Solapur University, Solapur

B.Sc. Part III PHYSICS

New CBCS Semester Pattern Syllabus
with effect from June 2018

Theory Course 70 % University Assessment (UA) and 30 % College Assessment (CA)

SEMESTER – V

Core Papers

Physics Paper-IX: Mathematical Physics & Statistical Physics- (Phy - 3509)
           100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Physics Paper-X: Solid State Physics - (Phy - 3510)
           100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Physics Paper-XI: Classical Mechanics - (Phy - 3511)
        100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Discipline Specific Elective Papers
(Student can opt. any one of the following DSE papers)
DSE - 1:
Physics Paper-XII: Nuclear Physics - (Phy 3512)
           100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

DSE - 2:
Physics Paper-XII: Energy Studies - (Phy 3512)
           100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Total (A)……400 Marks
12 Credits

Solapur University, Solapur

B.Sc. Part III PHYSICS

New CBCS Semester Pattern Syllabus
with effect from June 2018

Theory Course 70 % University Assessment (UA) and 30 % College Assessment (CA)

SEMESTER - VI

Core Papers

Physics Paper-XIII: Electrodynamics - (Phy 3613)
         100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Physics Paper-XIV: Materials Science - (Phy 3614)
         100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Physics Paper-XV: Atomic, Molecular Physics and Quantum Mechanics.
         (Phy 3615)
         100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

Discipline Specific Elective Papers
(Student can opt. any one of the following DSE papers)

DSE – 1
Physics Paper-XVI: Electronics - (Phy 3616)
         100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

DSE – 2
Physics Paper-XVI: Instrumentation- (Phy 3616)
         100 Marks (3 Credits) (70 Marks UA + 30 Marks CA)

         Total (B)……400 Marks
          12 Credits

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B.Sc. Part III PHYSICS
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CORE PRACTICALS

Physics Practical IV: - 100 Marks (70 Marks UA + 30 Marks CA)
Physics Practical V: - 100 Marks (70 Marks UA + 30 Marks CA)
Physics Practical VI: - 100 Marks (70 Marks UA + 30 Marks CA)

DISCIPLINE SPECIFIC ELECTIVE PRACTICALS

Physics Practical VII: - 100 Marks (70 Marks UA + 30 Marks CA)

Annual Examination of Practical Course of Semester V and VI will be conducted at the end of sixth semester. [400 Marks: 20 Credits (UA – 280 Marks + CA – 120 Marks)]

Physics Practical IV to VII are divided into Group-I to VI.

Group (I to III) experiments UA (35*3) + CA (25*3) =105 + 75 = 180 Marks
Group (IV) experiment UA (35*1) + CA (25*1) =35 + 25 = 60 Marks

Scale down of 20 Marks of CA:
(10 Marks for Punctually Completed Journal, 05 Marks for Pre- Presentation of Seminar, 05 Marks for tour, 05 Marks for attendance of Seminar/Conference/Workshop/Symposia and 15 Marks for Completion and Pre-Presentation of Project. Total should be reduced to 20).

Scale down of 35 Marks for UA per Group: As per given in the practical slips
 Assessment Part of Practical Course UA ……   140 Marks
Group – V:

1. Journal ……..……..…………..…..   **30 Marks**
    i)   Certified Journal……………………   20 Marks
    ii) Neatness & Punctuality (5+5)...…… 	10 Marks
2. Seminar report   …........................   **20 Marks**
3. Tour and Tour report ……..………   **20 Marks**
    (Tour of minimum 2-3 Days / Two different industrial visits)

Group - VI:
4. Scientific Project……………………..   **70 Marks**
    i) Theme of the project.........................   05 Marks
    ii) Data collection……………………....   05 Marks
    iii) Applicability………………………..   05 Marks
    iv) Workout / Success of the Project...............   05 Marks
    v) Report writing……………………...   20 Marks
    vi) Visit to the concerning industry/Firm/Institute   10 Marks
    vii) Participation / Presentation in Seminar/Conference/
    Workshop /Symposia…................   10 Marks
    viii) Power Point Presentation…...............   10 Marks

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    Total (C) ………………………………… 400 Marks (20 Credits)

Grand total of B Sc. III Physics: (A) + (B) + (C) = 400 + 400 + 400 =1200 Marks.
(12 + 12 + 20 = 44 Credits)

NB:
 ➢ **During University Practical examination one examiner will assess the Group – V (Journal, Seminar and Industrial Visit / Tour) of the student. And another examiner will assess Group -VI (Project) of the student.**
 ➢ **Every student has to perform all six groups cyclically rotated in three days of the University Practical Examination.**

NATURE OF UNIVERSITY ASSESSMENT QUESTION PAPERS FOR BOTH CORE AND DISCIPLINE SPECIFIC ELECTIVE PAPERS

(W. E. F. JUNE 2018)

Time: - 2 hrs 30 min.   **Total marks: - 70**

Q.No.1)   Select the correct answer from the given alternatives.   **(14)**
    1) --
    a) ………….....…b)…………..…...……c)………....……...…….d)…………………
    2)   . . . . . Do . . . . .
    3)   . . . . . Do . . . . .
    4)   . . . . . Do . . . . .
    5)   . . . . . Do . . . . .
    6)   . . . . . Do . . . . .
    7)   . . . . . Do . . . . .
    8)   . . . . . Do . . . . .
    9)   . . . . . Do . . . . .
    10)   . . . . . Do . . . . .
    11)   . . . . . Do . . . . .
    12)   . . . . . Do . . . . .
    13)   . . . . . Do . . . . .
    14)   . . . . . Do . . . . .

Q.No.2) Answer any seven of the following   **(14)**
    1)
    2)
    3)
    4)
    5)
    6)
    7)
    8)

Q.No.3)   A) Answer any two of the following   **(10)**
      1)
      2)
      3)
   B) Write the answer   **(04)**

Q.No.4) Answer any two of the following   **(14)**
    1)
    2)
    3)

Q.No.5) Answer any one of the following
   1) Long answer type question / Derivation/expression   **(10)**
   Example related to the above question   **(04)**

   2) Long answer type question / / Derivation/expression   **(10)**
   Example related to the above question   **(04)**

NB:
    1. At least three numerical based questions must be asked in Question No. 1
    2. Question No. 2 must include two examples.
    3. Question No. 3A and 4 must include one example.
    4. Question paper must cover all the topics of the syllabus in the proper proportion.

Semester V
Core Paper
Physics Paper-IX: Mathematical Physics and Statistical Physics

1. Vector theorems and introduction to partial differential equation   **(7)**
      1.1 Gauss's theorem
      1.2 Green's theorem
      1.3 Stoke's theorem
      1.4 Differential equation
            1.4.1 Types of differential equation
            1.4.2 Degree,Order, Linearity, Homogeneity of differential equation
            1.4.3 Concept of singular points of differential equation
      1.5 Frobenius method of solving differential equation
            1.5.1 Legendre differential equation (without solution)
            1.5.2 Bessel differential equation (without solution)
            1.5.3 Hermite differential equation (with solution)

2. Orthogonal Curvilinear Coordinates   **(8)**
      2.1 Introduction to Cartesian, Spherical polar and Cylindrical Coordinate system
      2.2 Concept of Orthogonal Coordinate system
      2.3 Gradient in Orthogonal Coordinate system
      2.4 Divergence in Orthogonal Coordinate system
      2.5 Curl in Orthogonal Coordinate system
      2.6 Laplacian Operator in Orthogonal Coordinate system
      2.7 Extension of Orthogonal Coordinate system in Cartesian, Spherical polar and
           Cylindrical Coordinate system

3. Basic Concept in Statistical Physics   **(8)**
      3.1 Micro and Macro States
      3.2 Micro canonical and Canonical Ensemble
      3.3 Phase Space
      3.4 Accessible microstates
      3.5 A Priory Probability
      3.6 Thermodynamic Probability
      3.7 Probability Distribution
      3.8 Entropy and Probability

4. Maxwell Boltzmann Statistics   **(7)**
      4.1 Maxwell Boltzmann Distribution Law
      4.2 Evaluation of constants α and β
      4.3 Molecular Speeds
      4.4 Thermodynamic functions in terms of partition function

5. Quantum statistics - I   **(9)**
      5.1 Bose Einstein Statistics
      5.2 Bose Einstein Distribution Law
      5.3 Experimental study of black body radiation
      5.4 Derivation of Plank's radiation formula
      5.6 Deduction of Wein's Formula from Plank's radiation formula
      5.7 Deduction of Rayleigh's Jeans Law from Plank's radiation formula
      5.8 Deduction of Wein's Displacement Law from Plank's radiation formula
      5.9 Stefan's Law from Plank's radiation formula

6. Quantum Statistics - II   (6)

      6.1 Fermi Dirac Distribution Law
      6.2 Application to free electrons in metals
      6.3 Electron energy Distribution
      6.4 Fermi Energy
      6.5 Comparison of M.B., F.D. and B.E. statistics

Reference Books: -
1. Theory and problems of vector analysis- Schaum outline series- Murray R, Spiegel
2. Mathematical methods for physics – George Arfken
3. Thermodynamics and statistical physics – Sharma, Sarkar
4. Statistical Mechanics –B.B. Laud
5. Statistical and thermal physics – S. Loknathan
6. Statistical Mechanics – SatyaPrakash, J.P. Agrawal
7. Elementary Statistical Mechanics – Kumar, Gupta
8. An approach to Statistical Physics – Debi Prasad Ray

Physics Paper-X: Solid State Physics

1. Crystallography: **(09)**
    1.1 Lattice and Basic
    1.2 Unit cell
    1.3 Bravis lattices (2-D, 3-D)
    1.4 Inter-planer spacing
    1.5 Miller indices
    1.6 Packing fraction and co-ordination number for BCC, SC, FCC & HCP structures

2. X- ray Diffraction by Crystals: **(07)**
    2.1 Production of X-rays and its properties
    2.2 Reciprocal Lattice and its properties
    2.3 Bragg's Law in reciprocal lattice
    2.4 Powder method of X-ray diffraction for crystal structure

3. Free electron Theory: **(08)**
    3.1 Properties of metals
    3.2 Free electron model (Drude& Lorentz model)
    3.3 Electrical, thermal conductivity of metals and Wiedmann-Franz relation
    3.4 Sommerfield's theory
    3.5 Fermi-Dirac distribution.
    3.6 Fermi energy, degeneracy and non-degeneracy of metals

4. Band theory of solids: **(08)**
    4.1 Formation of bands in solids (PE, KE and total energy of electron in isolated atom)
    4.2 Formation of energy bands (Valence band, conduction band and forbidden energy gap)
    4.3 Motion of electron in one dimensional periodic potential (Kronig Penny model)
    4.4 Effective mass of electron
    4.5 Difference between metals semiconductors and insulators
    4.6 Hall Effect. And its applications

5. Magnetic materials: **(07)**
    5.1 Magnetic Terminology
    5.2 Classification of magnetic materials
        5.2.1 Dimagnetic material
        5.2.2 Paramagnetic material
        5.2.3 Ferromagnetic material
        5.2.4 Anti-ferromagnetic material
        5.2.5 Ferri-magnetic and ferrites
    5.3 Energy loss in the hysteresis

6. Superconductivity: **(06)**
    6.1 Superconductor
    6.2 Type I and Type II superconductors
    6.3 Critical temperature
    6.4 Effect of magnetic field
    6.5 Meissner effect
    6.6 Josephson effect
    6.7 Application of superconductor

Reference books:
1. Solid State Physics – S.O. Pillai (Wileyeasten Ltd)
2. Solid State Physics - A. J. Dekker
3. Solid State Physics - Charles Kittel
4. Solid State Physics - R.L. Singhal
5. Solid State Physics – Saxena and Gupta

Physics Paper – XI: Classical Mechanics

1. Mechanics of a particle and system of particles: **(6)**

    1.1 Mechanics of a particle using vector algebra and vector calculus

    1.2 Conservation theorems for linear momentum, angular momentum and energy of a particle

    1.3 Mechanics of a system of particles, concept of centre of mass

    1.4 Conservation theorems for linear momentum, angular momentum and energy of a system of particles

    1.5 Application of Newton's law of motion - Projectile motion in resistive medium

    1.6 Problems

2. Lagrangian Formulation: **(10)**

    2.1 Limitations of Newtonian Formulation

    2.2 Introduction of Lagrangian Formulation

    2.3 Constraints

    2.4 Degrees of freedom

    2.5 Generalised coordinates

    2.6 Principle of virtual work

    2.7 D'Alembert's Principle

    2.8 Lagrange's equation from D'Alembert's Principle

    2.9 Application of Lagrange's equation to

            i) A particle in space (Cartesian coordinates)

            ii) Atwood's Machine and

            iii) A bead sliding on uniformly rotating wire

            iv) Simple Pendulum

            v) Simple harmonic Oscillator

    2.10 Problems

3. Moving Coordinate systems: **(09)**

    3.1 Moving origin of coordinates

    3.2 Pseudo forces

    3.3 Rotating coordinate systems

    3.4 Coriolis force

    3.5 Foucault's pendulum

    3.6 Effects of Coriolis force in nature

    3.7 Effect of Coriolis force on freely falling body

    3.8 Promlems

4. Techniques of Calculus of Variation: **(6)**

    4.1 Hamilton's principle

    4.2 Deduction of Lagrange's equations from Hamilton's principle

    4.3 Applications:

            i) Shortest distance between two points in a plane

            ii) Brachistochrone problem

            iii) Minimum surface of revolution

5. Coupled Oscillations: **(7)**

    5.1 Frequencies of coupled oscillatory system

    5.2 Normal modes and normal coordinates

    5.3 Energy of coupled oscillations

    5.4 Energy transfer in coupled oscillatory system

    5.5 Problems

6. Motion of rigid body: **(7)**
   6.1 Motion of rigid body in space
   6.2 Euler's theorem
   6.3 Angular momentum and energy
   6.4 Euler's equations of motion

Reference Books:
   1. Classical Mechanics: Herbert Goldstein
   2. Classical Mechanics: N. C. Rana and P.S.Joag
   3. Introduction to classical Mechanics: R. G. Takawale and P.S. Puranic
   4. Clasical Mechanical: Gupta, Kumar and Sharma
   5. Classical Mechanics: P.V.Panat

DSE – 1

Physics Paper-XII: Nuclear Physics

1. Nuclear structure and properties (10)
    1.1 Composition of nucleus
    1.2 Nuclear radius
    1.3 Nuclear spin
    1.4 Nuclear magnetic moment
    1.5 Electric quodrupole moment
    1.6 Mass defect
    1.7 Binding energy
    1.8 Packing fraction
    1.9 Liquid drop model of nucleus
    1.10 Semi-empirical mass formula

2. Nuclear reactions (6)
    2.1 General scheme of nuclear reactions
    2.2 Q value of nuclear reactions
    2.3 Threshold energy
    2.4 Cross section of nuclear reactions (qualitative)
    2.5 Stripping reactions
    2.6 Pick-up reactions

3. Particle Accelerators: (8)
    3.1 Need of accelerator
    3.2 Cyclotron
    3.3 Limitations of cyclotron
    3.4 Phase stable orbit
    3.5 Betatron

4. Nuclear radiation detectors (7)
    4.1 Classification of detectors
    4.2 Geiger Muller counter
        i. Construction and working
        ii. Dead time, recovery time and resolving time
        iii. Self quenching mechanism
    4.3 Wilson Cloud chamber
    4.4 Scintillation counter

5. Nuclear Energy Levels (8)
    5.1 Alpha Decay- α-disintegration energy
    5.2 α particle spectra
    5.3 Nuclear energy levels
    5.4 β- decay- Experimental study of β-decay
    5.5 Continuous β- ray spectrum
    5.6 Pauli's Neutrino Hypothesis
    5.7 Nuclear Energy Levels from β- decay

6. Elementary particles (6)

    6.1 Introduction of elementary particles

    6.2 Types of interactions,

    6.3 Classification of elementary particles

    6.4 Properties of particles

    6.5 Introduction of quarks

    6.6 Different types of quarks

Reference Books:

1. Nuclear Physics : Irving Kaplan (Addison Wesley)
2. Nuclear Physics : S.N. Ghoshal (S.Chand Publising Co.)
3. Nuclear Physics : D.C.Tayal (Himalayan Publishing House)
4. Nuclear Physics : J.B.Rajam (S.Chand Publising Co.)
5. Concepts of Modern Physics : Arthur Beiser (Tata McGraw Hill Publishing)
6. Atomic and Nuclear Physics : N. Subhramanyam & Brijlal(S.Chand Pub. Co.)
7. Concepts of Nuclear Physics : B.L.Cohen (Tata McGraw Hill Publishing)
8. Nuclear Physics an introduction: W E Barcham

DSE - 2
Physics Paper XII: Energy Studies

1. **Energy** (8)
   - 1.1 Forms of energy
   - 1.2 Production of energy
   - 1.3 Energy and environment
   - 1.4 Energy and thermodynamics
   - 1.5 Conventional and non-conventional energy sources
   - 1.6 Energy resources
   - 1.7 Classification of energy resources
   - 1.8 Renewable and non-renewable energy sources

2. **Solar energy** (8)
   - 2.1 Natural effects of solar energy
   - 2.2 Solar energy plant
   - 2.3 Subsystems in solar energy plant
   - 2.4 Solar energy chains
   - 2.5 Solar constant, clarity index, solar insolation
   - 2.6 Solar photovoltaic cell or solar cell
   - 2.7 Solar photovoltaic systems
   - 2.8 Merits and demerits of solar PV panel system
   - 2.9 IV characteristics of photovoltaic cell
   - 2.10 Efficiency of solar cell

3. **Wind energy** (8)
   - 3.1 Wind
   - 3.2 Energy chains for wind energy
   - 3.3 Wind energy quantum
   - 3.4 Applications of wind energy
   - 3.5 Wind power density
   - 3.6 Wind turbine
   - 3.7 Efficiency factor of wind turbine (P-H) graph
   - 3.8 Types of wind turbine generator unit
   - 3.9 Horizontal Axis Wind Turbine (HAWT)
   - 3.10 Wind farm

4. **Biomass energy** (6)
   - 4.1 Origin of biomass
   - 4.2 Biomass energy resources
   - 4.3 Biomass conversion processes
   - 4.4 Direct conversion of biomass
   - 4.5 Thermochemical conversion of biomass (Pyrolysis)
   - 4.6 Biochemical conversion of biomass

5. Ocean Energy   (07)
   5.1 Introduction
   5.2 Ocean energy resources
   5.3 Off shore and on shore ocean energy conversion technologies
   5.4 Advantages and limitations of ocean energy conversion technologies
   5.5 The guidelines of ocean energy conversion plants
   5.6 Ocean energy routes.

6. Atmosphere and energy   (08)
   6.1 Introduction
   6.2 Energy transport in the atmosphere and to the poles
   6.3 Vertical structure of the atmosphere
   6.4 Vertical motion of humid air
   6.5 The diabetes
   6.6 Cumulus cloud formation
   6.7 Horizontal motion of air
   6.8 Geostrophic flow
   6.9 Origin of pressure difference

Reference books:
   1. Energy technology : S. Rao, Dr. B.B. Parulekar
   2. Energy: A textbook: Howard C. Hayden
   3. Solar energy and rural development- S. H. Pawar, C.D. Lokhande and R. N. Patil.
   4. Environmental Science (physical Principals and Applications)- Egbert Boeker, Reenk Van Grondelle

Semester – VI
Core Papers
Physics Paper XIII: Electrodynamics

1. Electrostatics and Charged particle dynamics: **(8)**
- 1.1   Coulomb's Law
- 1.2   Gauss law in differential form
- 1.3   Poisson's and Laplace's equations
- 1.4   Applications of Poisson's and Laplace's equation to spherical systems
- 1.5   Motion of charged particles in constant uniform electric (E) field
- 1.6   Motion of charged particles in constant uniform magnetic (B) field
- 1.7   Motion of charged particles in constant uniform crossed electric and magnetic fields

2. Time varying fields.   **(7)**
- 2.1   Electromotive force
- 2.2   Electromagnetic induction - Faraday's law
- 2.3   Lenz's law
- 2.4   Integral and differential forms of Faraday's law.
- 2.5   Self inductance
- 2.6   Application of Self inductance to solenoid
- 2.7   Mutual inductance
- 2.8   Application of Mutual inductance to transformer

3. Maxwell's equations.   **(9)**
- 3.1   Magnetic Susceptibility and Permeability
- 3.2   Biot-Savart's law
- 3.3   Derivation of $\nabla.\vec{B} = 0$
- 3.4   Ampere's law
- 3.5   Derivation of $\nabla X \vec{B} = \mu_0 \vec{J}$ OR Differential form of Ampere's law
- 3.6   Equation of continuity
- 3.7   Displacement Current density
- 3.8   Maxwell's correction to Ampere's law
- 3.9 Maxwell's equations for time dependent electric and magnetic fields in vacuum
- 3.10 Maxwell's equations for time dependent electric and magnetic fields in material medium
- 3.11   Physical significance (Integral form) of Maxwell's Equations

4. Electromagnetic waves.   **(8)**

- 4.1 Conservation of energy in electromagnetic fields and Poynting's theorem
- 4.2 Conservation of momentum in electromagnetic fields
- 4.3 Wave equations for electric and magnetic fields in vacuum
- 4.4 Plane wave solutions, orthogonality of $\vec{E}, \vec{B}$ and propagation vector $\vec{K}$
- 4.5 Plane E. M. waves in Dielectric
- 4.6 Plane E. M. waves in conductors Attenuation of wave in metal (skin depth)

5. Reflection and Refraction of E. M. waves: **(8)**

5.1 Boundary conditions for e. m. field vectors $\vec{D}, \vec{B}, \vec{E}$ & $\vec{H}$

5.2 Reflection and refraction of e. m. waves at a boundary of two dielectrics (Normal incidence only)

5.3 Reflection from a conducting plane- normal incidence.

5.4 Total Internal Reflection.

6. Radiation from electric dipole: **(5)**

6.1 Electric dipole

6.2 Retarded time and retarded potential

6.3 Electric dipole radiation

6.4 Radiation reaction for Electric dipole

Reference Books:

1. Introduction to Electrodynamics (third edition) – David. J. Griffith's.
2. Introduction to Electrodynamics (second edition) – David. J. Griffith's.
3. Classical Electrodynamics – S. P. Puri
4. Classical Electrodynamics – J. D. Jackson.
5. Electrodynamics – B.B. Laud.
6. Foundations of Electromagnetic theory – Reitz and Milford.

Physics Paper XIV: Materials Science

1. Materials and their properties: **(7)**
    1.1 Classification of materials
    1.2 Organic, inorganic and biological materials
    1.3 Properties of materials
        1.3.1 Mechanical properties
        1.3.2 Thermal properties
        1.3.3 Optical properties
        1.3.4 Electrical properties
        1.3.5 Magnetic properties

2. Polymer materials: **(8)**
    2.1 Polymers
    2.2 Polymerization mechanism
        2.2.1 Additional polymerization
        2.2.2 Condensation polymerization
        2.2.3 Homo-polymer
        2.2.4 Co-polymer
    2.3 Degree of polymerization
    2.4 Defects in the polymers
    2.5 Mechanical properties of polymers, deformation, reinforced polymers
    2.6 Applications of polymers.

3. Ceramic Materials: **(6)**
    3.1 Classification of ceramic materials
    3.2 Structure of ceramics
    3.3 Ceramic possessing
    3.4 Properties of Ceramics
    3.5 Applications of Ceramics

4. Composite Materials: **(5)**
    4.1 Fabrication of composites
    4.2 Mechanical properties of composites
    4.3 Particle-Reinforced Composites
    4.4 Fiber-Reinforced composites
    4.5 Applications of composites

5. Biomaterials: **(5)**
    5.1 Bio-Mechanism
    5.2 Classification of Biomaterials
    5.3 Processing of Biomaterials
    5.4 Properties of Biomaterials
    5.5 Applications of Biomaterials

6. Nanomaterials: (14)

    6.1 Introduction to nano-sized materials and structures

    6.2 Brief history of nanomaterials and challenges in nanotechnology

    6.3 Significance of nano-size and properties

    6.4 Classification of nano structured materials

    6.5 Methods of synthesis of nanomaterials

    6.5.1 Bottom-up and Top-down approaches

    6.5.2 Physical methods: High energy ball milling, Physical vapour deposition, Ionized cluster beam deposition, sputter deposition, Ultrasonic spray pyrolysis etc.

    6.5.3 Chemical methods: colloidal method, co-precipitation and sol-gel method

    6.5.4 Hybrid method: Electrochemical and chemical vapour deposition.

Reference Books:
1. Material science by S.L. Kakani, Amit Kakani, New age international publishers.
2. Materials science and engineering, V. Raghavan, 5th edition, PHI
3. Materials science by R.S. Khurmi, S. Chand
4. Materials science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw-Hill.
5. Semiconductor physics and devices by S.S. Islam, Oxford university press, 1st edition
6. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, by Thomas Varghese & K.M. Balakrishna, Atlantic publication
7. Introduction to nanoscience and nanotechnology, by Chattopadhyay K.K., Banerjee A.N., PHI
8. Materials science – V. Rajendran & A. Marikani (TMHl).
9. Elements of material Science & engineering.- I.H.Van Vlack (4th Edition.).
10. Nanotechnology: Principles and Practices by Sulbha Kulkarni, Capital Publishing Co.New Delhi.
11. Introduction to nanotechnology, by C. P. Poole Jr. and F. J. Ownes, Willey Publications.
12. Origin and development of nanotechnology by P. K. Sharma, Vista International publishing house.
13. Nanostructure and nanomaterials synthesis, Properties and applications, by G. Cao, Imperials College Press, London.

Physics Paper -XV: Atomic Physics, Molecular Physics and Quantum Mechanics

1. Atomic Spectra (6)
1.1 Review of quantum numbers
1.2 Electronic configuration of alkali metals
1.3 Spectral notations
1.4 Alkali spectra
1.5 Doublet fine structure of alkali metals
1.6 Spectrum of Sodium
1.7 Selection rules
1.8 Intensity rules

2. Effects of Magnetic and Electric fields on Atomic Spectra (6)
2.1 Anomalous Zeeman effect and its explanation from vector atom model
2.2 Paschen Back effect
2.3 Paschen Back effect in principal series doublet
2.4 Selection rules for Paschen Back effect
2.5 Stark effect of hydrogen
2.6 Weak field Stark effect in hydrogen
2.7 Strong field Stark effect in hydrogen

3. Molecular Spectra and Raman Effect (10)
3.1 Molecular bond
3.2 Rotational energy levels and Rotational spectra
3.3 Vibrational energy levels and Vibrational spectra
3.4 Vibration-Rotation spectra
3.5 Electronic spectra of a diatomic molecule
3.6 Franck-Condon principle
3.7 Raman effect
3.8 Characteristic properties of Raman lines
3.9 Classical theory of Raman effect

4. Quantum Mechanics (5)
4.1 Heisenberg's uncertainty principle (Statement) and its similarity with concept of matter waves
4.2 Physical significance of ψ
4.3 Time dependent and time independent Schrödinger wave equations
4.4 Eigen values and Eigen functions
4.5 Probability current density

5. Application of Schrodinger's time independent wave equation (10)
5.1 Particle in a Box (one and three dimensional cases), its Eigen values and Eigen functions.
5.2 Step Potential (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
5.3 Potential Barrier (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
5.4 Potential Well (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
5.5 Linear Harmonics Oscillator – Eigen values and Eigen functions
5.6 Zero point energy

6. Operators (8)

    6.1 Operators in quantum mechanics
    6.2 Expectation values and properties
    6.3 Angular momentum operators
    6.4 Commutation properties for components L_x, L_y, L_z
    6.5 Commutation for L^2 and L_z operators and their Eigen values
    6.6 Schrodinger's equation for hydrogen atom
    6.7 Separation of radial and angular parts

Reference Books:
1. Atomic Spectra – H.E. White
2. Molecular Spectroscopy - Banwell
3. Molecular Spectroscopy – Hertzberg
4. Quantum Mechanics - J. Powell and B. Creassman
5. Introduction to Quantum Mechanics - Pauling and Wilson
6. Elements of Quantum Mechanics - Kamal Singh and S.P. Singh.
7. Perspectives of Modern Physics – Arther Beiser
8. Quantum Mechanics – Chatwal Anand

DSE– 1
Physics Paper- XVI: Electronics

1. Operational Amplifier: (09)
    1.1 Block diagram of OP-AMP
    1.2 Characteristics of OP-AMP
    1.3 OP-AMP parameters
    1.4 OP-AMP as inverting amplifier
    1.5 OP- AMP as non- inverting amplifier
    1.6 Applications of OP-AMP
        1.6.1 Adder
        1.6.2 Subtractor
        1.6.3 Differentiator
        1.6.4 Integrator
        1.6.5 Comparator
        1.6.6 Schmitt's trigger

2. Timer: (06)
    2.1 Functional Block diagram of IC 555, its Pin connections
    2.2 Operating modes
        2.2.1 Monostable
        2.2.2 Astable
    2.3 Applications of timer IC 555 as
        2.3.1 Linear ramp generator
        2.3.2 Square wave generator
        2.3.3 Voltage to frequency converter

3. Silicon Controlled Rectifier (SCR) (07)
    3.1 Four layer PNPN diode
    3.2 SCR construction and working
    3.3 Characteristics of SCR,
    3.4 Turn ON and Turn OFF methods of SCR,
    3.5 Applications of SCR to control the speed of DC motor,

4. Diac and Triac (06)
    4.1 Construction, working and characteristics of Diac
    4.2 Applications of Diac
        4.2.1 Lamp dimmer
        4.2.2 Heat control
    4.3 Construction, working and characteristics of Triac
    4.4 Applications of Triac
        4.4.1 High power lamp switch
        4.4.2 Electronic change over power transformer

5. Display Devices (9)
    5.1 Classification of Displays
    5.2 Light emitting Diode displays
    5.3 Liquid Crystal Displays and its Important Features
    5.4 Gas Discharge plasma Displays
    5.5 Segmented gas discharge displays
    5.6 Segmental displays using LEDS

6. Field Effect Transistor   (8)
6.1 Review of JFET
6.2 Metal Oxide Semiconductor FET (MOSFET)
    6.2.1 Schematic symbols and Types of MOSFET-a) D-MOSFET and b) E-MOSFET
6.3 D-MOSFET
    6.3.1 Circuit Operation
    6.3.2 Transfer Characteristic
    6.3.3 Transconductance and input impedance
6.4 E-MOSFET
    6.4.1 Circuit Operation
    6.4.2 Transfer Characteristic
    6.4.3 Transconductance and input impedance

Reference Books:
1. Electronic Principles – Malvino & Leech
2. Basic Electronic – Grob
3. Electronic Circuits and Devices – Allan Mottershed
4. Linear Op-Amp – Ramakanth Gaikwad
5. Principles of Electronics (Eleventh Edition)– V.K.Mehta (S Chand and Co. Ltd.)
6. Basic Electronics Solid State – B. L. Thereja. (S Chand and Co. Ltd.)

DSE-2
Physics Paper- XVI: Instrumentation

1. Transducers and Sensors **(12)**

    1.1 Transducers and Sensors (Working principle, efficiency, applications):

    1.2 Active and passive transducers.

    1.3 Characteristics of Transducers.

    1.4 Transducers as electrical element and their signal conditioning.

    1.5 Temperature transducers: RTD,

    1.6 Thermistor.

    1.7 Position transducer: Strain gauge, piezoelectric transducer.

    1.8 Inductance transducer: Linear variable differential transformer (LVDT),

    1.9 Capacitance transducer.

    1.10 Magnetoresistive transducer.

    1.11 Sensor- Dry reed relay

    1.12 Servomotor sensors

2. Characterization techniques-I (Electron Microscopy) **(05)**

    2.1 Resolution and Magnification of Electron microscope

    2.2 Construction, working of SEM

    2.3 Application of SEM

    2.4 Construction and working of TEM

    2.5 Application of TEM

    2.6. Difference between optical and electron microscopy.

3. Characterization techniques-II (Spectroscopic techniques) **(10)**

    3.1 UV-Visible spectroscopy

        3.1.1 Principle

        3.1.2 Construction and working of ultra-visible (UV) spectrophotometer

        3.1.3 Application of UV-Visible spectroscopy

    3.2 Infra Red (IR) Spectroscopy

        3.2.1 Principle

        3.2.2 Construction and working of IR spectrophotometer

        3.2.3 Application of IR spectroscopy

    3.3 Raman spectroscopy

        3.3.1 Principle

        3.3.2 Construction and working of Raman Spectrometer

        3.3.3 Application of Raman Spectroscopy

    3.4 X-ray photoemission spectroscopy (XPS)

        3.4.1 Principle

        3.4.2 Construction and working of X-ray photoemission Spectrometer

        3.4.3 Application of XPS.

4. X-ray Diffraction **(04)**

    4.1 Principle

    4.2 Construction and working of X-ray diffractometer

    4.3 Application of X-ray diffraction.

    4.4 X-ray Fluorescence (XRF).

5. Mossbauer Spectroscopy (05)

    5.1 Principle

    5.2 Construction and working of Mossbauer spectrometer

    5.3 Application of Mossbauer Spectroscopy.

6. Bio-medical Instruments (09)

    6.1 Electro Cardio Gram (ECG)

        6.1.1 Principle

        6.1.2 Construction and working of ECG

        6.1.3 Application of ECG.

    6.2 Electro Encephala Graph (EEG)

        6.2.1 Principle

        6.2.2 Construction and working of EEG

        6.3.3 Application of ECG.

    6.3 Magnetic Resonance Imaging (MRI)

        6.3.1 Principle

        6.3.2 Construction and working of MRI

        6.3.3 Application of MRI.

Reference Books:

1. Electronic Instrumentation - H.S. Kalsi
2. Handbook of Biomedical Instrumentation- R.S. Khandpur and Raghbir Khandpur.
3. Biomedical instruments and measurements- M. L. Cromwell.
4. Introduction to Biomedical Instruments: Barbara Christ
5. Fundamentals of molecular spectroscopy- Colin N. Banwell & E. M. McCash, 4th Edition.
6. Basic Electronics Solid State – B. L. Thereja. (S Chand and Co. Ltd.)
7. Instrumentation devices and system- Rangan, Sarma, Mani, (Tata Mc Graw Hill.)
8. Instrumentation measurements and analysis- Nakra, Chaudhari, (Tata Mc Graw Hill.)
9. Sensor and Transducers- Patrandis (PHI)
10. Elements of X-ray diffraction-B. D. Cullity

B. Sc. Part III Physics Practical
Group-I: General Physics, Heat and Sound

1. S.T. of a Soap film
2. S.T. by Ferguson's modified method
3. S.T. by ripple method
4. Modulus of rigidity of a wire by Maxwell's needle
5. Y and η using Flat Spiral Spring
6. Y by Koenig's method
7. Stefan's fourth power law
8. Viscosity of a given liquid by logarithmic decrement.
9. Motion of Spring and calculate (a) Spring Constant and (b) Value of G
10. Thermal conductivity by Lee's method
11. Velocity of sound by CRO
12. Thermocouple: To study Seebeck and Peltier effect

Group-II
1. Crystallography and study of XRD pattern
2. Hall effect
3. Hysteresis by magnetometer
4. High resistance by leakage method
5. Resistivity and band gap of semiconducting material by four probe method.
6. Thin film preparation by any chemical method
7. Self inductance by Owen's bridge
8. Measurement of BH, BV and q using Earth Inductor
9. Thermo-electric power of thin film
10. Calibration of bridge wire by Carey Foster's bridge method.
11. Absolute capacitance of condenser by BG method.
12. Phase Diagram

Group-III

01. Cardinal points by Newton's method
02. Cardinal points by turn method
03. Lloyd's single mirror
04. Transverse and spherical aberration of thick lens
05. Diameter of a Lycopodium powder
06. Resolving power of prism
07. Elliptically and circularly polarized light
08. e/m by Thomson method
09. Diffraction due to straight edge.
10. Dispersive Power of grating
11. Y by Cornu's method
12. Resonating pendulum

Note: At least 10 experiments must be completed from each group (Group-I to Group-III).

Group-IV

(A) Nuclear Physics and Computer
1. Estimation of efficiency of GM counter
2. Determination of Beta particle range and maximum energy
3. To create resume by MS word and worksheet of student mark sheet by MS Excel. Convert resume and worksheet into PDF. Mail this PDF document and take its print.
4. Plot graph using origin, calculate slope and make calculations
5. Create poster of your seminar presentation by power point presentation.
6. Create documents in IEEE format by using mathematical model, mathematical functions, various signs and symbols

(B) Energy studies
1) To study photo response of given solar cell.
2) To study the current-voltage characteristic of solar cell under illumination.
3) Study of sensible heat storage using liquid.
4) Thermal efficiency of liquid – flat plate collector.
5) Study of box type solar cooker.
6) Determination of instantaneous thermal efficiency of parabolic collector.

(C) Electronics
1) Astable Multivibrator using IC555
2) OP-AMP as inverting amplifier
3) OP-AMP as comparator –Schmitt's trigger
4) RS and JK flip flops
5) FET as VVR
6) Study of mono-stable operation of IC 555

(D) Instrumentation
1) Study IR, UV and XPS pattern of the material.
2) Determination of Crystal structure by XRD and study of microstructure by SEM/TEM pattern.
3) Study of ECG/EEG/MRI pattern
4) Study of Mossbauer XPS Pattern
5) Temperature sensor: NTCR/PTCR
6) LDR

Note: Group-IV is DSE type. Student can choose any two sub-groups from Group-IV as per her/his selected DSE theory papers (Physics paper-XII and Physics Paper-XVI). At least 05 experiments must be completed from each sub-group (Group-IV).

References:
1) B.Sc Practical Physics- Harnam Singh, P.S. Hemane (S Chand and Comp. Ltd.)
2) Advanced Practical Physics –Nelkon
3) Practical physics - Rajopadhye and Purohit
4) Practical Physics – P R Sasi Kumar
5) Physics Practical- Subramanayam and Brijlal
6) Physics Practical – Worsnop Flint.
7) B.Sc. Physics Practical- C. L. Arora