge – distinction between B and H – Lorentz force on a charge in an EM field, mention of expression F = q (E + V X B) and its explanation. Origin of induced emf in a conducting rod moving in a magnetic field (from force on charged particles).

Ampere's circuital law – statement – proof from line integral over an irregular path which encloses current - comparison of Gauss's law and Ampere's law – application of Ampere's law to calculate magnetic fields due to (a) a straight long conductor (b) a long solenoid. Characteristics of magnetic field- Div B = 0 (qualitative)- concept of magnetic vector potential (brief). Current loop as a magnetic dipole, illustration from the magnetic loop due to a circular current loop- expression for torque on a magnetic dipole in a magnetic field. 8 Hrs

8.MAXWELL'S FIELD EQUATIONS: **Deduction of equations from empirical laws of Gauss, Faraday and Ampere. Limitations of Ampere's law, Maxwell's concept of displacement current, derivation of expression for displacement current density from charging of a capacitor – significance of displacement current.**

Derivations of EM wave equation(for E and B) for free space, velocity of EM waves, light as an EM wave, EM eave equation for dielectric medium, expression for refractive index. Plane wave solutions of EM wave equation in free space –characteristics of EM waves, transverse nature of EM waves (derivation), relation between E and B components(qualitative)- to show that E and B are perpendicular to each other- diagram of a plane Polarized EM wave. Poynting vector – pointing theorem (no derivation), significance of Poynting vector. Production of E M waves-Hertz experiment – description of experiment and discussion of its results. 9 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

REFERENCES:

1) **Introduction to Electrodynamics – David J Griffths.**
2) **Electricity and magnetism – Mahajan A.S and Rangwala.**
3) **Electricity and magnetism – Berkeley physics course Vol II.**
4) **Fundamentals of physics – Halliday, Resnick and Walker- sixth edition.**
5) **Electrodynamics – Jackson.**
6) **Electromagnetism – B.B. Laud.**
7) **Fundamentals of Electricity and magnetism – D.N Vasudeva.**
8) **Electricity and magnetism – Brijlal and Subramanyam.**
9) **Feynman lectures – vol II.**
10) **Electricity and magnetism – K.K.Tiwari.**
11) **Fundamentals of Electricity and magnetism – Arthur F Kip.**
12) **Electricity and magnetism –R. Murugheshan.**
13) **Text book of Electronics - Basavaraj.B.**
14) **Basic electronics–Thereja.**
15) **Text book of electrical technology – B.L.Thereja.**

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PRACTICALS – IV

(One experiment per week to be conducted in 3 hours duration)

1) **Series resonance.**
2) **parallel resonance.**
3) **Self inductance – Anderson's bridge.**
4) **Dielectric constant – RC circuit.**
5) **Low pass and high pass filters – cut-off frequency.**
6) **Helmholtz tangent galvanometer- Reduction factor 'K' and B_H**
7) **Field on the axis of a circular coil – both sides.**
8) **Network theorems–Maximum power transfer, Thevenin's & Norton's theorems.**
9) **Half wave and full wave rectifiers- without & with filters.**
10) **Current sensitivity of BG.**
11) **Diffraction grating – normal incidence.**
12) **Cauchy's constants – graphical method & direct calculation for two wavelengths.**
13) **Lloyd's mirror – determination of wavelength.**
14) **Cornu's fringes – elastic constants.**
15) **Thermo emf of a thermocouple using potentiometer – melting point.**
16) **Measurement of L and C by equal voltage method.**

NOTE:

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2. **Experiments mentioned in III and IV semester may be redistributed depending upon the facilities available in the laboratory.**
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4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments.**

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FIFTH SEMESTER (PAPER-V)

ATOMIC PHYSICS, SPECTROSCOPY,LASERS AND ASTROPHYSICS.

(3 hours of lecture per week)

45 Hours

1.ELECTRON:

Discovery of electron, properties of electron, e/m of electron by Thomson's method, charge of an electron by Millikan's oil drop experiment. 4 Hrs

2. ATOMIC STRUCTURE:

Different types of atomic model (qualitative explanation), expression for radius of the orbit, energy of the electron in various orbits, wave number and Rydberg constant according to the Bohr's model(no derivation). Effect of finite mass of the nucleus on atomic spectra (with derivation). Ratio of masses of electron and proton on the basis of Rydberg constant. 4 Hrs

3. VECTOR ATOM MODEL:

Concepts of vector atom model – Space quantization and spinning of electron. Stern and Gerlach experiment – theory and experimental study. Relation between orbital and magnetic moment of an electron (derivation). Expression for Bohr magneton. Spin magnetic moment of an electron (qualitative). Quantum numbers associated with vector atom model. Pauli's exclusion principle and its significance. Expression for maximum number of electrons in an orbit. Spin- orbit coupling – L-S coupling and j – j coupling. 7 Hrs

***4. OPTICAL SPECTRA*: Spectral terms, spectral notations, selection rules and intensity rules. Fine structure of spectral lines- example with sodium D lines. Zeeman effect-experimental study, Larmour precession. Quantum explanation of normal and anomalous Zeeman effects. Paschen–Back effect and Stark effect (qualitative) 5 Hrs**

***5. OPTICAL SPECTRA*:**

Different regions of molecular spectra- origin of molecular spectra. Pure rotational spectra of diatomic molecules- expression for rotational constant. Vibrational – rotational spectra of a diatomic molecules (in detail). Electronic spectra (qualitative). Frank- Condon principle (statement only). Applications of molecular spectroscopy. 4 Hrs

6. SCATTERING OF LIGHT: **Coherent and incoherent scattering. Rayleigh scattering, blue colour of the sky. Raman effect – experimental study. Quantum theory of Raman effect, characteristic properties of Raman lines, intensity and polarization of the Raman lines – depolarization factor. Application of the Raman effect (qualitative). 4 Hrs**

***7. LASERS*: Spontaneous and stimulated emissions. Einstein's A and B coefficients (no derivation). Laser action –condition for laser action, active medium, population inversion, pumping – different methods of pumping. Characteristics of laser light. Ruby and He-Ne lasers – explanation with energy level diagrams. Semiconductor laser – construction and working. Applications of lasers in Communication – OFC, Scientific research, industries, medicine, military operations and computers. 6 Hrs**

8. HOLOGRAPHY:

Hologram – principle of recording and production, chief features of hologram, applications of hologram. 2 Hrs

***9. ASTROPHYSICS*:**

Stars – Distance of a star – stellar paradox method, units of astronomical distances- AU, Ly, Parsec and their relations. Luminosity, brightness of a star. Relation between apparent and absolute magnitude of a star. Spectral classification of stars. H-R diagram. Calculation of mass, mean density, radius and temperature of sun. Internal temperature of a star (derivation). Internal pressure of a star (no derivation). Photon diffusion time. Mass-Luminosity relation for a star. Sources of stellar energy. Evolution of stars – main sequence, red giants, white dwarfs and neutron stars. Expression for radii of white dwarfs and neutron stars, black holes. 6 Hrs

***10. COSMSLOGY*:**

Expansion of universe according to Einstein's view, Hubble's law-age of the universe. Big Bang theory-experimental evidence of Big Bang theory-Penzias and Wilson experiment (CMB Radiation). 3 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

***REFERENCES*:**

1. **Concepts of Modern Physics- A.Beiser**
2. **Modern Physics- R Murugeshan**
3. **Molecular Spectroscopy- Banwell**
4. **Modern Physics Vol- I & II- B Basavaraju**
5. **Astrophysics- B Baidyanathan**
6. **Introduction to Cosmology- Narlikar**
7. **Optics and Atomic Physics- Satyaprakash**
8. **Optics and Atomic Physics- Khandelwal.**

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FIFTH SEMESTER (PAPER-VI)

GENERAL & SPECIAL THEORY OF RELATIVITY, STATISTICAL MECHANICS,

WAVE MECHANICS, NANO PHYSICS.

(3 hours of lecture per week)

45 Hours

1. SPECIAL THEORY OF RELATIVITY:

***Concept of Newtonian mechanics*, space, time mass, frame of reference, Newtonian relativity, Galilean concept. Ether hypothesis, relativity concept of physical quantities, absoluteness of velocity of light, Michelson – Morley experiment (no derivation), significance of null result of experiment, postulates of Einstein special theory of relativity, Lorentz – transformation equations (no derivation). Relativity of simultaneity, length contraction, time dilation, velocity addition theorem.**

Relativistic dynamics: Mass variation(no derivation), mass – energy relation(derivation), relativistic expression for kinetic energy, energy - momentum relation. Classical and relativistic concepts of space and time, Minkowski's world, concept of four vectors, (xyz,√ct), world line- space time interval and its invariance.

12 Hrs

***2.GENERAL THEORY OF RELATIVITY*:**

Inertial and gravitational mass, principle of equivalence, curved space time, Einstein theory of gravitation (brief), experimental verification of theory of relativity. 3 Hrs

3. WAVE MECHANICS:

wave particle duality, de broglie concept of matter wave, de broglie wavelength, Davisson – Germer experiment, group velocity and phase velocity of de broglie waves,characteristics of matterwaves, quantum mechanical operators.

Heisenberg uncertainity principle – physical significance – non existence of electrons in nucleus – radius of Bohr' orbits – γ ray Microscope experiment – wave function, physical significance, Born interpretation of wave function – basic postulates of wave mechanics.

Time Independent and Time Dependent Schrondinger wave equation (both derivations)– Normalization – properties – Eigen values – Eigen functions – application of Schrodinger Time Independent wave equation – Free particle in one Dimensional potential box (Derivation) –Three Dimensional potential box –problems.

15 Hrs

***4.STATISTICAL MECHANICS*:**

Necessity of statistical approach, microscopic and macroscopic states, thermodynamic probability, ensembles, phase space, probability, density of states. Classical statistics- M-B and M-B distribution function(no derivation), Quantum statistics- F-D and B-E statistics(derivation), derivation of Planck's law from B-E statistics, comparison of MB-BE-FD statistics. 9 Hrs

5. NANO PHYSICS:

Concept of Nanotechnology, material science, Nanotechnology, nano structural materials, graphite. Properties of nano materials- mechanical, chemical, magnetic, applications. Fullerenes (carbon- 60), carbon nanotubes, production by air discharge method, properties. Nano electronics- semiconductor structures, quantum wells, quantum wires, quantum dots, quantum computers, applications, nano medicines. 6 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

REFERENCES:

1) **Modern physics – R.Murugheshan and Kiruthiga Prasath.**
2) **Berkeley physics course – Vol 3, 4 and 5.**
3) **Theory of space, time and gravitation- S.G.Pimpale.**
4) **Special theory of relativity – Resnick.**
5) **Lasers and Non-linear optics – B.B.Laud.**
6) **Lasers – Tyagarajan and Ghatak.**
7) **Quantum mechanics – Arul das.**
8) **Introductory quantum mechanics – Y.R.Waghmare.**
9) **Fundamentals of physics – Halliday, Resnick and Walker- sixth edition.**

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V SEMESTER PRACTICAL – V

(**One experiment per week to be conducted in 3 hours duration)**

1. **e/m of an electron –Thomson Method –graphical calculation**
2. **Capacity of condenser using B.G –graph of deflection Vs voltage**
3. **Spectral response of photoconductor**
4. **Transistor characteristics –CE configuration –determination of** R_i, R_o and β
5. **LCR circuit –measurement of frequency voltage and phase difference using CRO**
6. **Full wave bridge rectifier –display of waveform, ripple factor, with and without filter. Graph** I_{dc} V_s V_{dc}
7. **G.M counter –Absorption Co-efficient of γ rays.**
8. **Iodine absorption band spectrum.**
9. **Hysteresis curve (B-H loop) for a ferromagnetic substance**
10. **Absorption Co-efficient of $KMnO_4$ – Determination of wavelength λ**
11. **G.M Counter –Characteristic** $\left(N \pm \sqrt{N}\right)$ V_S V **graph.-Operating Voltage.**
12. **LASER –wavelength and particle size by diffraction grating**
13. **Thermionic emission- determination of work function.**
14. **High resistance by leakage –graphical and direct method - correction for leakage resistance of capacitor.**

NOTE:

1) **Suitable and relevant experiments may be included.**
2) **Experiments mentioned in V and VI semester may be redistributed depending upon the facilities available in the laboratory.**
3) **Minimum of 8 experiments should be done in each practical.**
4) **Experiment should be elaborative so as to extend for 3 hours duration**
5) **Error estimation may be included for few experiments**

V SEMESTER PRACTICAL – VI

Dissertation Or minor project.

3 hours per week

- **The students may do the dissertation or minor project work either individually or in a group.**
- **Maximum number of students in a group is four.**
- **Topic or subject is to be selected under the guidance of the respective teacher.**
- **The students have to submit the duly certified report at the examination**.

SIXTH SEMESTER (PAPER-VII)

SOLID STATE PHYSICS AND ELECTRONICS

(3 Hours Of Lecture Per Week) 45 Hours

1. *X-RAYS*:

Production – Coolidge tube- brief explanation, equation λ_{min}=hc/ev. Types of X-rays(mention).

Scattering Of X-Rays: Laue's work. Bragg's law of diffraction , derivation of 2dsin=nλ. X-ray spectrometer- construction , working and calculation of d.

Compton Scattering : Explanation, equation for Compton shift (no derivation) – discussion of different cases, comparison of Raman effect and Compton effect.

X-Ray Spectra: Continuous spectra- origin due to inverse photo electric effect-Duane-Hunt empirical law. Characteristic spectrum- Origin due to electronic transition. Mosley's law, explanation using Bohr's theory. Significance of Mosley's law- arrangement of periodic table(mention) 6 Hrs

2.SPECIFIC HEAT OF SOLIDS:

Quantum concept: Einstein's theory, equation for specific heat capacity (no derivation), merits and demerits. Debye's theory: Assumption- derivation of Debye's formula, application to (i) High temperature- agreement with Dulong-Petit's law, (ii) Low temperature – Debye's T^3 law.

3 Hrs

3.ELECTRICAL PROPERTIES OF METALS:

Quantum Free Electron Theory Of Metals: Sommerfeld's model- assumptions, energy state of free electrons in metal – obey F-D Statistics and Pauli's principle. Density of states, derivation of expression for Fermi energy, Fermi temperature-Average energy at absolute zero, $E_0=3/5E_f(0)$-application to electrical conductivity- qualitative explanation- collision time as a function of E_f .

Band theory of solids: Brief review of concept of energy bands and classification of solids.

Semiconductors: Intrinsic semiconductor –equation for concentration of charge carriers in valance band and conduction band (no derivation). Law of mass action- $np = n_i^2 = AT^3 e^{-Eg/kT}$. Equation for Fermi level. Equation for electrical conductivity.

Extrinsic semiconductor:- P and N type – explanation using energy bands- formation of acceptor and donor levels, equation for Fermi level- temperature dependence of Fermi level. Equation for electrical conductivity.

Hall Effect: Theory- expression for hall voltage and hall coefficient, relation between R_H and μ. Mention of applications. 9 Hrs

4.SUPERCONDUCTIVITY: Experimental observations – Transition temperature, persistent current, Isotope effect, Meissner effect. – Principle of magnetic levitation.(Qualitative)

Effect of magnetic field on super conductor – critical field. Type-I and Type-II super conductors. Mention of application.

Theory of super conductivity: BCS theory – qualitative explanation - formation of cooper pair, exchange of phonons.

High temperature superconductors - Recent advances, Applications.(1) construction of electromagnets, (2) transmission of electric power (super conducting cables), (3) magnet shielding. 4 Hrs

5.SOLID STATE DEVICE AND CIRCUITS:

Transistors:

Different configurations, Biasing- self biasing of CE circuit – voltage divider method – circuit operation, input and out put equations.

Transistor as an amplifier in CE mode- practical circuit of single stage CE amplifier- circuit operation, DC load line, Q-point, AC load line. Derivation of expression for Z_i A_v A_i and A_p interms of h-parameters, approximation.

Hybrid parameters- Definition for a linear circuit- notation and equivalent circuit for CEconfiguration.

Oscillators: Feedback amplifier, positive and negative feedback, comparison, Barkhausen's criterion for sustained oscillation. Phase-shift oscillator- principle, circuit operation, equation for o/p frequency (no derivation). Non sinusoidal oscillators: mention of different types.

Multivibrators- distinguishing features of different types, uses of multivibrators. Astable multivibrators– transistorized circuit, circuit operation, waveform, switching time and frequency of oscillation (No derivation)

Field effect transistor: Types (mention). JFET-construction of N-channel JFET, principle of working (qualitative), common source configuration- characteristics, definition of r_d, g_m and μ. Application of FET (Mention). Comparison with BJT.Integrated circuits: Integrated circuits and their advantages (brief)

Operational amplifier: symbol, characteristics of ideal OP-AMP. OP-AMP as linear amplifier using IC 741- inverting and non inverting modes, virtual ground, equation for gain, Mention of application of OP- AMP.

12 hrs

6.DIGITAL ELETRONICS: Brief review of basic gates and universal gates. Derivation of basic gates using NAND and NOR gates. EX-OR gate – symbol, truth table. Mention of IC gates.

Boolean algebra: Basic laws (statement) De-Morgan's theorem –statement and brief explanation. Boolean expressions –simple equations and their realisation using gates.

Flip-Flops: Basic principle of Flip-Flop circuits. RS Flip-Flop –symbol, brief explanation using logic diagram and truth table, draw backs. Clocked RS flip-flop (principle only) truth table. 5 Hrs

7.COMMUNICATION: Radio communication: Modulation: Review of principle, frequency spectrum of AM. Equation for AM modulation (no derivation) – Current and power calculation.

FM Modulation –Principle (brief). Comparison of AM and FM modulation

AM transmitter- block diagram, explanation. AM receiver- Super Heterodyne Receiver- block diagram, explanation, characteristics of radio receiver, sensitivity, selectivity, and fidelity (brief). Advantages of SHR.

Television: Basic principle of monochrome TV transmitter- block diagram, brief explanation, need for scanning and synchronizing signals.

Basic principle of monochrome TV receiver- block diagram – brief explanation. Basic Principle of color T V – Additive mixing. 4 Hrs

Note: Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

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SIXTH SEMESTER (PAPER-VIII)

NUCLEAR PHYSICS AND NON CONVENTIONAL ENERGY SOURCES

(3 Hours Of Lecture Per Week) 45 Hours

1.ATOMIC NUCLEUS: **Constitution of nucleus – proton-electron and proton-neutron theories nuclear angular momentum, magnetic dipole moment, and electric quadruple moment- mirror nuclei, nuclear isomers. Problems 3 Hrs**

2.NATURAL RADIOACTIVITY: **Law of successive tra*ns*formation – Radioactive equilibrium – transient equilibrium and secular equilibrium. Radioactive dating (a) Age of earth, (b) Age of rock. Carbon dating (c) Estimate the age of wood. Problems 5 Hrs**

3.NUCLEAR DETECTORS: **G-M counter – Scintillation counter – discussion of different scintillators (Principle, construction and working). Problems. 4 Hrs**

4.PARTICLE ACCELERATORS: **Linear accelerator – Construction and working with theory. Cyclotron – Construction and working with theory and Betatron – Construction and working with theory. Problems. 6 Hrs**

5.NUCLEAR REACTIONS: **Conservation laws, nuclear reaction kinematics –Q-value of nuclear reaction. Expression for threshold energy of endoenergic reaction. Nuclear cross section. Problems. 4 Hrs**

6.NUCLEAR FORCES: **Characteristics of nuclear forces - meson theory 2 Hrs**

7.NUCLEAR MODELS: **Liquid drop model, Semi empirical formula. Shell model (qualitative) 2Hrs**

8.*NUCLEAR DECAY:* α-decay – Gamow's theory (qualitative). β-Decay β –ray spectrum, – neutrino hypothesis. 2 Hrs

9.NUCLEAR FISSION AND FUSION: **Nuclear fission, Nuclear fusion – thermo nuclear reactions - sources of stellar energy – p-p chain CNO chains – controlled thermonuclear reactions. Nuclear reactors –classification - Indian nuclear programme. Four factor formula. 4 Hrs**

10.COSMIC RAYS: **Discovery – primary and secondary cosmic rays. Altitude, lattitude effects – East-West asymmetry – cosmic ray showers. Bhabha's theory – origin of cosmic rays. 3 Hrs**

11.ELEMENTARY PARTICLES: **Classification – symmetries and conservation laws –– Quark model - gluons (brief). Basic interactions in nature, unification (brief). 3 Hrs**

12. *NON CONVENTIONAL ENERGY SOURCES:* Introduction to energy sources, primary energy sources, secondary energy sources, supplementary source. Introduction to Energy sources and their availability.

Commercial and conventional energy sources. Major sources of energy – Fossil fuels –water power or energy stored in water – energy of nuclear fission.

Minor sources: Sun, wind, tides in the sea, geothermal, ocean thermal electric conversion, fuel cells, thermo electric generators etc.,

Solar energy: Applications – Photo thermal devices –solar cooker, solar hot water system – principle

Photo voltaic system: solar lantern, water pumps and street lights principles. Application of solar energy.

7 Hrs

NOTE : Sufficient numbers of problems are to be worked out in each section which would enhance the understanding of the subject.

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REFERENCES:

1. **Modern physics- R. Murughesan and Kiruthiga Prasath.**
2. **College physics – N. Sunderrajan**
3. **Atomic physics- Brijlal and Subramayam**
4. **Laser- Avadhanalu M N**
5. **Solid State Physics – S O Pillai**
6. **Solid State Physics and Electronics – R K Babber and V K Puri**
7. **Nuclear Physics – D.C.Tayal**
8. **Modern Physics – Kenneth Krane**
9. **Solid State Physics – A J Dekker**
10. **Electronic Principle – Malvino**
11. **Operational Amplifier – Gayakwad**
12. **Introduction to Cosmology – J V Narliker**
13. **Theory of Relativity – Resnick and Halliday**
14. **Atomic and Nuclear Physics – S N Ghoshal**
15. **Nuclear Physics - I Kaplan**
16. **Introduction to Quantum mechanics – U R Waghmara**
17. **Laser and Nonlinear optics – B B Laud**
18. **Theory of Space time and Gravitation - S G Pimpale**
19. **Optics – Ajoy Ghatak**
20. **Optics and Atomic Physics – Satyaprakash**
21. **Quantum mechanics – P T Mathews**
22. **Quantum mechanics – Ghatak and Lokanathan**
23. **Principle of Electronics - V K Metha**
24. **Basic Electronics – B L Theraja**
25. **Practical Physics – C L Arora**

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VI SEMESTER PRACTICAL – VII

(One experiment per week to be conducted in 3 hours duration)

1. **FET characteristics – drain and transistor characteristics, determination of** $g_m,\ r_d,\ and\ \mu$
2. **CE amplifier –frequency response, band width and gain band width.**
3. **OP – AMP: – using IC 741 – inverting amplifier, frequency response, gain calculation for different feedback resistances, - band width and gain band width.**
4. **Logic gates: Construction and study of AND, OR, NAND, and NOR gates using discrete Components.**
5. **Astable multivibrator – using transistor –determination of output frequency and duty cycle.**
6. **Determination of h-parameter for CE – mode.**
7. **Phase shift oscillator –using transistor or IC.**
8. **Boolean expression –implementation using ICs (simple 5 equations).**
9. **G.M counter – Half life of a radioactive source.**
10. **Earth inductor –determination of B_H and B_v .**
11. **RS Flip Flop: Construction using IC and verification of truth table. Demonstration of action of clocked pulse.**
12. **Rydberg constant – By hydrogen discharge tube or Solar hydrogen spectrum .**
13. **Triode characteristics – anode and mutual characteristics – Determination of** $g_m,\ r_p,\ and\ \mu$
14. **Photo tube –Verification of inverse square law of radiation.**
15. **Verification of Malu's law using Laser light.**
16. **Frank-Hertz Experiment.**

NOTE:

1. **Suitable and relevant experiments may be included.**
2. **Experiments mentioned in V and VI semester may be redistributed depending upon the facilities available in the laboratory.**
3. **Minimum of 8 experiments should be done in each practical.**
4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments.**

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VI SEMESTER PRACTICAL – VIII

(One experiment per week to be conducted in 3 hours duration)

1. **OP – AMP: – using IC 741 – non - inverting amplifier, frequency response, gain calculation for different feedback resistances, - band width and gain band width.**
2. **OP AMP: Filter circuits.**
3. **Logic gates: Construction and study of AND, OR, NAND, and NOR gates using ICs**
4. **Astable multivibrator: - using IC -555 – determination of output frequency and duty cycle.**
5. **Energy gap of semiconductor using meter bridge- determination of unknown temperature (melting point of wax) by graph.**
6. **Mutual inductance by absolute method using B.G.**
7. **G.M counter –inverse square law of γ rays.**
8. **Hall Effect : Measurement of Hall co – efficient.**
9. **AM – Modulator and demodulator –construction using transistor or IC –measuring depth of modulation.**
10. **Determination of Planck's constant and work function using photo tube.**
11. **Determination of Fermi energy of copper using meter bridge.**
12. **FET Amplifier – Common source – frequency response, band width and gain bandwidth.**
13. **Solar cell characteristics.**
14. **LDR – Absorption Co – efficient of glass, using Laser**
15. **Regulated power supply using zener diode.**
16. **Fermi energy of Copper**

NOTE:

1. **Suitable and relevant experiments may be included.**
2. **Experiments mentioned in V and VI semester may be redistributed depending upon the facilities available in the laboratory.**
3. **Minimum of 8 experiments should be done in each practical.**
4. **Experiment should be elaborative so as to extend for 3 hours duration.**
5. **Error estimation may be included for few experiments**

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