Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

Choice Based Credit System

Syllabus: Physics

Name of the Course: B. Sc. III (Sem -V & VI)

(Syllabus to be implemented June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Syllabus For B. Sc. III Physics

Choice Based Credit System (CBCS) Pattern

To be implemented from Academic Year 2024-25

1. Preamble:

Bachelor of Science (B.Sc.) in Physics is the course disseminating knowledge of the subject from fundamental concepts to state-of-technologies. Indeed, the curriculum encompasses knowledge of various themes such as Mathematical Physics, Classical Mechanics, Atomic & Molecular Physics Materials Science, Quantum Mechanics, and Electronics etc. The Choice Based Credit System (CBCS) is implemented for this course. Out of 4 theory papers, in each semester, 3 papers are of core. However, students have to opt one paper from DSE papers. Also, one Add on Skill enhance course is included as SEC. In the practical course of 400 marks there are compulsory experiments for practical course IV, V, VI and VII (Project/ Internship). Moreover, project work is also mandatory in curriculum at last semester to ensure better practical knowledge and hence better job opportunities in Research & industrial sector. The details are mentioned in the syllabus.

2. Objectives of the course:

The aim of the course is to generate trained manpower with adequate theoretical and practical knowledge of physics domain. Due care is taken to inculcate conceptual understanding in basic phenomena, materials, appropriate practical skills suitable for research and industrial needs. Objectives are

- To design the syllabus with specific focus on key Learning Areas.
- To equip student with necessary fundamental concepts and knowledge base.
- To develop specific practical skills.
- To impart training on circuit design, analysis, building and testing.
- To prepare students for demonstrating the acquired knowledge.
- To encourage student to develop skills for accepting challenges of upcoming technological advancements.

3 . Course outcome and Advantages:

After completing the course students will be familiarized with necessary laboratory techniques and tools of Physics and find exposure in research, analytical and presentational skills. Physics has tremendous job potential. The successful and well-trained students will be to get various Physics related job. Post graduate and Research opportunities.

- Medium of Instruction: English
- Syllabus Structure.
- University follows semester system.
- An academic year shall consist of two semesters.
- B.Sc. Part-III Physics shall consist of two semesters: Semester V and Semester VI

4. Distribution of Practical Marks (400):

Sr. No.	**UA (320)**		**CA (80)**	
1.	Practical's (45 x 4 Practical's)	180	Practical's (15 x 4 Practical's)	60
2.	Project (Project-40, Report-10, Oral-10, Presentation-10, Idea/Theme-10)	80	Project (Presentation & Oral) (10 + 10)	20
3.	Journal	20		
4.	Industrial visit/ Industrial Case Study/ Visit to industrial exhibition /Participation in Conference/ Workshop/ Seminars	20		
5	Seminar	20		
	Total marks	**320**	**Total marks**	**80**
			Total marks	**400**

A) University Assessment (UA) (320 marks):

Practical Marks (45 X 4=180 marks) may be as given below.

- Flexibility should be given to the students to draw diagrams of respective experiments.
- **Project (80 marks) :** Every student should take up a project and submit the report of the work carried out. The project work will be assessed independently at the time of practical examination.
- It is mandatory for the students to produce certified journal at the time of practical examination.
- **Journal** **20 Marks**

Certified Journal	10 Marks
Neatness & Punctuality (5+5)	10 Marks

- **Industrial visit / Local industry case study / Job training/ Visit to industrial exhibition/Participation in the Conference/ Workshop/seminars(20 marks)** :In order to give the exposure of Industry/ Research Institute and advances in the field of Physics, industrial visit should be arranged and the report should be submitted OR he/she should submit the report of the case study of local industry or on job training (minimum four days) OR he/she may visit to an industrial/ Science exhibition OR participate in conference / Seminar / workshop and produce certificate of participation, for 20 marks.
- Seminar (20 marks) Every student of B.Sc. III, Physics will have to deliver seminar of at least 10 minutes on any advanced topic in Physics using ICT (power point presentation) and submit the report of presentation, for 20 marks.

B) College Assessment (80marks):

- **Practical's Test:** 4 Experiments each of 15 marks per group (4 x 15) = 60 marks.
- **Project:** Project presentation and oral (10 + 10) of 20 marks.

C) Skill Enhancement Course (SEC):

Student has to complete min one of these activities on his own resources and has to produce the certificate of the same at the end of VI semester. If any official documentation is necessary from institute, it will be provided, e.g. consent letter, etc. The Internship/Industrial Training must have minimum of 240 hours.

6) A) Passing Standard:

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secures less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in internal assessment and passed in university examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same stipulated marks of external examination and his/her performance shall be scaled to 100 marks.

B) ATKT: passed in all papers except 6 (six) papers combined together of semester III and IV of B.Sc. Part-II examination and clearly passed in B.Sc. Part-I shall be permitted to enter upon the course of Semester V of B.Sc. III Physics.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology

Choice Based Credit System (CBCS) (w.e.f. 2024-25)

Revised Structure for B. Sc-III Physics

Course Structure:

Subject/ Core Course	Name and Type of the Name	No. of papers/ Practical	Hrs./week			Total Mark	UA	CA	Credits
			L	T	P				
Class:	**B.Sc.- III Semester - V**								
Ability Enhancement Course (AECC)	English (Business English)	Paper II Part A	4	--	--	50	40	10	2.0
Core (Students can opt any one subjects among the three. Subjects excluding interdisciplinary offered at B.Sc. II)	DSE 1 E	**Paper IX:** Mathematical Physics and Statistical Physics	4	--	--	100	80	20	4.0
	DSE 1 F	**Paper X:** Solid State Physics	4	--	--	100	80	20	4.0
	DSE 1G	**Paper XI:** Classical Mechanics	4	--	--	100	80	20	4.0
	DSE 1 A	**Paper XII:** Nuclear Physics	4	--	--	100	80	20	4.0
Total theory Sem. V			**20**	**-**	**-**	**450**	**360**	**90**	**18**
Skill Enhancement Course	SEC 2	*Skill Course	-	--	-	100	80	20	4.0
Class	**B.Sc.- III Semester -VI**								
Ability Enhancement Course (AECC)	English (Business English)	Paper II Part B	4	--	--	50	40	10	2.0
Core (Students can opt any one subjects among the three Subjects excluding	DSE 1 H	**Paper XIII:** Electrodynamics	4	--	--	100	80	20	4.0
	DSE 1 I	**Paper XIV :** Materials Science	4	--	--	100	80	20	4.0

interdisciplinary offered at B.Sc. II.	DSE 1J	**Paper XV :** Atomic Physics, Molecular Physics and Quantum Mechanics	4	--	--	100	80	20	4.0

	DSE 2A	**Paper XVI:** Electronics	4	--	--	100	80	20	4.0
Total (Theory)			**20**	**--**	**--**	**450**	**360**	**90**	**18**
Core	DSE 1E &1H	Practical IV	--	--	5	100	80	20	4.0
	DSE 1F & 1 I	Practical V	--	--	5	100	80	20	4.0
	DSE 1G & 1 J	Practical VI	--	--	5	100	80	20	4.0
	DSE 1A & 2A	Practical VII (Project / Internship)	--	--	5	100	80	20	4.0
Total (Practical's)					20	400	320	80	16
Grand Total			**40**	**--**	**20**	**1300**	**1040**	**260**	**52**

***Skill Enhancement Course (SEC):**

The students can choose MOOCs/ NPTEL/SWAYAM/ Pathshala /Add-on / Skill based courses of university/college-initiated courses of same credits.

Summary of the Structure of B.Sc. Programme as per CBCS pattern

Class	Semester	Marks-Theory	Credits Theory	Marks - Practical	Credits - Practical's	Total - credits
B.Sc.-III	V	450	18	--	--	18
	VI	450	18	400	16	34
Total		900	36	400	16	52
Grand Total	**900 (T) +400 (P) = 1300**					

Numbers of Papers Theory: Ability Enhancement Course (AECC) 02

Theory: Discipline Specific Elective Paper (DSE) 08

Skill Enhancement Courses 01

Abbreviations:

L: Lectures

T: Tutorials

P: Practicals

UA : University Assessment

CA: College Assessment

CC: Core Course

AEC: Ability Enhancement Course

DSE: Discipline Specific Elective Paper

SEC: Skill Enhancement Course

GE: Generic Elective

***List of Skill Enhancement Courses**

1) Certificate course in Testing and Repairs of Electric Appliances.

2) Thin film deposition and Characterization Techniques.

3) Scientific Research paper writing and Publications.

4) Medical Physics.

5) Energy Resources.

6) Python.

B.Sc. III, Physics, Semester-V

DSE 1 E

Paper-IX: Mathematical Physics and Statistical Physics

Credits: 04

1. Vector theorems and introduction to partial differential equation (10)

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 (10)

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 (10)

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 (10)

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 (12)

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 (08)

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

B.Sc. III, Physics, Semester-V

DSE 1 F

Paper- X: Solid State Physics

Credits: 04

1. **Crystallography** **(10)**
   - 1.1 Lattice and Basis
   - 1.2 Unit cell
   - 1.3 Bravais lattices (2-D, 3-D)
   - 1.4 Inter-planer spacing
   - 1.5 Miller indices
   - 1.6 Packing fraction and co-ordination number for SC, BCC, FCC & HCP structures
2. **X-ray Diffraction by Crystals** **(10)**
   - 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** **(12)**
   - 3.1 Properties of metals
   - 3.2 Free electron model (Drude and Lorentz model)
   - 3.3 Electrical, Thermal conductivity of metals and Wiedemann-Franz relation
   - 3.4 Sommerfeld's theory
   - 3.5 Fermi-Dirac distribution
   - 3.6 Fermi energy, degeneracy and non-degeneracy of metals.

4. **Band Theory of Solids** **(12)**

4.1 Formation of bands in solids (PE, KE and total energy of electron in an 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-Penney 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 **(08)**

5.1 Magnetic terminology

5.2 Classification of magnetic materials

5.2.1) Diamagnetic materials

5.2.2) Paramagnetic materials

5.23) Ferromagnetic materials

5.2.4) Anti-ferromagnetic materials

5.2.5)Ferri-magnetic material and ferrites

5.3 Energy loss in the hysteresis

6. Superconductivity **(08)**

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 Applications of superconductors

Reference Books:

1. Introduction to Solid State Physics – Charles Kittel (Wiley)
2. Solid State Physics – S. O. Pillai (NEW AGE INTERNATIONAL PUBLISHERS)
3. Solid State Physics – A. J. Dekker (Laxmi Publications)
4. Solid State Physics – R. K. Puri, V.K. Babbar (S. Chand)
5. Solid State Physics – R. L. Singhal (KNRN Publication)
6. Fundamentals of Solid State Physics – Saxena B. S. and Gupta R.C. (Pragati Prakashan)

B.Sc. III, Physics, Semester-V

DSE 1G

Paper – XI: Classical Mechanics

Credits: 04

Unit No: 1. Mechanics of a particle and system of particles (10)

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

Unit No: 2. Lagrangian Formulation (12)

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

Unit No: 3. Moving Coordinate systems (10)

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 Problems

Unit No: 4. Techniques of Calculus of Variation (10)

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

Unit No: 5. Coupled Oscillations (10)

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

Unit No: 6. Motion of rigid body (08)

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. Classical Mechanical: Gupta, Kumar and Sharma

5. Classical Mechanics: P.V. Panat

B.Sc. III, Physics, Semester-V

DSE – 1A

Paper-XII: Nuclear Physics

Credits: 04

1. Nuclear Structure and Properties

(12)

1.1 Composition of nucleus
1.2 Nuclear radius
1.3 Nuclear spin
1.4 Nuclear magnetic moment
1.5 Electric quadrupole 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 **(08)**

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 **(10)**

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 **(10)**

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 **(10)**

5.1 Alpha decay- α disintegration energy

5.2 α particle spectra

5.3 Nuclear energy levels

5.4 Beta 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 (10)

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 Publishing Co.)
3. Nuclear Physics : D.C. Tayal (Himalayan Publishing House)
4. Nuclear Physics : J.B. Rajam (S. Chand Publishing 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

B.Sc. III, Physics, Semester V

Skill Enhancement Course

SEC 2

Skill Course

Credits: 04

***List of Skill Enhancement Courses**

1) Certificate course in Testing and Repairs of Electric Appliances.

2) Thin film deposition and Characterization Techniques.

3) Scientific Research paper writing and Publications.

4) Medical Physics.

5) Energy Resources.

6) Python

B.Sc. III, Physics, Semester VI

DSE 1 H

Physics Paper- XIII: Electrodynamics

Credits: 04

1. Electrostatics and Charged particle dynamics (10)

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 particle in constant electric (E) field

1.6 Motion of charged particle in constant magnetic (B) field

1.7 Motion of charged particle in constant crossed uniform electric and magnetic fields

2. Time varying fields (10)

2.1 Electromotive force

2.2 Electromagnetic induction-Faraday's laws

2.3 Lenz's law

2.4 Integral & Differential forms of Faraday's laws

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 (12)

3.1 Magnetic Susceptibility and permeability

3.2 Biot - Savart law

3.3 Derivation of $\nabla . \vec{B} = 0$

3.4 Ampere's law

3.5 Derivation of $\nabla \times \vec{B} = \mu_0 J$ 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 (10)

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 (10)

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 (08)

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

B.Sc. III –Physics, Semester-VI

DSE 1 I

Paper XIV: Materials Science

Credits: 04

1. **Materials and their properties:** **(10)**
   - 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:** **(10)**
   - 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:** **(10)**
   - 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: **(08)**

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: **(08)**

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 vapors 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 vapors 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.

B.Sc. III –Physics, Semester-VI

DSE 1 J

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

Credits: 04

1. Atomic Spectra **(10)**

1.1 Review of quantum numbers

1.2 Electronic configuration of alkali metals

1.3 Spectral notations with examples

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 **(10)**

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 **(12)**

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 (08)

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)

5.1Particle in a Box (one and three dimensional cases), its Eigen values and Eigen functions.

5.2Step Potential (Statement, boundary conditions, Schrodinger's equations in different regions and discussion of results)

5.3 Potential Barrier (Statement, boundary conditions, Schrodinger's equations indifferent 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 (10)

6.1 Operators in quantum mechanics

6.2 Expectation values and properties

6.3 Angular momentum operators

6.4 Commutation properties for components Lx, Ly, Lz

6.5 Commutation for L^2 and Lz 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 – Mathews and Venkateshan
5. Introduction to Quantum Mechanics - Pauling and Wilson
6. Elements of Quantum Mechanics - Kamal Singh and S.P. Singh.
7. Perspectives of Modern Physics – Arthur Beiser
8. Quantum Mechanics – Chatwal Anand
9. Quantum Mechanics – I , The fundamentals- S. Rajasekar, R. Velusamy

B.Sc. III –Physics, Semester-VI

DSE 2A

Paper- XVI: Electronics

Credits: 04

1. Operational Amplifier: **(10)**

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: **(08)**

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

- 2.3.1 Linear ramp generator
- 2.3.2 Square wave generator
- 2.3.3 Voltage to frequency converter

3. Silicon Controlled Rectifier (SCR) **(10)**

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 **(08)**

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 **(12)**

5.1 Classification of Displays

5.2 Light emitting Diode displays

5.3 Liquid Crystal Displays and its Important Features

5.4 Other displays

5.4.1 Gas Discharge plasma Displays

5.4.2 Electrophoretic Image Displays (EPID)

5.4.3 Liquid Vapour Display (LVD)

6. Field Effect Transistor **(12)**

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.)
7. Electronic Instrumentation – H. S. Kalsi

B. Sc. Part III Physics Practical

Group-I

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. Resonating pendulum

Group-II

1. Crystallography and study of XRD pattern
2. Hall effect
3. e/m by Thomson method
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. Calibration of bridge wire by Carey Foster's bridge method.
10. Absolute capacitance of condenser by BG method.

Group-III

1. Cardinal points by Newton's method
2. Cardinal points by turn method
3. Lloyd's single mirror
4. Transverse and spherical aberration of thick lens
5. Diameter of a Lycopodium powder
6. Resolving power of prism
7. Elliptically and circularly polarized light
8. Diffraction due to straight edge.
9. Dispersive Power of grating
10. Y by Cornu's method

Group-IV

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. Astable Multivibrator using IC555
7. OP-AMP as inverting amplifier
8. OP-AMP as comparator –Schmitt's trigger
9. RS and JK flip flops
10. Study of mono-stable operation of IC 555

Note: At least 8 experiments must be completed from each group.

(Group-I to 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
