THE NATIONAL COLLEGE

AUTONOMOUS

JAYANAGAR, BANGALORE-560070

Department of Physics

V and VI Semester B.Sc. Physics Syllabus

(Effective from 2020-21 onwards)

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Bachelor of Science- Physics

An undergraduate degree in physics provides an excellent basis not only for graduate study in physics and related fields, but also for professional work in such fields as astrophysics, biophysics, engineering and applied physics, geophysics, or medicine. The undergraduate curriculum offers students an opportunity to acquire deep conceptual understanding of fundamental physics. This course would enable students to pursue master courses in physics which would turn their interpersonal skills in field of pure and applied sciences.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Introduction to fundamentals of quantum mechanics, spectroscopy, astronomy, statistical, nuclear and solid-state physics in final year of undergraduate physics course would enable students to connect and correlate the concepts that are associated with modern era of sciences. Unlike I Year and II Second, this year emphasizes Physics as core subject for students, as they study two theoretical papers and two practical papers per semester. Students are introduced to few elementary concepts based on Crystal Physics, Nanomaterials, Schrodinger wave equation, Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann Statistics which act as fundamental basis that connect to understand the underlying concepts of contemporary physics. The fifth and sixth semester curriculum plays a vital role as their introduction to concepts of modern physics could allure interested students to apply these concepts practically when they venture into research. This academic year would ensure students to find real time applications as it is the need of hour in resolving several challenging problems in pure science.
PEO2: These concepts would make him/her to find their KPI (Key Personal Interest) so that they can explore their KPA (Key Personal Area) in physics as they pursue their masters in future.

PROGRAM OUTCOMES (PO)

PO1: Student can pursue their career as theoretical physicist/experimentalist based on his/her interest in physics.
PO2: Introduction to quantum mechanics entrances student to check for different perspective and dimensions of mechanics giving an insight into quantum mechanical operators.
PO3: Students could pursue understanding the fundamental question that arises on the existence of our Universe with strong foundation of modern physics.
PO4: Students are enabled to realize the importance of physics in selecting the materials that could contribute for betterment of society when core social centered research problems are considered; the views of Solid-state physics and Nanoscience cater students to purse Materials Science.
PO5: Students are enabled to connect both the aspects theoretical (P501, P503, P601 and P604) and experimental (P502, P504, P602 and P604) for better understanding as the course content in practical papers are parallel to contents in theoretical modules. Practical would make the student visually connect to the phenomena.
P06: Students are prepared to take up exams at reputed institutes as technical experts that make them apt to work in research environment.
P06: Students are allowed to explore new applications like weather forecasting and Radiography during their V and VI Semester course respectively.

Syllabus for V Sem. B.Sc. (Physics) Paper V –Phy 501:
Statistical Physics, Quantum Mechanics – I, Atmospheric Physics & Nanomaterials

UNIT I: Statistical Physics (15 hours)

Specification of state of the system, Macro state, Micro State, Phase Space, Stirling's Approximation, Thermodynamic Probability and its calculation (Description of each with an example); Entropy and Thermodynamic probability($S = k ln\Omega$). Basic postulates of Statistical Physics; Ensemble (Micro – canonical, canonical and grand canonical ensembles)

2 hours

Maxwell – Boltzmann Statistics: Maxwell – Boltzmann Distribution function (Derivation of $n_i = \frac{g_i}{e^{\alpha+\beta E_i}}$, Energy distribution function $f(E_i) = \frac{n_i}{g_i}$); Maxwell – Boltzmann law of velocity distribution (mention- most probable velocity, average velocity, rms velocity) Limitations of M – B statistics.**3 hours**

Bose – Einstein Statistics:B-E distribution function (Derivation of $n_i = \frac{g_i}{e^{\alpha+\beta E_i}-1}$) Bose-Einstein condensation properties of liquid He (qualitative) [Mention of expression of Bose Temperature T_B–Concept BE Condensation –variation of N_o (number of particles in Zero energy state) and N_e (number of particles in non-Zero energy state) with temperature- BE condensation properties of Liquid He^4 (Qualitative description)]

Radiation as photon gas, Bose's derivation of Planck's law, Rayleigh-Jeans law, Wein's law ; Specific heat capacity of metals [Einstein's theory of specific heat capacity of solids – [Derivation of the equation $C_V = 3R\left[\left(\frac{\theta}{T}\right)^2 \frac{e^{\frac{\theta}{T}}}{\left(e^{\frac{\theta}{T}}-1\right)^2}\right]$ where $\theta = h\nu/k$]**5 hours**

Fermi – Dirac Statistics:

Fermi-Dirac distribution function; Fermi sphere and Fermi energy, Fermi gas; Electronic specific heat capacity in metals (Mention of the contribution to specific heat capacity from free electrons)

Comparison of Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac distribution functions **5 hours**

UNIT II: Quantum Mechanics – I (15 hours)

Failure of Classical Physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photoelectric effect, Compton Effect and specific heat of solids, Planck's quantum theory, Explanation of the above effects on the basis of quantum mechanics

[Experimental observation, failure of classical theory, quantum mechanical explanation, Photoelectric effect -Einstein's explanation, Compton Effect – mention of expression for wavelength shift (no derivation), Specific heat of solids -Einstein's and Debye's explanation of specific heat (qualitative). Stability of atom and atomic spectra, Black body radiation, Mention of Planck's equation, arrive at Wien's and Rayleigh-Jean's equation for energy distribution from Planck's equation].**5 hours**

de Broglie hypothesis of matter waves (λ in terms of momentum, energy, temperature for monoatomic gas molecules); Thomson's experiment; Davisson and Germer's experiment – normal incidence method; Concept of wave packet, Group velocity and particle velocity(relation between group velocity and particle velocity) Heisenberg's uncertainty principle - different forms; Gamma ray microscope experiment; Application to Non – existence of electron in nucleus. **10 hours**

UNIT III: Atmospheric Physics

Fixed gases and variable gases; Temperature structure of the atmosphere; hydrostatic balance, variation of pressure with altitude, scale height; Relative and Absolute humidity **4 hours**

Atmosphere dynamics –Accelerated rotational frames of reference – Centripetal and Coriolis force Gravity and pressure gradient forces Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks. **3 hours**

Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; satellite observations in weather forecasting. **3 hours**

Nanomaterials – Introduction, classification – (0D, 1D, 2D). Quantum dots, nanowires and nanofilms, Multilayered materials- Fullerene, Carbon Nano Tube (CNT), Graphene (Mention of structures and properties);Synthesis techniques (Top down- Explanation of Milling& bottom up - Sol gel process). Characterisation techniques- (brief description of SEM, TEM, AFM).

Electron confinement (0D, 1D, 2D- energy levels as a particle in a box);Size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Distinct properties of nano materials (Mention- optical, electrical, mechanical and magnetic properties); Mention of applications: (Fuel cells, catalysis, phosphors for HD TV, next generation computer chips, elimination of pollutants, sensors). **5 hours**

References:

1. Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (2004)
2. Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education ,(2005)
3. Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (2000)
4. Principles of Quantum Mechanics,***Ghatak and Lokanathan***, Macmillan, (2004)
5. Statistical Mechanics, An Introduction, **Evelyn Guha**, Narosa (2008)
6. Statistical Mechanics, ***R.K.Pathria***, 2nd edition, Pergamon Press (1972)
7. Statistical and Thermal physics, ***F.Reif***, McGraw Hill International(1985)
8. Statistical Mechanics, ***K.Huang***, Wiley Eastern Limited, New Delhi (1975)
9. Basic of Atmospheric Physics, A Chandrasekar, PHI Learning Private Limited (EEE)
10. Weather, climate and atmosphere by Siddartha.
11. Atmospheric Science by John M Wallace and Peter V Hobbs, Elsevier Publications (2006).
12. Introduction to Atmospheric Science by Turberick and Lutzens, Elsevier Publications
13. Nano materials, K. P. Bandopadhyay.
14. Nanocrystals, C. N. Rao, P. John Thomas.
15. Nanotubes and wires, C. N. Rao, A. Govindaraj.

PHYSICS – 502, PRACTICAL PHYSICS – V (A)

1. Applications of oscilloscope in the (a) study of Lissajous figures (b) calculation of rms voltage (c) calculation of frequency of AC. **(Mandatory)**
2. Galton Board experiment – Estimation of probability
3. Verification of Maxwell's distribution of velocity
4. Study of statistical distribution on nuclear disintegration data (using GM counter as a black box)
5. Characteristics of a photo cell-determination of stopping potential.
6. Determination of Planck's constant.
7. Characteristics and spectral response (selenium photocell)
8. Determination of particle size using XRD Scherer's formula.
9. Temperature of atmospheric air - by using Thermograph (Bimetallic type)- Plotting the graph of temperature Vs time.
10. Relative humidity using hair hygrometer
11. Estimation of relative humidity using wet and dry bulb thermometer
12. Wind speed and direction by Hand held anemometer and wind wane
13. Estimation of height from the given pressure data
14. Regulated power supply (using Zener diode).
15. Determination of transistor h-parameters.
16. Frequency response of a CE amplifier.
17. Transistor as a switch and active device.
18. Construction of RFO or AFO - using transistor
19. Emitter follower
20. Temperature coefficient of resistance and energy gap of thermistor.
21. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.

Note: A minimum of EIGHT experiments must be performed.

References :

1. Worsnop and Flint , Advanced practical physics for students, Asia Pub.(1979)
2. Singh and Chauhan, Advanced practical physics, 2 vols., Pragatiprakashan, (1976)
3. Misra and Misra, Physics Lab. Manual, South Asian publishers (2000)
4. Gupta and Kumar, Practical physics, Pragatiprakashan, (1976)
5. Ramalingam&Raghuopalan : A Lab. Course in Electronics
6. Bharagav et al : Electronics, TTI

Syllabus for V Sem. B.Sc. (Physics) Paper VI – Phy 503:

Astrophysics, Solid State Physics & Semiconductor Physics

UNIT-I: Astrophysics (15 hours)

Parallax and distance: Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

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. **3 hours**

Stellar classification: Pickering classification and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics.

Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of virial theorem.

Surface or effective temperature and color of a star : Wien's displacement law. Expressions for - average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star. Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star.**7 hours**

Evolution of stars: Stages of star formation(GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion- its types, Chandrasekhar limit. Event horizon, singularity and Schwarzchild's radius (qualitative) **5 hours**

Unit-2: Solid State Physics(15 hours)

Crystal systems and X-rays: Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. **6 hours**

Free electron theory of metals : Electrical conductivity- classical theory (Drude-Lorentz model); Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons (with derivation); Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero(derivation). Hall effect in metals

6 hours

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect,Type I and type II superconductors– BCS Theory (qualitative); Applications - SQUIDs. **3 hours**

Unit-3: Semiconductor Physics -Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration (derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – mention of expressions for carrier concentrations and conductivity– impurity states in energy band diagram and the Fermi level.

Formation of P-N junction, depletion region, Biased P-N junction, variation of width of the depletion region, drift and diffusion currents –expression for diode current. **6 hours**

Special Diodes: Zener diode – characteristics and its use as a voltage regulator. Photo diodes, Solar cells and LED (principle, working and applications). **4hoursTransistors:** Transistor action,Characteristics (CE mode), DC Biasing, Load line analysis (Operating Point, Fixed Bias – Forward bias of Base – Emitter, collector – emitter loop, transistor saturation, Load line analysis ; Voltage divider bias – Transistor saturation, Load line analysis)Transistor as an amplifier(CE mode). h-parameters**5 hours**

References :

1. Astronomy : Fundamentals and Frontiers – **Jastrow& Thompson**
2. Chandrashekhar and his limit – **G. Venkataraman**
3. An introduction to Astrophysics – **BaidyanathBasu**
4. Astrophysics Concepts, ***M. Herwit***: John Wiley, 1990.
5. Astrophysics. ***Krishnaswamy***(ed)
6. Introduction to solid State Physics, ***Charles Kittel***, VII edition, 1996.
7. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (2000)
8. Elementary Solid State Physic, **J P Srivastava**,PHI,(2008)
9. Essential of crystallography**, M A Wahab**, Narosa Publications (2009)
10. Solid State Physics-**F W Ashcroft and A D Mermin-**Saunders College (1976)
11. Solid State Physics-**S O Pillai-**New Age Int. Publishers (2001)
12. Priniples of Electronics by **V.K.Mehta**
13. Electronic Principles, Eigth edition by Albert Malvino and David J. Bates
14. Kauffman Universe- Edition 8

PHYSICS – 504, PRACTICAL PHYSICS – V(B)

1. Parallax Method – Distance of objects using trigonometric parallax.
2. HR Diagram & the physical properties of stars.
3. Analysis of stellar spectra.
4. Determination of temperature of a star (artificial) using filters.
5. Analysis of sunspot photographs & solar rotation period.
6. Mass luminosity curve – Estimation of mass of a star.
7. Mass of binary stars.
8. Resistivity of a material by four probe method.
9. Determination of Lorentz Number
10. Semiconductor temperature sensor.
11. LED characteristics and spectral response.
12. LDR characteristics – dark resistance – saturation resistance.
13. Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
14. Study of Hall effect in a metal.
15. Characteristics of LASER diode.
16. Spectral response of a photodiode and its I – V characteristics.
17. Determination of Fermi energy of a metal.
18. Determination of thermal conductivity of a metal by Forbe's method.
19. Measurement of heat capacity of metals.

Note: A minimum of EIGHT experiments must be performed.

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragatiprakashan, 1976
7. Ramalingom&Raghuopalan : A Lab. Course in Electronics
8. Bhargav et al : Electronics, TTI

Syllabus for VI Sem. B.Sc. (Physics) Paper VII – Phy601
Atomic, Molecular & Nuclear Physics

UNIT I: Atomic And Molecular Physics(15 hours)

Vector Model of the Atom

Review of Bohr's theory of hydrogen atom, Sommerfeld's modification of the Bohr atomic model (qualitative). Spatial quantization and spinning electron. Different quantum numbers associated with the vector atom model, Spectral terms and their notations, Selection rules, Coupling schemes(*l*-s and j-j coupling in multi electron systems), Pauli's Exclusion Principle, Expression for maximum number of electrons in an orbit. Spectra of alkali elements (sodium D-line), Larmor precession, Bohr magneton, Stern-GerlachExperiment**.**Zeeman Effect-Experimental study, theory of normal and anomalous Zeeman effect based on quantum theory. **10 hours**

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. **5 hours**

UNIT II:Radioactive Decay, Detectors & Accelerators (15 hours)

Alpha particle scattering: Rutherford's theory of alpha scattering (assuming the path to be hyperbolic) **2 hours**

Radioactive Decay : Laws of radioactive decay, half – life, mean life, decay constant; theory of successive disintegration (expression for number of atoms of n^{th} element in the chain – Bateman equations); radioactive equilibrium (secular and transient - cases of long lived parent, short lived parent, daughter and parent of nearly equal half – life)**3 hours**

Alpha decay: Range and energy, Geiger- Nuttal law , Characteristics of alpha spectrum, Gamow's theory of alpha decay [Barrier height, tunneling effect, λ=Pf f is the frequency of collision of nucleon with the potential barrier; P is the probability of transmission through the barrier); Barrier penetrability factor (p)= $e^{-\sqrt{\frac{2\mu}{\hbar^2}}\int_{r_0}^{r_i}\sqrt{V(r)-E}dr}$ (no derivation)]

Derivation of Q-value-of alpha decay; Exact energy of alpha particle emitted. **3 hours**

Beta decay : Types of beta decay (electron, positron decay and electron capture) Characteristics of beta spectrum and Pauli's neutrino hypothesis

2 hours

Detectors : Variation of ionization current with applied voltage in a gas counter, Proportional counter, GM Counter (Construction, working, characteristics, efficiency and quenching)**3 hours**

Particle accelerators : Linear accelerator, Cyclotron, Betatron**2 hours**

UNIT III:Nuclear Reactions Particle Physics& Radiography(15 hours)

Nuclear Reactions: Types of reactions, Conservation laws in nuclear reactions with examples, derivation of Q – value for reactions using the energy – momentum conservation, exoergic& endoergic reactions, threshold energy,Power reactors.**6 hours**

Elementary Particles: 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, isospin, strangeness and charm); Concept of Quark Model, Color quantum number and gluons, **6 hours**

Radiography: X ray diagnostics and imaging; principle, function and display of Computed Tomography Scanner; Use of radiation in cancer detection and diagnosis; Biological effects of radiation.**3 hours**

Reference Books:

1. Concepts of Modern Physics, Beiser 3rd edition, Student edition, New Delhi (1981).
2. Introduction to Atomic Physics – H.E. White
3. Introduction to Modern Physics – H.S. Mani, G.K. Mehta-West Press (1989).
4. Principles of Modern Physics, A.P. French, John Wiley, London (1958).
5. Modern Physics - S.N. Ghoshal, Part 1 and 2 S. Chand and Company (1996).
6. Physics of the Atom, Wehret. al. McGraw Hill
7. Atomic and Nuclear Physics,S. N. Ghoshal: Vol. II. (2000).
8. Alpha, beta and gamma spectroscopy, K. Seighbahn: Vol. I and II, John Wiley (1967)
9. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
10. Nuclear Physics, D C Tayal, Himalaya Publishing House, 5^{th} Edition
11. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
12. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
13. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
14. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
15. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde(IOP- Institute of Physics Publishing, 2004).
16. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
17. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)
18. The Feynmen lecture series on Physics by Feynmen.
19. The Physics of Radiology, 4^{th} edition by H.E.Johns and J.R.Cunninghan, published by Charles C.Thomos (1983)

PHYSICS – 602, PRACTICAL PHYSICS – VI(A)

1. Study of hydrogen spectrum.
2. Sommerfeld's fine structure constant determination.
3. Determination of e/m by Thomson's method.
4. Characteristics of GM counter.
5. Determination of half-life of K^{40}.
6. Millikan's Oil drop experiment
7. Analysis of band spectrum of PN molecule.
8. Analysis of rotational spectrum of nitrogen.
9. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
10. Absorption spectrum of $KMnO_4$.
11. B – H Curve using Oscilloscope
12. Verification of Curie – Weiss Law
13. To verify and design AND, OR, NOT and XOR gates using NAND gates
14. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.
15. Digital Half-adder & Full-adder circuits using logic gate ICs.
16. Half Subtractor& Full Subtractor, using logic gate ICs
17. Verification of inverse square law using GM counter (with a radioactive source).

Note: A minimum of EIGHT experiments must be performed.

References:

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragatiprakashan, 1976

Syllabus for VI Sem. B.Sc. (Physics) Paper VIII – Phy603:
Electronics, Magnetic Materials, Dielectrics & Quantum Mechanics – II

UNIT I: OPAMPS (8 hours)

Operational amplifiers

Block Diagram of an OPAMP,Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open loop configuration - Limitations, Gain Bandwidth Product, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground**2 hours**

Feedback concepts, Advantages of feedback, types of feedback, Expression for Gain; OPAMP as a feedback amplifier – Non – Inverting and Inverting amplifier, Modification of input and output impedances with feedback ; Voltage follower; Differential amplifier with feedback;**2 hours**

Linear Applications - frequency response of Low pass, high pass and band pass filters (first order), inverting summing amplifier, ideal Differentiator, Integrator.**2 hours**

OPAMP Oscillators

Positive Feedback concept - oscillator operation –Barkhausen Criterion; Types of oscillator circuits (Qualitative); Phase shift oscillator and Wien bridge oscillator (using op amp).**2 hours**

Digital Electronics (7 hours)

Number Systems: binary, octal, hexadecimal (interconversions); Number codes: BCD, Gray Code (conversions to other systems); Signed Numbers; Arithmetic using 1's and 2's complement. **2 hours**

Logic gates and truth tables: OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR.**1 hour**

Boolean laws and theorems – simplification of SOP equations; Realization of AND, OR, NOT using universal gates NAND and NOR;**2 hours**

Combination logic: Adders (full and half adder) and Subtractors.**2 hours**

UNIT II – Magnetic Properties of Matter and Dielectrics (15 hours)

Magnetic Properties of Matter

Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia, Para, and ferro magnetic materials;**3 hours**

Classical Langevin Theory of dia and paramagnetic domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials. **5 hours**

Dielectrics: Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation),Clausius-Mosotti equation (derivation), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, examples and applications.**7 hours**

UNIT-III:Quantum mechanics-II (15 hours)

Theconcept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger's wave equation. Max Born's interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, eigen values and Eigen functions. Applications of Schrodinger's equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function – extension to three dimensional box; Development of Schrodinger's equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state.

References

1. OPAMPS and Linear Integrated Circuits, **Ramakant A Gayakwad**, PHI Learning Private Limited, 4th Edition
2. Operational Amplifiers with Linear Integrated Circuits, **William D Stanley**, Pearson, 4th Edition
3. Electronic Devices and Circuit Theory**, Robert Boylestead and Louis Nashelsky**, PHI Learning Private Limited, 10th Edition
4. Digital Principles and applications, **Leach and Malvino**, MC – Graw Hill, 5th Edition
5. Introduction to solid State Physics, ***Charles Kittel***, VII edition, 1996.
6. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (2000)
7. Elementary Solid State Physic, **J P Srivastava**,PHI,(2008)
8. Essential of crystallography**, M A Wahab**, Narosa Publications (2009)
9. Solid State Physics-**F W Ashcroft and A D Mermin**-Saunders College (1976)
10. Solid State Physics-**S O Pillai**-New Age Int. Publishers (2001)
11. Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (2004)
12. Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education,(2005)
13. Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (2000)
14. Principles of Quantum Mechanics,***Ghatak and Lokanathan***, Macmillan, (2004)

PHYSICS – 604, PRACTICAL PHYSICS – VI(B)

1. Low pass filter using Op-amp
2. High pass filter using Op-amp
3. Band pass filter using Op-amp
4. Op-Amp inverting and non – inverting amplifier – ac or dc
5. Op-Amp as a differential amplifier – Common Mode And Differential Mode
6. Op-Amp -summing amplifier – ac and dc,
7. Op-Amp integrator and differentiator.
8. Phase shift oscillator using Op-Amp
9. Wien-bridge Oscillator using op – amp
10. To design an AstableMultivibrator of given specifications using 555 Timer
11. Determination of dielectric constant.
12. Determination of dipole moment of organic liquid
13. Determination of mass absorption coefficient of gamma rays.

Note: A minimum of EIGHT experiments must be performed.

References:

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practical physics, PragatiPrakashan, 1976