PARVATHANENI BRAHMAYYA

SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, VIJAYAWADA - 520 010, Andhra Pradesh

Autonomous, NAAC A+ Grade, ISO Certified Institution

Since 1975

50 Years of Educational Excellence

NAAC - SSR IV CYCLE

M.Sc. PHYSICS

REGULATION 17

2019-20

PROGRAMME STRUCTURE &

SYLLABUS

Parvathaneni Brahmayya Siddhartha College of Arts & Science: Vijayawada-10.

(An Autonomous college in the jurisdiction of Krishna University)

Accredited at A+ grade by NAAC

2019 Batch M.Sc -Physics

List of Courses

C CODE	COURSE TITLE	CREDITS	TOTAL	CIA	SEE
	FIRST SEMESTER				
PH1T1	MATHEMATICAL PHYSICS	5	100	30	70
PH1T2	CLASSICAL MECHANICS	5	100	30	70
PH1T3	QUANTUM MECHANICS-I	5	100	30	70
PH1T4	ELECTRONICS	5	100	30	70
PH1L1	GENERAL PHYSICS LAB-I	4	100	30	70
PH1L2	ELECTRONICS LAB-I	4	100	30	70
	TOTAL	**28**	**600**	**180**	**420**
	SECOND SEMESTER				
PH2T2	QUANTUM MECHANICS-II	5	100	30	70
PH2T3	STATISTICAL MECHANICS	5	100	30	70
PH2T4	SOLID STATE PHYSICS	5	100	30	70
PH2T5	ELECTRO MAGNETIC THEORY, LASER & MODERN OPTICS	5	100	30	70
PH2L1	GENERAL PHYSICS LAB-II	4	100	30	70
PH2L2	ELECTRONICS LAB-II	4	100	30	70
	TOTAL	**28**	**600**	**180**	**420**
	THIRD SEMESTER				
PH3T1	COMPUTATIONAL METHODS & C PROGRAMMING	5	100	30	70
PH3T2	ADVANCED QUANTUM MECHANICS	5	100	30	70
PH3T3	MOLECULAR PHYSICS	5	100	30	70
PH3T4	CONDENSED MATTER PHYSICS-I	5	100	30	70
PH3L1	ADVANCED PHYSICS & OPTICS LAB	4	100	30	70
PH3L2	ELECTRONICS IC VERSION LAB	4	100	30	70
	TOTAL	**28**	**600**	**180**	**420**
	FOURTH SEMESTER				
PH4T1	NUCLEAR & PARTICLE PHYSICS	5	100	30	70
PH4T2	ANALYTICAL TECHNIQUES	5	100	30	70
PH4T3	CONDENSED MATTER PHYSICS-II	5	100	30	70
PH4T4	CONDENSED MATTER PHYSICS-III	5	100	30	70
PH4L1	CONDENSED MATTER PHYSICS LAB	4	100	30	70
PH4P1	PROJECT WORK	4	100	-	100
	TOTAL	**28**	**600**	**150**	**450**

Programme: M.Sc. Physics

Semester : I

Practical: I **w.e.f :2019-20**

Title of the course :GENERAL PHYSICS LAB - I **Course Code: PH1L1**

Total No of Periods : 96

CO No.	After finishing the course the students
CO1	Learn the applications of semiconductor materials in devices.
CO2	Understand the need of solar energy for the societal needs toward pollution free power.
CO3	Apply theoretical knowledge to find out the velocity of sound waves in liquids practically.
CO4	Learn how the radiation transmits to surroundings from a source.
CO5	Will be able to handle various equipment in a proper and useful manner.

Minimum 7 experiments are to be done and recorded

1.Determination of velocity of sound in a liquid using ultrasonic interferometer

2 Characteristics of electromagnetic coils

(a) by varying distance between the coils (b) by varying current

3. Characteristics of Solar cell
4. Determination of Hall coefficient and Hall angle of germanium
5. Determination of dielectric constant of a solid
6. Determination of Planck's constant
7. Determination of Stefan's constant
8. Magneto resistance
9. Lattice dynamics
10. Heat Capacity of solids

Reference Books:

1. Advanced practical physics Vol – I Dr. S. P. Singh
2. Advanced practical physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma

4. Practical Physics: P. R. Sasi Kumar

5. University Practical physics by D. C. Tayal

6. Viva – Voce in advanced physics : Gupta , Kumar, Sharma

Programme: M.Sc. Physics

Semester : I

Practical: II **w.e.f :2019-20**

Title of the course :ELECTRONICS LAB - I **Course Code: PH1L2**

Total No of Periods : 96

CO No.	After finishing the course the students
CO1	Understand the connection between theory of different circuits and their experimentation.
CO2	Understand the characteristics of Op-Amps and transistors practically.
CO3	Understand the circuits constructed with Op-Amps and gain knowledge on applications of Op-Amps.
CO4	Understand the principles and theories of different circuits like amplifiers, multivibrators and oscillators.
CO5	Gain knowledge on applications of transistors and Op-Amps for the future work.

Minimum 7 experiments are to be done and recorded

1.RC phase shift oscillator

2. Astable multivibrator using transistor

3. Inverting amplifier using IC741

4. Non inverting amplifier IC741

5. Summing amplifier using IC741

6. Difference amplifier using IC741

7. Astable multivibrator using IC741

8. Low pass filter

9. High pass filter

10. wein bridge oscillator

Reference Books:

1. Advanced practical physics Vol – I Dr. S. P. Singh
2. Advanced practical physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar

5. University Practical physics by D. C. Tayal
6. Viva – Voce in advanced physics : Gupta , Kumar, Sharma
7. Linear Integrated Circuits by Ramakanth Gayakwad

SYLLABUS

SEMESTER – I

Programme: M.Sc. Physics

Semester : **I**

Paper: I **w.e.f :2019-20**

Title of the course : **MATHEMATICAL PHYSICS** **Course Code: PH1T1**

Total No of Periods : **70**

CO No.	After finishing the course the students will be able to
CO1	Understand the basic concepts of special functions and apply these functions to solve the problems
CO2	Understand the concept of different transforms and applications in different fields.
CO3	Understand the concept of Fourier series and solve the practical problems.
CO4	Understand the basic concepts of complex analysis and evaluation of the problems.
CO5	Understand the concept of tensor analysis and apply in different field to know the behaviour of the function. .

Unit-I (Special Functions) (14 hrs)

Solution by series expansion - Legendre, associated Legendre, Bessel, Hermite and Laguerre equations, physical applications - Generating functions, orthogonality properties and recursion relations.

Unit-II (Integral Transforms) (14 hrs)

Laplace transform; first and second shifting theorems - Inverse Laplace transforms by partial fractions - Laplace transform of derivative and integral of a function

Unit-III (Fourier Series) (14 hrs)

Fourier series of arbitrary period - Half-wave expansions - Partial sums - Fourier integral and transformations; Fourier transform of delta function.

Unit-IV (Complex Variables) (14 hrs)

Complex, Algebra, Cauchy – Riemann conditions - Analytic functions - Cauchy's integral theorem - Cauchy's integral formula - Taylor's Series - Laurent's expansion – Singularities - Calculus of residues - Cauchy's residue theorem - Evaluation of residues - Evaluation of contour integrals.

Unit-V (Tensor Analysis) (14 hrs)

Introduction - Transformation of coordinates - Contravariant, Covariant and Mixed tensors - Addition and multiplication of tensors - contraction and Quotient Law - The line element - fundamental tensors.

Text and Reference Books:

1. Mathematical Methods for Physicists, G. ARFKEN and H.J. WEBER (Elsevier Inc.).
2. Laplace and Fourier Transforms, J.K. GOYAL and K.P. GUPTA (Pragati Prakashan, Meerut).
3. Matrices and Tensors in Physics, A.W. JOSHI (New Age Int).
4. Mathematical Physics, B.D. GUPTA (Vikas Pub. House).
5. Complex Variables, MURRAY R. SPIEGEL (Schaum's Outlines).
6. Vector Analysis, MURRAY R. SPIEGEL (Schaum's Outlines).

MODEL QUESTION PAPER
M.Sc., DEGREE EXAMINATION
First Semester
PH1T1 – MATHEMATICAL PHYSICS
(2019-2020 Regulation Onwards)

Duration: 3 hours **Maximum Marks: 70 Marks**

Answer All Questions **5×14=70** **Marks**	**CO**	**BTL**
1. (a) Obtain the series solution of Hermite's differential equations (b) Show that $P_n(-x) = (-1)^n P_n(x)$ (OR) (c) Prove the orthogonal property of Lagurre polynomial (d) From the generating function show that $H^1_n(x) = 2_n H_{n-1}(x)$	**CO1**	**BTL1** **BTL2** **BTL1** **BTL2**
2. (a) State and prove First & Second shifting properties of Laplace Transforms (b) Show that L $\{\cos at\} = \frac{s}{s^2+a^2}$ and L $\{\sin at\} = \frac{a}{s^2+a^2}$ (OR) (c) State and explain Laplace Transform of derivates. (d) Evaluate $L^{-1}\left\{\frac{1}{(s-4)^5} + \frac{5}{(s-2)^2+5^2} + \frac{s+3}{(s+3)^2+6^2}\right\}$	**CO2**	**BTL1** **BTL2** **BTL3** **BTL1** **BTL2** **BTL5**
3. (a) Define periodic function and obtain the expression for Fourier coefficients. (b) Explain the half wave expansion in Fourier series. (OR) (c) State and prove properties of Fourier's Transforms. (d) Find the sin and cosine Fourier transform of e^{-ax}	**CO3**	**BTL1** **BTL2** **BTL1** **BTL2** **BTL3**
4. (a) State and prove Cauchy's integral theorem. (b) Evaluate $\oint \frac{Z^2+Z+1}{Z-1}$ dz, where c is the circle (i) |Z| =2 (ii) |Z| = ½ (OR) (c) Sate and explain Taylor's theorem. (d) State and explain Cauchy's residue theorem.	**CO4**	**BTL1** **BTL2** **BTL5** **BTL1** **BTL2**

5. (a) Explain about contravariant and covariant Tensors with examples. (b) Prove that $A_{\mu\nu} B^{\mu} C^{V}$ is an invariant if $B^{\mu} C^{V}$ are contra variant vectors & A_{μ} is a covariant tensor (OR) (c) Explain the addition of Tensors. (d) Explain Quotient Law of Tensors.	**CO5**	**BTL1** **BTL2** **BTL3** **BTL1** **BTL2**

M.Sc. Physics

Semester: I

Paper: II **w.e.f: 2019-20**

Title of the course :CLASSICAL MECHANICS Course Code: PH1T2

Total No of Periods: 70 hrs

CO No.	After finishing the course the students
CO1	Understand the concepts related to mechanical systems,co ordinates, gain knowledge on Lagrangian and Hamilton formalism and describe the motion of mechanical systems using Lagrangian and Hamilton formulation.
CO2	Understand the central forces and solve central force problems.
CO3	Understand the physical concepts of Variational principle, principle of least action, Legendre and Canonical transformations, Poisson brackets and develop the problem solving skills.
CO4	Understand the formulation of Hamilton-Jacobi equation, theory of small oscillations, and develop thinking ability to solve practical problems.
CO5	Understand the concept of rigid body dynamics and rotating frames and the usage of mathematics.

Unit-I (14 hrs)

Mechanics of a particle and system of particles: Conservation laws, Constraints, D'Alembert's principle and Lagrange's equations, Simple applications of the Lagrangian Formulation to Harmonic oscillator, Atwood's machine and Simple pendulum.

Generalized momentum and Cyclic Coordinates, Hamilton function H and conservation of energy, Derivation of Hamilton's equations.

Unit-II (14 hrs)

Reduction to the equivalent one body problem. The equation of motion and first Integrals, The equivalent One – Dimensional problem and classification of orbits, The differential equation for the orbit, Conditions for closed orbits (Bertrand's theorem), The Kepler's laws, Scattering in a central force field.

Unit-III (14 hrs)

Hamilton's principle, Deduction of Hamilton's equations form modified Hamilton principle, Derivation of Lagrange's equations from variation Hamilton's principle, Principle of Least Action.

Legendre transformations, Canonical transformations, Example of Canonical transformations (Harmonic Oscillator) Infinitesimal canonical transformations, Poisson's brackets, Equations of motion, conservation theorems in the Poisson bracket formulation, the angular momentum Poisson's bracket relations.

Unit-IV (14 hrs)

Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as an example of the Hamilton – Jacobi Method, Hamilton –Jacobi equation for Hamilton's characteristic function.

One dimensional oscillator, two coupled oscillations, normal coordinates and normal modes, kinetic and potential energies in normal coordinates vibrations of linear triatomic molecule.

Unit-V (14 hrs)

Independent coordinates of rigid body, The Euler angles, and infinitesimal rotations as vectors (angular velocity), angular momentum and inertia tensor, principal moments of inertia.

Rotational kinetic energy of a rigid body, Euler's equations of motion for a rigid body, Torque-free motion of a rigid body, The Coriolis Effect.

Text and Reference Books:

1. Classical Mechanics, H.GOLDSTEIN (Addison Wesley) 2005.
2. Classical Mechanics, J.C. UPADHYAYA (Himalaya Publishing House) 2010.
3. Classical Dynamics of Particles and Systems, J.B.MARION (Academic Press).

MODEL QUESTION PAPER (PHYSICS)

M.Sc., DEGREE EXAMINATION

First Semester

PH1T2 – CLASSICAL MECHANICS

(2019-2020 Regulation Onwards)

Duration: 3 hours **Maximum Marks: 70 Marks**

Answer All Questions **Marks 5×14=70**	**CO**	**BTL**
1. (a) State and prove D-Alembert's principle and derive Lagrange's equation of motion from it. (OR) (b) What is Hamiltonian function H and derive Hamilton's equations.	**CO1**	**BTL2** **BTL2**
2. (a) How will you reduce two body problem into one body. Explain first integrals. (Or) (b) Discuss briefly the problem of scattering in a central force field. (c) State and prove kepler's second law.	**CO2**	**BTL2** **BTL2** **BTL2** **BTL2**
3. (a) Obtain Lagrange's equation from variation principle and explain the principle of least action. (Or) (b) Show that (i) Canonical transformation forms a group (ii) Poison bracket is invariant under canonical transformation	**CO3**	**BTL2** **BTL4** **BTL3**
4. (a) Explain Hamilton-Jacobi theorem and obtain the amplitude of harmonic oscillator. (Or) (b) What are normal coordinates and normal modes ? Obtain normal modes for linear tritomic molecule.	**CO4**	**BTL2&** **BTL3** **BTL2&** **BTL3**

5. (a) Explain Euler angles and Obtain expression for angular velocity of a rigid body. (Or) (b) Write down the kinetic energy of rigid body. (c) State and explain coriolis effect.	**CO5**	**BTL2** **BTL2** **BTL2**

Programme: M.Sc. Physics

Semester : I

Paper: III **w.e.f :2019-20**

Title of the course : QUANTUM MECHANICS - I Course Code: PH1T3

Total No of Periods : 70

CO No.	After finishing the course the students
CO1	Learn the historical aspects of development of quantum mechanics, formulate one dimensional problems and solve Schrodinger equation for different matter wave systems.
CO2	Understand the concepts of wave function and operator algebra.
CO3	Learn to apply quantum formalism to the concepts of angular momentum and solves Schrodinger equation in 3D using spherical polar coordinates.
CO4	Learn different time independent perturbation methods with examples.
CO5	Learn to solve time dependent perturbation problems with approximation methods.

Unit-I (Schrodinger wave equation and potential problems in one dimension)(14 hrs)

Necessity of quantum mechanics, Inadequacy of classical mechanics; Schrodinger equation; continuity equation; Ehrenfest theorem; admissible wave functions; Stationary states. One-dimensional problems, wells and barriers. Harmonic oscillator by Schrodinger equation.

Unit-II (Vector spaces) (14 hrs)

Linear Vector Spaces in Quantum Mechanics: Vectors and operators, change of basis, Dirac's bra and ket notations. Eigen value problem for operators. The continuous spectrum. Application to wave mechanics in one dimension. Hermitian, unitary, projection operators. Positive operators. Change of orthonormal basis. Orthogonalization procedure.

Unit-III (Angular momentum and three dimensional problems) (14 hrs)

Angular momentum: commutation relations for angular momentum operator. Angular Momentum in spherical polar coordinates, Eigen value problem for L^2 and L_z , L_+ and L_- operators, Eigen values and eigen functions of rigid rotator and Hydrogen atom.

Unit-IV (Time-independent perturbation) (14 hrs)

Time-independent perturbation theory: Non-degenerate and degenerate cases; applications to a) normal helium atom b) Stark effect in Hydrogen atom. Variation method. Application to ground state of Helium atom. WKB method.

Unit-V (Time dependent perturbation) (14 hrs)

Time dependent perturbation: General perturbations, variation of constants, transition into closely spaced levels –Fermi's Golden rule. Einstein transition probabilities, Interaction of an atom with the electromagnetic radiation. Sudden and adiabatic approximation.

Text and Reference Books:

1. Quantum Mechanics, E. MERZBECHER (Wiley).
2. Quantum Mechanics, L.I. SCHIFF (McGraw-Hill).
3. Modem Quantum Mechanics, J.J. SAKURAI (Pearson).
4. A text book of Quantum Mechanics, P.M. MATHEWS, K. VENKATESAN (Tata McGraw –Hill).
5. Foundations of Quantum Mechanics, R.D. RATNA RAJU (I.K. Int Pub House).

MODEL QUESTION PAPER (PHYSICS)

M.Sc., DEGREE EXAMINATION
First Semester
PH1T3 – QUANTUM MECHANICS - I
(2019-2020 Regulation Onwards)

Duration: 3 hours **Maximum Marks: 70 Marks**

Answer All Questions **Marks 5×14=70**	**CO**	**BTL**
1. (a) Discuss the formulation of Schrodinger's time independent and dependent equations. (b) Obtain their solutions. (Or) (c) Explain the behaviour of particle when it sees a step potential.	CO1	BTL1 BTL2 BTL4
2. (a) Describe Dirac's bra and ket notation (b) Explain Schmidt's orthogonalisation procedure. Or (c) Define Hermitian operator. (d) State and prove its two important properties.	CO2	BTL1 BTL5 BTL1 BTL5
3. (a) Express the angular momentum operators in spherical polar coordinates. (b) Evaluate the commutator of L_x & L_y. Or (c) Explain rigid rotator (b) Obtain the energy eigen values and eigen functions of a rigid rotator.	**CO3**	**BTL2** **BTL4**
4. (a) Discuss the time independent perturbation theory for degenerate system. (b) Discuss the stark effect in hydrogen atom Or (c) Discuss variation method. (d) Use it to obtain the ground state energy of Helium atom.	**CO4**	**BTL3** **BTL4** **BTL3** **BTL4**

5. (a) Discuss time dependent perturbation theory 4M (b) Derive Fermi Golden rule for constant perturbation.(5+5)M (Or) (b) Explain Einstein's transition probabilities. 4M (c) Derive expressions for them using time dependent perturbation theory. (10M)	**CO5**	**BTL3** **BTL4**

Programme: M.Sc. Physics

Semester : I

Paper: IV **w.e.f :2019-20**

Title of the course : ELECTRONICS Course Code: PH1T4

Total No of Periods : 70

CO No.	After finishing the course the students
CO1	Understand the basic concepts of differential and operational amplifier.
CO2	Understand the circuits and application of operational amplifier for societal needs.
CO3	Understand the concepts of amplitude modulation and frequency division multiplexing using communication electronics.
CO4	Understand the basic concepts of digital electronics, working of flip flops, counters and shift registers.
CO5	Understand the architecture of 8085 microprocessor and programming techniques to perform arithmetic and logical operations.

Unit-I : **Operational Amplifiers** (14Hrs)

Block diagram of a typical Op-Amp- dual input and balanced output differential amplifier. Open loop configuration inverting and non inverting amplifiers. Op-amp with negative feedback- voltage series feedback – effect of feedback on closed loop gain input resistance, output resistance, bandwidth and output offset voltage- voltage follower.

Unit-II : **Practical Op-amps** (14Hrs)

Input offset voltage , input bias current, input offset current, total output offset voltage, CMRR frequency response. Summing amplifier, scaling and averaging amplifiers, integrator and differentiator, instrumentation amplifier.

Oscillators principles ,oscillator types , frequency stability, response , The phase shift oscillator, Wein bridge oscillator , Multivibrators- Monostable and astable ,comparators – square wave and triangular wave generators.

Unit-III : **Communication Electronics** (14Hrs)

Amplitude modulation , Generation of AM waves , Demodulation of AM waves , DSBSC modulation, Generation of DSBSC waves, Coherent detection of DSBSC waves, SSB modulation, Generation and detection of SSB waves , Frequency division multiplexing (FDM).

Unit-IV : Digital Electronics (14Hrs)

Combinational Logic circuits- , Multiplexer (data selectors)-application of multiplexer - De multiplexer (data distributors) , Sequential Logic circuits - Flip-Flops: R-S Flip Flop, JK

Flip Flop , JK master slave Flip-Flops ,T- Flip Flop, D Flip Flop, Shift registers, synchronous and asynchronous counters.

Unit V : Microprocessors (14Hrs)

Introduction to microprocessors – memory 8085 CPU - Architecture – Demultiplexing the address bus – instruction set – addressing modes – writing assembly language programmes

Reference Books:

- Op-Amps & Linear integrated circuits, RAMAKANTH A.GAYAKWAD (PHI),2002,4th Edition
- Fundamentals of Digital Circuits, A. ANANDA KUMAR, (PHI),2016,4th Edition
- Microprocessor Architecture, Programming and Applications with 8085/8086, R. S.GAONKAR (Wiley Eastern),2002, 5thEdition
- Electronics: Analog and Digital, I.J. NAGARATH (PHI),2013, 2nd Edition
- Op-Amps & Linear integrated circuits-ROYCHOWDHURY

MODEL QUESTION PAPER (PHYSICS)
M.Sc., DEGREE EXAMINATION
First Semester
PH1T4 – ELECTRONICS
(2019-2020 Regulation Onwards)

Duration: 3 hours **Maximum Marks: 70 Marks**

Answer All Questions **Marks 5×14=70**	**CO**	**BTL**
1. (a) Discuss the construction and working of the differential amplifier (OR) (b) Explain the effect of negative feedback on voltage series feedback amplifier. Derive expressions for (i) Closed loop voltage gain (ii) Input resistance with feed back (iii) Band width with feed back (iv) Voltage follower	CO1	BTL2 PO1,PO2
2. (a) Explain the construction and working of Integrator and differentiator and discuss their frequency response. (OR) (b) Discuss the Bark-Hausen criteria. Explain the construction and working of RC- phase shift Oscillator	CO2	BTL2 PO1,PO2
3. (a) Define modulation and de-modulation. Discuss any two methods for the generation and detection of DSBSC waves. (OR) (b) What are the advantages of SSB over DSB . Explain the different methods to produce SSB waves	CO3	BTL2 PO1,PO2
4. . (a) With the suitable circuits explain the construction and working of synchronous and asynchronous counters (OR) (b) With the help of clock timing diagram construction and working of clocked SR and master- slave JK flip- flops.	CO4	BTL2 PO1,PO2 BTL2
5. (a) Discuss the architecture of 8085 microprocessor (OR) (b) Explain the instruction set and addressing modes of 8085 microprocessor.	CO5	BTL2 PO1,PO2,PO4

SEMESTER – II

Practical – I, GENERAL PHYSICS LAB - II PH2L1

CO. No	After finishing the course the students will be able to	
CO1	Self learn and perform experiments related to light **(BTL 3)**	PO1,PO2, PO3,PO7
CO2	Explain physical phenomena in the tests performed (**BTL 3, BTL4)**	PO2, PO3,PO4,PO6
CO3	Explain the connection between physical laws and their application. (**BTL 3)**	PO1,PO2, PO3,PO6
CO4	Do the statistical analysis of the results obtained by the experiment and interpret the results. (**BTL 3, BTL4)**	PO1,PO2, PO5,PO4
CO5	Understand the results and make detailed, full report of the experiment. **(BTL 3, BTL4)**	PO2, PO3,PO4,PO6

LIST OF PRACTICALS

Minimum 7 experiments are to be done and recorded

1. Determiantion of thickness of wire using laser
2 Determination of wavelength of light using diffraction grating
3. Determination of refractive index of liquid
4. Double refraction
5. Determination of Rydberg constant
6. Determination of Viscosity of liquid
7. Determination of lattice parameter by Powder X-Ray diffraction model
8. Determination of Numerical Aperture of optical fiber
9. Determination of Hall coefficient
10.Efficiency of solar cell

Reference Books:

1. Advanced Practical Physics Vol – I Dr. S. P. Singh
2. Advanced Practical Physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar
5. University Practical Physics by D. C. Tayal
6. Viva – Voce in Advanced Physics : Gupta , Kumar, Sharma

SEMESTER – II

Practical – II, ELECTRONICS LAB - II PH2L2

CO. No	After finishing the course the students will be able to	
CO1	Build basic digital circuits. **(BTL1, BTL2)**	PO1,PO2, PO3,PO7
CO2	Utilise items such as IC7410,7411 7801, 7432, etc. **(BTL2, BTL3)**	PO2, PO3,PO4,PO6
CO3	Explain the operation and working of digital electrical devices. **(BTL3, BTL4)**	PO1,PO2, PO3,PO6
CO4	Demonstrate facility at constructing and troubleshooting digital circuits in the laboratory with the proper use of test equipment. **(BTL4, BTL5)**	PO1,PO2, PO5,PO4
CO5	Demonstrate the ability to work as part of a technical team, particularly in the laboratory. **(BTL4, BTL5)**	PO2, PO3,PO4,PO6

Minimum 7 experiments are to be done and recorded

1. Verification of basic gates and Demorgans laws
2. Realisation of basic gates using Nand and Nor
3. RS and clocked RS flip flop
4. JK master slave flip flop
5. Half adder and full adder
6. Multiplexer
7. Demultiplexer

Microprocessor(8085) programs

8. i) addition of two 8 bit numbers ii) subtraction of two 8 bit numbers
9. Program for logical operations (and, or, xor, not)
10. i) Program to find biggest number in an array
    ii) Program to find the square of a number

Reference Books:

1. Advanced Practical Physics Vol - I Dr. S. P. Singh
2. Advanced Practical Physics Vol - II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar
5. University Practical Physics by D. C. Tayal
6. Viva – Voce in Advanced Physics : Gupta , Kumar, Sharma
7. Linear Integrated Circuits by Ramakanth Gayakwad

SYLLABUS
SEMESTER – II

Paper-I: ELECTROMAGNETIC THEORY - (PH2T1)

Unit – I (Electrostatics)

Electrical field- Coulombs law-Continuous charge distribution- divergence and curl of electrostatic fields, Gauss's law-Applications: Field due to spherically symmetric charge distribution, Electric field intensity due to a line of charge(uniformly charged cylinder).
Electric Potential-Poisson's equation and Laplace's equation, Solution - Potential of localised charge distribution-Electrostatic boundary conditions- Work done to move a charge : Energy of a point charge distribution- energy of a continuous charge distribution.

Unit-II (Magnetostatics)

Current density, Magnetic induction-Force on a current element: Ampere's force law, Magnetic interaction of steady line currents, Biot Savarts law Magnetic induction -Divergence of magnetic induction **B**
Magnetic vector potential **A,** Divergence of A**,** Lorentz condition, Curl of magnetic induction **B,** Magnetic scalar potential, Magnetic Intensity, Magnetic Susceptibility, Permeability.

Unit – III (Maxwell's equations)

Equation of continuity, displacement current, Maxwell's equations-derivation of Maxwell's equations, Maxwell's equations in integral form, Maxwell's equations in free space, in linear isotropic media, Poynting theorem
Propagation of electromagnetic waves, Electromagnetic waves in free space, in conducting media, Polarisation of electromagnetic waves.

Unit – IV (Interaction of EMW with matter)

Boundary conditions for the electromagnetic field vectors **B,E, D**, and **H** at the interface between two media, Reflection and Refraction at the boundary of non conducting media, General treatment of reflection and refraction, Fresnel's equation, Brewster angle and degree of polarisation

Unit- V (Potentials and Radiating systems)

Potential formulation: scalar and vector potentials, Gauge transformations: coulomb gauge & Lorentz gauge, Retarded potentials, Lienard Weichart potentials
Radiating systems, Radiation due to an oscillating electric dipole, Radiation due to a small current element.

Text and Reference Books:

1. Electromagnetic theory and Electrodynamics, SATYAPRAKASH (KNRN Ed. Pub.)
2. Introduction to Electrodynamics, D.J. Griffiths (Pearson Addison Wesley)
3. Electromagnetics, B.B. LAUD (New Age International Publishers)
4. Introduction to Modern Optics, GRANT R. FOWLES (Dover Pub Inc.).
5. Electrodynamics JACKSON
6. Electrodynamics GUPTA, KUMAR, SHARMA

SEMESTER – II

Paper: II QUANTUM MECHANICS-II PH2T2

Total No of Periods : 70

CO No.	After finishing the course the students will be able to	PO
CO1	Understand the concept of Total angular momentum, addition of angular momenta and transformation between bases- examples. **(BTL2, BTL3)**	PO1,PO2, PO3
CO2	Understand the role of Pauli's exclusion principle in quantum mechanics in connection with statistical mechanics and importance of Stern-Gerlach experiment **(BTL2, BTL3, BTL4)**	PO1, PO2,PO3
CO3	Understand the pictures of QM and the concept of identical particles. **(BTL2, BTL3, BTL4)**.	PO1, PO2, PO3
CO4	Understand the theory of Scattering in quantum mechanics. **(BTL2, BTL3, BTL4)**	PO1,PO2, PO3
CO5	Understand the concept of B-O approximation, MO theory and VB theory. Gain knowledge on application of H2 and H2+, which are useful for research. **(BTL2, BTL3, BTL4, BTL5)**.	PO1, PO2, PO3

Paper-II: - QUANTUM MECHANICS - II - (PH2T2)

Unit-I (Total angular momentum)

Total angular momentum J, Commutation relations of total angular momentum with components. Eigen values of J^2 and J_Z, Eigen values of J_+ and J_- .Explicit matrices for J^2, J_x, J_y & J_z. Addition of angular momenta. Clebsch-Gordon coefficients for $J_1 = ½$, $J_2 = ½$ and $j_1 = 1$, $j_2 = ½$.-

Unit -II (Spin Angular Momentum)

Pauli's exclusion principle and connection with statistical mechanics, spin angular momentum, Stern-Gerlach experiment and limitations, Pauli spin matrices, commutation relations, operators, Eigen values and Eigen functions. Electron spin functions.-

Unit -III (Quantum Dynamics and Identical Particles)

Equation of motion in Schrodinger's picture and Heisenberg's picture, correspondence between the two. Correspondence with classical mechanics. Application of Heisenberg's picture to Harmonic oscillator. The indistinguishability of identical particles – The state vector space for a system of identical particles – Creation and annihilation operators. Dynamical variables – the Quantum dynamics of identical particle systems.- CO(3)

Unit -IV (Scattering Theory)

Introduction to scattering – notion of cross section – scattering of a wave packet – Green's function in scattering theory – Born's approximation – first order approximation – criteria for the validity of Born's approximation. Form factor – scattering from a square well potential – partial wave analysis – Expansion of plane wave – optical theorem – calculation of phase shifts – low energy limit – energy dependence of βe -

Unit -V (Molecular Quantum Mechanics)

The Born-Oppenheimer Approximation – The molecular orbital method -The hydrogen molecule-ion- hydrogen molecule– The valence band method — Comparison of the methods – Heitler – London method.-

Text and Reference Books:

1. Quantum Mechanics, E. MERZBECHER (Wiley).
2. Quantum Mechanics, L.I. SCHIFF (McGraw-Hill).
3. Modem Quantum Mechanics, J.J. SAKURAI (Pearson).

4. A text book of Quantum Mechanics, P.M. MATHEWS, K. VENKATESAN (Tata McGraw Hill).
5. Foundations of Quantum Mechanics, R.D. RATNA RAJU (I.K. Int Pub House).
6. Quantum mechanics: Concepts and Applications, N. ZETTILI (John Wiley & Sons).
7. Quantum Mechanics: Theory & Problems, KAKANI and CHANDALIA (S. Chand & Sons).
8. Physical Chemistry, PETER ATKINS (W. H. Freeman and Co.)

Model Question Paper

M. Sc., PHYSICS – SECOND SEMESTER

Paper – II, QUANTUM MECHANICS – II, PH2T2

Time: 3 Hours **Max.Marks:70**

Answer All Questions

CO1	1. (a) Obtain the Eigen values and Eigen functions of J^2 and J_z operators. (Or) (b) Explain how two angular momenta can be coupled. What are Clebsch-Gordan coefficients?	BTL2, BTL3
CO2	2. (a) Explain stern Gerlach experiment and its limitations. (Or) (b) Obtain the matrices for σ_x, σy and σ_z spin operators and discuss their properties.	BTL2, BTL3, BTL4
CO3	3. (a) Discuss the Schrödinger's picture and Heisenberg's picture quantum dynamics. Explain the relation between two pictures. (Or) (b) Define the creation, annihilation and number operators for a system of identical particlesShow that the possible state function is symmetric for bosons and anti-symmetric for fermions.	BTL2, BTL3, BTL4
CO4	4. (a) Explain the scattering phenomena and describe the role of green's function in scattering theory. (Or) (b) Explain the principle of partial wave analysis of scattering problem.	BTL2, BTL3, BTL4
CO5	5. (a) Explain the LCAO approximation of molecular orbital theory apply it to obtain the ground state properties of hydrogen molecule ion. (Or) (b) Explain Born's approximation and compare MO and VB method.	BTL2, BTL3, BTL4, BTL5

SEMESTER – II

Paper: III STATISTICAL M MECHANICS - PH2T3

Total No of Periods: 70

CO No.	After finishing the course the students will be able to	PO
CO1	Understand the basic concepts of statistical mechanics, phase space and ensembles (**BTL 2)**	PO1,PO2, PO6
CO2	Understand theorems and applying conclusions to specific problems related to large group of particles (**BTL 2)**	PO1, PO2,PO6
CO3	Understand the energy associated with different ensembles and partition function (**BTL3)**	PO1, PO2, PO6
CO4	Understand the postulates of quantum statistical mechanics and can apply theory of QM to the distribution of particles related to various systems (**BTL 3)**	PO1,PO2, PO3,PO6
CO5	Apply statistical laws to the stellar object and particles to understand the evolution of universe and to study the properties of matter (**BTL 2)**	PO1, PO2, PO6

Paper-II: STATISTICAL MECHANICS - (PH2T3)

Classical Statistical Mechanics

Unit-I

Foundations of statistical mechanics; specification of states of a system. Contact between statistics and thermodynamics, Postulate of classical statistical mechanics, phase space, trajectories – Ensembles – micro canonical, canonical and grand canonical.

Unit-II

Density of states – Liouville's theorem – equipartition theorem – Classical ideal gas; entropy of ideal gas in micro canonical ensemble – Gibb's paradox .

Unit-III

Canonical ensemble – ensemble density – partition function – Energy fluctuations in canonical ensemble – Grand canonical ensemble – Density fluctuations in the Grand canonical ensemble – Equivalence between the canonical ensemble and Grand canonical ensemble.

Quantum Statistical Mechanics

Unit-IV

Postulates of quantum statistical mechanics – Density matrix – Ensembles in quantum statistics – statistics of indistinguishable particles, Maxwell – Boltzmann, Bose- Einstein and Fermi – Dirac statistics, Thermodynamic properties of ideal gases on the basis of micro canonical and grand canonical ensemble. The partition function

Unit-V

Ideal Fermi Gas: Equation of state of an ideal Fermi gas, theory of white dwarf stars, Landau diamagnetism. Ideal Bose Gas: Photons, Bose Einstein condensation – Random walk problem.

Text and Reference Books:

1. Statistical and Thermal Physics, S. LOKANADHAN and R.S. GAMBHIR (PHI).
2. Statistical Mechanics: Theory and Applications, S.K. SINHA (Tata McGraw-Hill).

3. Fundamentals of statistical and Thermal Physics, F.REIF (Waveland Press, Inc.).
4. Statistical Mechanics, GUPTA AND KUMAR (Pragati Prakashan, Meerut).
5. Statistical mechanics B.B Laud

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Model Question paper
M. Sc., PHYSICS – SECOND SEMESTER

Paper – II, STATISTCAL MECHANICS, PH2T3

Time: 3 Hours **Max.Marks:70**

Answer All Questions

CO1	1 (a) Define micro state and macro state. Explain canonical and micro canonical ensembles (Or) (b) Define phase space. Explain the phase trajectories.	**BTL 2**
CO2	2. (a) State and prove (i) Liouvilles theorem (ii) Equi partition theorem (Or) (b) Give an account of (i) Entropy of mixing of ideal gas (ii) Gibb's paradox.	**BTL 2**
CO3	3. (a) Define partition function Explain the distributions in canonical ensemble (Or) (b) Discuss the density fluctuations in grand canonical ensemble.	**BTL 3**
CO4	4. (a) Explain the particle distributions in Bose – Einstein statistics (Or) (b) Discuss the particle distributions in Fermi-Dirac statistics	**BTL 3**
CO5	5. (a) Discuss the Bose- Einstein condensation (Or) (b) Discuss the theory of white dwarf stars	**BTL 2**

SEMESTER – II
Paper – IV, SOLID STATE PHYSICS - PH2T4

Total No of Periods : 70

CO No.	After finishing the course the students will be able to	PO
CO1	Understand the basic concepts of translation vectors, lattices, symmetry operations, lattice types and simple crystal structures. **(BTL1)**	PO1
CO2	Understand the experimental diffraction methods, reciprocal lattice and Brillouin zones. **(BTL1, BTL2, BTL3, BTL4)**	PO1,PO2,PO5, PO6
CO3	Understand the effect of magnetic fields and electric fields inside the metals. **(BTL1, BTL2, BTL3, BTL4)**	PO1, PO2,PO5, PO6
CO4	Understand the concepts of Fermi levels and quantization of orbits in magnetic fields. **(BTL1, BTL2)**	PO1, PO5, PO6
CO5	Understand the concepts of band gap and various electronics models in solids. **(BTL1, BTL2)**	PO1, PO2,PO5, PO6

Paper – IV, SOLID STATE PHYSICS - PH2T4

Unit-I (Crystal Structure)

Periodic array of atoms-Lattice translation vectors and lattices, symmetry operations, Basis and the Crystal Structure, Primitive Lattice cell, Fundamental types of lattices-Two Dimensional lattice types, three Dimensional lattice types, Index system for crystal planes, simple crystal structures- sodium chloride, cesium chloride and diamond structures.

Unit-II (Crystal Diffraction and Reciprocal Lattice)

Bragg's law, Experimental diffraction methods - Laue method and powder method, derivation of scattered wave amplitude, indexing pattern of cubic crystals and non-cubic crystals (analytical methods). Geometrical structure Factor, Determination of number of atoms in a cell position of atoms. Reciprocal lattice, Reciprocal lattice to bcc and fcc lattices.

Unit-III (Free Electron Fermi Gas)

Energy levels and density of orbitals in one dimension, Free electron gas in 3 dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Motion in Magnetic Fields – Hall effect, Ratio of thermal to electrical conductivity.

Unit-IV (Fermi Surfaces of Metals)

Reduced zone scheme, periodic Zone schemes, Construction of Fermi surfaces, Electron orbits, hole orbits and open orbits, Experimental methods in Fermi surface studies – Quantization of orbits in a magnetic field, De-Hass-van Alphen Effect, extremal orbits, Fermi surface of Copper.

Unit-V (Band Theory of Solids)

Nearly free electron model, Origin of the energy gap, The Bloch's theorem, Kronig-Penney Model, wave equation of electron in a periodic potential, Brillouin Zone, Crystal momentum of an electron-Approximate solution near a zone boundary, Number of orbitals in a band – metals and insulators. Distinction between metals, insulators and semiconductors.

Text and Reference Books:

1. Solid State Physics, A.J. DEKKER (Macmillan).
2. Introduction to Solid State Physics, CHARLES KITTEL (John Wiley & Sons).
3. Introduction to Solid State Physics, ARUN KUMAR (PHI).

4. Elements of Solid State Physics, J.P. SRIVASTAVA (PHI).
5. Solid State Physics, GUPTA and KUMAR (K. Nath & Co.).

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Model Question Paper
M. Sc., PHYSICS – SECOND SEMESTER

Paper- IV: SOLID STATE PHYSICS - PH2T4

Time: 3 Hours **Max.Marks:70**

Answer all the questions

CO1	1. (a) Write a note on lattice translation vector. Give classification of different three dimensional lattices. (Or) (b) What are symmetry operations, describe the crystal structure of sodium chloride?	BTL1, BTL2
CO2	2. (a) Give an account of powder method of crystal structure analysis. (Or) (b) Explain (i) geometrical structure factor (ii) Reciprocal lattice	BTL3, BTL4 BTL1, BTL2
CO3	3. (a) Explain the energy levels and density of orbitals of free electron gas in 3 dimensions. (Or) (b) Explain the motion of electron in magnetic fields.	BTL1,BTL2, BTL3, BTL4
CO4	4. (a) Distinguish between reduced zone and periodic zone schemes. Explain the construction of Fermi surfaces (Or) (b) Explain (i) The quantization of orbits in a magnetic field (ii) De-Hass- Van alphen effect	BTL1, BTL2 BTL1, BTL2
CO5	5. (a) Using kronig penny model explain the motion of electron in a periodic potential (Or) (b) State and explain Bloch's theorem.	BTL1, BTL2 BTL1, BTL2

Paper: I ELECTROMAGNETIC THEORY, LASERS & MODERN OPTICS - PH2T5

Total No of Periods : 70

CO No.	After finishing the course the students will be able to	PO
CO1	Understands Maxwells equations and propagation of electromagnetic waves in different media derive Poyntings theorem from Maxwells equations and interpret the terms in the theorem physically. **(BTL1, BTL2)**	PO1,PO2
CO2	Derives the boundary conditions for E, B, H, D and Fresnels equations learns potential formulation using Lorentz guage, coulomb gauge. **(BTL3, BTL4)**	PO1, PO2,PO3
CO3	Understand the principles of Lasers. **(BTL1, BTL2)**	PO1, PO2, PO6
CO4	Understand different broadening mechanisms, different types of Lasers and applications. **(BTL3, BTL4)**	PO1,PO2, PO3,PO6
CO5	Understand the basic concepts of Fiber Optics and different fibers. **(BTL1, BTL2)**	PO1, PO2, PO6

Paper-I: ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS - (PH2T5)

Unit – I (Maxwell's equations)

Equation of continuity, displacement current, Maxwell's equations-derivation of Maxwell's equations, Maxwell's equations in integral form, Maxwell's equations in free space, in linear isotropic media, Poynting theorem

Propagation of electromagnetic waves, Electromagnetic waves in free space, in conducting media, Polarisation of electromagnetic waves.

Unit – II (Interaction of EMW with matter)

Boundary conditions for the electromagnetic field vectors **B,E, D**, and **H** at the interface between two media, Reflection and Refraction at the boundary of non conducting media, Fresnel's equation, Brewster angle and degree of polarisation.

Potential formulation: scalar and vector potentials, Gauge transformations: coulomb gauge & Lorentz gauge,

Unit-III (Principles of Lasers)

Lasers: Introduction – directionality- brightness- monochromaticity - coherence – relation between the coherence of the field and the size of the source – absorption and emission processes - the Einstein coefficients - amplification in a medium- laser pumping Boltzmann's principle and the population of energy levels – attainment of population inversion - two level – three level and four level pumping. Optical feedback: the optical resonator laser power and threshold condition confinement of beam within the resonator – stability condition.

Unit-IV (Lasers and Optical Processes)

Laser output - Absorption and emission - shape and width of broadening lines – line broadening mechanisms – natural, collision and Doppler broadening.

Types of Lasers: Ruby laser, He-Ne Laser, Semiconductor GaAs laser, applications of lasers.

Unit-V (Fiber Optics)

Fiber Optics : Introduction – total internal refraction –optical fiber modes and configurations- fiber types – rays and modes- Step index fiber structures – ray optics representation - wave equations for step indexed fibers – modal equation – modes in step indexed fibers – power flow in step indexed fibers .Graded indexed fiber structure: Structure – Numerical aperture and modes in graded index fibers – Signal degradation in optical fibres.

Text and Reference Books:

1. Electromagnetic theory and Electrodynamics, SATYAPRAKASH (KNRN Ed. Pub.)
2. Introduction to Electrodynamics, D.J. Griffiths (Pearson Addison Wesley)
3. Electromagnetics, B.B. LAUD (New Age International Publishers)
4. Introduction to Modern Optics, GRANT R. FOWLES (Dover Pub Inc.).
5. Electrodynamics JACKSON
6. Electrodynamics GUPTA, KUMAR, SHARMA
7. Laser and Non-Linear Optics, B.B. LAUD (New Age International Publishers
8. Lasers and their Applications, M.J. BEESLEY (Taylor and Francis).
9. Optical Fiber Communications, GERD KEISER (Tata McGraw-Hill Book).

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Model Question Paper

M. Sc., PHYSICS – SECOND SEMESTER

Paper - I, ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS - PH2T5

Time: 3 Hours Max.Marks:70

Answer All Questions

CO No.		BTL
CO1	1. (a) Derive Maxwell's equations in differential form. (b) Express them in integral form and explain their significance. (Or) (c) Discuss the propagation of plane electromagnetic waves in conducting media	BTL1, BTL2
CO2	2. (a) Derive the boundary conditions satisfied by B, H and E, D at theinterface between two different media (Or) (b) Show that in regions of space free of charges and currents, the electromagnetic field propagates as Transverse wave.	BTL3, BTL4
CO3	3. (a) Obtain the relation between the coherence of the field and the size of the source. (b) What is population inversion? Explain why lasing action	BTL1, BTL2

	cannot occur without population inversion. (Or) (c) What are Einstein's coefficients? Discuss how amplification can be achieved	
CO4	4. (a) Explain the working of Ruby laser. (b) Explain the working of He-Ne laser (Or) (c) Describe in detail about the line broadening mechanisms	BTL3, BTL4
CO5	5. (a) Explain the concept of total internal reflection. (b) Discuss the modes and power flow in step index fibre. (Or) (c) Explain the structure of graded index fibres. (d) Give an account of signal distortion in optical fibres.	BTL1, BTL2

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M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
ADVANCED PHYSICS & OPTICS LAB	PH3L1	8	-	-	4	2017-18

Course Description : In this course students do different experiments based on optical phenomena and some advanced concepts in physics

Course Objectives:

1. To understand the various magnetic material properties.
2. To learn the electrical and optical properties of the semiconductor materials.
3. To observe the process of nuclear disintegration of radio active materials.
4. To understand the thermal properties of different materials.
5. To learn the formation of different spectra.

Course Outcomes: At the end of this course, students should be able to:
CO1: Will be able to do experiments related to measurements of properties of solids.
CO2: Acquire basic skills to critically elaborate and interpret experimental data
CO3: Will acquire the capability of handling the equipment and experimental problem solving
CO4: Discuss, design and carry out some simple experiments to demonstrate basic principles
CO5: Communicate results through written reports and oral presentations.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3L1	CO1	H					L	M
	CO2		H				L	M
	CO3			H	L		L	M
	CO4			H	L		L	M
	CO5			H	L		L	M

Syllabus		
	ADVANCED PHYSICS & OPTICS LAB (PH3L1) **Minimum 7 experiments are to be done and recorded** 1. Refractive index of organic liquids using laser 2. Dielectric constant of solids 3. Determination of losses in optical fiber using bending technique 4. Determination of wavelengths of the spectral lines of mercury spectrum using Hartmann's dispersion formula- Prism 5. Determination of wavelengths of the spectral lines of mercury spectrum using Hartmann's dispersion formula- Grating 6. Determination of Cauchy's constants using glass/calcite/quartz 7. Characteristic curve of GM counter, estimation of its operating voltage 8. Dielectric constant of solids by varying the separation between two capacitor plates. 9. Laser diffraction 10. Dead time of GM counter	

Reference Books:

1. Advanced practical physics Vol – I Dr. S. P. Singh
2. Advanced practical physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar
5.University Practical physics by D. C. Tayal
6. Viva – Voce in advanced physics : Gupta , Kumar, Sharma

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M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
ELECTRONICS IC - VERSION AND C PROGRAMMING LAB	PH3L2	8	-	-	4	2017-18

Course Description : In this course, students design different circuits learnt in the theory using IC741 op amp.

Course Objectives:

1. To understand the construction of various circuits using IC's.
2. To learn the construction and working of IC-741 in different circuits.
3. To learn the construction and working of IC-555 in various circuits.
4. To understand the frequency response of various circuits.
5. To learn the C language and able to do programming.

Course Outcomes: At the end of this course, students should be able to:
CO1: Get exposed to problem solving through programming.
CO2: Identify situations where computational methods and computers are useful
CO3: Write a program on a computer, edit, compile, debug, correct, recompile and run it
CO4: Be able to demonstrate facility at constructing and trouble shooting IC circuits in the laboratory with the proper use of test equipment
CO5: Should demonstrate the ability to work as part of a technical team, particularly in the laboratory.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3L2	CO1			H	M		L	M
	CO2			H	M		L	M
	CO3			H	M		L	M
	CO4		H				L	M
	CO5			H			L	M

Syllabus

Electronics IC - Version and C programming lab
(PH3L2)

Minimum 7 experiments are to be done and recorded

1. Integrator using IC-741
2. Differentiator using IC-741
3. Band pass filter IC-741
4. Rectangular wave generator using IC-555
5. Square wave generator using IC-555
6. C- programming for Newton-Raphson method
7. C- programming for Trapezoidal rule
8. C- programming for Simpson's 1/3 rule
9. C- Programming for to find the no. of odd and even number in a given list of numbers.
10. C-Programming for bisection method

Reference Books:

1. Advanced practical physics Vol – I Dr. S. P. Singh
2. Advanced practical physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar
5. University Practical physics by D. C. Tayal
6. Viva – Voce in advanced physics : Gupta , Kumar, Sharma
7. Opamps and Integrated circuits : Ramakant Gayakwad

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M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
COMPUTATIONAL METHODS AND PROGRAMMING	PH3T1	5	-	-	5	2017-18

Course Description: Computational Methods brings to light the numerous uses of numerical methods in engineering. It clearly explains the application of these methods mathematically and practically, emphasizing programming aspects when appropriate.

Course Objectives:

1. To understand the fundamentals of C- language.
2. To improve the Programming skills.
3. To understand the importance and applications of Arrays.
4. To understand various numerical methods used in computation and C- programming.
5. To solve simple problems pertaining to Physics using these methods.

Course Outcomes: At the end of this course, students should be able to:

CO1: Understand the concepts of fundamentals of data types and operators.
CO2: Understand and apply of the concept of expressions and control statements in C- language
CO3: Learn the concepts of Arrays and User Defined Functions
CO4: Understand and solve the Linear, Nonlinear and Simultaneous Equations
CO5: Understand and apply the concept of Interpolations, Numerical Differentiation and Integration to solve problems.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3T1	CO1	H					L	M
	CO2	H					L	M
	CO3	H					L	M
	CO4		H				L	M
	CO5	H	L				L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	Fundamentals and Operators **(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.	12
II	Expressions, I/O and Control Statements **(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 – – Print f- Simple programs. **(b) Control statements:** If-Else statements –Switch statements-The operators –GO TO – While, Do-While, FOR statements-BREAK and CONTINUE statements.	12
III	Arrays and User Defined Functions **(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.	12
IV	Linear, Nonlinear and Simultaneous Equations **(a) Linear and Nonlinear Equations**: Solution of Algebra and transcendental equations- Bisection, False position and Newton-Raphson methods-Basic principles-Formulae- algorithms. **(b) Simultaneous Equations**: Solutions of simultaneous linear equations - Gauss elimination and Gauss Seidel iterative methods-Basic principles-Formulae-Algorithms	12
V	Interpolations, Numerical Differentiation and Integration **(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 1/3rule-Formulae-Algorithms.	12

Text and Reference books:

1. Introductory methods of Numerical Analysis, S.S. SASTRY (PHI).
2. Numerical Methods, E. BALAGURUSAMY (Mc Graw Hill).
3. Programming with C, BYRON S. GOTTFRIED (Schaum’s Outlines).
4. Programming in ANSI C, E. BALAGURUSAMY (Tata Mc Graw-Hill).

M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
ADVANCED QUANTUM MECHANICS	PH3T2	5	-	-	5	2017-18

Course Description: The concepts of relativistic quantum mechanics and quantum field theory are included in this course.

Course Objectives:

1. To understand the relativity in quantum mechanics
2. To understand covariant notation and its use.
3. To understand the concept of second quantisation.
4. To understand quantisation of different fields
5. To understand the fundamentals of quantum electrodynamics.

Course Outcomes: At the end of this course, students should be able to:

CO1: Learn all the basic equations of motion and constants of motion in relativistic quantum mechanics.

CO2: Learn different transformations in covariant notation.

CO3: Get acquinted with second quantization and learn quantization of real fields.

CO4: Learn the quantization of complex field and relativistic fields like Dirac field and Maxwell's field and scattering phenomena from fields.

CO5: Get familiarity with basic concepts of quantum electrodynamics..

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3T2	CO1	H					L	M
	CO2		H				L	M
	CO3	H					L	M
	CO4		H				L	M
	CO5	H					L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	Relativistic Quantum Mechanics Klein-Gordon equation- continuity equation (probability and current 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.	12
II	Relativistic Quantum Mechanics Hydrogen atom-covariant notation-covariance of Dirac equation - Invariance of Dirac equation under Lorentz transformation- Pure rotation and Lorentz transformation- Charge conjugation- HoletheoryandChargeconjugation – Projectionoperatorsforenergyandspin– Bilinear covariants - Dirac equation for Zero mass and spin half particles.	12
III	Field Quantizatin Introduction for quantization of fields- Concept of field - Second quantization – Hamiltonian formulation of classical field - Quantum equations of the field - Real scalar field - Schrodinger field- Quantization of real scalar field and Schrodinger field-	12
IV	Field Quantizatin Quantization of complex scalar field, Dirac field - Quantization of Dirac field, Maxwell's field- Quantization of Maxwell's field, – Thompson scattering, Compton Scattering and Moller scattering.	12
V	Field Quantizatin The Hamiltonian in a radiation field – the interaction term in the semi classical theory of radiation- Quantization of radiation field. Covariant perturbation theory, S matrix expansion in the interaction picture, Feynman diagrams and Feynman rules for QED (Quantum Electrodynamics).	12

Text and Reference Books:

1. Relativistic Quantum Mechanics, J.D.BJORKEN and S.D.DRELL (McGraw-Hill).
2. Advanced Quantum Mechanics, J.J. SAKURAI (Addison Wesley).
3. Relativistic Quantum Mechanics and Quantum Fields, T-Y WU and W-Y PAUCHY HWANG (Allied Publishers).
4. Relativistic Quantum Mechanics and Quantum Field Theory, V. DEVANATHAN (Alpha Science International).

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Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
MOLECULAR PHYSICS	PH3T3A	5	-	-	5	2017-18

Course Description: This course gives theory of the basic concepts of molecular spectroscopy and energy levels and spectra of rotational, vibrational and electronic spectroscopies and their instrumentation and applications.

Course Objectives:

1. To learn molecular quantum numbers and electronic configuration of different molecules.
2. To learn principles, instrumentation and applications of rotational and Raman spectroscopy
3. To understand the vibrational motion of diatomic molecules and role of dipole moment in molecular spectroscopy
4. To understand molecular vibrations and character tables
5. To learn the electronic spectroscopy of diatomic molecules

Course Outcomes:

CO1: Understand the basic concepts of molecular physics and write ground state configuration of molecules
CO2: Learn Rotational and Raman spectroscopy theories and use principles in a wide range of applications.
CO3: Understand the Vibrational and Rotational-Vibrational theories
CO4: Understand the character tables and gain knowledge on symmetry operations and build connection between mathematical development and conceptual understanding
CO5: Understand the theory of electronic spectroscopy and construct Deslander's table and Fort rat diagram

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3T3A	CO1	H					L	M
	CO2		H				L	M
	CO3		H				L	M
	CO4		H				L	M
	CO5	H	M				L	M

Syllabus

Unit	Learning Units	Lecture Hours
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.	12
II	**Rotational Spectroscopy** Microwave spectrum of a diatomic molecule. Rigid rotator and non-rigid rotator approximations. Effect of isotopic substitution. 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 states. Influence of nuclear spin and statistical weights on pure rotational Ram an spectra of CO_2, O_2, H_2 and D_2	12
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 CO_2 and the influence of nuclear spin on Infrared and Raman vibration-rotation spectrum ofCO_2	12
IV	**Molecular Vibrations** C_{2v} and C_{3v} character tables from the properties of irreducible representations. Relationship between reducible and irreducible representations. C_{2V} 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 H_2O, NH_3, and formaldehydemolecules	12
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 vibrionic transitions. The Fortrat diagram and the band head. Combination relations and evaluation of rotational constants for bands (1 - 1) having only P and R branches	12

Text and Reference Books:

1. Introduction to Atomic Spectra, H.E. WHITE (McGraw-Hill).
2. Fundamentals of Molecular Spectroscopy, C.N. BANWELL and E.M. McCASH (TataMcGraw-Hill).
3. Modern Spectroscopy, J.M. HOLLAS (John Wiley &Sons).
4. Physics of Atoms and Molecules, BRANSDEN and JOACHAIN Pearson).

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M.Sc., (PHYSICS) Programme - III Semester

COURSE	COURSE CODE	L	T	P	C	Year
CONDENSED MATTER PHYSICS-I	PH3T4A	5	-	-	5	2017-18

Course Description: Condensed Matter Physics -I is the field of physics that deals with the macroscopic and microscopic physical properties of matter, especially the solid and liquid phases which arise from electromagnetic forces between atoms. More generally, the subject deals with "condensed" phases of matter: systems of many constituents with strong interactions between them.

Course Objectives:

1. To understand the lattice defects in different crystals
2. To understand the thermal and optical properties of crystals due to lattice defects.
3. To learn the concepts of luminescence and phosphorescence
4. To Understand the Specific heat of solids in different crystals
5. To Understand the magnetic properties and different theories of magnetism

Course Outcomes: At the end of this course, students should be able to:

CO1: Understand the lattice defects in different crystals
CO2: Understand the thermal and optical properties of crystals due to lattice defects
CO3: Learn the concepts of luminescence and phosphorescence
CO4: Understand the Specific heat of solids in different crystals .
CO5: Understand the magnetic properties and different theories of magnetisation.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH3T4A	CO1	H					L	M
	CO2	H					L	M
	CO3			H			L	M
	CO4	H					L	M
	CO5			H			L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
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.	12
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.	12
III	**Luminescence** Luminescence General remarks, Excitation and emission, Decay mechanisms, Thallium- activated alkali halides, The sulfide phosphors, Electroluminescence.	12
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.	12
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 $T^{3/2}$ law. Ferromagnetic Domains. Antiferromagnetism The two sub lattice model, Super exchange interaction Ferrimagnetism The structure of ferrites, The saturation magnetization, Elements of Neel's theory.	12

Text and Reference Books:

1. Solid State Physics, A.J. DEKKER (Macmillan).
2. Introduction to Solid State Physics, CHARLES KITTEL (John Wiley &Sons).
3. Solid State Physics, GUPTA and KUMAR (K. Nath& Co.).
4. Solid State Physics, S.O. PILLAI (New Age International).

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M.Sc., (PHYSICS) Programme - IV Semester

COURSE	COURSE CODE	L	T	P	C	Year
Condensed Matter Physics Lab	PH4L1	8	-	-	4	2017-18

Course Description : The main objective of the course is to make the students understand the experiments based on some physical concepts in material science courses.

Course Objectives:

1. to experimentally study some of the fundamental concepts in condensed matter physics
2. To teach some experiments of dielectric constants
3. To understand the different phenomena involved in experiments.
4. To teach experiments of susceptibility
5. To teach error analysis

Course Outcomes: At the end of this course, students should be able to:
CO1: Conduct experiments on the phenomena learnt in condensed matter physics.
CO2: Explain physical phenomena in the experiments performed.
CO3: Explain the connection between physical laws and their application.
CO4: Do the statistical analysis of the results obtained by the experiment and interpretation of results.
CO5: Understand the physics behind the results and make detailed, full report of the experiment.

CO - PO MATRIX

	CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PH4L1	CO1				H		L	M
	CO2				H		L	M
	CO3		H	M			L	M
	CO4				H		L	M
	CO5				H		L	M

Syllabus

Condensed Matter Physics Lab
(PH4L1)

Minimum 7 experiments are to be done and recorded

1. Magnetic susceptibility of solids
2. Magnetic susceptibility of liquids
3. Resistivity of semiconductor by four probe method
4. Coefficient of linear expansion
5. ESR spectrometer
6. Composite Piezo electric Oscillator
7. Molecular Polarizability of liquids
8. Curie point of ferro electric material
9. Dipole moment of acetone
10. Dielectric constant of Benzene

Reference Books:

1. Advanced practical physics Vol – I Dr. S. P. Singh
2. Advanced practical physics Vol II : DR. S.P. Singh
3. Practical Physics : Gupta, Kumar, Sharma
4. Practical Physics: P. R. Sasi Kumar
5.University Practical physics by D. C. Tayal
6. Viva – Voce in advanced physics : Gupta , Kumar, Sharma

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M.Sc., (PHYSICS) Programme - IV Semester

COURSE	COURSE CODE	L	T	P	C	Year
ACADEMIC/INDUSTRY PROJECT WORK	PH4L2	8	-	-	4	2017-18

Course Description : A short research activity on any significant or interesting aspects of the works (preferably relevant to the students' field of study/specialization) has to be performed or observed by a student in the organization. As part of curriculum students are required to write a short report generally named as a Research activity under the guidance of supervisor.

Course Objectives:

1. To promote independence, creativity and communication skills of the students
2. To enable the practical application of theoritical knowledge
3. To develop proper planning, organization and execution
4. To apply and adapt a variety of problem solving strategies to solve problems.
5. To develop positive attitude towards problems in career and life.

Course Outcomes: At the end of this course, students should be able to:
CO1: Get the ability to connect different areas of knowledge and develop ideas to do a project.
CO2: Will be able to learn on his own and take steps to improve it.
CO3: Will acquire collaborative skills through working in a team.
CO4: Demonstrate a strong working knowledge of ethics and professional responsibility.
CO5: Acquire skills to communicate his work effectively and present ideas clearly in both written and oral forms.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH4L2	CO1	H					L	M
	CO2	H					L	M
	CO3			H	H		L	M
	CO4	H				H	L	M
	CO5	H	M				L	M

PROJECT WORK: Academic/Industry : PH4L2

1. Every student (a) has to undertake the research oriented academic project or (b) has to undergo industrial training (during holidays for a minimum of 4 weeks) and has to submit a report at the end of the training.
2. The report should be submitted in the prescribed format only (50-75pages)
3. The project work carried out in the IV Semester is to be submitted one month before the Semester end examinations.
4. The academic project work can be done in the same institution where the studentisstudying (if the facilities are available) or can be undertaken in any other academic institution (if the facilities are not available in their institution).
5. There will be no internal assessment for the project work. A maximum of 100 marks are allotted for external valuation along with viva on the project report submitted. The external valuation of the project work will be done along with the SEM IV practical examination.

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M.Sc., (PHYSICS) Programme - IV Semester

COURSE	COURSE CODE	L	T	P	C	Year
NUCLEAR AND PARTICLE PHYSICS	PH4T1	5	-	-	5	2017-18

Course Description: Nuclearand Particle Physics course describesthe structure ofnuclei—theirformation,stability, and decay. It aims to understand the fundamental nuclear forces in nature, their symmetries, andthe resulting complex interactions between protons and neutrons in nuclei and among quarks insidehadrons, including the proton.

Course Objectives:

1. To know the basic properties of nucleus and their properties.
2. To visualize the nuclear characteristics through different nuclearmodels.
3. To understand nuclear reactions in nuclear reactors for generation of nuclearenergy.
4. To learn classification of elementary particles and gain knowledge on basic concepts of particle physics.
5. To demonstrate the mechanism of particle accelerators and creation of novelparticles.

Course Outcomes: At the end of this course, students should be able to:

CO1: Acquire knowledge in the content areas of Nuclear physics, focussing on concepts that are commonly used in this area

CO2: Learn different nuclear models and decay process to understand the nuclear structure and properties

CO3: Understand the reactions, conservation laws, release of energy in nuclear fission and fusion processes.

CO4:Learn classification of elementary particles and gain knowledge on basic concepts of particle physics

CO5: Understand the theory and principles of accelerators and gain knowledge on wide range of applications.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH4T1	CO1	M					L	M
	CO2	H					L	M
	CO3	H					L	M
	CO4	H					L	M
	CO5		H	M			L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Introduction and Nuclear Forces** **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 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).	12
II	**Nuclear Models and Nuclear Decay** **Nuclear Models:** Weizsacker'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. **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, selection rules, angular correlation.	12
III	**Nuclear Reactions and Nuclear Energy** **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.	12
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 (Gell-Mann and Nishijima formula) and charm, Elementary ideas of CP and CPT invariance, SU(2), SU(3) multiplets, Quark model.	12
V	**(Accelerators and Applications)** **Accelerators:** Electrostatic accelerators, cyclotron accelerators, synchrotrons **Applications:** Trace Element Analysis, Rutherford Back-scattering, Mass spectrometry with accelerators, Concepts of Diagnostic Nuclear Medicine and Therapeutic Nuclear Medicine.	12

Text and Reference Books:

1. Nuclear Physics, D.C.TAYAL (Himalaya publishing Co.).
2. Introductory Nuclear Physics, KENNETHS.KRANE (John Wiley & Sons).
3. Introduction to Nuclear Physics, HARALD A. ENGE (Addison Wesley).
4. Concepts of Nuclear Physics, BERNARD L.COHEN(McGraw-Hill).
5. Introduction to High Energy Physics, D.H.PERKINS (Cambridge University Press).
6. Introduction to Elementary Particles, D. GRIFFITHS (Wiley-VCH).
7. Nuclear Physics, S.B.PATEL (Wiley Eastern Ltd.).
8. Fundamentals of Nuclear Physics, B.B. SRIVASTAVA (Rastogi Publications).

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M.Sc., (PHYSICS) Programme - IV Semester

COURSE	COURSE CODE	L	T	P	C	Year
ANALYTICAL TECHNIQUES	PH4T2	5	-	-	5	2017-18

Course Description: Analytical Techniques course is aimed to train the students the principles, basic theory,instrumentation, and applications of selected analytical instruments. Analytical technique is a method thatis used to determine a chemical or physical property of a material.

Course Objectives:

1. To understand the theory of different analytical techniques.
2. To develop the skills to practice of analytical techniques.
3. To establish an appreciation of the role of Physics in quantitative analysis.
4. To provide scientific understanding of analytical techniques.
5. To provide the detail interpretation of results.

Course Outcomes: At the end of this course, students should be able to:

CO1: Understand the basic concept of theory, experimental methods and applications of Nuclear Magnetic Resonance

CO2: Understand the fundamentals of Electron Spin Resonance (ESR) including experimental techniques, theory, fine and hyper structures

CO3: Understand the fundamentals of Nuclear Quadrapole Resonance (NQR) includes principle, block diagram, spectrometer and various experimental methods

CO4: Apply the concepts of Electron spectroscopy to analyse the properties of materials.

CO5: Understand the concepts of Mossbauer Effect and applications.

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH4T2	CO1	H					L	M
	CO2		M				L	M
	CO3		M				L	M
	CO4		H				L	M
	CO5	H	M				L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	(Nuclear Magnetic Resonance) 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	12
II	(Electron Spin Resonance) Electron spin resonance – Spectrometer, Experimental methods, Thermal equilibrium and Relaxation methods, Characteristics of g and A values, Unpaired electron, Fine structure and Hyperfine structure.	12
III	(Nuclear Quadrapole Resonance) Nuclear Quadrapole Resonance spectroscopy, 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, pulsemethods.	12
IV	(Electron Spectroscopy) 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.	12
V	(Mossbauer Spectroscopy) The Mossbauer Effect, Recoilless Emission and Absorption, The Mossbauer Spectrometer, Experimental methods, Chemical shift, Magnetic Hyperfine interactions.	12

Text and Reference Books:

1. Nuclear Magnetic Resonance, E.R. ANDREW (Cambridge UniversityPress).
2. Spectroscopy, B.P. STRANGHAN and S. WALKER, Volume-I (John Wiley & Sons).
3. Pulse and Fourier Transform NMR, T.C. FARRAR and E.D. BECKER, (AcademicPress).
4. Molecular Structure and Spectroscopy, G. ARULDAS (Prentice Hall ofIndia).
5. Basic Principles of Spectroscopy, RAYMOND CHANG (McGrawHill).
6. Mossbauer Effect and Its Applications, V.G. BHIDE (McGrawHill).

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M.Sc., (PHYSICS) Programme - IV Semester

COURSE	COURSE CODE	L	T	P	C	Year
Condensed Matter Physics – II (Special)	PH4T3A	5	-	-	5	2017-18

Course Description: This course is focussed to equip the students with knowledgeand understanding of the key structural properties of different classes of materials. Students will gainskills in characterization of materials.

Course Objectives:

1. To understand the properties of different materials.
2. To understand the formation and applications of glass materials.
3. To understand the importance of bio materials.
4. To understand the importance of nano materials
5. To provide the detailed information of carbon nano tubes

Course Outcomes: At the end of this course, students should be able to:

CO1:Understand the importance of materials, phase rule and phase diagrams of binary and ternary systems

CO2: Understand the theories of glass transition , preparation and applications of glass materials related to research

CO3: Understand the importance of bio materials and their applications

CO4: Understand the types of liquid crystals and nano materials.

CO5: Synthesize and characterise nano materials and study their electrica, mechanical properties and optical properties by different characterisation techniques.

CO - PO MATRIX

	CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PH4T3A	CO1	H					L	M
	CO2	H	M				L	M
	CO3		H				L	M
	CO4		H				L	M
	CO5	H	M				L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
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	12
II	Glasses The glass transition – Theories of 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.	12
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.	12
IV	Liquid Crystals and Nanomaterials **Liquid Crystals:** Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, 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.	12
V	Synthesis, Characterization and Properties of nanomaterials **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.	12

Text and Reference Books:

1. Inorganic Solids, D.M. ADAMS (John Wiley &Sons).
2. Physics of Amorphous Materials, S.R.ELLIOTT (Longman).
3. Phase Transformations in Metals and Alloys, D.A. PORTER AND K.E. EASTERLING (CRC Press).
4. Thermotropic Liquid Crystals, Fundamentals, VERTOGEN and de JEU (Springer).
5. Nanocrystalline materials, H. GLEITER (Review article from "Progress in Materials Science, Volume 33, Issue 4, 1989, Pages223-315").
6. Biomaterials: An Introduction, JOON PARK and R.S. LAKES (Springer).
7. Biomaterials: Principles and Applications, J.B. PARK (CRC Press).
8. Science of Engineering Materials and Carbon Nanotubes,

C. M. SRIVASTAVA and C. SRINIVASAN (New Age Int).

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COURSE	COURSE CODE	L	T	P	C	Year
Condensed Matter Physics – III (Special)	PH4T4A	5	-	-	5	2017-18

Course Description: Condensed Matter Physics–III course will help students obtain a basic knowledge of the theory ofsuperconductors and the Josephson effect and their applications in cryoelectronics. The study of dielectricproperties concerns storage and dissipation of electric and magnetic energy in materials.

Course Objectives:

1. To understand the principles of some crystal growth techniques.
2. To understand the basic concepts of superconductivity
3. To understand the different phenomena where superconductivity is applied.
4. To understand the basic concepts of dielectrics
5. To understand the basic concepts of ferroelectrics.

Course Outcomes: At the end of this course, students should be able to:

CO1: Apply some crystal growth techniques to form crystals
CO2: Analyse the basic concepts of superconductivity
CO3: Analyse different phenomena involving superconductivity and their applications
CO4: Analyse the basics of dielectrics and their applications
CO5: Analyse the basics of ferroelectrics and their applications

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
PH4T4A	CO1				H		L	M
	CO2			H			L	M
	CO3				M		L	M
	CO4			H	M		L	M
	CO5			H	M		L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	Crystal Growth Techniques Bridgeman - Czochralski - Liquid Encapsulated Czochralski (LEC) growth techniques - zone refining and floating zone growth - chemical vapour deposition (CVD) - Molecular beam epitaxy - vapour phase epitaxy - hydrothermal growth - Growth from melt solutions - Flame fusion method.	12
II	Superconductivity-Introduction Meissner effect –- Isotope effect - specific heat - thermal conductivity and manifestation of energy gap - Vortices, type I and type II superconductors, Quantum tunneling - Cooper pairing due to phonons, BCS theory ofsuperconductivity.	12
III	Applications of Superconductivity Ginzburg-Landau theory and application to Josephson effect - dc Josephson effect, ac Josephson effect, macroscopic quantum interference, applications of superconductivity - high temperature superconductivity(elementary).	12
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, Clausius - Mossotti equation - Complex dielectric constant	12
V	Ferroelectrics General properties of ferroelectric materials - Classification and properties of representative ferroelectrics - Dipole theory of ferro electricity, objections against the dipole theory, Ionic displacements and the behaviour of $BaTiO_3$ above Curie temperature, theory of spontaneous polarization of $BaTiO_3$ - Thermodynamics of ferroelectric transitions, Ferroelectric domains.	12

Text and Reference Books:

1. Solid State Physics, A.J. DEKKER(Macmillan).
2. Introduction to Solid State Physics, CHARLES KITTEL (John Wiley &Sons).
3. Solid State Physics, GUPTA and KUMAR (K. Nath&Co.).

MATLAB SYLABUS

Unit-I

Introduction to MATLAB - Installation of MATLAB - Use of MATLAB -Key features - MATLAB Software -MATLAB window -Command window -Workspace -Command history -Setting directory -Working with the MATLAB user interface- Basic commands -Assigning variables -Operations with variables

Unit-II

Data files and Data types-Character and string Arrays and vectors Column vectors- Row vectors- Basic Mathematics- BODMAS Rules- Arithmetic operations Operators and special characters -Mathematical and logical operators

Unit-III

Solving arithmetic equations Operations on matrix- Creating rows and columns Matrix -Matrix operations Finding transpose- determinant and inverse -Solving matrix Other operations Trigonometric functions- Complex numbers fractions Real numbers Complex numbers

Unit-IV

Plotting - XY- plotting functions - Subplots and Overlay plots -Special Plot types - Interactive plotting -Function Discovery - Regression -3-D plots

Unit-V

Symbolic Math in MATLAB- Calculus: Numerical Integration Linear Algebra Roots of Polynomials- Algebraic equations Differential Equations (1st & 2nd order) -Transforms (Fourier, Laplace, etc) Ordinary Differential equations