SEMESTER - IV

CORE PAPER - X

NUCLEAR AND PARTICLE PHYSICS

Instructional Hrs. :90 **Sub. Code : 16PHPC410**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Thermodynamics .To make them prepare for state & national level physics examinations.

Unit -I **18 Hrs.**

Nuclear force and Binding

Properties of Nuclear Force - Ground state properties of Deuteron - Square well solution of Deuteron - Low energy, neutron proton scattering - Limits of energy for the scattering of different partial waves - Binding energy - Weizacker's semi empirical mass formula - Application of semi empirical formula for alpha decay - mass parabola for stability of nuclei against beta decay - Evidence of shell effects - Single particle energy levels for infinite square well, harmonic oscillator with spin orbit potential - Application of shell model for spin and parity

Unit -II **18 Hrs.**

Radioactive disintegration

Properties of radioactive rays - Law of radioactivity - Half life and mean life-Radioactive equilibrium - Radioactive series - Range of alpha particles - Alpha spectrum and Fine structure - Alpha-Particle Disintegration Energy- Gamow's theory of Alpha decay - Energetics of Beta decay - Beta-Ray Spectra- Pauli's neutrino hypothesis - Properties of neutrino - Gamma emission - Selection rules - internal conversion - Fission process on the basis of liquid drop model - Nuclear fission energetics - Stability limits against spontaneous fission - Potential for fission - Bohr-Wheeler model

Unit -III **18 Hrs.**

Nuclear reactions

Types of nuclear reaction - Conservation laws in nuclear reactions - Balance of Mass and Energy in nuclear reactions - The Q equation and its solution - Proton, deuteron, neutron and alpha induced reactions - Cross section of nuclear reactions - Separation of center of mass motion in two body problem - Partial wave method for scattering and reaction cross section - Compound nucleus hypothesis -Breit Wigner one level formula

Unit -IV **18 Hrs.**

Neutron Physics and detectors

Properties of neutron - Classification of neutrons according to energy - Sources of neutron - Neutron detectors - Neutron multiplication and fission chain reaction - Four factor formula - Reactor materials - Geiger Muller counter -Semi conductor detectors (Diffused junction detector, Surface barrier detector) - Uses of semiconductor detectors - Scintillation detector

Unit- V **18 Hrs.**

Particle Physics

Meson Physics - Yukawa's hypothesis - Properties of Pi mesons - Classification of elementary particles -- Particle Interaction types - Feynman diagram for electromagnetic interaction, np interaction, weak decays - Symmetry and Conservation laws - Energy and momentum - Angular momentum - Parity - Baryon number - Lepton number - Isospin - Strangeness and Charm - Quark model - Isospin versus strangeness chart (Super multiplet) of mesons and baryons, three quark triplet, quark anti quark couplings

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **S.N. Ghosal**,*Nuclear Physics*, S. Chand Company Ltd (2010)
2. **D.C. Tayal**,*Nuclear Physics*, Himalaya Publishing House Ltd.,
3. **Pandya and Yadav,** *Elements of Nuclear Physics*, Nath & Co, Meerut, 1983,

REFERENCE BOOKS

1. **S.B. Patel,** *Nuclear Physics an Introduction*, New Age international Publishers, 2009
2. **K.S. Krane,** *Introductory Nuclear Physics*, Wiley India Ltd.,
3. **I. Kaplan**,*NuclearPhysics*s, Narosa Publishing House 2002

SEMESTER - IV

CORE PAPER - XI

MOLECULAR SPECTROSCOPY

Instructional Hrs. :90 **Sub. Code : 16PHPC411**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Spectroscopy .To make them prepare for state & national level physics examinations.

Unit-I **18 Hrs.**

Microwave and Raman Spectroscopy

Rotation of molecules and their spectra - diatomic molecules - intensity of line spectra - the effect of isotropic substitution - non-rigid rotator and their spectra - polyatomic molecules (linear and symmetric top molecules) - Classical theory of Raman effect - pure rotational Raman spectra (linear and symmetric top molecules).

Unit-II **18 Hrs.**

Infra-red and Raman Spectroscopy

The energy of diatomic molecules - Simple Harmonic Oscillator -the Anharmonic oscillator - the diatomic vibrating rotator - vibration-rotation spectrum of carbon monoxide - breakdown of Born-Oppenheimer approximation - the vibrations of polyatomic molecules - influence of rotation on the spectra of polyatomic molecules (linear and symmetric top molecules) - Raman activity of vibrations - vibrational Raman spectra - vibrations of Spherical top molecules.

Unit-III **18 Hrs.**

Electronic Spectroscopy of Atoms

Electronic wave function and atomic quantum numbers - hydrogen spectrum -orbital, spin and total angular momentum - fine structure of hydrogen atom - many electron spectrum: Lithium atom spectrum, angular momentum of many electrons - term symbols - the spectrum of helium and alkaline earths - equivalent and non equivalent electrons -basics of X-ray photoelectron spectroscopy.

Unit-IV **18 Hrs.**

Electronic Spectroscopy of Molecules

Diatomic molecular spectra: Born-Oppenheimer approximation - vibrational spectra and their progressions - Franck-Condon principle - dissociation energy and their products - rotational fine structure of electronic-vibration transition - molecular orbital theory - the spectrum of

molecular hydrogen - change of shape on excitation - chemical analysis by electronic spectroscopy - reemission of energy -fundamentals of UV photoelectron spectroscopy.

Unit-V **18 Hrs.**

Spin Resonance Spectroscopy

Spin and magnetic field interaction - Larmor precession - relaxation time - spin-spin relaxation - spin-lattice relaxation - NMR chemical shift - coupling constants - coupling between nuclei -chemical analysis by NMR - NMR for nuclei other than hydrogen - ESR spectroscopy - fine structure in ESR.

Note :*Italics* denotes Self Study Topics

TEXT BOOKS

1.**Aruldhas.G**, *Molecular structure and spectroscopy*, PHI Learning Pvt Ltd, New Delhi,2008.

REFERENCE BOOKS

1. **Gupta., Kumar., Sharma**., *Spectroscopy*, Pragati Prakashan, Meerut, 2006.
2. **Gurdeep R.Chatwal,***Spectroscopy(Atomic and Molcular),*Himalaya Publishing House, New Delhi,2006.
3. **Straughan and S.Walker**.,*Spectroscopy,* Vol 1, 2, 3, Chapman & Hall, Chennai, 1976.
4. **Banwell**. **C.N.**,*Spectroscopy*,, III edition, Tata McGraw Hill, New Delhi, 1980.
5. **Barrow**. **G.M.**, *Introduction to molecular spectroscopy* , Tata McGraw Hill, New Delhi, 1962.

SEMESTER-IV

CORE PRACTICAL - IV

SPECIAL ELECTRONICS

Inst.Hrs:120 **Sub.Code:16PHPCP04**
Max.Marks: CIA-40; ESE-60 **Credits: 4**

Any Twelve Experiments

1. OP-Amp : Circuits using diodes - Half wave, full wave, clipper and clamper
2. IC 555 timer application - Monostable and AstableMultivibrator
3. A/D Converters - any one method.
4. D/A Converters - Binary weighted and Ladder methods
5. Modulation Counter
6. 7473 -Up/Down Counter ,Shift Register, Ring Counter and Johnson Counter
7. Instrumentation amplifier
8. Tunnel diode - characteristics
9. Square and Square root of a single byte , two digit BCD number.
10. Code Conversions - (i) Decimal to Hexadecimal (ii) Hexadecimal to Decimal (iii) Hexadecimal to ASCII and (iv) ASCII to Hexadecimal.
11. Largest /Smallest number in an array and Ascending / descending order of N numbers.
12. LED Interfacing.
13. Stepper Motor Interfacing.
14. Traffic control simulation.
15. Hex Key board interfacing.
16. Musical Tone Generator.
17. ADC Interface.
18. DAC Interface.