KRISHNA UNIVERSITY

MACHILIPATNAM

PG SYLLABUS

M.SC PHYSICS –R 2012

IV SEMESTER SYLLABUS & MODEL PAPERS

KRISHNA UNVIERSITY

MACHILIPATNAM-521001

COURSE STRUCTURE FOR M.Sc PHYSICS (W.E.F 2012-13)

III SEMESTER

CORE PAPERS

PHY 301: COMPUTATIONAL METHODS AND PROGRAMMING

PHY 302: ADVANCED QUANTUM MECHANICS

PHY 303: MOLECULAR PHYSICS

PHY 304: CONDENSED MATTER PHYSICS

IV SEMESTER

PHY 401: NUCLEAR AND PARTICLE PHYSICS

PHY 402: ANALYTICAL TECHNIQUES

PHY 403: ADVANCES IN MATERIALS SCIENCE

PHY 404: CONDENSED MATTER PHYSICS(SPECIAL)

KRISHNA UNIVERSITY
MACHILIPATNAM-521001.

(REGULATION 2012-2013)

M.SC. PHYSICS (IV SEMESTER)

PAPER-I : NUCLEAR AND PARTICLE PHYSICS PHY 4.1

UNIT-I :

INTRODUCTION: Objective of studying Nuclear Physics, Nomenclature, nuclear radius, Mass & Binding energy, Angular momentum, Magnetic dipole moment, Electric quadrupole moment, parity and symmetry, Domains of instability, Energy levels, Mirror nuclei.

NUCLEAR FORCES : Characteristics of Nuclear Forces- Ground state of deuteron, scattering cross-sections, qualitative discussion of neutron-proton and proton- proton scattering at low energies- charge independence, spin dependence and charge symmetry of nuclear forces - exchange forces and tensor forces- Meson theory of nuclear forces(Yukawa's Potential).

UNIT-II :

NUCLEAR MODELS : Weisazacker's semi-empirical mass formula- mass parabolas- Liquid drop model -Bohr –Wheeler theory of nuclear fission - Nuclear shell model : magic numbers, spin orbit interaction, prediction of angular momenta and parities for ground states, Collective model., More-realistic models

NUCLEAR DECAY : Alpha decay process, Energy release in Beta-decay, Fermi's theory of Beta- decay, selection rules, parity violation in Beta-decay, Detection and properties of neutrino, energetics of Gamma decay, selection rules, angular correlation, Mossbauer effect.

UNIT-III :

NUCLEAR REACTIONS : Types of reactions and conservation laws, Nuclear kinematics - the Q – equation, Threshold energy- Nuclear cross section

NUCLEAR ENERGY : Nuclear fission- energy release in fission- Stability limit against spontaneous fission, Characteristics of fission, delayed neutrons, Nuclear fusion, prospects of continued fusion energy. Four factor formula for controlled fission (nuclear chain reaction)- nuclear reactor- types of reactors.

UNIT-IV : ELEMENTARY PARTICLE PHYSICS

Classification - Particle interactions and families, symmetries and conservation laws (energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness quantum number) Discovery of K-mesons and hyperons (Gellmann and Nishijima formula) and charm, Elementary ideas of CP and CPT invariance, SU(2), SU(3) multiplets, Quark model. CP violation−Ko- Ko system

UNIT-V :

ACCELERATORS: Electrostatic accelerators, cyclotron accelerators, synchrotrons, linear accelerators, colliding beam accelerators.

Applications : Trace Element Analysis, Rutherford Back-scattering, Mass

spectrometry with accelerators, Diagnostic Nuclear Medicine, Therapeutic Nuclear Medicine.

TEXT BOOKS : Nuclear Physics by D.C.Tayal, Himalaya publishing Co.,

Introductory Nuclear Physics Kenneth S. Krane

Reference Books:

1. Introduction to Nuclear Physics by Harald A.Enge
2. Concepts of Nuclear Physics by Bernard L.Cohen.
3. Introduction to High Energy physics by D.H. Perkins
4. Introduction to Elementary Particles by D. Griffiths
5. Nuclear Physics by S.B.Patel, Wiley Eastern Ltd.,
6. Fundamentals of Nuclear Physics by B.B. Srivastava , Rastogi

NOTE: Question paper contain 5 questions with internal choice have to be set from each unit

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KRISHNA UNIVERSITY

MACHILIPATNAM-521001.

(Regulation 2012-2013) MODEL PAPER

SEMESTER – IV

PAPER – I NUCLEAR AND PARTICLE PHYSICS PHY 4.1

Time : 3 Hrs Max

Marks:70

Answer All questions

All questions carry equal marks

1 (a) Explain how is nuclear radius and binding energy related to mass number
(b) Explain magnetic dipole moment and electric quadrupole moment of nuclei

Or

(c) Explain the "parity" and "symmetry" of the nuclei.
(d) Discuss the Yukawa's theory of meson exchange.

2 (a) Discuss the formulation of Weisazacker's semi empirical masss formula and obtain the condition for stable isotope.
(b) Explain the significance of study of mass parabolas.

Or

(c) Briefly explain the features of shell model.
(d) Explain the detection and properties of neutrino.

3 (a) Mention the different types of nuclear reactions
(b) Explain the significance of the Q- value of a nuclear reaction

Or

(c) Explain the four factor formula for controlled fission.
(d) Derive the stability limit against spontaneous fission/

4 (a) Discuss the Baryon number and Lepton number.
(b) Explain the elementary ideas of CP and CPT invariance

Or

(c) Explain the properties of elementary particles.
(d) Explain SU(2) and SU(3) multiplets

5 (a) Explain the working of cyclotron accelerator

Or

(b) Explain the Rutherford back scattering experiment
(c) Mention the Diagnostic nuclear medicines.

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KRISHNA UNIVERSITY
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M.Sc., PHYSICS (IV SEMESTER)

PAPER – II ANALYTICAL TECHNIQUES PHY 4.2

UNIT – I

NMR Theory , Basic principles, Nuclear spin and Magnetic moment, Relaxation mechanism, Spin lattice and Spin-spin relaxation times by pulse methods, Bloch's equations and solutions of Bloch's equations, Experimental methods, CW NMR spectrometer.

UNIT – II

Electron spin resonance – Spectrometer, Experimental methods, Thermal equilibrium and Relaxation methods, Characteristics of g and A values, Unpaired electron, Fine structure and Hyperfine structure.

UNIT – III

Nuclear Quadra pole Resonance spectroscopy, the fundamental requirements of NQR spectroscopy, General principles, Integral spins and Half integral spins, Experimental detection of NQR frequencies, Block diagram of NQR spectrometer – Experimental methods of SR oscillator, CW oscillator, pulse methods.

UNIT – IV

Photo electron spectroscopy, its theory, Instrumentation and Applications, Energy Dispersive Spectra (EDS), Auger Electron Spectroscopy (AES), Scanning Electron Microscope, Transmission Electron Spectroscope, Differential Scanning Calorimeter, Differential Thermal Analysis and Thermal Gravimetric Analysis.

UNIT – V

Mossbauer Spectroscopy: The Mossbauer effect, Recoilless Emission and Absorption, The Mossbauer Spectrometer, Experimental methods, Chemical shift, Magnetic Hyperfine interactions.

BOOKS:

1. Nuclear Magnetic Resonance by E. R. Andrews, Cambridge University press.
2. Spectroscopy by B.P. Stranghan and S.Walker, Volume – I
3. Pulse and Fourier Transform NMR by T. C. Farrar and E.D. Becker, Academic Press 1971.
4. Mossbauer Spectroscopy – M.B. Bhide.

KRISHNA UNIVERSITY
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MODEL PAPER
M.Sc., Degree Examination A pril – 2014

Semester – IV :Physics
PAPER – II- ANALYTICAL TECHNIQUES PHY 4.2

Time: 3 hrs. Max. Marks: 70

Answer all questions.

1. a) Explain the principle of NMR spectroscopy.
   b) With the help of a neat block diagram explain the principle and working of NMR Spectrometer.

   Or

   c) Derive Bloch's equations and obtain their solutions.

2. a) Explain the principle of ESR spectroscopy.
   b) Explain the principle and working of ESR spectrometer with the help of neat diagram.

   Or

   c) Explain fine structure and hyperfine structure in ESR Spectrum.
   d) Explain the characteristics of g and A values.

3. a) Give the general principle and fundamental requirements of NQR spectroscopy.
   b) Explain the working of SR oscillator with a neat block diagram.

   Or

   c) Write short notes on integral and half integral spins.

4. a) Explain the theory of photo electron spectroscopy..
   b) Give the applications of photo electron spectroscopy.

   Or

   c) Explain the principle and working of Scanning electron microscope.
   d) Explain the principle and working of Differential scanning calorimeter.

5. a) Explain recoilless emission and absorption.
   b) Explain the working of mossbauer spectrometer.

   Or

   c) Write notes on chemical shift and magnetic hyperfine interactions

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Regulation (2012-2013)
M.SC. PHYSICS (IV SEMESTER)

PAPER-III -ADVANCES IN MATERIALS SCIENCE PHY 4.3 (PHY 40312)

Unit-I

Classification of Materials: Types of materials, Metals, Ceramics (and glasses) polymers, composites, semiconductors.

Metals and alloys: Phase diagrams of single component, binary and ternary systems, diffusion, nucleation and growth. Diffusional and diffusionless transformations. Mechanical properties. Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

Unit-II

Glasses : The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials.

Applications of Glasses: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

Unit-III

Biomaterials - Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants**:** Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants: Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

Unit-IV

Liquid Crystals: Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, Few applications of liquid crystals.

Nanomaterials: Different types of nano crystalline materials: nano crystalline metals, nano crystalline ceramics, Mesoporous materials, Carbon nanotubes, nano-coatings, zeolites, quantum dot lasers, Nano structured magnetic materials.

Unit – V

Synthesis of nanomaterials: Vacuum synthesis, sputtering, laser ablation, liquid metal ion sources, Gas-Phase synthesis, condensed-phase synthesis **Characterization methods**: XRD and TEM, **Properties of Nanostructure materials**: Electrical and mechanical properties, Optical properties by IR and Raman spectroscopy. Applications of nanomaterials

BOOKS:

1 Inorganic solids by **D. M. Adams** (John-Wiley)
2 Physics of Amorphous Materials by **S.R.Elliott**.
3 Phase transformation in metal and alloys, **D. A. Porter and K. E. Easterling**
4 Fundamental of thermotropic liquid crystals by **deJen and Vertogen**
5 Nanocrystalline materials (Review article from Progress in Materials Science) - **H. Gleiter**
6 Introduction to Biomaterials Science and Engg. by **J.B. Park**
7 Materials Science and Engg. by **C. M. Srivastava**

KRISHNA UNIVERSITY
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M.Sc. DEGREE EXAMINATION, Model Paper
Fourth Semester
Physics
PAPER-III ADVANCES IN MATERIALS SCIENCE **PHY 4.3 (PHY 40312)**
Time : Three hours Maximum : 70 marks

Answer ALL questions. One from each unit.
All questions carry equal marks.

1. (a) Classify different types of materials and explain about them.
(Or)
(b) Describe the different types of diffusional transformation in solids with suitable diagrams.

2. (a) Discuss the various theories of glass formation or glass transition. Describe the factors that determine glass transition temperature.
(Or)
(b) Discuss the any two applications of glasses.

3. (a) What are implant materials, discuss about stainless steel and Ti based alloy implants.
(Or)
(b) Explain about different surgical tapes, sutures, adhesives used in surgery.

4. (a) Explain different liquid crystalline phases and their phase transitions
(Or)
(b) Write a note on Carbon nanotubes and Mesoporous mateirials

5. (a) Discuss the synthesis of nanoparticles by gas phase synthesis and sputtering.
(Or)
(b) Discuss the characterization of nano particles by IR and Raman spectroscopy.

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M.Sc, PHYSICS (IV SEMESTER)
PAPER-IV CONDENSED MATTER PHYSICS (SPECIAL) PHY 4.4

UNIT- I

Crystal growth techniques: Bridgeman-Czochralski-liquid encapsulated czochralski(LEC) growth technique-zone refining and floating zone growth-chemical vapour deposition (CVD)-Molecular beam epitaxy(MOVPE)-vapour phase epitaxy-hydrothermal growth-Growth from melt solutions-Flame fusion method.

UNIT- II

Superconductivity-Introduction: The Meissner effect –- Isotope effect- specific heat-thermal conductivity and manifestation of energy gap. Vortices, type I and type II superconductors, Quantum tunnelling-Cooper pairing due to phonons, BCS theory of superconductivity.

UNIT-III

Applications of Superconductivity: Ginzsburg-Landau theory and application to Josephson effect: d-c Josephson effect, a-c Josephson effect, macroscopic quantum interference, applications of superconductivity-high temperature superconductivity (elementary).

UNIT- IV

Dielectrics

Macroscopic description of the static dielectric constant , The static electronic and ionic polarizabilities of molecules , Orientational Polarization, The static dielectric constant of gases. The internal field according to Lorentz, The static dielectric constant of solids, Clasius -Mosetti equation The complex dielectric constant and dielectric losses, Dielectric losses and relaxation time, Cole-Cole diagrams. The classical theory of electronic polarization and optical absorption.

UNIT -V

Ferroelectrics

General properties of ferroelectric materials. Classification and properties of representative ferroelectrics, the dipole theory of ferroelectricity, objections against the dipole theory, Ionic displacements and the behaviour of BaTiO3 above the curie temperature, the theory of spontaneous polarization of BaTiO3. Thermodynamics of ferroelectric transitions, Ferroelectric domains.

Text Books:

1. Solid State Physics by A.J. Dekker (Macmillan)
2. Solid State Physics by C. Kittel
3. Solid state Physics by Guptha Kumar and Sarma

NOTE : Question paper contains 5 questions with internal choice have to be set from each unit

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KRISHNA UNIVERSITY
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M.Sc.DEGREE EXAMINATION
MODEL QUESTION PAPER
Fourth Semester
Physics
PAPER-IV CONDENSED MATTER PHYSICS (SPECIAL)
(PHY40412) PHY 4.4 (Regulation 2012-2013)

Time:Three hours Maximum:70 marks

Answer ALL questions. One from each unit.
All questions carry equal marks.

1. (a) Describe the Czochralski and Bridgeman techniques of growth of crystals from melt.

Or

(b) Describe in detail the Molecular beam epitaxy (MOVPE) technique in growing single crystals.

2. (a) What are Cooper pairs? How are they formed?
(b) Explain the BCS theory of superconductivity.

Or

(c) What are Meissner and Isotopes effects?
(d) Explain Type-I and Type-II Superconductors.

3. (a) Explain the Ginzsburg –Landau theory and application to Josephson effect.

Or

(b) Dicsuss the applications of Superconductivity.
(c) Explain high Tc Superconductivity.

4. (a) What is meant by local field and internal field in solid dielectrics?
(b) Obtain clasius-mosotti equation.

Or

(c) Explain the terms complex dielectric constant and dielectric loss.
(d)Discuss briefly classical theory of electronic polarization.

5. (a) Explain the chief characteristics of ferroelectric materials.
(b) Explain the objections against the dipole theory.

Or

(c) Explain the behaviour of Barium Titanate above the Curie temperature.
(d) Discuss ferroelectric domains.

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