P.B SIDDHARTHA COLLEGE OF ARTS &SCIENCE VIJAYAWADA

Under Choice Based Credit System

Board of studies of

M.Sc., PHYSICS

Semester - III

(With effect from 2022-23)

M.Sc. Physics

*(*with effect from **2022-23**admitted batch*)*

Name of the Department: PHYSICS

Name of the Programme: Master of Science., Physics

The M.Sc. (Physics) course shall be of two years' duration, extended over four semesters and grading system is followed in linewith national policies andinternational practices. The candidate shall be allowed a maximum of four years (8 semesters) of duration to be eligible for the award of M.Sc. (Physics) degree, failing which he / she shall have to register once again as a fresh candidate.

PROGRAMME OUTCOMES (POs)

On successful completion of the M.Sc Physics programme the student will be able to:

PO1	Understand of the basic concepts of physics systematically
PO2	Apply physical principles and concepts to solve wide range of practical problems.
PO3	Plan and execute physics related investigations to analyze and evaluate the information using suitable methods.
PO4	Able to execute theoretical and experimental project work
PO5	Excel in research related to Physics and Material Characterization
PO6	Develop the ability to work independently and also in a group
PO7	Engage in life long learning and adapt to changing professional and societal needs

III SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / ID/DS/ SE/OE/ MOOCS	Internal Marks	External Marks	No. of Credits
		L	P	T				
22PH3T1	Quantum Mechanics –II	4	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
22PH3D1	Electromagnetic Theory	4	0	0	DSE	30	70	4
22PH3D2	Lasers and Non linear Optics	4	0	0	DSE	30	70	4
22PH3D3	Condensed Matter Physics – I	4	0	0	DSE	30	70	4
22PH3D4	Thin Film Physics and Technology	4	0	0	DSE	30	70	4
22PH3D5	Microprocessors and Microcontrollers	4	0	0	DSE	30	70	4
22PH3D6	Optical System Design	4	0	0	DSE	30	70	4
LAB PRACTICALS								
22PH3L1	Advanced Physics and Optics	0	6	0	Core	30	70	3
22PH3L2	Electronics IC – Version	0	6	0	Core	30	70	3
OPEN ELECTIVE (INTERDISCIPLINARY/MULTIDISCIPLINARY) COURSES (CHOOSE ANY ONE)								
22OE3PH1	Principles of Analytical Instruments	3	0	0	OEC	30	70	3
22OE3PH2	Introduction to nanomaterials	3	0	0	OEC	30	70	3
22OE3PH3	Physics in everyday life	3	0	0	OEC	30	70	3
TOTAL FOR III SEMESTER						**210**	**490**	**25**

P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010

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QUANTUM MECHANICS - II

Offered to : M.Sc.(PHYSICS)

Course Code: 22PH3T1

Course Type : Core

Course: QUANTUM MECHANICS - II

Year of Introduction : 2004

Year of offering : 2022

Year of Revision : 2022

Percentage of Revision : Nil

Semester : III

Credits : 4

Hours Taught : 60 hrs. per Semester

Max.Time : 3 Hours

Course Prerequisites (if any) :

Course Description : Quantum Mechanics - II (**22PH3T1**) is a second course in quantum theory leads from quantum basics to basic quantum field theory, and lays the foundation for research-oriented concepts. This course is aimed to give insights on angular momentum, basic concepts of scattering cross-section & amplitude and to solve simple problems on scattering besides relativistic quantum physics

Course Objectives:

1. To apply the formalism tostudytheo r b i t a l angularmomentumconcept
2. Toapplytheformalismtostudythes p i n a n d t o t a l angularmomentumconcept
3. To learn the scattering processes of different problems
4. To learn the formalism of relativistic quantum mechanics
5. To learn covaiance of Dirac's equation under different transformations

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

CO1: Analyse the problems related to orbital angular momentum
CO2: Analyse the problems related to spin and total angular momentum
CO3: Understand different scattering problems
CO4: Analyse and compare Klein Gordan theory and Dirac's theory
CO5: Understand the concept of covariance under different transformations

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Orbitalangularmomentum** Introduction, Orbital Angular momentum, commutation relations for angular momentum operator. Ladder operators, Angular Momentum in spherical polar coordinates, Eigen valueproblem for L^2 and L_z, Eigen value problem for L+ and L-operators, Eigen values and Eigenfunctions of Rigid rotator and Hydrogen atom. (CO1)	12
II	**Spin andTotalAngularMomentum** Spin angular momentum, Pauli's exclusion principle and connection with statistical mechanics, Pauli spin matrices for electron, Commutation relations, Pauli operators, Pauli eigen values and eigen functions, 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, J_X, Jy&J_Z. (CO2)	12
III	**ScatteringTheory** Scattering cross section, scattering amplitude, Partial waves, Scattering by a central potential: Partial wave analysis, significant number of partial waves, Scattering by an attractive square wellpotential, scattering length, Bornapproximation–Criteria for the validityof Bornapproximation. Scattering due to screened coulomb potential, Form factor, Optical theorem, Low energy limit. (CO3)	12
IV	**Relativisticquantummechanics** Klein - Gordon equation - continuity equation (probability and current density), Klein-Gordonequation in the presence of electromagnetic field, Dirac equation for a free particle,Diracmatrices-properties probability and current density, Dirac equation in presence of electromagnetic field, Constants of motion – Linearmomentum – Total angularmomentum (existenceofelectronspin), Velocityoperator, Helicityoperator, Zitterbewegung operator. (CO4)	12
V	**Covariantnotation** Covariant notation,covariance of Dirac equation,InvarianceofDirac equation under Lorentztransformation, Purerotation and Lorentz transformation, Chargeconjugation, Holetheory, Projection operators for energyand spin, Diracequation for Zero mass and spin halfparticles. (CO5)	12

Reference Books:

1. N.ZETTILI, Quantummechanics:ConceptsandApplications,(JohnWiley&Sons).
2. S.L. KAKANI and H. MCHANDALIA, Quantum Mechanics: Theory & Problems, Sultan Chand&Sons.2004
3. R.K. PRASAD, QuantumChemistry, New Age International (P) Limited, Publishers Second edition, 2002
4. G.ARULDHAS, QuantumMechanics, Prentice Hall of India Private Limited, 2002

Course Delivery method : Face-to-face / Blended
Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities Quiz.

P.B. Siddhartha College of Arts & Science, Vijayawada - 520 010.
(An Autonomous College in the jurisdiction of Krishna University)
M.Sc., (PHYSICS) Programme - III Semester
Course Code: 22PH3T1 Title: QUANTUM MECHANICS - II
(w.e.f admitted batch 2022-23)

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

Answer All Questions 5x4=20M

1.	(a) What is orbital angular momentum?	(CO1)	BTL2
	(or)		
	(b) Define ladder operators.	(CO1)	BTL2
2.	(a)Define Pauli's exclusion principle	(CO2)	BTL2
	(or)		
	(b) Discuss about Helicity operator.	(CO2)	BTL2
3.	(a) Write the covariant form of Dirac's equation.	(CO3)	BTL2
	(or)		
	(b)What are the projection operators for energy and spin?	(CO3)	BTL2
4.	(a) Write the Dirac's equation in electromagnetic field?	(CO4)	BTL2
	(or)		
	(b) What are constants of motion?	(CO4)	BTL2
5.	(a) Define scattering amplitude.	(CO5)	BTL2
	(or)		
	(c) Discuss about Pauli's operator.	(CO5)	BTL2

Answer All Questions **5x10=50 M**

6.	(a) Evaluate the commutation relations for the components of angular momentum operator.	(CO1)	BTL3
	(Or)		
	(b) Obtain the Eigen values and eigen functions of L^2 and L_z.		
7.	(a) Discuss the connection of Pauli's exclusion principle with statistical mechanics.	(CO2)	BTL2
	(Or)		
	(b) What are Pauli spin matrices and discuss their properties.		
8.	(a) Discuss about the partial wave analysis.		
	(Or)		
	(b) Explain the Criteria for the validity of Born approximation.	(CO3)	BTL2

9. (a) Derive Klein-Gordon equation in the presence of an electromagneticfield. (CO4) BTL3

(Or)

(b) Obtain probability and current density using Dirac's equation.

10. (a) Write notes on i) pure rotation and

ii) Lorentztransformation. (CO5) BTL2

(Or)

(b) Explain about Holetheory.

Note: Question paper contains 5 short answer questions (two questions from each unit) and 5 essay questions (two questionfrom each unit) with internal choice

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ELECTROMAGNETIC THEORY

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH3D1

Course Type : Domain specific elective (DSE) **Course:** ELECTROMAGNETIC THEORY

Year of Introduction : 2004 **Year of offering :** 2022

Year of Revision : 2022 **Percentage of Revision :** 60%

Semester : III **Credits : 4**

Hours Taught : 60 hrs. per Semester **Max.Time** : 3 Hours

Course Prerequisites (if any) :

Course Description : Electromagnetic Theory (22PH3T2) course is designed to review the fundamentals and application of electromagnetic field theory. This course also enables the students to understand all Maxwell's equation in time varying field and their role in solving the problems related to electromagnetics. In this course the students will also learn about waveguides, electric and magnetic dipole, and electric quadrupole radiation besides the relativistic electrodynamics.

Course Objectives:

1. To Understanding of the importance of Maxwell's equations in solving practical electromagnetic field problems.
2. To understand the propagation of waves in wave guides.
3. To learn about the fields produced by stationary and moving charge charged systems and propagation of electromagnetic fields.
4. To make the students learn about radiation from electric and magnetic dipole, and electricquadrupole
5. To learn about four vector space and notations

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

CO1:Derive the electromagnetic wave equations from Maxwell's equations and calculate the energycarried by electromagnetic waves

CO2: To measure the charge on a surface, calculate the energy stored in aElectromagnetic field and intensity of energy crossing a point in EM field

CO3:Understand the concept of retarded potentials in electromagnetic fields.

CO4: Derive fields of different systems

CO5:work in four vector space

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Electromagnetic Waves** Maxwell's equations in differential and integral forms, Electromagnetic waves in vacuum, Plane waves innon-conducting media: Energy flux in a plane wave, radiation pressure and momentum, plane waves in conducting media, the skin effect, Reflection and refraction of plane waves at a plane interface- Fresnel's laws; Reflection from the surface of a metal. (CO1)	12
II	**Wave guides** Introduction-Propagation of Waves between conducting Planes, Waves in Guides of arbitrary Cross-section, Wave Guides of rectangular Cross –section, coaxial wave guide, Resonant Cavities, Dielectric wave Guides (CO2)	12
III	**Scalar and Vector Potentials:** Coulomb and Lorentz gauge, Wave equation for potentials: Hamiltonian in generalized potential form. Field equations and their solution. Retarded potentials – Radiation from an Oscillating Dipole - Linear Antenna. (CO3)	12
IV	**Electromagnetic radiation:** Lienard-Wiechert potentials, Potentials for a charge in uniform motion-Lorentz formula, radiation from an acceleration charged particle at low velocity- Larmor formula, radiation from a charged particle moving in a circular orbit, electric quadrupole radiation.(CO4)	12
V	**Relativistic Electrodynamics** Review of special theory of relativity, Lorentz transformations-consequences, Minkowski four vectors, energy-momentum four vector, covariant formulation of mechanics, Transformation of electric and magnetic fields under Lorentz transformations, field tensor, invariants of electromagnetic field, covariant formulation of electrodynamics. radiation from relativistic particles (CO5)	12

Reference Books:

1. B.B. LAUD Electromagnetics, New Age International Publishers, second edition, 2009
2. D.J. GRIFFITHS Introduction to Electrodynamics, Pearson Addison Wesley, sixth impression, 2008
3. SATYA PRAKASH Electromagnetic theory and Electrodynamics, Kedarnath Ramnath. Pub. 2010

Course Delivery method : Face-to-face / Blended
Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities : Quiz.

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M.Sc., (PHYSICS) Programme - III Semester
Course Code: 22PH3D1 Title: ELECTROMAGNETIC THEORY
(w.e.f admitted batch 2022-23)

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

Answer All Questions(5x4=20M)

1.	(a) Write Maxwell's equations in differential form	(CO1)	BTL2
	(or)		
	(b)What is relative permittivity?	(CO1)	BTL2
2.	(a) Write about the propagation of waves in conducting planes?	(CO2)	BTL2
	(or)		
	(b) What are resonant cavities?	(CO2)	BTL2
3.	(a) Write about gauges.	(CO3)	BTL2
	(or)		
	(b)What are retarded potentials?	(CO3)	BTL2
4.	(a) What are Lienard Weichart potentials.	(CO4)	BTL2
	(or)		
	(b)Describe electric quadrapole	(CO4)	BTL2
5 .	(a)What are Lorentz transformations.	(CO5)	BTL2
	(or)		
	(b) Write notes on four vectors	(CO5)	BTL2

Answer all questions. All questions carry equal marks **(5x10=50M)**

6.	(a) Derive Maxwells equations in integral form.		
	(Or)	(CO1)	BTL3
	(b) Discuss the propagation of electromagnetic waves in conducting media.		
7.	(a) Discuss the propagation of waves in rectangular wave guide		
	(Or)	(CO2)	BTL3
	(b) Discuss the propagation of waves in dielectric wave guides.		
8.	(a)Derive wave equation for potentials. .		
	(Or)		
	(b) Derive expressions for vector potential and scalar potential for the radiation from an oscillating dipole.	(CO3)	BTL2
9.	(a) Derive the potential for a charge in uniform motion.		
	(Or)		
		(CO4)	BTL2
	(b) Discuss electric quadrapole radiation		

10. (a) Describe the

transformation of electric and magnetic fields under Lorentz transformation (CO5) BTL2

(Or)

(b) Describe the covariant formulation of electrodynamics.

Note: Question paper contains 10 short answers (two questions from each unit) and 5 questions (one question from each unit with internal choice).

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LASERS AND NON LINEAR OPTICS

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH3D2

Course Type : Domain specific elective(DSE) **Course:** Lasers and Non linear Optics

Year of Introduction : 2004 **Year of offering :** 2022

Year of Revision : 2022 **Percentage of Revision :** 100

Semester : III **Credits : 4**

Hours Taught : 60 hrs. per Semester **Max.Time** : 3 Hours

Course Prerequisites (if any) :

Course Description : Lasers and Non Linear Optics (22PH3D2) course provides an insight on the principles of lasers and their applications in various areas of science and industry. It also provides fundamentals of nonlinear optics and interaction of light with matter. The non-linear behaviour is typically observed only when the electricfield of the light is comparable to the atomic electric field. Such fields can be obtained from lasers. In nonlinear optics, the superposition principle no longer holds. This course is also emphasized on fundamentals and applications of Holography and fiber optics.

Course objectives:

1. To understand the principles and operation of various kinds of lasers and their applications invarious areas of science and industry
2. To understand the fundamentals of lasers and their role in non-linear optics, holography, fiberoptics
3. To learn fundamentals of nonlinear optics and interaction of light with matter
4. To learn the concept of holography imaging.
5. To learn the basics of fiber optics

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

CO1: Understand principles of laser physics and required threshold conditions.
CO2: Apply the principle to different laser systems.
CO3: Understand different phenomena of non linear optics
CO4: Understand the concepts of holography and its applications
CO5: Understand the propagation of light in different optical fibers.

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Principles of Lasers** Introduction – directionality- brightness-monochromaticity-coherence–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 (CO1)	12
II	**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: Argon ion gas laser, Dye laser, Nd: YAG laser, Semiconductor laser, Applications of lasers. (CO2)	12
III	**Nonlinear Optics** Basic Principles- Harmonic generation – Second harmonic generation- Phase matching – Third Harmonic generation-Optical mixing –Parametric generation of light – Parametric light oscillator-Frequency up conversion-Self focusing of light. (CO3)	12
IV	**Holography** Introduction to Holography-Basic theory of Holography-Recording and reconstruction of Hologram- Diffuse object illumination-Speckle pattern – Frenel and Fourier transform Holography - Applications of Holography (CO4)	12
V	**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 fibers.(CO5)	12

Text and Reference Books:

1. Laser and Non-Linear Optics, B.B. LAUD (New Age International Publishers)
2. Introduction to Modern Optics, GRANT R. FOWLES (Dover Pub Inc.).
3. Lasers and their Applications, M.J. BEESLEY (Taylor and Francis).
4. Optical Fiber Communications, GERD KEISER (Tata McGraw-Hill Book)

Course Delivery method : Face-to-face / Blended

Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities : Quiz.

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M.Sc., (PHYSICS) Programme - III Semester
Course Code: 22PH3D2 Title: LASERS AND NON LINEAR OPTICS
(w.e.f admitted batch 2022-23)

Time: 3 Hours **Max. Marks: 70**
Answer All Questions **5x4=20M**

1.	(a) What are the characteristics of laser?		(CO1)	BTL2
	(or)			
	(b) Discuss Boltzmann principle.	(CO1)	BTL2	
2.	(a) Define emission and absorption.	(CO2)	BTL2	
	(or)			
	(b) Write notes on line broadening.		(CO2)	BTL2
3.	(a) What is non linear interaction.	(CO3)	BTL2	
	(or)			
	(b)What is optical pumping?	(CO3)	BTL2	
4.	(a) Discuss the theory of holography		(CO4)	BTL2
	(or)			
	(b)Discuss speckle pattern.		(CO4)	BTL2
5.	(a) Discuss total internal reflection.		(CO5)	BTL2
	(or)			
	(b)Distinguish rays and modes		(CO5)	BTL2

Answer All Questions **5x10=50 M**

6. (a) Derive the condition for attainment of population inversion in three level laser.
(Or)
(b) Derive the threshold condition for confinement of beam in a resonator (CO1) BTL2

7. (a) Explain different broadening mechanisms.
(Or)
(b) Explain the set up and working of Argon ion laser. (CO2) BTL3

8. (a) Discuss the second and third harmonic generations.
(Or)
(b)Explain parametric generation of light. (CO3) BTL3

9. (a) Discuss the recording and reconstruction of hologram
Or)
(b) Discuss the fourier transform holography (CO4) BTL2

10. (a) Explain the structure of step index fiber

(Or)

(b) Explain the structure of graded index fiber (CO5) BTL2

Note: Question paper contains 5 short answer questions (two questions from each unit) and 5 essay questions (onequestion from each unit) with internal choice.

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CONDENSED MATTER PHYSICS-I (Special)

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH3D3

Course Type : Domain specific elective(DSE) **Course:** Condensed matter physics-1 (special)

Year of Introduction : 2004 **Year of offering :** 2022

Year of Revision : 2022 **Percentage of Revision :** Nil

Semester : III **Credits : 4**

Hours Taught : 60 hrs. per Semester **Max.Time** : 3 Hours

Course Prerequisites (if any) :

Course Description : Condensed Matter Physics (22PH3D3) 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. The diversity of systems and phenomena available for study makes condensed matter physics the most active field of contemporary physics. This course covers various kinds of crystal defects and their generation and influence on material properties. This course is intended to understand the optical, thermal, and magnetic properties of the solids.

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: Remember the concepts of crystal structures and their properties
CO2: Understand the importance of crystal defects
CO3: Analyze the process involved in the Luminescence.
CO4: Understand the importance of specific heat of solids.
CO5: Analyze the theories involved in different magnetic domains.

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Crystal Defects** The structure of metals, lattice defects and configurational entropy – The number of vacancies and interstitial as function of temperature, the formation of lattice defects in metals, interstitial diffusion in metals, chemical diffusion in metals-Kirkendalll effect, Edge and screw dislocation, Estimates of dislocations densities, The Frank - Read mechanism of dislocation multiplication. (CO1)	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 F'-centers and vice- versa, Photoconductivity in crystals containing excess metal, Color centers resulting from excess halogen, Color centers produced by irradiation with X-rays. (CO2)	12
III	**Luminescence** Introduction, Kinds of Luminescence, Excitation and emission, Efficiency of Phosphor, Decay mechanisms, Thermo luminescence and glow, Thallium- activated alkali halides, the sulfide phosphors, Electroluminescence.(Co3)	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 andGruneisenrelation. (CO4)	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. Ferrimagnetism. The structure of ferrites, The saturation magnetization, Elements of Neel's theory. (CO5)	12

Reference Books:

1. A.J.DEKKER, Solid State Physics,Macmillan, 2002
2. CHARLES KITTEL, Introduction to Solid State Physics, John Wiley&Sons, 2007
3. GUPTA and KUMAR, Solid State Physics, K. Nath&Co., 2000
4. S.O. PILLAI, Solid State PhysicsNewAgeInternational, 2006
5. M.A. Wahab, Solid State Physics, Narosa, 2019, 3rd edition

Course Delivery method : Face-to-face / Blended
Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities : Quiz.

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M.Sc., (PHYSICS) Programme - III Semester
Course Code: 22PH3D3 Title: CONDENSED MATTER PHYSICS -I (special)
(w.e.f admitted batch 2022-23)

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

Answer All Questions **5x4=20M**

1.	(a).Define line defects in crystals	(CO1)	BTL2
	(or)		
	(b) Explain Frenkel and schotky defects?	(CO1)	BTL2
2.	(a) Explain the formation of excitons in ionic crystals ?	(CO1)	BTL2
	(or)		
	(b) Discuss the formation of F-Centers ?	(CO2)	BTL2
3.	(a) Describe Fluorescence .	(CO2)	BTL2
	(or)		
	(b) Explain phosphorescence	(CO3)	BTL2
4.	(a) What is a phonon mean free path? Explain	(CO4)	BTL2
	(or)		
	(b) Define lattice specific heat and explain its significance	(CO4)	BTL2
5.	(a) Discuss quenching of orbital angular moment	(CO5)	BTL2
	(or)		
	(b) Expalin ferro magnetism	(CO5)	BTL2

Answer All Questions **5x10=50 M**

6	(a) Discuss the classification of lattice defects (Or) (b) Explain the formation of lattice defects in metals	(CO1)	BTL2
7	(a) Write a note on electronic, thermal and optical excitations in ionic crystals (Or) (b) Explain the transformation of F-centers into F^I centers	(CO2)	BTL2
8	(a) Explain the time decay mechanism in luminescent materials. (Or) (b) Explain the thermo luminescence in Thallium activated alkali halides	(CO3) (CO4)	BTL2 BTL3
9	(a) Discuss the propagation of elastic waves in array of identical atoms (Or) (b) Explain the Debye's theory of lattice specific heat		
2.	(a) Discuss the quantum of Paramagnetism (Or) (b) Explain the Curie's law and exchange integral	(CO5)	BTL3

Note: Question paper contains 10 short answers (two questions from each unit) and 5 questions (one question from each unit with internal choice).

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ADVANCED PHYSICS & OPTICS

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH3L1

Course Type : Core (P) **Course:**ADVANCED PHYSICS & OPTICS

Year of Introduction : 2004 **Year of offering :** 2022

Year of Revision : 2022 **Percentage of Revision : Nil**

Semester : III **Credits : 4**

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 the formation of different spectra.

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

CO1: Understand the different concepts of physics through experiments.

CO2: To apply the concepts of condensed mater physics to understand the properties of different materials

CO3: To analyse the results obtained from different experiments through graphical analysis.

Syllabus

PRACTICAL – V
ADVANCED PHYSICS & OPTICS (22PH3L1)
(Minimum 10 experiments are to be done)

1. Determination of Rydberg constant using mercuryspectrum.
2. Determination of wavelengths of the spectral lines of mercuryspectrum using Hartmann's dispersion formula-Prism.
3. Electrons spin resonances.
4. Determination of Cauchy's constants usingPrism.
5. Viscosity of a liquid by oscillating discmethod.
6. Characteristic curve of GM counter.
7. Determination of Curie temperature.
8. Study of Laser diffraction.
9. Coefficient of linear expansions
10. Fourier analysis.
11. Non-Destructive Testing –Ultrasonic
12. Comparison of the experimental and theoretical frequencies of band gaps of mono-atomic and diatomiclattices.
13. Optical absorption coefficient ofsolutions
14. Analysis of Ramanspectrum.
15. Study of interference of light (biprism or wedgefilm)
16. Any two online virtual lab experiments with in the syllabus have to be carried out (using MHRD webresource).

Course Delivery method : Face-to-face / Blended

Course has focus on : Employability

Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php

Co-curricular Activities :workshop

P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010

Autonomous -ISO 9001 – 2015 Certified

ELECTRONICS IC – VERSION

Offered to : M.Sc.(PHYSICS) **Course Code**: 22PH3L2

Course Type : Core (P) **Course:**Electronics IC - Version.

Year of Introduction : 2004 **Year of offering :** 2022

Year of Revision : 2021 **Percentage of Revision : Nil**

Semester : III **Credits : 4**

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-5551 in various circuits.
4. To understand the frequency response of various filters.
5. To understand the working of wave form generators.

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

CO1: To apply the concepts of electronics for different circuits.
CO2: To analyse the the variation between theoretical and practical circuits.
CO3: To analyse the results obtained from different experiments through graphical analysis.

Syllabus

PRACTICAL – VI : (20PH3L2)
ELECTRONICS IC – Version
(Minimum 10 experiments are to be done)

1. Rectangular wave generator using IC555
2. Astable multivibrator using IC555
3. IC 555 timer – SchmittTrigger
4. IC 741 timer – SchmittTrigger
5. Twin-T oscillator
6. Colpitts oscillator
7. Integrator usingIC741
8. Differentiator using IC741
9. Wien bridge oscillator using IC741
10. Voltage follower
11. Low Pass Filter
12. High Pass Filter
13. Band pass filter using IC741
14. Triangular wave generator using IC741
15. Any two online virtual lab experiments with in the syllabus have to be carrie out (using MHRD webresource).

Course Delivery method : Face-to-face / Blended

Course has focus on : Employability

Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php

Co-curricular Activities : workshop

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PRINCIPLES OF ANALYTICAL INSTRUMENTS (Open elective)

Offered to : M.Sc.(PHYSICS) **Course Code**: 22OE3PH1

Course Type : open elective (OE) **Course:** Principles of Analytical Instruments

Year of Introduction : 2021 **Year of offering :** 2022

Year of Revision : 2021 **Percentage of Revision : Nil**

Semester : III **Credits : 4**

Hours Taught : 60 hrs. per Semester **Max.Time** : 3 Hours

Course Prerequisites (if any) :

Course Description : The Principles Analytical Instruments (22OE3PH1) course is aimed to give fundamentals of selective instruments and their applications in chemical, pharmaceutical, clinical, food-processing laboratories, and oil refineries. They are employed to obtain qualitative and quantitative information about the presence or absence of one or more components of the sample.

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Course Objectives:

1. To understand the working of different spectroscopic techniques
2. To understand the basic principles of chromatography
3. To learn the working of different lasers systems and the process of holography
4. To Understand the basic principles of nuclear magnetic resonance
5. To learn the basic principle of X-Ray diffraction and its applications in cryptography

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

CO1: Remember the concepts of spectroscopy
CO2: Understand the importance of chromatography
CO3: Analyze the process involved in the generation of different lasers
CO4: Understand the importance of mass spectrometry
CO5: Understand the microscopic techniques involved in determing the strucure of materials

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**SPECTROPHOTOMETRY** **Spectrophotometry** Introduction - Beer-Lambert law – UV-Visible spectroscopy – Instrumentation, Essential parts of spectrophotometer- Gratings and prisms – Radiant energy sources – filters – Photosensitive detectors- Photomultiplier tubes -Atomic absorption spectrophotometry – Flame emission and atomic emission photometry – Construction, working principle, instrumentation and applications. (CO1)	8
II	**CHROMATOGRAPHY** General principles –classification –chromatographic behavior of solutes– quantitative determination – Gas chromatography– Liquid chromatography –High-pressure liquid chromatography – Applications. (CO2)	8
III	**LASERS AND HOLOGRAPHY** Basic principles of lasers - Spontaneous and stimulated emission – Laser beam properties Types of lasers- Ruby laser-He-Ne laser - GaAs laser - Dye laser – Applications of Lasers. Introduction to Holography –Recording and reconstruction of Hologram –Applications of Holography (CO3)	8
IV	**NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY** NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry. (CO4)	8
V	**STRUCTURE AND MICROSCOPIC TECHNIQUES** X- ray diffraction, Bragg's law, Powder X-ray Diffractometer - Basic principles, Instrumentation and applications of Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy, Differential scanning calorimetry and Thermo gravimetric analysis (CO5)	8

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, Instrumental methods of analysis, , 7th Edition, 2012.
2. Robert E. Sherman., "Analytical Instrumentation",
3. GUPTA and KUMAR, Solid State Physics, K. Nath&Co., 2000
4. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill ,2nd Edition 2007
5. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

Course Delivery method : Face-to-face / Blended
Course has focus on : Employability
Websites of Interest :https://nlist.inflibnet.ac.in/vsearch.php
Co-curricular Activities : Quiz.

P.B. Siddhartha College of Arts & Science, Vijayawada - 520 010.
(An Autonomous College in the jurisdiction of Krishna University)
M.Sc., (PHYSICS) Programme - III Semester

Course Code: 22OE3PH1**Title:PRINCIPLES OF ANALYTICAL INSTRUMENTS**
(open elective)
(w.e.f admitted batch 2022-23)

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

Answer All Questions **5x4=20M**

1.	**(a)** Define Beer-Lambert's law		(CO1)	BTL2
	(or)			
	(b)Give examples for radiant energy sources			
2.	(a) What is a spectrophotometer ?	(CO1)	BTL2	
	(or)			
	(b) What is chromatography ?		(CO2)	BTL2
3.	(a) Define liquid chromatography.	(CO2)	BTL2	
	(or)			
	(b)Define stimulated emission	(CO3)	BTL2	
4.	(a) What is holography?	(CO3)	BTL2	
	(or)			
	(b)what are mass analyzers?	(CO4)	BTL2	
5.	(a) Define Brag's law of X-Ray diffraction	(CO5)	BTL2	
	(or)			
	(b) What is differential scanning calorymetry ?	(CO5)	BTL2	

Answer All Questions **5x10=50 M**

6.	(a) Discuss the construction and working of UV-Visible spectrometer (Or) (b) Give an account on atomic absorption spectroscopy	(CO1)	BTL2
7.	(a) Explain the classification of chromatography (Or) (b) Discuss the high pressure liquid chromatography and its applications	(CO2)	BTL3
8.	(a) Explain the construction and working of He-Ne laser. (Or) (b)Discuss the recording andreconstruction of hologram	(CO3)	BTL2
9.	(a) Give an account on NMR spectroscopy (Or) (b) Explain the different methods of mass spectroscopy	(CO4)	BTL2
10.	(a) Discuss the powder X-ray diffraction method (Or)		

(b) Explain the principle and working of scanning electron microscope and its applications (CO5) BTL2

Note: Question paper contains 5 short answer questions two questions from each unit) and 5 essay questions (two question from each unit) with internal choice.