KRISHNA UNIVERSITY

MACHILIPATNAM

PG SYLLABUS

M.Sc PHYSICS –R 2012

III 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)

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(REGULATION 2012-2013)

M.SC. PHYSICS (III SEMESTER) SYLLABUS

Paper-I : COMPUTATIONAL METHODS AND PROGRAMMING PHY 301

UNIT-I :

(a) Fundamentals of C Language :C character set-Identifiers and Keywords-Constants-Variables-Data types-Declarations of variables –Declaration of storage class-Defining symbolic constants –Assignment statement.

(b)Operators: Arithmetic operators-Relational Operators-Logic Operators-Assignment operators- Increment and decrement operators –Conditional operators.

UNIT –II :

(a)Expressions and I/O Statements Arithmetic expressions –Precedence of arithmetic operators-Type converters in expressions –Mathematical (Library) functions –Data input and output-The getchar and putchar functions –Scanf – Printf-Simple programs.

(b) Control statements: If-Else statements –Switch statements-The operators –GO TO – While, Do-While, FOR statements-BREAK and CONTINUE statements.

UNIT –III :

(a)Arrays : One dimensional and two dimensional arrays –Initialization –Type declaration-Inputting and outputting of data for arrays –Programs of matrices addition, subtraction and multiplication

(b)User Defined functions: The form of C functions –Return values and their types –Calling a function – Category of functions. Nesting of functions. Recursion. ANSI C functions-Function declaration. Scope and life time of variables in functions.

UNIT-IV

(a) Linear and Non –linear equations:

Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms

(b) Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss

Seidel iterative methods-Basic principles- Formulae-Algorithms

UNIT-V :

(a) Interpolations:

Concept of linear interpolation-Finite differences-Newton‘s and Lagrange‘s interpolation formulae-principles and Algorithms

(b) Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor‘s series-Numerical integration-Trapezoidal and Simpson‘s 1/3 rule-Formulae-Algorithms

Text and Reference books:

1. Introductory methods of Numerical Analysis **:** Sastry
2. Numerical Methodes : Balagurusamy
3. Programming in ANSI C (TMH) : Balagurusamy
4. Programming with ‘C’-Byron Gottfried ,Tata Mc Graw Hill

5. Computer oriented Numerical Methodes -Rajaraman

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

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KRISHNA UNIVERSITY
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(Regulation 2012-2013)

MODEL PAPER

SEMESTER-III

PAPER –I COMPUTATIONAL METHODES AND PROGRAMMING PHY 301

Time : 3 Hrs **Max Marks : 70**

Answer All questions
All question carry equal marks

1. (a) Explain different operators used in 'C' language
   (b) Write a 'C' programme to convert the Fahrenheit temperature to centigrade
   Or
   (c) Discuss the different data types used in 'C' language
   (d) Explain the Declaration of storage class.

2 (a)Illustrate the use of 'while loop' with a flow chart. Write a programme to find the average heights of students in a class using 'while' loop

Or

(b) Explain the statements (i) GOTO (ii)FOR (iii) BREAK (iv) CONTINUE ,with examples.
Write a 'C' programme to find out the roots of a quadratic equation

3 (a) Explain One dimensional and Two dimensional arrays ,with examples.
Or
(b) Write a C-programme for multiplication of two Matrices

4 (a) Explain bisection method. Write a computer oriented programme and the algorithm to find the smallest positive root of the equation $f(x) = 0$,using bisection method.

Or

(b) Explain Gauss-Sidel iterative method for solving simultaneous algebraic eqtions.Write a computer oriented algorithm and the corresponding programme to solve a system of linear algebraic equations
Using Gauss-Sidel method.

5 (a)Explain the Lagrange's interpolation formula Write a computer oriented algorithm to interpolate and extrapolate using given pairs of values of 'x' and 'y' by Newton's backward interpolation formula.

Or

(b) Explain how you obtain Trapezoidal rule true Newton-cote's quad ration formula. Write a computer oriented algorithm and corresponding C programme to evaluate a $\int f(x)dx$ numerically ,unit Trapezoidal rule

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M.Sc., physics (III semester) 2012-13

Paper – II Advanced Quantum Mechanics PHY 3.2

Relativistic quantum mechanics:

Unit –I

Klein-Gordon equation- continuity equation(probability and curretn density)- Klein-Gordon equation in the presence of electromagnetic field - Dirac equation for a free particle - probability and current density - constants of motion- Dirac equation in presence of electromagnetic field.

Unit-II

Hydrogen atom-covariant notation-covariance of Dirac equation - Invariance of Dirac equation under Lorentz transformation- Pure rotation and Lorentz transformaton- Charge conjugation - Hole theory and Charge conjugation - Projection operators for energy and spin – Bilinear covariants - Dirac equation for Zero mass and spin half particles.

Field Quantisation:

Unit III

Introduction for quantisation of fields- Concept of field - Second quantisation - Hamiltonian formulation of classical field - Quantum equations of the field - Real scalar field - Schrodinger field- Quantisation of real scalar field and schrodinger field- Quantisation of complex scalar field.

Unit IV

Dirac field - Quantisation of Dirac field, Maxwell's field- Quantisation of Maxwells field - A brief introduction to charge and mass renormalization, Bethes treatment of Lamb shift.

Unit V

The hamiltonian in a radiation field – the interaction term in the semi classical theory of radiation- Quantisation of radiation field. Covariant perturbation theory, S matrix expansion in the interaction picture, Feynmann diagrams and Feymann rules for QED. Thompson scattering, Compton Scattering and Moller scattering.

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M.Sc., Degree Examination, November /December 2013.

III semester, Physics

Paper II – Advanced quantum mechanics (model paper)

Time : 3 hrs Max.marks:70

Answer all questions. All questions carry equal marks.

1. a) Obtain the continuity equation in Klein – Gordon relativistic theory. Discuss the drawbacks of this theory.

   b) Obtain klein – Gordon equation for a charged particle moving in an electromagnetic field.

   Derive expressions for charge density and current density.

   (OR)

   c) Explain Dirac's proposal to overcome the drawbacks of Klein-Gordon theory. Obtain Dirac's Hamiltonian for a free particle.

   d) Discuss the properties of Dirac's α and β matrices.

2. a) Apply Dirac's theory to the electron and prove that electron has a spin $h/2\pi$.

   b) Explain the significance of the terms charge conjugation and hole theory.

   (OR)

   c) Obtain covariant form of Dirac equation.

   d) Discuss the properties of Dirac's Υ matrices.

3) a) Explain the concept of field quantisation and discuss the Hamiltonian formulation of

   Classical field.

   b) Discuss the quantisation of real scalar field.

   (OR)

   c)Expain the second quantisation procedure applied to the case of a Bose-Einstein system.

4) a) Discuss the quantisation of Dirac field.

   b) Discuss the quantisation of maxwell field.

   (OR)

   c) Write notes on charge and mass renormalization.

5) a) Discuss the quantisation of radiation field.

   (OR)

   b) Give a brief account of Co-variant perturbation theory and its applications.

   c) Write notes on Thompson and Compton scattering.

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M.SC. PHYSICS (III SEMESTER)

PAPER-III MOLECULAR PHYSICS PHY 3.3 (PHY 30312)

UNIT - I

Molecular States : Molecular Quantum numbers and classification of electronic states. Hund's coupling cases 'a' and 'b'. Symmetry adapted linear combination (SALC) of atomic orbitals of individual atoms and the resulting molecular orbitals, electronic configuration and ground states of linear molecules H_2 , C_2 , N_2 ,O_2 and CO_2 and non-linear molecules H_2CO and H_2O. Symmetry properties of electronic and rotational levels. (Ch. 6.2, 6.3)

UNIT - II

ROTATIONAL SPECTROSCOPY: Microwave spectrum of a diatomic molecule. Rigid rotator and non-rigid rotator approximations. The effect of isotopic substitution. Vibrational satellites. Moment of Inertia and bond lengths of diatomic and linear tri-atomic molecule. Quantum theory and mechanism of Raman scattering. Rotational Raman spectra. Symmetry properties of rotational levels of 1 states. Influence of nuclear spin and statistical weights on pure rotational Raman spectra of CO_2 , O_2 , H_2, D_2. (Ch. 1.3, 4.2, 4.4, 4.8)

UNIT-III

VIBRATIONAL SPECTROSCOPY: The vibrating-rotating diatomic molecule. Harmonic and anharmonic oscillator energy levels. Evaluation of rotational constants from Infrared spectra. Evaluation of rotational constants from Raman vibration–rotation spectra. Vibrational modes of CO2 and the influence of nuclear spin on Infrared and Raman vibration-rotation spectrum of CO2. (Ch. 5.1, 5.2.4)

UNIT-IV

MOLECULAR VIBRATIONS: C2v and C3v Character tables from the properties of irreducible representations. Relationship between reducible and irreducible representations. **C2V character table:** Symmetry types of translational, rotational and binary products. Reducible representation, vibrational modes and their activity (allowed and forbidden fundamentals, overtones and combination bands in IR and Raman) of H2O, NH3, and formaldehyde molecules.

UNIT – V

ELECTRONIC SPECTROSCOPY OF DIATOMIC MOLECULES:

Vibrational analysis of an electronic band system of a diatomic molecule. Progressions and sequences. Deslandres table and vibrational constants. Isotope effect in vibrational spectra and its applications.

Rotational analysis: Selection rules and rotational fine structure of vibronic transistions. The fortrat diagram and the band head. Combination relations and evaluation of rotational constants for bands (1 - 1) having only P and R branches. Ch. *6.2.*

Books:

Molecular spectra and Molecular Structure (van Nostrand) – G. Herzberg
High resolution Spectroscopy (Butterworths) J.M.Hollas.
Introduction to Atomic Spectra – H.E. White (T)
Fundamentals of molecular spectroscopy – C.B. Banwell (T)

Note : Question paper contains 5 questions of equal marks with internal choice to be set from each unit.

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M.Sc. DEGREE EXAMINATION, Model Paper

Third Semester Physics

Paper III – MOLECULAR PHYSICS PHY 3.3 (Phy 30312)

Time : Three hours Maximum : 70 marks

Answer ALL questions. One from each unit.

All questions carry equal marks.

(1) (a) Write down the ground state electronic configurations and term symbols of C_2 and N_2 molecules. Explain Hund's coupling case 'a'.

(Or)

(b) Write down the ground state electronic configuration and term symbols of H_2CO & H_2O. Explain Hund's coupling case 'b'.

(2) (a) Derive an expression for moment of inertia of a simple rigid diatomic molecule and hence discuss the rotational structure of such a molecule.

(Or)

(b) What are symmetry properties of rotational levels and discuss how nuclear spins and statistical weights could influence the rotational Raman spectra of diatomic molecule.

(3) (a) Outline the theory of vibrating-rotator.

(b) Evaluate the rotational constants from infrared spectra.

(Or)

(c) Discuss the influence of nuclear spin on IR and Raman vibration-rotation spectrum of CO_2

(4) (a) Define reducible and irreducible representations. Write the C_{2v}, C_{3v} character table from the properties of irreducible representations.

(Or)

(b) Describe the vibrational modes and their activity in case of H_2O and Formaldehyde (H_2CO) molecules.

(5) (a) Write a note on Deslandres tables and vibrational constants.

(Or)

(b) Discuss how rotational constants are evaluated for bands having only P and R branches.

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M.Sc. PHYSICS (III SEMESTER)
PAPER IV: CONDENSED MATTER PHYSICS (SPECIAL) PHY3.4

UNIT- I

Defects: Properties of metallic lattices and simple alloys: The structure of metals –classification of lattice defects. Configurational -entropy –The number of vacancies and interstitial as function of temperature –The formation of lattice defects in metals. Lattice defect in ionic crystals and estimation of concentration of defects in ionic crystals. Edge and screw dislocation The Frank read mechanism of dislocation multiplication.

UNIT- II

Optical Properties: Optical and thermal electronic excitation in ionic crystals, The ultraviolet spectrum of the alkali halides; excitons, Illustration of electron-hole interaction in single ions, Qualitative discussion of the influence of lattice defects on the electronic levels, Non stoichiometric crystals containing excess metal, The transformation of F centers into F1-centers and vice-versa, Photoconductivity in crystals containing excess metal, The photoelectric effect in alkali halides, Coagulation of F centers and colloids, Color centers resulting from excess halogen, Color centers produced by irradiation with X-rays.

UNIT- III

Luminescence: Luminescence General remarks, Excitation and emission, Decay mechanisms, Thallium-activated alkali halides, The sulfide phosphors, Electroluminescence.

UNIT- IV

Lattice Vibrations and Thermal Properties : Elastic waves in one dimensional array of identical atoms. Vibrational modes of a diatomic linear lattice and dispersion relations. Acoustic and optical modes. Infrared absorption in ionic crystals. Phonons and verification of dispersion relation in crystal lattices. Lattice heat capacity – Einstein and Debye theories. Lattice thermal conductivity- Phonon mean free path . Origin of thermal expansion and Gruneisen relation.

UNIT -V

Magnetic Properties of Solids

Quantum theory of Para magnetism, Crystal Field Splitting, Quenching of the orbital Angular Momentum Ferromagnetism Curie point and the Exchange integral, Saturation Magnetization at Absolute Zero, Magnons, Bloch's T3/2 law. Ferromagnetic Domains. Antiferromagnetism The two-sublattice model, Superexchage interaction Ferrimagnetism The structure of ferrites, The saturation magnetization, Elements of Neel's theory.
(Solid State Physics by C.Kittel Chapters 14 and 15)

Text and Reference Books

1. A.J. Dekker: Solid state physics
2. C. Kittel: Solid State Physics
3. S.O. Pillai: Solid State Physics

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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(PHY30412) PHY3.4

M.Sc.DEGREE EXAMINATION

MODEL QUESTION PAPER

Third Semester

Physics

PAPER-IV CONDENSED MATTER PHYSICS (SPECIAL)

(Regulation 2012-2013)

Time:Three hours Maximum:70 marks

Answer ALL questions.

1. (a) Classify various lattice defects and discuss about their configurations.

Or

(b) Explain the formation of lattice defects in metals.
(c) Explain the difference between edge and screw dislocations.

2. (a) Explain what do you know from the ultraviolet spectrum of the alkali halides?
(b) Write a note on electron-hole interaction in single ions.

Or

(c) What is photoelectric effect in alkali halides? Explain.
(d) What are colour centres? How are they produced?

3. (a) Explain Luminescence and various types of Luminescence.
(b) Discuss about the various decay mechanisms.

Or

(c) Discuss about Electroluminescence.
(d) Explain Thallium activated alkali halides.

4. (a) Explain the vibrational modes of a diatomic linear lattice
(b) Verify the dispersion relation in crystal lattices.

Or

(c) Briefly discuss the variation of specific heat capacity of solids with temperature.
(d) Explain lattice thermal conductivity and phonon mean free path.

5. (a) Bring out the importance of quantum theory of paramagnetism.
(b) Explain the quenching of the orbital angular momentum.

Or

(c) What are Magnons? Obtain Bloch's $T^{3/2}$ law.
(d) Explain the structure of Ferrites.

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