

SRI VENKATESWARA UNIVERSITY :: TIRUPATI
SVU COLLEGE OF SCIENCES

DEPARTMENT OF PHYSICS
(M.Sc. Course Structure and Examination Scheme)



NEP Based Syllabus for
M.Sc. PHYSICS
Choice Based Credit System (CBCS)
(w.e.f. the Academic Year 2024-2025)

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SRI VENKATESWARA UNIVERSITY: TIRUPATI
SVU COLLEGE OF SCIENCES
MASTER OF SCIENCES
DEPARTMENT OF PHYSICS

Re – Structured P.G Programme as per NEP – 2020, (NHEQF) And Guidelines Of APSCHE
(WEF THE BATCH ADMITTED IN THE ACADEMIC YEAR 2024-2025)

(C.B.C.S), SYLLABUS ANDSCHEME OF EXAMINATION
(WITH EFFECT FROM THE ACADEMIC YEAR 2024-2025)

M.Sc., PHYSICS

SEMESTER – I								
S.No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total marks
1.	CC	PHY-101	Classical and Statistical Mechanics	4	4	70	30	100
2.		PHY-102	(A) Solid State Physics	4	3	50	25	75
			(B) Material Science					
3.		PHY-103	(A) Electromagnetic Theory, Lasers and Modern Optics	4	3	50	25	75
			(B) Optical, Microwaves and Satellite Communications					
4.		PHY-104	Practical –I (related to CC 102 & 103)	6	2	35	15	50
5.	SOC	PHY-105	(A) Advanced Digital Electronics and Microcontrollers	4	3	50	25	75
			(B) Advanced Microprocessors and Applications					
6.		PHY-106	(A) Mathematical Physics	4	3	50	25	75
			(B) Computational Methods and Programming					
7.	*P	PHY-107	Practical – II (related to SOC 105 & 106)	6	2	35	15	50
Total				36	20	340	160	500
8.	Audit Course	PHY-108	Indian Knowledge Systems – 1	4	0	0	100	0

- **CC (Core Courses)** – PHY-101 Core Course is mandatory and PHY-102 and PHY-103 Core Courses Student can choose one from each code.
- ***SOC (Skill Oriented Courses)** – Student can choose one from each code.
- ***Practical – I** relating to PHY-102 and PHY-103 Core Courses and **Practical - II** relating to PHY-105 and PHY-106 Skill Oriented Courses (SOC).
- **Audit Course** – Zero Credits but mandatory with only a Pass.

SEMESTER – II								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total marks
1.	CC	PHY-201	Quantum Mechanics	4	4	70	30	100
2.		PHY-202	(A) Condensed Matter Physics	4	3	50	25	75
			(B) Nanomaterials and Devices					
3.		PHY-203	(A) Applied Spectroscopy	4	3	50	25	75
			(B) Solid State Spectroscopy					
4.	P	PHY-204	Practical –III (related to CC 202 & 203)	6	2	35	15	50
5.	SOC	PHY-205	(A) Photonics	4	3	50	25	75
			(B) Vacuum and Thin Film Technology					
6.		PHY-206	(A) Advanced Embedded Systems	4	3	50	25	75
			(B) Solar Energy - Thermal Aspects					
7.	P	PHY-207	Practical – IV (related to SOC 205 & 206)	6	2	35	15	50
8.	OOTC	PHY-208	Open Online Transdisciplinary Course – 1	-	2	-	100	100
Total				36	22	340	260	600
9.	Audit Course	PHY-209	Indian Knowledge Systems – 2	4	0	0	100	0

- **CC (Core Courses)** – PHY-201 Core Course is mandatory and PHY-202 and PHY-203 Core Courses Student can choose one from each code
- ***SOC (Skill Oriented Courses)** – Student can choose one from each code
- ***Practical - III** relating to PHY-202 and PHY-203 Core Courses and **Practical - IV** relating to PHY-205 and PHY-206 Skill Oriented Courses (SOC)
- ***Open Online Transdisciplinary Course (OOTC)** - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,
- **Audit Course** – Zero Credits but mandatory with only a Pass

SEMESTER – III								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total marks
1.	CC	PHY-301	Advanced Quantum Mechanics	4	4	70	30	100
2.		PHY-302	(A) Physics of Semiconductor Devices	4	3	50	25	75
			(B) IC Fabrication Technology					
3.		PHY-303	(A) Advances in Physics	4	3	50	25	75
			(B) Physics of Advanced Materials					
4.	P	PHY-304	Practical –V (related to CC 302 & 303)	6	2	35	15	50
5.	SOC	PHY-305	(A) Advanced Characterization Techniques	4	3	50	25	75
			(B) Sensors and Transducers					
6.		PHY-306	(A) Introduction to VLSI Design	4	3	50	25	75
	(B) Solar energy – Photo Voltaics							
7.	P	PHY-307	Practical – VI (related to SOC 305 & 306)	6	2	35	15	50
8.	OOTC/ Open Elective	PHY-308	Open Online Transdisciplinary Course – 2 (OR) Open Elective- Vacuum Technology and Applications	-	2	70	30	100
*	Seminars /Tutorials/Remedial Classes and Quiz as a part of Internal Assessment			4	-	-	-	-
Total				36	22	410	190	600

- **CC** (Core Courses) – PHY-301 Core Course is mandatory and PHY-302 and PHY-303 Core Courses Student can choose one from each code
- ***SOC** (Skill Oriented Courses) – Student can choose one from each code
- ***Practical - V** relating to PHY-302 and PHY-303 Core Courses and **Practical - VI** relating to PHY- 305 and PHY-306 Skill Oriented Courses (SOC)
- ***Open Online Transdisciplinary Course (OOTC)** - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc., / ***Open Elective**

SEMESTER – IV			
PHY-401	Open Online Skill Development Courses (OOSDC)	H/W -	8 Credits
PHY-402	Project work – Orientation Classes (PW)	H/W 24	12 Credits
Conducting classes for competitive exams, communication skills, UGC/CSIR and NET/SLET Examinations		H/W 12	0 Credits

SEMESTER – IV								
S.No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total marks
1.	OOSDC/	PHY-401	Open Online Skill Development Courses	-	8	140	60	200
		(OR)						
	SDC (Skill Development Course)	PHY-401	(A) Mobile and Wireless Communications	4	4	70	30	100
			(B) Nuclear and Particle Physics	4	4	70	30	100
2.	PW	PHY-402	Project work – Orientation Classes	16	12	300	0	300
*	Conducting classes for competitive exams, communication skills, UGC / CSIR and NET / SLET Examinations			12	-	-	-	
	Total			36	20	440	60	500
Total Semesters				144	84	1320	880	2200

- **Open Online Skill Development Course (OOSDC)** - Students can choose any **Two** relevant courses of his/her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc. **(OR)** Skill Development Course (SDC) **to get 8 credits (with 4 credits from each course).**

Vision:

Envisions training students for quality education in diverse areas of pure and applied Physics keeping pace with academic and basic/applied research knowledge domains.

Mission:

The objective is to bring together professionals who possess a strong understanding of the fundamental laws of nature and a solid foundation in key areas of Physics. It is to provide a high-quality teaching and learning experience with hands-on training and explore new dimensions of teaching via various methodologies and platforms. Further, it is to continue the process of strengthening existing courses by periodically reviewing and introducing new programmes in alignment with the latest advances in science.

PROGRAM EDUCATIONAL OBJECTIVES: At the end of the program, the student will be able to:

Understand the basic and advance concepts of different branches of physics.
Perform and design experiments in the areas of electronics, atomic, nuclear, Condensed matter, and computational physics.
Apply the concepts of physics in specialized areas of condensed, nuclear, renewable energies, particle physics, etc. in industry, academia, research and day to day life.

PROGRAM OUT COMES: At the end of the program, the student will be able to:

PO1	Apply scientific knowledge to solve complex physics problems.
PO2	Identify, formulate, and analyze advanced scientific problems reaching substantiated conclusions using first principles of mathematics, physical, and natural sciences.
PO3	Design solutions for advanced scientific problems and design system components or processes that meet the specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal consideration.
PO4	Use research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Create, select and apply appropriate techniques, resources, and modern scientific Tools to complex physics problems with an understanding of the limitations.
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the Professional scientific practice.

PO7	Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Apply ethical principles and commit to the norms of scientific practice.
PO9	Function effectively as an individual, and as a member or leader in diverse teams, And in multidisciplinary settings.
PO10	Communicate effectively on scientific activities with the Scientific/ Engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective representations, and give receive clear instructions.
PO11	Demonstrate knowledge and understanding of the scientific principles and apply. These apply to one's work, as a member and leader in a team, managing projects, and in multidisciplinary environments.
PO12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of scientific and technological change.

PROGRAM SPECIFIC OUT COMES: At the end of the program, the student will be able to:

PSO1	Understand the basic and advanced concepts of different branches of physics.
PSO2	Perform and design experiments in the areas of electronics, atomic, nuclear, Condensed matter, and computational physics.
PSO3	Apply the concepts of physics in specialized areas of condensed, nuclear, renewable energies, particle physics, etc. in industry, academia, research and day-to-day life.

PHY-101		Classical and Statistical Mechanics					L-4, T-0, P-2			4 Credits		
Pre-Requisite: Understanding of Classical and Statistical Mechanics												
Course Objectives: The aim and objective of the course on Classical and Statistical Mechanics is to train the students of M.Sc. in the Lagrangian and Hamiltonian formalisms and the techniques of statistical ensemble theory and classical and quantum statistics so that they can use these in the modern branches of physics such as Quantum Mechanics, Quantum Field Theory and understand the macroscopic properties of the matter in bulk in terms of its microscopic constituents, etc.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand the necessity of Action, Lagrangian, and Hamiltonian formalism.										
CO2		Use d'Alambert principle and calculus of variations to derive the Lagrange equationsof motion.										
CO3		Describe the motion of a mechanical system using Lagrange-Hamilton formalism.										
CO4		Find the connection between Statistical Mechanics and thermodynamics. And use ensemble theory to explain the behavior of Physical systems.										
CO5		Explain the statistical behavior of Bose-Einstein and Fermi-Dirac systems and their applications. Describe physical problems using quantum statistics.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	-	2	2	2	2
CO2	3	2	2	2	2	1	1	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	2	2	2	2
CO4	3	2	2	2	1	1	1	-	2	2	2	2
CO5	3	2	2	2	1	1	1	-	2	2	2	2

PHY-101: Classical and Statistical Mechanics

UNIT – I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws, Constraints and their classification, Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alembert's principle, Lagrange's equations of motion. Applications: Inclined plane, Linear harmonic oscillator and simple pendulum.

Hamiltonian principle, Lagrange's equation from Hamilton's principle, Hamilton's equation of motion, Applications, Simple pendulum, Compound pendulum.

UNIT – II: Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations, Generating function and their properties, Condition for transformation to be canonical, Illustration of canonical transformation, Poisson – Brackets, Canonical equations in terms of Poisson's, Bracket notation. Lagrange - Brackets and their properties. Hamiltonian - Jacobi equation, one dimensional harmonic oscillator, Action Angle variables, Kepler problem in action angle variables.

UNIT- III: Ensembles and Partition Functions

Ensembles: Phase space – Concept of ensembles – Types of ensembles – Microcanonical ensemble-Canonical ensemble-Grand canonical ensemble-Comparison of various ensembles.

Partition Functions: Canonical partition function – Molecular partition function – Transnational partition function – Rotational partition function – Vibrational partition function- Electronic and Nuclear partition functions. Applications of Rotational partition function.

UNIT – IV: Classical and Quantum Statistics

Classical statistics: Maxwell - Boltzmann distribution - Equipartition theorem.

Quantum statistics: Bose – Einstein distribution, Bose – Einstein condensation, Einstein and Debye's theories of heat capacities- Fermi - Dirac distribution –Electrons in metals- Thermionic emission -Comparison of statistics.

Books for Study

1. Classical Mechanics, N.C. Rana and P.S. Joag - Tata Mc-Graw Hill (1991).
2. Classical Mechanics, H. Goldstein - Addison Wesley, (1980).
3. Classical Mechanics, J.C. Upadaya - Himalaya Publishing House, (2014).
4. Classical Mechanics, Gupta, Kumar and Sharma - Pragati Edition, (2019).
5. Classical Dynamics of Particles and systems by J.B. Marion, Thomson Books/cole, (2004).
6. Statistical Mechanics by B.K. Agarwal, Melvin Eisner-Publisher John Wiley & Sons, (1988).
7. Statistical Mechanics and properties of Matter by ESR Gopal — Publishers Ellis Horwood, (1974).
8. Statistical and Thermal Physics by F. Reif – Publisher Waveland Press, (2009).
9. Elementary Statistical Mechanics by C. Kittel- Dover Publications, (2012).

PHY-102 (A)	Solid State Physics	L-4,T-1,P-2	3 Credits									
Course Objectives: 1. To impart knowledge on different types of interactions, forces and temperature effect on solids and lattice vibrations. 2. To learn the behavior of electrons in solids based on classical and quantum theories and classification of solids using band theory. 3. To provide basic knowledge in semiconductors and drift, diffusion processes and Hall effect 4. To provide basic ideas in superconductivity and the related theories and parameters.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand different bonds in solids, lattice energies, ionic crystals properties and importance of lattice vibrations.											
CO2	Explain electronic properties of solids in classical, quantum and the nearly free electron model Able to classify materials as metals, insulators and semiconductors and sketch the band diagram for each											
CO3	Able to understand the semiconductors, application of Hall effect, drift and diffusion processes											
CO4	Learn the concept of superconductivity, properties, theories and applications of superconductors.											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	2	2	3	2			2
CO2	3	2	3	2	2	3	1		2	3		
CO3	3	3	3	3	2	2	1				3	
CO4	2	3		3	3	2	1				2	

PHY-102 (A): Solid State Physics

UNIT – I: Lattice Energy and Lattice Vibrations

Origin of chemical binding in ionic and van der Waals crystals - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: mono and diatomic one dimensional infinitely long lattices – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties – Experimental measurement of dispersion relation.

UNIT – II: Band Theory of Solids

Drude – Lorentz theory - Sommerfeld model – its consequences – electron-lattice interaction (Quantitative only) – Bloch function - Motion of electron in periodic potential – Kronig - Penny model – Formation of energy bands in solids – Brillouin zones – Concept of effective mass – Distinction between metals, insulators and semiconductors.

UNIT – III: Semiconductor Physics

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Direct and indirect band gap semiconductors – Hall effect - Continuity equation – Drift and Diffusion – Einstein relation- Generation and recombination and life time of non-equilibrium carriers

UNIT – IV: Superconductivity

Concept of zero resistance – Magnetic behavior – Distinction between a perfect conductor and superconductor – Meissner effect–Expression for entropy difference between normal and superconducting states – London's equations – Penetration depth – BCS theory – Josephson junctions -- Applications of superconductors

Books for Study

1. Solid State Physics, C. Kittel, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Macmillan India Ltd.
3. Elementary Solid State Physics, M. Ali Omar, Addison-Wesley.
4. Solid State Physics, M.A. Wahab, Narosa Publishing House.
5. Solid State Electronic Devices, B.G. Streetman.
6. High T C Superconductivity, C.N.R. Rao and S.V. Subramanyam.

PHY-102 (B)	Material Science	L-4, T-1, P-2	3 Credits									
Pre-requisite: Course enables the students to gain knowledge in materials science												
Course Objectives: Course enables the students to gain knowledge in materials science: ➤ To understand the crystallographic properties viz. crystal structures, defects and dislocations of solids for their industrial application ➤ To understand the elastic properties, phase diagrams of alloys and phase transformation along with theories of lattice specific heat. ➤ To understand the properties of semiconductor and dielectric materials for their application in electronic industry. ➤ To understand the properties of magnetic materials and superconducting materials.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Delineate the concepts of crystal structures, defects and dislocations.											
CO2	Understand the mechanical and thermal properties of solids											
CO3	Provide thorough knowledge on semiconductor and dielectric materials for their application in industry											
CO4	Provide thorough knowledge on magnetic materials for their industrial application											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	2	1	2	2	2
CO2	3	3	2	1	2	2	1	2	1	2	2	2
CO3	2	2	3	2	2	2	1	2	1	2	2	2
CO4	3	3	2	1	2	2	1	2	1	2	2	2

PHY-102 (B): Materials Science

UNIT- I: Crystal Structure and Imperfections:

Introduction- Structure of materials – Interatomic Forces and Types of Bonding – Crystal Lattice and Translation Vectors-Miller Indices- Types of Lattices- Simple Crystal Structures; Close packed structures and Loose Packed Structures- Packing Fraction - Non-Crystalline solids - Imperfection in solids – Vacancies – Interstitials – Dislocations: Screw and Edge Dislocations - Schmid's law - Surface imperfection.

UNIT- II: Mechanical and Thermal Properties of Solids

Stress, Strain, Elastic properties – Deformation – Elasticity – Hardness - Solid solutions and alloys - Phase diagrams - Gibbs phase rule - Single component systems – Eutectic phase diagram – Lever rule -Properties of Phase diagrams - Phase transformation. Lattice Specific Heat: Classical Theory: Dulong and Petit Theory- Quantum Theory: Einstein Theory of Specific Heat.

UNIT- III: Semiconductor and Dielectric Properties

The Band structure of semiconductors – Intrinsic Semiconductors: carrier concentrations – Extrinsic semiconductors: P-Type and N-Type Semiconductors-Carrier Concentrations – Fermi level - Variation of conductivity, Mobility with Temperature - Hall effect - Hall coefficients for Intrinsic and Extrinsic semiconductors – Hall effect devices. Dielectric Properties: Polarization and Permittivity - Dielectric constant – Different types of Polarizations and Polarizabilities : Electronic, Ionic and Orientation Polarizability.

UNIT- IV: Magnetic properties

Introduction: Diamagnetic materials – Paramagnetism materials – Ferromagnetic materials - Domain theory - Magnetic hysteresis, Weiss Molecular Field Theory of Ferromagnetism, -Magnetic Anisotropy - Exchange energy –Anti-ferromagnetism. Giant -Magnetoresistance, - Colossal Magnetoresistance, Superconductors: Properties – Type I and Type-II Superconductors- High T_c materials: YBCO and Bi-systems (Brief idea), Applications.

Books for Study

1. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley & Sons, 2007.
2. K. Vijayamohan Pillai and Meera Parthasarathi Functional Materials: A Chemist's Perspective by, Orient Blackswan (21 November 2013)
3. C. Kittel, "Introduction to Solid State Physics" Wiley Eastern Ltd, 2005.
4. V. Raghavan, "Materials Science and Engineering: A First Course", Prentice Hall, 2006
5. A.J. Dekker, "Solid State Physics", Macmillan & Co, 2000.
6. Michael Shur, "Physics of Semiconductor Devices", Prentice Hall of India, 1995.

PHY-103 (A)		Electromagnetic Theory, Lasers and Modern Optics					L-4, T-1, P-2			3 Credits		
Pre-requisite: Understanding of graduate level optics and Lasers												
Course Objectives: The aim and objective of the course on Electromagnetic Theory, Lasers and Modern Optics is to expose the M.Sc. students to the basics of the challenging research field of optical fibers and their use in nonlinear optics.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand the electro statistics and magneto statistics and also the properties of propagation of electromagnetic radiation in different media										
CO2		Know about the properties of laser beam and the working of different lasers and applications										
CO3		Describe the Fourier analysis in optics problems and to understand the concept of holography										
CO4		Analyze the propagation of light in optical fibers and to know the various applications of optical fibers										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	2	1	1	-	1	1	-	-
CO2	3	2	2	1	2	1	-	-	1	1	-	-
CO3	3	3	3	-	2	1	2	-	1	1	-	-
CO4	3	2	3	2	3	-	2	-	1	1	-	-

PHY-103 (A): Electromagnetic Theory, Lasers and Modern Optics

UNIT – I: Electromagnetic Theory

Electromagnetic radiation; Introduction – electromagnetic induction – Maxwell's equations in differential and integral forms - General wave equation-Propagation of Light in free space Propagation of light in isotropic dielectric medium – Propagation of light in conducting medium

- Skin depth – Reflection and refraction at the boundary of a dielectric interface – Fresnel's equations – Propagation of light in crystals - Double refraction.

UNIT – II: Lasers and Non-Linear Optics

Introduction to lasers – Spontaneous and stimulated emission – Laser beam properties - Einstein coefficients – Population inversion – Pumping schemes – Threshold condition for laser oscillation Laser cavity - Q factor– Different experimental methods – Ruby laser - GaAs laser - He-Ne laser Argon ion laser – CO₂ laser – Laser applications.

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency up-conversion – Guided wave optics - Pulse compression - Optical solutions.

UNIT – III: Holography, Fourier Optics

Introduction to Holography – Basic theory of Holography– Fresnel and Fourier transform Holography. Applications of Holography.

Introduction to Fourier optics – Two-dimensional Fourier transforms – Transforms of Dirac-delta function – The convolution integral – convolution theorem- Spectra and correlation – Parseval's formula – Apodization – Array theorem.

UNIT – IV: Fiber Optics:

Introduction to Fiber Optics-Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication –Fiber optic cables – Attenuation – Signal distortion on optical wave guides - Erbium doped fiber amplifiers - Block diagram of fiber optic communication system - Applications of optical fibers

Books for Study

1. Introduction to Electrodynamics, D.J. Griffiths, Prentice-Hall, India, 2015
2. Electromagnetics, B.B. Laud, Wiley-Eastern, New Delhi, 2011
3. Introduction to Modern Optics, G. R. Fowels, 2012
4. Lasers and their Applications, M.J. Beesly, Taylor and Francis, 1976
5. Lasers and Non-Linear Optics, B.B. Laud, Wiley Eastern Ltd., 1983
6. Optics, E. Hecht, Addison Wiley, 1974
7. Optical Fiber Communications, G. Keiser, McGraw Hill Book, 2000

PHY-103 (B)	Optical, Microwave and Satellite Communications	L-4, T-1, P-2	3 Credits									
Pre-requisite: Understanding of Basic Optical, Microwave and Satellite Communications												
Course Objectives: The aim and objective of the course on Optical, Microwave and Satellite Communications for the students of M.Sc. Physics is to equip them with the knowledge of Optical, microwave and satellite Communications.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand microwave communication system											
CO2	Understand functioning of Radar systems											
CO3	Study different digital modulation techniques											
CO4	Differentiate losses in optical fiber link and state transmission characteristics of optical fiber											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY-103 (B): Optical, Microwave and Satellite Communications

UNIT – I: Microwave Communications

Advantages and Disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading Sources, Detectors, components, antennae used in MW communication systems.

UNIT – II: Radar Systems

Radar block diagram and operation, radar frequencies, pulse considerations. Radar range equation, derivation of the radar range equation, minimum detectable signal, receiver noise, Signal to noise ratio, Integration of radar pulses, Radar cross section, Pulse repetition frequency, Antenna parameters, Radar transmitters, receivers.

UNIT - III: Digital Communications

Digital Communications: Principles of digital communications, digital radio, frequency shift keying, phase shift keying, quadrature amplitude modulation, bandwidth efficiency, carrier recovery.

UNIT – IV: Optical and Satellite Communications

Optical Communications: Optical transmitter and receiver for analog and digital communications, coherent and non-coherent detection, signal to noise ratio, error rate, coding. Satellite Communications: Orbital satellites, geostationary satellites, orbital patterns, look angles, orbital spacing, satellite systems, Link modules.

Books for Study

1. Microelectronics by Jacob Millman, 2nd Edition, Mc Graw-Hill International Book Co., New Delhi, 1990.
2. Optoelectronics: Theory and Practice, edited by Allen Chappel, 11th Edition, McGraw-Hill, International Book Co., New York, 1978.
3. Microwaves by K.C. Gupta, 2nd Edition, Wiley Eastern Limited, New Delhi, 1979.
4. Advanced Electronics Communications Systems by Wayne Tomasi, 6th Edition, Prentice-Hall, 1998.

PHY-104: Practical-I (related to CC 102 &

103) PHY-102 (A)

1. Four Probe Method – Band gap determination of semiconductor.
2. Thermistor – Thermistor constant and Energy gap determination.
3. Thermo emf of bulk samples.
4. X-ray diffraction grain size determination.

PHY-102 (B)

1. Calculation of crystallite size and lattice parameter from XRD spectra.
2. Estimation of Mobility and carrier concentration in a semiconductor from Hall effect measurements.
3. Thermoelectric power of given crystal.
4. Thermistor characteristics.

PHY-103 (A)

1. Laser-Slit width and Wire Diameter.
2. X-Ray Diffraction-Determination of Lattice Constant and Grain Size.
3. Thermo emf of Bulk Samples.
4. Refractive Index of Liquids.

PHY-103 (B)

1. Determination of Bending Loss in Optical Fiber.
2. Determination of Pitch of Wire mesh.
3. Geo linking multiple data sets.
4. Subset image.

PHY-105 (A)			Advanced Digital Electronics and Microcontrollers				L-4, T-1, P-2			3 Credits		
Pre-requisite: Basic knowledge about Advanced Digital Electronics and Microcontrollers												
Course Objectives: The aim of the course on Advanced Digital Electronics and Microcontrollers is to introduce M.Sc. students to the fundamental concepts of the subject. The course is designed to equip them with knowledge of digital electronics and microcontrollers that are relevant to contemporary applications. This foundational understanding will enable students to apply these principles across various branches of physics according to their specific needs.												
Course Outcomes: At the end of the course, the student will be able to												
CO1			Understand construction and working of advanced digital electronic circuits									
CO2			Design integrated logic circuits families and their applications.									
CO3			Understanding of microcontroller internal architecture and evaluation.									
CO4			Knowledge of instruction set, interrupts and memory organization of 8051 microcontroller.									
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	2	1	2	2	2
CO2	3	3	2	1	2	2	1	2	1	2	2	2
CO3	2	2	3	2	2	2	1	2	1	2	2	2
CO4	3	3	2	1	2	2	1	2	1	2	2	2

PHY-105 (A): Advanced Digital Electronics and Microcontrollers**UNIT – I: Combinational and Sequential Logics**

Combinational Logic: Multiplexers, Demultiplexer, Decoders- BCD-to-Decimal decoder, BCD-to-Seven-Segment Decoder. Encoders and Priority Encoders: Octal-to-Binary Encoder, Decimal-to-BCD Encoder.

Sequential Logic: Flip-Flops, A1-bit memory, The RS Flip-Flop, JK Flip – Flop, JK Master Slave Flip-Flops, T-Flip-Flop, D-Flip-Flop

UNIT – II: Shift Registers and Counters

Shift Registers: Serial-in Serial-out, Serial-in Parallel-out, Parallel-in Serial-out, Parallel-in Parallel-out Registers.

Counters: Asynchronous- Ripple Counter, Decoding Gates. Synchronous Counter-Binary Counter, Modified Counters: MOD-3, MOD-5, MOD-6, MOD-10 Counters.

UNIT – III : IC Logic families

Digital IC terminology, TTL logic family, TTL series characteristics, Improved TTL series, TTL loading and fan-out, other TTL characteristics, Connecting TTL outputs together, tristate TTL, ECL family, MOS digital ICs & Characteristics, CMOS logic & characteristics, Bilateral switch, TTL driving CMOS and vice-versa, Low voltage technology.

UNIT – IV: Microcontrollers

Introduction: 8051 Internal Architecture, Register Structure, I/O pins, Memory Organization, 8051 Addressing modes. 8051 Assembly Language Programming Tools.

8051 Instruction set: Data Transfer Instructions, Arithmetic instructions, Logical instructions, Boolean Variable Manipulation Instructions-Bit Addressability, Single-Bit instructions, Program Branching Instructions-Jump, Loop, and Call instructions, Rotate Instructions, Stack Pointer.

Books for Study

1. Digital Systems by Ronald J. Tocci, 6th Edition, PHI, 1999.
2. Digital Principles and Applications by A.P. Malvino and Donald P. Leach, Tata McGraw- Hill, New Delhi, 1993.
3. S.K. Bose, “Digital Systems”, 2/e, New Age International (P) Limited, 1992.
4. Digital Electronics by D.K. Kaushik, Dhanpat Rai Publishing company, 2005.
5. The 8051 Microcontroller and Embedded systems, by Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt. Ltd., 2000.

PHY-105 (B)	Advanced Microprocessors and Applications					L-4, T-1, P-2			3 Credits			
Pre-requisite: Understanding of Advanced Microprocessors and its Applications.												
Course Objectives: The goal of the Advanced Microprocessors and Applications course is to provide M.Sc. students with a comprehensive understanding of microprocessors, programming, and interfacing techniques.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understanding of microprocessor architecture and evaluation										
CO2		Develop skill of writing programs in ALP for various applications of 8085 & 8051										
CO3		Interface various peripherals with 8085 & 8051.										
CO4		Understanding interrupts and direct memory access										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2

PHY-105 (B): Advanced Microprocessors and Applications

UNIT – I: Microprocessors and its Architecture

Internal microprocessor architecture, Real mode and protected modes of memory addressing, Memory paging.

Addressing modes- Data addressing modes, program memory-addressing modes, Stack-memory addressing modes.

UNIT – II: Programming the Microprocessor

Instruction Set- Data movement instructions, Arithmetic and logic instructions, Program control instructions, Assembler details.

Modular programming, using the keyboard and video display, Data conversions.

Hardware Specifications- Bus buffering and latching, Bus timing, Ready and Wait state, Minimum mode versus maximum mode.

UNIT – III: Memory Interface

Memory devices, Address decoding, 8088 and 80188 (8-bit) memory interface, 8086, 80186, 80286.

Basic I/O Interface- Introduction to I/O interface, I/O port address decoding, ADC and DAC interface.

UNIT – IV: Interrupts

Basic interrupt processing, Hardware interrupts, expanding the interrupt structure, 8259A PIC.

Direct Memory Access- Basic DMA operation, 8237 DMA controller.

Book for Study

1. B.B. Brey, “The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium pro processor architecture, programming and interfacing”, 4/e, PHI, 1999.
2. K.J. Ayala, “The 8086 Microprocessor: Programming & Interfacing the PC” Penram International Publishing (India) Pvt. Ltd., 1995.
3. Douglas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”, 2/e, McGraw Hill, International Edition, 1992.
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, “The 80x86 IBMPC and Compatible Computers, (Volumes I & II)”. 2/e, Printice –Hall, Inc., 1998.
5. Walter A. Triebel and Avatar Singh, “Software, Hardware and Applications” PHI, 1995.
6. Yu Cheng Lin and Glenn A. Gibson, “Microcomputer systems: The 8086/8088 Family Architecture, Programming and Design”, PHI, 1992.

PHY-106 (A)		Mathematical Physics					L-4, T-1, P-0			3 Credits		
Pre-requisite: Understanding of the concepts of Mathematical Physics												
Course Objectives: The aim and objective of the course on Mathematical Physics is to equip the M.Sc. students with the mathematical techniques that he/she needs for understanding theoretical treatment in different courses taught in this class and for developing a strong background if he/she chooses to pursue research in physics as a career.												
Course Outcomes: At the end of the course, the student will able to												
CO1		Understand the basics and applications of special functions in all the branches of Physics.										
CO2		Use Fourier series and transformations as an aid for analyzing physical problems.										
CO3		Apply integral transform to solve mathematical problems of Physics interest.										
CO4		Formulate and express a physical law in terms of complex variables and simplify it by use of coordinate transforms.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	1	-	2	1	1	2
CO2	3	3	2	2	-	1	1	-	2	1	1	2
CO3	3	3	2	2	-	1	1	-	2	1	1	2
CO4	3	3	2	2	-	1	1	-	2	1	1	2

PHY-106 (A): Mathematical Physics

UNIT - I: Special Functions

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations – Solutions – Generating functions – Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations – (Proof for Legendre polynomials only).

UNIT - II: Integral Transforms

Fouriers Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms- Power in Fourier series – Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, saw tooth wave and triangular wave) – Inverse Laplace transforms – properties.

UNIT - III: Numerical techniques

Solution of an equation – Bisection method, Regular False method, Newton - Rhapsom method - Solutions of simultaneous – Gauss elimination method and Gauss-Seidel method - Interpolations - Newton's interpolation and Lagrange's interpolation, Curve fitting – Method of Least squares. Numerical differentiation and integration – Trapezoidal rule and Simpson's 1/3 rule – Solutions of differential equations - Euler's method and Runge-Kutta Methods.

UNIT – IV: Complex Variables

Functions – Complex differentiation - Analytic function - Cauchy – Reimann equations – Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Books for Study

1. Functions for Scientists and Engineers, W.W. Bell, D.Van Nostrand Company, London (1968)
2. Fourier Analysis, Hsu P Jewi, Unitech Division
3. Laplace Transforms by Murray Spiegle, Schaum's outline series, McGraw Hill, International Book Company, New York.
4. Applied Mathematics for Engineers, Pipes and Harval, Third Edition, McGraw Hill Books Co.
5. Mathematical Physics, H.K. Das and Ramaverma, S. Chand & Co Ltd., New Delhi, 2011.
6. Mathematical Physics, B. Bhattacharyya, New Central Book Agency Pvt. Ltd., 2010
7. Theory and Properties of Complex Variables, Murray R. Speigal, Schaum's outline series, Mc Graw Hill Book Co., Singapore.
8. Complex Variables and Applications, Churchle

PHY-106 (B)	Computational Methods and Programming							L-4, T-1, P-2		3 Credits		
Pre-requisite: Understanding of Computational Methods and Programming												
Course Objectives: The aim and objective of the course on Computational Methods and Programming is to familiarize the students of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C, etc., so that they can use these in solving simple physics problems.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Apply basics knowledge of computational physics in solving the physics problems.										
CO2		Programme with the high level language such as C.										
CO3		Use various numerical methods in solving physics problems.										
CO4		Analyze the outcome of the algorithm/program graphically.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	2	3	2	3	2
CO2	3	3	3	1	2	1	1	1	3	2	3	2
CO3	3	3	3	2	2	1	1	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2

PHY-106 (B): Computational Methods and Programming

UNIT – I:

Fundamentals of C language:

C character set: Identifiers and keywords, Constants, Variables, Data types, Declaration of variables, Declaration of storage class, Defining symbolic constants, Assignment statement. Operators: Arithmetic operators, Relational operators, Logic operators, Assignment operators, Increment and decrement operators, Conditional operators.

Expressions and I/O statements:

Arithmetic expressions, Precedence of arithmetic operators, Type converters in expressions, Mathematical (library) functions, Data input and output - Getchar and putchar functions, Scanf, Printf – Simple programs.

UNIT – II:

Control statements:

If-Else statement, Switch statement, The ? operator, GO TO, While, Do-while, FOR statements, BREAK and CONTINUE statements.

Arrays:

One dimensional and two dimensional arrays – Initialization, Type declaration, Inputting and outputting of data for arrays, Programs of matrices addition, subtraction and multiplication.

UNIT – III

User Define 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.

Pointers: Accessing the address of variable, Declaration and Initialization of pointer variables, Accessing the value of the variable through its pointer, Pointer Expressions, Pointers and Arrays, Pointers and structures.

UNIT – IV: Linear and non-linear equations:

Solution of Algebraic and transcendental equations: Bisection, Falsi position and Newton Rhapsom methods: Basic principles, Formulae, Algorithms.

Simultaneous equations: Solutions of simultaneous linear equations: Gauss elimination and Gauss-Seidel iterative methods, Basic principles: Formulae, Algorithms.

Books for Study

1. Programming with 'C' by Byron Gottfried, 4th Edition, Tata McGraw Hill, 2010.
2. Programming in 'C' by Balaguruswamy, 8th Edition, Tata McGraw-Hill, 1990.
3. Numerical Methods by E. Balaguruswamy, Tata Mc Graw Hill, 1999.
4. Computer oriented numerical methods by Raja Raman, 4th Edition, PHI Learning, 2018.
5. Let Us C, Yeswanth Kanetkar, 17th Edition, Infinity Science Press, 2008.

PHY-107: Practical-II (related to SOC 105 & 106)

PHY-105 (A)

1. Flip Flops (R-S, R-S-T, J-K).
2. Amplitude and Frequency Modulation/Demodulation.
3. Addition, Subtraction, Multiplication and Division of two 8-bit numbers using 8051 Microcontroller.
4. Ascending and Descending order of a given 8-bit numbers using 8051 Microcontroller.

PHY-105 (B)

1. Addition and Subtraction of two 32-bit numbers.
2. Multiplication of two unsigned numbers.
3. Division of 16-bit numbers by an 8-bit number.
4. Largest number in a given 8-bit numbers.

PHY-106 (A)

1. Finding Roots of Polynomial Equation-Newton Raphson Method using C language.
2. Numerical Integration by Simpson's 1/3 rule with Algorithm, Flow Chart and Output using C language.
3. Verification of Interpolation with Algorithm, Flow Chart and output using C language.
4. Finding Roots of Polynomial Equation-Newton Raphson Method using C language.

PHY-106 (B)

1. Numerical Integration by Simpson's 1/3 rule with Algorithm, Flow Chart and Output using C language.
2. Verification of Interpolation with Algorithm, Flow Chart and output using C language.
3. Finding roots of Quadratic equation using C-language.
4. Multiplication of two $N \times N$ matrices using C-language.

PHY-108: Indian Knowledge Systems – 1**Indian knowledge System (IKS)-Syllabus**

- Unit I : Introduction to Indian Knowledge Systems (IKS): About Indian Knowledge System; Definition of Indigenous/ Traditional Knowledge; Scope, and Importance of Traditional Knowledge.
- Unit II : Indian Heritage of Knowledge: Ancient Indian Knowledge: The Vedas and its components-the Vedangas Ancient Indian books and treaties: The Sastras.; The Great Indian Epics: The Ramayana and The Mahabharata Epics and religious treaties.
- Unit III : Ancient India- Bharat Varsha: People of Ancient Bharat Varsha; Our great natural heritage: The great Himalayas and the rivers; The civilizations of the Sindhu-Ganga valley, and the Brahmaputra valley; Our coastal plains; Our Nature: Forests and Minerals; Ancient Indian Traditional Knowledge and Wisdom about nature and climate.
- Unit IV : Contribution of Ancient India to Health Sciences: Traditional Indigenous systems of medicines in India: - Ayurveda and Yoga; Elements of Ayurveda: Gunas and Doshas, Pancha Mahabhuta and Sapta-dhatu; Concept of disease in Ayurveda; Ayurvedic lifestyle practices: Dinacharya and Ritucharya; Important Ayurvedic Texts; Hospitals in Ancient India; Ayurveda: Gift of India to the modern world.

PHY-201	Quantum Mechanics	L-4, T-1, P-2	4 Credits									
Course Objectives: 1. To provide an understanding of the formalism and language of quantum mechanics, operators and one dimensional problems 2. To gain knowledge of Quantum Dynamics and three dimensional problems 3. To understand the concepts of perturbation theory and their applications to physical situations. 4. To illustrate scattering theory and to determine the scattering parameters.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Solve problems in quantum mechanics using Schrodinger's equation and Dirac representation.											
CO2	Grasp the concepts of different pictures and familiar with the applications and solving of three dimensional problems											
CO3	Know how the approximation methods applied to atomic, nuclear and solid-state physics											
CO4	Understand scattering theory, formulate and solve scattering equation-solve problems using this theory											
Mapping of course outcomes with the program outcomes:												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	-	-	3	3	3	1
CO2	3	3	2	3	3	2	-	-	2	3	3	1
CO3	3	2	4	3	2	3	-	-	2	3	3	2
CO4	3	1	2	3	3	3	-	-	2	3	3	1

PHY-201: Quantum Mechanics

UNIT - I: Formulation and Simple Problems

Wave particle duality – Postulates of quantum mechanics -Linear vector space: Hilbert space - Dirac's Bra and Ket notations- Hermitian operators and their properties- Matrix representation of an operator- Unitary operators- Unitary transformation - The Kronicker Delta and Dirac delta functions- Eigen values and Eigen functions for finite potential well and step barrier

UNIT - II: Quantum Dynamics and Simple Problems

Equations of motion - Schrodinger Picture- Heisenberg Picture- Interaction Picture- Equivalence of various Pictures- Commutator bracket- Properties, Eigen values and Eigen functions for Simple harmonic oscillator- abstract operator method in one dimension Eigen values and Eigen functions for a free particle and particle in a box in three dimensions.

UNIT - III: Approximate Methods

Time independent perturbation theory for non-degenerate levels: Perturbed harmonic oscillator, Normal Helium atom, Stark effect of the plane rotator. First order perturbation theory for degenerate levels: Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).

WKB approximation; Variation methods

UNIT - IV: Scattering Theory

Introduction: classical theory of scattering - Quantum theory of scattering - Method of partial wave analysis - Scattering by a perfectly rigid sphere - Born approximation - Validity of Born approximation - optical theorem.

Books for Study

1. Quantum Mechanics: Concepts and Applications by Nouredine Zettili, Wiley, Ed., 2021
2. Introduction to Quantum Mechanics by David J. Griffiths and Darrell F. Schoeter, Third Ed., Cambridge University Press India Pvt Ltd., 2018.
3. Quantum Mechanics: G. Aruldas PHI learning private limited Second edition, 2018
4. Quantum Mechanics: S.L. Kakani and H.M. Chandalia Sultan Chandand, Sons First Edition, 2004
5. Advanced Quantum Mechanics: B.S. Rajput, Pragatiprakashan, 2019
6. Quantum Mechanics: V.K. Thankappan, New Age International (P) Ltd., Publishers, 1993
7. A Textbook of Quantum Mechanics: P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill Publishing Company, 2008
8. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma, Jai Prakash Nath and Company, 2007
9. An Introduction to Quantum Mechanics, P.T. Mathews Mc Graw Hill Publishing Company, 19

PHY-202 (A)		Condensed Matter Physics				L-4, T-1, P-2				3 Credits		
Course Objectives: 1. To familiar with the different crystal growth techniques and various crystal imperfections 2. To understand the dielectric properties and ordering of dipoles in dielectrics and ferroelectrics 3. To learn the different types of magnetism, magnetism-based phenomenon and ferri magnetism applications 4. To learn properties and applications of amorphous, liquid crystals and polymers												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Learn the classification of growth techniques and its importance, able to analyze the defects and its importance in properties of solids										
CO2		Understand different dielectric properties, differentiate between ferroelectrics and applications of ferroelectrics										
CO3		Explain various magnetic phenomena and describe the different types of magnetic ordering based on the exchange interaction, and magnons and their importance										
CO4		Understand the properties and applications of amorphous, liquid crystals and polymers										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	3	-	2	2	1	1	1
CO2	3	3	2	3	3	3	-	2	2	1	1	1
CO3	3	2	2	3	3	3	-	2	2		1	1
CO4	3	1	2	3	3	3	-	2	2	1	1	1

PHY-202 (A): Condensed Matter Physics

UNIT - I: Crystal Growth and Imperfections in Crystals

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth: Bridgman, Czochralski techniques.

Imperfections: Classification of imperfections – Point defects – Schottky and Frenkel defects - Expressions for equilibrium defect concentrations

UNIT- II: Dielectrics and Ferroelectrics

Dielectrics: Introduction – Dipole moment – various types of polarization – Electronic, ionic and Orientational polarization – Langevin's theory – Lorentz field

Ferroelectrics: Ferroelectric crystals– Spontaneous polarization – Classification and properties of ferroelectrics – BaTiO₃–Oxygen ion displacement theory.

UNIT- III: Ferromagnetism and Anti-ferromagnetism

Ferromagnetism: Introduction – Weiss molecular field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Magnetic bubbles

Anti-ferromagnetism: Introduction – Two sub lattice model, Ferri - magnetism - Ferrites – Structure – Applications

UNIT - IV: Functional Materials

Amorphous semiconductors: Band structure – Electronic conduction – Optical absorption – Applications. Liquid crystals: Classification – Orientational order and intermolecular forces – Magnetic effect – Optical properties – Applications.

Polymers: Classification – Structural property correlation – Applications.

Books for Study

1. Solid State Physics, C. Kittel, Edition: 8th 2012, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Edition: 1st, 2000. Macmillan India Ltd.
3. Solid State Physics, M.A. Wahab, Edition: 3rd, 2020, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Edition: 31st, 2019, Pragathi
5. Solid State Physics, R.L. Singhal, 2018, KedarNath, Ram Nath & Co. Publications, Meerut.
6. Science of Engineering Materials and carbon nano tubes, C.M. Srivastava and C. Srinivasan, Edition: 3rd, 2010 New Age Inter. Pub.
7. Crystal Growth, B.R. Pamplin, 1977, Pergmon Press.
8. Crystal Growth from High Temperature Solutions, D. Elwell and H.J. Scheel, 1975, Academic

PHY-202 (B)	Nanomaterials and Devices						L-4, T-1, P-2			3 Credits		
Course Objectives: 1. To provide knowledge of nanomaterials classification, properties and density of states function 2. To learn different synthesis methods to grow nano structures 3. To provide knowledge of carbon nano tubes and its properties 4. To learn Nano electronic devices, Solar cells and concepts related to future electronics devices.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Classify material as 0D, 1D, 2D and 3D on the basis of density of states and and sketch the band diagram for each and correlate the physical chemical properties with physical dimensions.										
CO2		Categorize different synthesis methods to grow variety of nanostructures.										
CO3		Describe allotropic forms of carbon and how they are synthesized, understand mechanical and electrical properties of carbon structures and their device applications.										
CO4		Gain knowledge on nanomaterial applications and recent advancement in 2D technologies.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	2	-	2	1	2	1
CO2	3	3	3	3	3	2	2	-	2	1	2	1
CO3	3	2	3	3	3	3	2	-	2	1	2	1
CO4	3	1	3	3	3	2	2	-	2	1	1	1

PHY-202 (B): Nanomaterials and Devices

UNIT- I: Introduction to Nanomaterials

Introduction to Nanomaterials – Significance of Nanomaterials - Zero, One and Two Dimensional Nanomaterials - Quantum confinement - Density of states - Properties Dependence of dimensionality – Chemical, Optical, thermal, Electrical, Magnetic Mechanical, Theoretical Aspects- density functional theory

UNIT – II: Synthesis of Nanomaterials

Introduction to Bottom – up and Top- down approaches - Ball milling –Inert Gas condensation – Physical vapour deposition - Molecular Beam Epitaxy – Sputtering – Pulsed laser Deposition – Chemical vapour deposition - Sol Gel – Electro spinning - Hydrothermal Synthesis.

UNIT- III: Nano – Carbon

Carbon molecules: Nature of the carbon bond Small carbon clusters —Structure of C₆₀ and its properties –Synthesis of bucky balls and Applications.

Carbon Nanotubes: Fabrication –Structure - Electrical Properties – Mechanical properties – Applications of carbon Nanotubes

Graphene: Fabrication – Structure – Electrical Properties – Mechanical properties – Applications.

UNIT – IV: Nano Devices

Introduction – Nanofabrication –Photo- Lithography – Pattern transfer – Introduction to MEMS

Single Electron Transistor – Solar Cells – Light Emitting diodes – Gas Sensors- Microbatteries - Field emission display devices –Fuel Cells.

Books for Study

1. Nanomaterials: Synthesis, Properties and Applications – Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, 2002.
2. Introudction to Nanotechnology – Charles P. Poole Jr and Frant J. Owens, Wiley Interscience, 2003.
3. Nanopracticles from Theroy to Applications edited by Gunter Schmid, Wiley VCH, 2004.
4. Nanoelectronics and Nanosystems by K. Glosekotter and J. Dienstuthi (Springer), 2004.

PHY-203 (A)	Applied Spectroscopy	L-4, T-1, P-2	3 Credits									
Pre-requisite: Understanding of the basic and advanced Applied Spectroscopy												
Course Objectives: The aim and objective of the course on Applied Spectroscopy is to expose the M.Sc. students to the basics of the challenging research field of optics. To understand in detail about rotational and vibrational effects on diatomic and polyatomic molecular spectra. To understand the details and analysis of rotational, vibrational and Raman spectra of molecules using various techniques. To know the instrumentation involved in different spectrophotometers like UV-VIS –IR, NIR and FTIR. To become familiar with the concepts of different types of luminescence and their applications.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand the molecular structure and the importance of various molecular transitions.											
CO2	Have knowledge about the rotational, vibrational and Raman spectroscopy of molecules and their various applications.											
CO3	Study the instrumentation of UV Vis and IR spectroscopy and Importance of spectroscopy. Able to thoroughly understand the instrumentation techniques that are used in different regions of spectra.											
CO4	Have the knowledge of Luminescence and their various applications. Students could be able to learn about fluorescence and phosphorescence spectroscopy in detail and their applications.											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	1	2	1	2	3	1	2
CO2	3	2	2	2	3	1	2	1	2	3	1	2
CO3	2	2	2	2	3	2	2	1	2	3	2	2
CO4	3	2	2	1	2	1	2	2	2	3	2	2

PHY-203 (A): Applied Spectroscopy

UNIT- I: Molecular Spectroscopy

Introduction – Rotational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for $^1\Sigma_g^+ - ^1\Sigma_g^+$ and $^1\Sigma_g^+ - ^1\Sigma_u^+$ bands– Evaluation of rotational constants with reference to above transition. Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves and dissociation energy, and pre-dissociation energy. Vibrations of polyatomic molecules: CO₂ and H₂O.

UNIT- II: Raman Spectroscopy

Introduction – Theory of Raman Scattering – Rotational Raman Spectra – Vibrational Raman Spectra – Mutual Exclusion Principle – Polarization of Raman Scattered Light – Single Crystal Raman Spectra – Resonance Raman Scattering -Structure Determination using FTIR and Raman Spectroscopy. Fourier Transform (FT) Raman Spectroscopy , Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy.

UNIT – III: Spectrophotometry

Introduction – Beer's law – Absorptivity – UV and visible absorption – Instrumentation – Essential parts of spectrophotometer – Photosensitive detectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes – IR Spectrophotometry – Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure -Qualitative and Quantitative analysis – Importance of photography in the spectrochemical analysis.

UNIT - IV: Fluorescence and Phosphorescence Spectroscopy

Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the triplet state – Population of the triplet state – Delayed Fluorescence – Excitation spectra – Experimental methods – Emission lifetime measurements – Time resolved emission spectroscopy – Applications of Fluorescence and Phosphorescence.

Books for Study

1. Molecular Structure and Spectroscopy by G. Aruldas, Printice-Hall Pvt. Ltd. (2001).
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill, 1983.
3. Spectroscopy Straughan and Walker (vol. 2 & 3, John Wiley & Sons, 1976.
4. Instrumental Methods of Analysis Willard, Merritt, Dean & Settle, CBS Pub, 2001.
5. Spectrochemical Analysis, L.H. Ahrens and S.R. Taylor, Addison – Wesley, London.
6. Elements of Spectroscopy, Gupta, Kumar and Sharma Pragati Prakasan, New Delhi (2012).
7. Problems in Spectroscopy, S.V.J. Lakshman, ICSU, Costed, 1988.
8. Basic Principles of Spectroscopy by R. Chang, Mic Graw Hill, 1971.
9. Principles of Fluorescence Spectroscopy, Joseph R. Lakowicz - Plenum Press, (1983).

PHY-203 (B)	Solid State Spectroscopy	L-4, T-1, P-2	3 Credits									
Pre-requisite: Understanding of basic and advanced Solid State Spectroscopy												
Course Objectives: The aim and objective of the course on Solid State Spectroscopy is to expose the M.Sc. students to the basics of the challenging research field High resolution spectroscopic techniques. To acquire thorough knowledge on ligand field theory and crystal field theory in spectroscopy. To know the importance of rare earth ions doped different hosts and to understand the concept of Judd-Ofelt theory and its applications in lasers. To develop and to understand different types of detectors and its uses. To get knowledge on two photon spectroscopy and its advantages over single photon spectroscopy.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Have knowledge on crystal field theory and the effect of weak crystal field on S, P, D and F terms.											
CO2	Understand the importance of rare earth doped materials and able to evaluate various laser parameters.											
CO3	Understand the instrumentation techniques involved in various spectrophotometers with use of various detectors.											
CO4	Acquire the knowledge on two photon spectroscopy.											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	2	1	2	3	2	2
CO2	3	2	1	2	1	2	3	2	2	3	3	2
CO3	2	2	2	2	2	1	2	2	1	3	3	2
CO4	3	2	2	2	1	2	2	1	1	3	2	2

PHY-203 (B): Solid State Spectroscopy

UNIT - I: Solid State Spectroscopy I – Transition Metal Ions

Introduction – Crystal fields and ligand fields-Concept of ligand field – Scope of ligand field theory – ‘d’ and other orbitals (s,p,f) – Quantitative basis of crystal fields – Octahedral crystal field potential on the d-wave functions – The evaluation of $10 Dq$ - Effect of weak field on S, P, D and F terms.

Term energy level diagrams – Correlation diagram for d^2 configuration in octahedral coordination – Tanabe-Sugano diagrams for d^2 configuration in octahedral field.

UNIT - II: Solid State Spectroscopy II – Rare Earth Ions

Introduction – Intensity of absorption and emission bands – Oscillator strengths – Intra-configurational f-f transitions – Selection rules – Electric and Magnetic dipole transitions – Judd-Ofelt theory and evaluation of Judd-Ofelt parameters – Radiative transition probabilities of excited states of rare earth ions – branching ratios, – Non-radiative process – Energy transfer – Resonance energy transfer – Process of IR to visible up conversion – Applications of rare earth doped luminescent materials.

UNIT – III: High Resolution Spectroscopy

Introduction – Light detectors – Single photon counting technique – Phase sensitive detectors – Laser optogalvanic spectroscopy – Matrix isolation spectroscopy – Laser cooling and its applications.

UNIT- IV: Two Photon Spectroscopy

Introduction – Two photon absorption spectroscopy – Selection rules – Expression for the two photon absorption cross section – Photo acoustic spectroscopy – Experimental methodology and applications to Physics, Chemistry, Biology and Medicine.

Books for Study

1. Introduction to ligand fields, B. N. Figgis (Intersci. Pub. New York, 1966).
2. Laser Crystals, A.A. Kaminskii, Springer-Verlag, New York, 1981.
3. Laser and Excited states of Rare Earths, R. Reisfeld and C.K. Jorgensen, Springer-Verlag, New York, 1977.
4. Optical Properties of Transparent Rare Earth compounds, S. Hufner, Acad. Press, 1978.
5. High Resolution Spectroscopy, J.M. Hollas.
6. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill Pub. 1983.
7. Instrumental Methods of Analysis, Willard, Merritt, Dean and Settle, CBS Pub. 2001.
8. Opto Acoustic Spectroscopy and Detection, Yoh-Han Pao, Academic Press, 1977.

PHY-204 Practical –III (related to CC 202 & 203)**PHY-202 (A)**

1. BaTiO₃ -Transition temperature.
2. Ferromagnetism – Hysteresis.
3. Lattice vibration – Mono atomic and diatomic.
4. Liquid crystals – Phase transition.

PHY-202 (B)

1. Synthesis of nano particles – sol gel method.
2. Particle size determination – XRD.
3. Band gap calculation – Absorption spectra.
4. Functional groups – FTIR.

PHY-203 (A)

1. Determine the Cauchy's constant of the given prism.
2. Calculate the refractive indices, molar refractivity and molecular polarizability of organic liquids and inorganic solutions with sodium vapour lamp on a Abbe refractometer.
3. Zeeman effect- determination of specific charge of an electron using Zeeman effect.
4. Verify the Beer-Lambert law - (i) find band maximum (ii) find out unknown concentration of CuSO₄.5H₂O solution.

PHY-203 (B)

1. Dispersive nature of Iron atomic spectra.
2. Qualitative analysis.
3. Groove spacing in audio CD's.
4. Measurement of Optical band gap of Cr³⁺ ion from the absorption spectrum.

PHY-205 (A)		Photonics					L-4, T-1, P-2			3 Credits		
Pre-requisite: Understanding of graduate level related to Lasers Fiber optic sensors and Photonic materials												
Course Objectives: The aim and objective of the course on Photonics is to expose the M.Sc. students to the basics of the challenging research field of optical fibers and their use in integrated optics and photonic crystals.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		In depth knowledge on different lasers and their application										
CO2		Importance of Fiber optics and their components in communication and sensors										
CO3		Significance and role of wave guides and optics in integrated optics										
CO4		Advances in photonic crystals, circuits and applications with respect to conventional devices.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	1	-	-	3	-	1
CO2	3	2	1	1	1	1	-	-	-	3	-	1
CO3	3	2	2	1	2	1	-	-	-	3	-	1
CO4	3	2	1	1	1	2	-	-	-	3	-	1

PHY-205 (A): Photonics

UNIT– I: Laser systems, Properties and Applications

General description, structure, excitation mechanism and working of CO₂, Argon ion, Free-electron, Dye, Nd: YAG, Optical parametric oscillator, semiconductor. Laser beam linewidth, frequency stabilization, divergence and coherence. Q Switching and Methods of Q-switching. Model locking and methods of model locking. Frequency doubling and phase conjugation. Laser applications anisotropic separation, velocity measurements, interferometry and speckle metrology.

UNIT- II: Fiber Optic Components and Sensors

Connector principles, Fiber end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors, Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors–Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio sensing, Bio imaging, Bio sensing.

UNIT- III: Photonic Integrated Circuits

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers FTIR beam splitters–Prism and grating couplers–Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feedback lasers -Wave guide array laser.

UNIT- IV: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Books for Study

1. Lasers: Principles and applications by J.Wilson and J.F.B. Hawkes, Prentice, Hall of India, New Delhi, 1996.
2. Laser fundamentals, W.T.Silfvast, Foundation books, New Delhi, 1999.
3. Fiber Optic Communication, Joseph C.Palais, Pearson Education Asia, India, 2001
4. Introduction To Fibre Optics, A. Ghatak And K. Thyagarajan, Cambridge University Press, New Delhi, 1999
5. Optical Guided Wave Signal Devices, R. Syms And J.Cozens. Mcgraw Hill, 1993.
6. Optical Electronics, A Ghatak and K.Thyagarajan, Cambridge University Press, New Delhi,1991
7. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
8. Nanophotonics, P.N. Prasad, Wiley Interscience, 2003.

PHY-205 (B)	Vacuum and Thin Film Technology							L-4, T-1, P-2		3 Credits		
Pre-requisite: To impart knowledge in vacuum technology and preparation and applications of thin films												
Course Objectives: ➤ To impart knowledge on creation of various ranges of vacuum by using different pumps and respective measurement of vacuum using different gauges ➤ To understand the growth of thin films by various physical and chemical deposition techniques ➤ To provide basic knowledge on electrical and optical properties of thin films ➤ To understand the applications of thin films in various microelectronic, sensor and optical devices												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Gain in-depth knowledge about the production and measurement of various of vacuum and industrial application of vacuum technology										
CO2		Thorough knowledge on various synthesis processes of preparation of thin films using physical and chemical methods.										
CO3		Understand the electrical and optical properties of thin films and the advantages over the bulk materials.										
CO4		Expose to industrial applications of thin films in various micro-electronics, optoelectronic, sensor and optical devices										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	2	1	2	2	2
CO2	3	3	2	1	2	2	1	2	1	2	2	2
CO3	2	2	3	2	2	2	1	2	1	2	2	2
CO4	3	3	2	1	2	2	1	2	1	2	2	2

PHY- 205 (B): Vacuum and Thin Film Technology

UNIT - I: Basics of Vacuum

Fundamentals of kinetic theory applicable to vacuum technology - Vacuum pumps: Rotary pump - Diffusion pump - Turbo molecular pump Vacuum Gauges: Pirani gauge - Penning gauge - Hot cathode ionization gauge - Pump combinations – Design of vacuum systems - Leaks and Leak detection- Applications of vacuum.

UNIT - II: Preparation of Thin Films

Physical Methods: Vacuum evaporation - Resistive heating - Electron beam evaporation - Epitaxial deposition: Pulsed laser ablation - Molecular beam epitaxy. Sputtering - Glow discharge - DC and RF sputtering - Reactive sputtering - Magnetron sputtering - Chemical methods: Electroplating – Spray pyrolysis – Chemical vapour deposition (CVD) Measurement of film thickness -Multiple beam interferometer (MBI) methods – Quartz crystal thickness monitor.

UNIT - III: Properties of Thin Films

Transport Properties of Thin Films: Metallic Films: Sources of resistivity in metallic conductors

– sheet resistance and temperature coefficient of resistance of thin films – Influence of thickness on the resistivity of structurally perfect thin films – Fuchs Sondheimer theory – Annealing and agglomeration - Optical Properties -Reflection and transmission by single film and multilayer films– Determination of optical constants by Ellipsometry.

UNIT - IV: Applications of Thin Films

Photolithography-Pattern Generation-Thin film resistors – Thin film capacitors – Thin film diodes and transistors – Thin film solar cells - Thin film microbatteries – Thin film Gas sensors – Reflection and antireflection coatings - Optical filters - Transparent conducting oxide coatings - Hard coatings – Tribological coatings.

Books for Study

1. Vacuum Technology, A.Roth, North-Holland, 1986.
2. Vacuum Science and Technology, V.VasudevaRao, T.B.Ghosh and K.L.Chopra, Allied Publications, 1998.
3. Handbook of Thin Film Technology, L.I.Maissel and R.L.Glang, McGraw HillBook Co., 1970.
4. Thin Film Phenomena,K.L.Chopra,McGraw Hill Book Co., New York, 1969.
5. Vacuum Deposition onto Webs, Films and Foils, Charles A. Bishop, Elsevier, London, 2011.
6. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.
7. The User's Guide to Vacuum Technology, J.F. O'Henlon, John Wiley & Sons, 2003.

PHY-206 (A)	Advanced Embedded Systems	L-4, T-1, P-2	3 Credits									
Pre-requisite: An understanding of advanced embedded systems utilized in industries at the present days.												
Course Objectives: The aim and objective of the course on Embedded Systems for the students of M.Sc. Physics is to equip them with the knowledge of microcontrollers and other processors used in the industry.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand about the basic functions and structure of embedded systems											
CO2	Get familiarized with Embedded system Design Tools and Hardware											
CO3	Understand about the basic programming concepts of embedded systems											
CO4	Know about the applications of PIC microcontrollers											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY-206 (A): Advanced Embedded Systems

UNIT - I: Introduction to Embedded Systems

Embedded systems in today's world – examples of Embedded systems – Microprocessors and Microcontrollers – Microchip and PIC microcontroller – Introduction to PIC microcontrollers using the 12 series.

Architecture of 16F84A – Memory organization in 16F84A – Timing generation – Power-up and Reset functions in 16F84A.

UNIT - II: Hardware Details of 16F84A

Parallel ports: Basic idea – Technical challenge – connecting to the parallel port – Parallel ports of PIC16F84A – Clock oscillator – Power supply – Interrupts – Timers and counters – watch dog timer – Sleep mode.

UNIT - III: Assembler and Assembler Programs

Basic idea – PIC 16 series instruction set and ALU – Assemblers and Assembler format – creating simple programs – Adopting a development environment – Building structured programs – Flow control: Branching and Subroutines – Generating time delays and intervals – Logical instructions – Arithmetic instructions.

UNIT - IV: PIC Microcontroller PIC 16F873A

Block diagram and CPU – Memory and memory maps – Interrupts – Oscillator, Reset and Power supply – Parallel ports.

PIC 16F87XA Timer 0 and Timer 1 – 16F87XA Timer 2, Comparator and PR2 register – Capture/Compare/PWM (CCP) Module – Pulse width modulation – ADC module.

Books for Study

1. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications by Tim Wilmshurst, First Edition, 2007, Newnes – Elsevier – Publishers.
2. Microcontrollers: Theory and Applications by Ajay V. Deshmukh, Tata McGraw-Hill, New Delhi, 2005.
3. Designing with PIC Microcontrollers by John B. Peatman, Pearson Education, Inc., 1998.
4. The 8051 Microcontroller and Embedded systems, by Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt. Ltd., 2000.

PHY-206(B)		Solar Energy – Thermal Aspects						L-4, T-1, P-2			3 Credits	
Pre-requisite: Basic knowledge on renewable energies and concept of thermal energy, black body radiation and the associated laws.												
Course Objectives: The aim of the course on Solar Energy – Thermal aspects is to introduce M.Sc. Physics students to the importance and applications of tapping the thermal component of energy coming from the Sun. The course is designed to understand the fundamental concepts on solar radiation, different definitions involved, a knowledge on the various types of solar collectors and applications of solar energy to the society. The course is aimed to give hands-on training for the students to learn the skills associated with solar thermal collectors.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand the basics of solar thermal energy and various associated concepts										
CO2		Learn the radiation measurement procedures via hands-on practical training.										
CO3		Know the types of solar collectors and learn collector performance analysis.										
CO4		Demonstrate skills related to collector performance analysis and applications of solar collectors.										
Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	1	4	3	2	2	2
CO2	3	4	2	1	2	2	1	4	4	2	2	2
CO3	2	2	3	2	4	2	4	4	3	2	2	2
CO4	3	3	2	1	2	2	1	4	4	2	4	4

PHY-206 (B): Solar Energy – Thermal Aspects

UNIT - I: Solar and Thermal Radiation- Basics

Spectral distribution of Extra-terrestrial radiation – Solar Constant - Concept of Zenith Angle and Air - Mass. Standard Time, Local Apparent Time, Equation of Time. Definitions of Declination, Hour Angle, Solar and Surface Azimuth Angles. Direct, Diffuse and Total Solar Radiations - Intensity Measurements - Thermoelectric Pyranometer and Thermoelectric Pyrheliometer.

Reflection, Absorption and Transmission of solar radiation – Transmittance - Absorptance product. Absorptance, Emittance and Reflectance. Spectrally Selective Surfaces - Direct measurement of solar absorptance and thermal emittance of a selective surface.

UNIT - II: Flat-Plate Collectors:

General description of a flat-plate collector - Liquid heating type flat-plate collector - Energy balance equation and efficiency. Temperature distribution in the flat-plate collectors - Collector heat loss coefficients - Collector efficiency factor, Collector heat-removal factor and Collector flow-factor. Standard method of testing the thermal performance of flat-plate collector - Evacuated tubular collectors.

UNIT - III: Concentrating Collectors

Types of Concentrating Collectors - non-imaging and imaging concentrators - single axis and two-axis tracking – Definitions of Aperture, Rim-angle, Concentration ratio and Acceptance angle. Thermal performance of Linear Parabolic Trough Collector with an uncovered receiver.

UNIT - IV: Solar Thermal Energy Applications

Principles of Solar Water Heating System- Natural and Forced Circulation types - sizing of domestic water system. Solar space heating systems - active heating system - liquid heating type - Passive space heating and cooling concepts. Solar Cookers, Solar Desalinators. Solar Air Heaters - Solar Driers - Principle of working – Solar thermal power generation.

Books for Study

1. Solar Thermal Energy Engineering, J.A. Duffie & W.A. Beckman, John Wiley & Sons (1990)
2. Solar Energy Utilization, G.D. Rai, Khanna Publications (1987).
3. Solar Energy-Fundamentals, design, modelling and applications, G.N.Tiwari, Narosa Pub., (2005)
4. Solar Energy-Principles of thermal energy collection & storage, S.P.Sukhatme, Tata Mc-Graw Hill Publishers, New Delhi (1999)
5. Treatise on Solar Energy - Vol. 1, H.P. Garg, John Wiley Pub., (2015).

PHY-207 Practical – IV (related to SOC 205 & 206)**PHY-205 (A)**

1. Determination of Bending Loss in Optical Fiber.
2. Determination of Pitch of Wire mesh.
3. Optical rotation by Sugar Solution.
4. Refractive index of the transparent solids.

PHY-205 (B)

1. Pump down characteristics (Theoretical and experimental) of a Rotary pump.
2. Pump down characteristics (Theoretical and experimental) of a Diffusion pump.
3. Pump down characteristics of high vacuum system.
4. Estimation of Optical band gap and optical constants of a thin film.

PHY-206 (A)

1. Write a program to addition and subtraction of two 8-bit numbers using PIC microcontroller.
2. Write a program to convert UPPER CASE letters to LOWER CASE letters using PIC Microcontroller.
3. Interface LED to PIC microcontroller 16F877.
4. Interface BUZZER to PIC microcontroller 16F877.

PHY-206 (B)

1. Measurement of global and diffuse radiation using thermoelectric pyranometer.
2. Measurement of direct solar radiation using thermoelectric pyrliometer.
3. Preparation of copper oxide selective surface by using chemical conversion method.
4. Preparation of black chrome selective surface by electroplating method.

PHY-209: Indian Knowledge Systems-2

PHY-301		Advanced Quantum Mechanics					L-4, T-1, P-2			4 Credits		
Course Objectives: 1. To gain the knowledge of identical particles and spin 2. To understand the orbital angular momentum and addition of angular momentum 3. To learn the basics of relativistic quantum Mechanics 4. To gain knowledge of fields and second quantization												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Learn distinguishability and indistinguishability of identical particles, construction of symmetric and anti-symmetric wave functions and able to solve real problems										
CO2		Grasp the concepts of angular moment as well as their quantization and addition rules, able to obtain Clebsch –Gordon coefficients and learn its importance in atomic physics										
CO3		Understand the principles of relativistic quantum mechanics and importance of Klein Gordon equation in solving real problems and know the concept of spin arising naturally from the Dirac equation										
CO4		Learn different fields and its importance and gain knowledge about second quantization										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	2	-	3	1	1	1
CO2	3	3	2	3	3	2	2	-	2	1	2	1
CO3	3	2	3	3	2	3	3	-	2	2	2	1
CO4	3	3	2	3	3	2	1	-	2	1	1	2

PHY-301: Advanced Quantum Mechanics

UNIT- I: Identical Particles and Molecules

Identical particles- Indistinguishability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions for two and three particle systems - Pauli's Exclusion Principle-Hydrogen molecule- Spin-orbit interaction- Ortho and Para hydrogen- Spin statistics connection.

UNIT - II: Angular Momentum

Introduction: Orbital Angular momentum, The angular momentum Operators, Commutation rules for angular momentum $[L_x, L_y]$ and $[L_x, L_z]$ and $[L_y, L_z]$; Eigen values and Eigen functions of L_z and L^2 - Angular momentum in general, Allowed values of total angular momentum J, Eigen values of J_+ and J_- ; Addition of angular momenta and Clebsch - Gordan co - efficient: Clebsch – Gordan co-efficient for $J_1=J_2=1/2$; Spin angular momentum - Pauli's matrices

UNIT - III: Relativistic Quantum Theory

Klein – Gordon Equation – KG equation in Co-variant form- Probability Density and Probability Current Density – Inadequacies of K.G. Equation – Dirac's Relativistic Equation for a Free Particle - Dirac's Matrices – Dirac's Equation in Co-variant form – Plane wave solution – Negative Energy States – Spin Angular Momentum - Existence.

UNIT - IV: Quantization of Wave Fields

Concept of Field - Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field - Second Quantization – Field equation - Quantization of Non-relativistic Schrodinger equation – Commutation and Anti-Commutation Relations- The N-representation - System of Fermions and Bosons – Creation and Annihilation.

Books for Study

1. Quantum Mechanics: Concepts and Applications by Nouredine Zettili, Wiley, Ed., 2021
2. Introduction to Quantum Mechanics by David J. Griffiths and Darrell F. Schoeter, Third Ed., Cambridge University Press India Pvt Ltd., 2018.
3. Quantum Mechanics: G. Aruldas PHI learning private limited Second edition, 2018
4. Quantum Mechanics: S.L. Kakani and H.M. Chandalia Sultan Chandand, Sons First Edition, 2004
5. Advanced Quantum Mechanics: B.S. Rajput, Pragatiprakashan, 2019
6. Quantum Mechanics: V.K. Thankappan, New Age International (P) Ltd., Publishers, 1993
7. A Textbook of Quantum Mechanics: P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill Publishing Company, 2008
8. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma, Jai Prakash Nath and Company, 2007
9. An Introduction to Quantum Mechanics, P.T. Mathews Mc Graw Hill Publis

PHY-302 (A)	Physics of Semiconductor Devices	L-4, T-1, P-2	3 Credits									
Pre-requisite: Understanding of basic and advanced Semiconductor devices												
Course Objectives: The aim and objective of the course on Physics of Semiconductor devices is to expose the students of M.Sc. students to experimental aspects of different semiconductor devise technologies, characterization and fabrication.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand various experimental techniques for semiconductor junctions and interfaces											
CO2	Use I-V characteristics to understand the function of devices											
CO3	Apply the knowledge of Junction transistors for various applications											
CO4	To get familiarization with Power Devices and Semiconductor Technology											
Mapping of course out comes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	1	-	-	1	-	1	1	1
CO2	-	-	-	3	-	-	-	3	1	1	1	1
CO3	-	-	1	2	3	-	1	3	2	2	2	2
CO4	-	-	1	3	3	1	1	2	2	2	2	2

PHY-302 (A): Physics of Semiconductor Devices

UNIT- I: Junction Diodes

Tunnel diode- I-V characteristics, Schottky barrier diode - operation and applications. Varactor diode, Gunn diode, IMPATT diode, TRAPATT diode, BARITT diode - basic principle, operation and its applications. Solar cell – Structure - Principle of operation – Solar cell parameters – Light Emitting Diodes (LEDs), Semiconductor lasers – principle of operation and applications.

UNIT - II: Bipolar Junction Transistors

Bipolar junction transistors: Principle of operation- Analysis of the ideal diffusion transistor – Calculation of terminal currents, DC parameters. Ebers-Moll Equations – Four regions of operation of a bipolar transistor. Real transistors - carrier recombination in the Emitter-Base junction depletion region – Effect of collector bias variation, avalanche multiplication in the collector – base junction and base resistance.

UNIT- III: Field effect transistors and charge-coupled devices

Junction field-effect transistors: JFET Principle of operation, Static I-V Characteristics of the idealized model. MOS capacitor: Surface field effect – Energy band diagrams of an MOS capacitor for different bias conditions, C-V characteristics of the MOS capacitor. Operating principle of MOSFET, I-V characteristics of an ideal MOSFET, Charge Coupled Devices (CCD)- principle of operation.

UNIT – IV: Technology of Semiconductor Devices

Crystal growth and Wafer preparation: Crystal Growth Methods, Neutron Transmutation Doping, Wafer Preparation. Methods of p-n junction formation: Melt Grown junctions, Solid State Diffusion, Alloying, Ion Implantation, Epitaxy, Growth and deposition of dielectric layers: Thermal oxidation of Silicon, Chemical Vapor Deposition, Plasma CVD, Sputtering, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

Books for Study

1. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons (Asia) Pvt. Ltd., Singapore, 2000.
2. Microwave Devices and Circuits, Samuel and Y. Lao, Prentice-Hall of India, 1999.
3. Microwave and Radar Engineering, M. Kulkarni, UMESH Publications, New Delhi, 1999.
4. Physics of Semiconductor Devices, S.M. Sze, 3rd Edition, Oct.2006, John Wiley.
5. Solid State Electronic Devices, B.G. Streetman, PHI, New Delhi.

PHY-302 (B)		IC Fabrication Techniques				L-4, T-1, P-2			3 Credits			
Pre-requisite: Understanding of IC Fabrication Techniques												
Course Objectives: The course on IC Fabrication Techniques aims to familiarize M.Sc. students with the fundamental aspects of IC fabrication, various techniques for preparing and processing IC technology, and deposition methods.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand and compare crystal growth and Epitaxial deposition techniques										
CO2		Understand structure and process of oxidation										
CO3		Study the diffusion processes										
CO4		Understand vacuum deposition techniques										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2

PHY-302 (B): IC Fabrication Techniques

UNIT – I: IC Fabrication Technology

Wafer preparation: Silicon crystal growth, Wafer orientation, Sawing and polishing, Crystalorientation, Doping of crystals during growth.

Epitaxial deposition: Introduction theory, Growth of an Epitaxial layer, evaluation of Epitaxiallayers.

UNIT – II: Oxidation

Introduction, equipment for thermal oxidation, oxidation process, oxide evaluation, recent advances in oxidation technology, oxide thickness determination, oxidation function, redistribution of dopant atoms during thermal oxidation, anodic oxidation.

UNIT - III: Impurity

Introduction and redistribution, the idea of diffusion, diffusion process, diffusion analysis, ion implementation.

UNIT – IV: Photo masking

Introduction – generation of photomask. Metallization: Metallization of requirements, vacuum deposition, deposition techniques, vacuum deposition cycle.

Books for Study

1. Integrated Circuits by K.R. Botkar, 9th edition, Khanna Publishers, 1987.
2. Microelectronics by Jacob Millman and Arvin Grabel, 2nd edition, Tata McGraw-Hill, 1987.
3. Integrated Electronics: Analog and Digital Circuits and Systems by Jacob Millman, Christos C. Halkias, Chetan D. Parikh, McGraw Hill Education, 2017.
4. Integrated Circuit Fabrication by S. Kumar and A. Gupta, CRC Press, Taylor & Francis Ltd, 2021.
5. IC Fabrication Technology by Gouranga Bose, McGraw Hill Education, 2017.

13. Publication Technology by Gouranga Datta, McGraw Hill Education, 2017.												
PHY-303 (A)			Advances in Physics					L-4, T-1, P-2			3 Credits	
Pre-requisite: Understanding of Advances in Physics												
Course Objectives: The aim and objective of the course on Advances in Physics for the students of M.Sc. Physics is to equip them with the knowledge of Nano technology, MEMS and remote sensing.												
Course Outcomes: At the end of the course, the student will be able to												
CO1			Understand the concepts of nanotechnology									
CO2			Physical and chemical techniques of nanomaterial synthesis									
CO3			Concepts of Micro and Nano devices									
CO4			Basics of remote sensing and understanding the concepts of Geographical Information system									
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY-303 (A): Advances in Physics

UNIT – I: Nano Technology

Introduction to Nanomaterials – Zero, One and Two Dimensional Nanostructures - Quantum confinement - Density of states and Dependence of dimensionality – Properties of Nanomaterials, Carbon Nanotubes, Fullerenes, Graphene.

UNIT-II: Synthesis of Nanomaterials

Synthesis of Nanomaterials – Physical Techniques: Ball Milling – Plasma Arc Deposition – Inert Gas Condensation – Pulsed Laser Deposition – Molecular Beam Epitaxy.
Chemical Techniques: Hydrothermal synthesis– Sol-Gel Process – Chemical Vapour Deposition.

UNIT – III: Micro and Nano devices

Microelectromechanical systems (MEMS): Introduction to MEMS, Basic MEM structure. Applications of MEMS: Pressure sensors, Accelerometers Mass flow sensors. Nanodevices: Quantum well and quantum dot devices: Infrared Detectors-Quantum Dot Lasers. Carbon nanotube emitters - Photoelectrical cells.

UNIT - IV: Remote Sensing

Definition of remote sensing; introduction to concepts and systems; Electromagnetic radiation; electromagnetic spectrum; image characteristics; remote sensing systems; remote sensing platform; Sources of remote sensing information. Application of Remote sensing in Environmental Management, Natural resource management – forest resources, water resources, land resources and mineral resources.

Books for Study

1. Nano structures and Nanomaterials: Synthesis, Properties and Application by Guozhiong Cao, Imperial College Press (2004).
2. Introduction to Nanotechnology, By Charles P. Poole, Jr and Frank J. Owens, Willey India (2006).
3. An Introduction to Microelectromechanical Systems Engineering by Nadim Maluf, Artech House Publishers, 2004
4. Nanomaterials Synthesis Properties and Applications, by Alen. S. Edelstein and Robert C. Cammarata, 1998.
5. Floyd F. Sabins Jr., Remote Sensing Principles and interpretation, by W.H. Freeman and Company, 2nd Ed., New York, 1987.
6. T.M. Lilles and & R.W. Kiefer, Remote Sensing and Image Interpretation', by John Wiley & Sons, New York, 1994.
7. An Introduction to GIS by Ian Heywood et al., Addison Wesley, Longmont Limited, England, 2011.

PHY-303 (B)		Physics of Advanced Materials					L-4, T-1, P-2			3 Credits		
Course Objectives: 1. To introduce the theories and concepts of elastic properties of solids 2. To learn the different theories related to thermal properties of solids 3. To introduce the concept of energy bands and Fermi surface 4. To introduce the concept of photo conductivity, different types of luminescence and decay mechanisms												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Learn the relation between stress and strain and gain knowledge on elastic constants and velocity of elastic waves in different directions in cubic crystals										
CO2		Gain understanding on classical theory of specific heat and quantum theory of specific heat, able to understand Gruneisen parameter and lattice thermal conductivity										
CO3		Know theories of different bands, Fermi surface construction and experimental determination of Fermi surface										
CO4		Understand the photo conductivity theories and different types of luminescence and decay mechanisms.										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	3	-	2	2	1	1	1
CO2	3	3	2	3	3	3	-	2	2	1	1	1
CO3	3	2	2	3	3	3	-	2	2		1	1
CO4	3	1	2	3	3	3	-	2	2	1	1	1

PHY-303 (B): Physics of Advanced Materials

UNIT - I: Elastic Properties of Solids

Lattice as a homogeneous and continuous medium - Analysis of stress and strain tensors – Hooke's law - Elastic compliances and stiffness constants – Elastic energy density – Reduction in the number independent elastic constants in cubic crystals – Cauchy's relations – Bulk modulus and compressibility – Elastic waves in cubic crystals – Formulation and solution of wave equations along [100], [110] and [111] directions – Experimental determination of elastic constants – Pulse-echo technique.

UNIT - II: Thermal Properties of Solids

Lattice specific heat at low temperatures – Einstein and Debye models – Anharmonicity – Thermal expansion – Gruneisen parameter- Lattice thermal conductivity – Elementary kinetic theory – Role of U and N processes.

UNIT - III: Energy bands and Fermi Surfaces

Energy band calculations: Plane Wave method and Augmented Plane Wave (APW) method. Importance of Fermi surface – Characteristics of Fermi surface – Construction of Fermi surface -Quantization of electron orbits - Experimental study of Fermi surface: nomalousskin effect –Cyclotron resonance – de Haas van Alphen effect.

UNIT- IV: Photoconductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types– Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications

Books for Study

1. Solid State Physics, C. Kittel, Edition: 8 th 2012, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Edition: 1st, 2000. Macmillan India Ltd.
3. Solid State Physics, M.A. Wahab, Edition:3rd, 2020, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Edition: 31st, 2019, Pragathi
5. Solid State Physics, R.L. Singhal, Kedar Nath, Ram Nath & Co. Publications, Meerut, 2018.

PHY-304 Practical –V (related to CC 302 & 303)

PHY-302 (A)

1. Tunnel Diode Characteristics.
2. LED Characteristics.
3. JFET – Characteristics.
4. BJT- Configuration Characteristics.

PHY-302 (B)

1. Standard Cleaning.
2. Oxide etching.
3. Al Deposition.
4. Device Measurement.

PHY-303 (A)

1. The viewer (e-workspace).
2. Geo-referencing.
3. Image enhancement.
4. Geo linking multiple data sets.

PHY-303 (B)

1. Creep – Activation energy.
2. Energy gap- Reverse saturation.
3. Anisotropy.
4. Seebeck coefficient determination – Thermo emf.

PHY-305 (A)			Advanced Characterization Techniques					L-4, T-1, P-2			3 Credits	
Pre-requisite: Understanding of graduate level related to advanced characterization techniques												
Course Objectives: The aim and objective of the course on Advanced characterization techniques is to expose the M.Sc. students to the basics of X-Ray diffraction and electron diffraction and microscopy methods ,to understand the advanced spectroscopic characterization techniques such as electron spin resonance, Mossbauer spectroscopy, Nuclear magnetic resonance and NQR spectroscopic techniques												
Course Outcomes: At the end of the course, the student will be able to												
CO1			To understand the XRD and Microscopic Techniques									
CO2			To understand the Advanced Spectroscopic Techniques									
CO3			To understand theoretical techniques Resonance Spectrometers and Mass Spectrometer									
CO4			To understand the NMR and NQR Techniques.									
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	1	-	-	3	-	1
CO2	3	2	1	1	1	1	-	-	-	3	-	1
CO3	3	2	2	1	2	1	-	-	-	3	-	1
CO4	3	2	1	1	1	2	-	-	-	3	-	1

PHY-305 (A): Advanced Characterization Techniques

UNIT- I: Diffraction and microscopic techniques

X-ray diffraction and Imaging techniques: Powder method, Transmission electron microscopy, Scanning electron microscopy and Atomic force microscope

UNIT – II: Advanced Spectroscopic Techniques

Spectroscopic Techniques: Energy dispersive spectroscopy, X-ray photoelectron spectroscopy and Auger Electron Spectroscopy.

UNIT- III: ESR and Mossbauer spectroscopy

Introduction to ESR: Magnetic moment of an electron, ESR theory- spin-spin interaction - Hyperfine interaction-g factor, Relaxation effects, Experimental methods and applications. Mossbauer spectroscopy: Introduction-Mossbauer effect, Recoilless emission and absorption, Mossbauer spectrum, Experimental methods and applications.

UNIT- IV: NMR and NQR Techniques

Introduction to NMR: Nuclear spin and magnetic moment, Quantum description of NMR, theory of NMR, chemical shift, Spin-lattice (T_1), spin-spin (T_2) couplings, Bloch equations and NMR applications.

Basic concepts of NQR spectra: Half integral and integral spins, Instrumentation, Super regenerative oscillator, applications of NQR.

Books for Study

1. Elements of X-ray Diffraction, B.D. Cullity.
2. Methods of Surface Analysis, Techniques and Applications, J.M. Walls Cambridge University Press, 1990.
3. X-ray Structure Determination, H. Stout and L.H. Jenson, Macmillan, London, 1968.
4. Instrumental Methods of Analysis, Willard Merritt, Dean Settle, CBS publishers, New Delhi, 1986
5. Spectroscopy, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York, 1976.
6. Spectroscopy, G. Chatwal and S. Anand, Himalaya Pub., 2002.
7. Spectroscopy, B.K. Sharma, Goel Publishers House, Meerut, 1975.
8. NMR Spectroscopy, R.K. Harris, Longman Sci. Tech, 1983.

PHY-305 (B)	Sensors and Transducers	L-4, T-1, P-2	3 Credits									
Pre-requisite: Basic knowledge about Sensors and Transducers												
Course Objectives: The aim of the course is to enlighten the basic principles and working of sensors and transducers ➤ To introduce the fundamental concepts of Sensors and Transducers ➤ To gain knowledge on the basic principles and working of strain gauges ➤ To understand the principles and working of optoelectronic transducers ➤ To understand the working principles of signal conditioners viz. Filters, Detectors, Amplifiers												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Provide fundamental knowledge on the basic principles of sensors and transducers											
CO2	Provide knowledge on principles and working of various strain gauges for their industrial applications.											
CO3	Provide knowledge on design and working principles of various optoelectronic transducers for application in electronic devices											
CO4	Knowledge on working of filters, Detectors and Amplifiers for their applications in electronic devices.											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	2	1	2	2	2
CO2	3	3	2	1	2	2	1	2	1	2	2	2
CO3	2	2	3	2	2	2	1	2	1	2	2	2
CO4	3	3	2	1	2	2	1	2	1	2	2	2

PHY-305 (B): Sensors and Transducers

UNIT – I: General Introduction to sensors/transducers

Definition of a transducer/sensor, Role of a transducer in a generalized measurement system, Classification of transducers, Significant parameters of transducer, Temperature scales, Mechanical temperature sensors, Platinum resistance thermometer, Thermistors, Thermocouples.

UNIT –II: Displacement and strain transducers

Displacement transducers - Variable resistance, inductance and capacitance, Linear voltage differential Transformer (LVDT), Strain - Definition, Principal of working of strain gauges, Gauge factor, Types of strain gauges, Materials for strain gauges, Temperature compensation, Application.

UNIT –III: Opto - electronic transducers

Photoemission tube, Photomultiplier cell, Photoconductive cell, Photovoltaic cell (solar cell). Photodiode, Photo – transistor, Photo FET, Light emitting diode. Liquid crystal display, Optoelectronic couplers, Laser diode.

UNIT –IV: Signal conditioners (Filters, Detectors & Amplifiers)

Filters, Integrators, Differentiators and active filters. Detectors- Peak Detectors sample and hold circuits. Phase sensitive detector and precision rectifiers, Amplifiers – chopper stabilized, DC amplifier, Instrumentation amplifiers, Logarithmic and anti-logarithmic amplifiers, Isolation amplifiers, Lock in amplifiers.

Books for Study

1. Instrumentation Measurement Analysis, Nakra and Chaudary, 4th Edition, Tata Mc Graw-Hill, 1985.
2. Instrumentation - Devices and Systems, Rangan, Mani and Sharma, 2nd Edition, Tata Mc Graw Hill, 1983.
3. A course in Electrical and Electronic Measurements and Instrumentation, AK Sawhney, 4th Edition, Dhanpat Rai & Company, 2016.
4. Instrumental Methods of Analysis, Willard, Meritt, Dean and Seattle, 7th Edition, Van Nostrand, 1981.
5. Hand Book of Biomedical Instrumentation, RS Khandpur, 3rd Edition, Tata Mc Graw-Hill, 1987.
6. Fundamentals of Electronic Devices, David A. Bell, 5th Edition, Oxford University Press, 2008.
7. An introduction to Operational amplifiers, SV Subramanyam, 2nd Edition, Macmillan India, 1980

PHY-306 (A)		Introduction to VLSI design				L-4, T-1, P-2			3 Credits			
Pre-requisite: Understanding of design and construction and performance of CMOS gates												
Course Objectives: The goal of this course is to introduce M.Sc. students to VLSI design. This foundational knowledge is crucial for understanding CMOS concepts and various techniques covered in this paper. It will help students build a strong foundation if they choose to pursue a research career in physics.												
Course Outcomes: At the end of the course, the student will able to												
CO1		Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.										
CO2		Analyze CMOS based logic circuit										
CO3		Realize logic circuits with different design styles										
CO4		Understand Front & Back end design aspects of simple VLSI Digital circuits										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	1	-	2	1	1	2
CO2	3	3	2	2	-	1	1	-	2	1	1	2
CO3	3	3	2	2	-	1	1	-	2	1	1	2
CO4	3	3	2	2	-	1	1	-	2	1	1	2

PHY-306 (A): Introduction to VLSI Design

UNIT - I: An Overview of VLSI and Logic Design with MOSFET

Complexity and Design, Basic concepts, Ideal switches and Boolean operations, MOSFETs as switches, Basic logics gates in CMOS, Complex logic gates in CMOS, Transmission Gate circuits, Clocking and data flow control.

UNIT - II: Physical Structure and Fabrication of CMOS ICs

Integrated Circuit layers, MOSFETs, CMOS layers, Designing FET arrays, Overview of silicon processing, Material growth and deposition, Lithography, The CMOS process flow, Design rules.

UNIT - III: Elements of Physical Design and Electrical Characteristics of MOSFETs

Basic concepts, Layout of basic structures, Cell concepts, FET sizing and the unit transistor, Physical design of logic gates, Design hierarchies, MOS physics, nFET current-voltage equations, FET RC model, pFET characteristics.

UNIT - IV: Electronic analysis of CMOS logic gates

DC characteristics of the CMOS inverter, Inverter switching characteristics, Power dissipation, DC characteristics: NAND and NOR gates, NAND and NOR transient response, Analysis of complex logic gates.

Books for Study

1. John P. Uyemura, "Introduction to VLSI circuits and Systems", John Wiley & Sons (Asia) Pte. Ltd., 2003.
2. S.K. Ghandhi, "VLSI Fabrication principles", 2/e, John Wiley & Sons (Asia) Pte. Ltd., 2003.
3. S.M. Sze, "VLSI Technology", 2/e, McGraw-Hill, 1988.
4. N.H.E. Weste and K. Eshraghian, "Principles of CMOS VLSI design", Pearson Education, Inc., 1999.
5. Yuan Taur and T.H. Ning, "Fundamentals of Modern VLSI devices", Cambridge University Press, 1998.
6. R.L. Geiger, P.E. Allen and N.R. Strader, "VLSI design Techniques for Analog and Digital Circuits", McGraw-Hill, 1990.
7. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, PHI, 1995.

PHY-306(B)	Solar Energy – Photovoltaics	L-4, T-1, P-2	3 Credits									
Pre-requisite: Knowledge on solar radiation, semiconductors, their types and preparation methods.												
Course Objectives: The aim of the course on Solar Energy – Photovoltaics is to introduce M.Sc. Physics students to the importance and applications of tapping the light component of energy coming from the Sun. The course is designed to understand the fundamental concepts on solar cells, different definitions involved, a knowledge on the various types of solar photovoltaic systems based on crystalline and amorphous Si, GaAS, CdTe and CIGS, and applications of solar photovoltaics to the society. The course is aimed to give hands-on training for the students to learn the skills associated with solar photovoltaic systems.												
Course Outcomes: At the end of the course, the student will be able to												
CO1	Understand the fundamental concepts of solar cells, manufacturing process and limitations.											
CO2	Acquire knowledge on cell efficiency study techniques and procedures.											
CO3	Demonstrate skills related to cell performance and fault analysis through hands-on training,											
CO4	Comprehend the applications of solar photovoltaics in day-to-day applications.											
Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	1	4	3	2	2	2
CO2	3	4	2	1	2	2	1	4	4	2	2	2
CO3	2	2	3	2	4	2	4	4	3	2	2	2
CO4	3	3	2	1	2	2	1	4	4	2	4	4

PHY-306 (B): Solar Energy – Photovoltaics

UNIT - I: Fundamentals

Photovoltaic effect, Types of interfaces - Choice of materials for fabrication of homojunction solar cells. Equivalent circuit. Cell output parameters -Fill-factor, efficiency, quantum efficiency. Effect of series and shunt resistance on efficiency. Variation of Open- circuit voltage and short circuit current with intensity of incident light. Effect of temperature on I-V characteristics. Heterojunction solar cells - Criteria for choosing absorber and window layers.

UNIT – II: Silicon Photovoltaics

Preparation of metallurgical grade and solar grade silicon - Single crystal silicon ingot growth – Float Zone and Czochralski methods – silicon wafer fabrication – wafer to cell formation - I-V characteristics and spectral response of single crystal silicon solar cells. Factors limiting the efficiency of silicon solar cells - Poly-silicon wafer fabrication methods – EFG, Web, Heat Exchange methods

UNIT – III: Thin Film Solar Cells

Amorphous Silicon (a-Si) – difference between crystalline and amorphous silicon. a-Si deposition by glow discharge method – Electrical and optical properties of a-Si. a-Si solar cell configurations. Outline of a-Si Solar module processing steps. GaAs, CdTe/CdS and CuInGaSe₂ (CIGS)/CdS solar cells - Cell configurations – techniques used for deposition of each layer - cell characteristics. Outline of CIGS module processing steps.

UNIT - IV: Solar Photovoltaic (PV) Systems

Photovoltaic Module Assembly - Description of steps involved in the fabrication of Silicon Photovoltaic Module - Performance of Photovoltaic Module - Module Protection - Modules in series and in parallel - Use of Bypass and Blocking Diodes, Solar photovoltaic system components – PV Array, battery, inverter and load. Applications of solar PV systems. Stand alone, Hybrid and Grid connected PV systems.

Books for Study

1. Solar Photovoltaics-Fundamentals, technologies & applications, C.S.Solanki PHI Pvt.Ltd, New Delhi (2015)
2. Fundamentals of Solar Cells, A.L. Farenbruch and R.H. Bube, Academic Press (2012)
3. Terrestrial Solar Photovoltaics by T. Bhattacharya, Narosa Publishing House (1998)
4. Amorphous Silicon solar cells K.Takahashi& M.Konagai, North Oxford Acad. Press (1986)
5. Science and technology of photovoltaics, P. Jayarama Reddy, BS Publications, 2009.

PHY-307 Practical – VI (related to SOC 305 & 306)**PHY-305 (A)**

1. ESR spectrometer determination of Lande's g-factor.
2. Identification of functional groups using FTIR spectrometer.
3. Determination of the size of the particle using XRD spectrum.
4. Polarization of light.
5. Determination of oscillator strength for Nd^{3+} ions.

PHY-305 (B)

1. Photodiode characteristics (I-V).
2. Solar cell characteristics (I-V).
3. LED characteristics (I-V).
4. Low-pass and High-pass filters.

PHY-306 (A)

1. Current-Voltage (I-V) Characteristics of n-MOSFET.
2. CMOS-NAND and NOR gates.
3. CMOS-Inverter.
4. CMOS-Full-adder.

PHY-306 (B)

1. Measurement of solar cell current-voltage characteristics to determine the efficiency.
2. Study the effect of slope on the maximum power generated by a solar cell.
3. Study the efficiency of modules connected in series and parallel.
4. Study the effect of bypass diode connected in series with photovoltaic modules.

(Open Elective)

PHY-308		Vacuum Technology and Applications					L-4, T-1			4 Credits		
Pre-requisite: Course in Vacuum Technology and Applications												
Course Objectives: The objective of the course on Vacuum and Thin Film Technology is to build fundamental as well as advanced understanding in the field of vacuum and thin film technology. Students will not only learn theoretical aspects but also acquainted with latest trends in the experimental techniques as well Students will also be introduced to the theoretical background of preparation of thin films.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Theoretical understanding of the concept of Fundamentals of kinetic theory Applicable to vacuum technology.										
CO2		Correlate observed experimental properties of thin films prepared with various techniques.										
CO3		Describe appropriate theoretical model for describing behavior of thin films.										
CO4		Understand the preparation of thin film technologies										
CO5		Applications of thin films										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	2	2	2	1	2	2	1	2
CO3	1	2	2	2	2	2	2	1	2	2	-	2
CO3	1	2	2	2	2	2	2	-	2	2	3	2
CO4	1	2	2	2	2	2	2	-	2	2	2	2
CO5	1	2	2	2	2	2	2	1	2	1	3	2

PHY- 308: Vacuum

Technology and Applications UNIT-I:

Basics Principles and Production of Vacuum

Vacuum – definition – Units of Vacuum – Vacuum ranges - Kinetic theory of gases related to vacuum - Physical parameters at low pressures – Vacuum components- Production of Vacuum: Classification of vacuum pumps – Rotary pump – Diffusion pump – Turbo-molecular pump – Ion pump – Cryogenic pump.

UNIT-II: Measurement of Vacuum

Classification of vacuum gauges – McLeod gauge – Pirani gauge – Ionization gauges : Penning gauge – Bayard Alpert gauge – Measurement of partial pressure –Residual gas analyzer - Pump combinations – Construction of high vacuum coating system.

UNIT_III: Leaks & Leak Detection and Applications of Vacuum

Leaks and detection of leaks – Pressure test – Halogen leak detector – Mass spectrometric leak detection. Applications of vacuum – Vacuum metallurgy – Freeze drying – Vacuum in Electron Microscopes- Electrical discharge tubes – Space simulators.

UNIT-IV: Thin Film Technology

Introduction, Preparation of Thin Films-Physical Methods: Vacuum evaporation - Resistive heating - Electron beam evaporation-. Epitaxial deposition -Pulsed laser ablation - Molecular beam epitaxy. Sputtering: Glow discharge - DC and RF sputtering - Reactive sputtering - Magnetron sputtering.

Books for Study

1. Vacuum Technology, A.Roth, 3rd Edition, North-Holland Publications, 2012.
2. Vacuum Science and Technology, V. V. Rao, T.B. Ghosh and K.L. Chopra, 3rd Editions, Allied Publications, 2008.
3. Handbook of Thin Film Technology, L.I.Maissel and R.L.Glang, Mc Graw HillBook Co., 1970.
4. Thin Film Phenomena, K.L .Chopra, Mc Graw Hill Book Co., New York, 1969.
5. Vacuum Deposition onto Webs, Films and Foils, Charles A. Bishop, Elsevier, London, 2015
6. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.
7. The User's Guide to Vacuum Technology, J.F. O'Henlon, John Wiley & Sons, 2003.

PHY-401 (A)		Mobile and Wireless Communications					L-3, T-1		4 Credits			
Pre-requisite: Understanding of Mobile and Wireless Communications												
Course Objectives: The aim and objective of the course on Mobile and Wireless Communications is to familiarize the M.Sc. students with the basics of the recently emerging mobile technologies.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand various generations of mobile communications and the concept of cellular communications										
CO2		Understand the basics of digital modulation techniques										
CO3		Know GSM mobile communication standards, its architecture, logical channels, advantages and limitations.										
CO4		Understand various coding and error correction techniques										
CO5		Understand the concepts of wireless networks										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	1	2	1	2	2	1	2
CO2	2	2	1	2	2	2	2	-	2	2	1	2
CO3	2	2	1	2	1	2	2	-	2	2	1	2
CO4	2	2	1	2	2	2	2	-	2	2	1	2
CO5	2	2	1	2	2	1	2	1	2	2	1	2

PHY-401 (A): Mobile and Wireless

Communications UNIT – I:

Base Band Data Transmission and Digital Modulation techniques: BPSK, QPSK, DPSK, QASK, BFSK, MSK, M-Ary techniques. Base band binary data transmission system – Inter symbol interference – Nyquist pulse shaping criteria.

UNIT – II:

Codes for Error Detection and Correction, Linear block codes, Convolutional codes. Encoding, Decoding of convolutional codes, State, Tree and Trellis diagrams. Maximum likelihood – Viterbi algorithm, Burst error correction.

UNIT – III:

Introduction to Wireless Communication Systems, Global system for mobile (GSM): cellular concept, system design. Transmission system, receiving system; frequency re-use; Spread spectrum

modulation; Multiple access techniques as applied to wireless communications; 1G, 2G, 3G, 4G and 5G wireless networks.

UNIT-IV :

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard, Wireless PANs, Hiper Lan, WLL.

Books for Study

1. Modern Digital and Analog communication system by B.P. Lathi: Oxford 3rd ed., 2011
2. Digital Communications Fundamentals and Applications by Bernard Sklar, Sklar Person Education, 2008
3. Principles of Communication Systems: Taub & Schilling, Tata McGraw-Hill, 1991
4. Principles of Communication, R.E. Ziemer, WH Tranter Fifth Edition John Wiley (fifth module)
5. Wayne Tomoasi: Morden Electronic Communication Systems. Person Education/PHI, 2014
6. John G Proakis : Digital Communication. MGH
7. Digital Communication Techniques Simon, Hindey Lindsey PHI
8. Communication Systems: Simon Haykin, John Wiley & Sons. Pvt. Ltd.
9. Digital and Analog Communication System: K Sam Shanmugam. John Wiley
10. Communication Systems Engineering: Proakis, Pearson Education
11. Digital & Analog Communication System – Leon W Couch, Pearson Education/PHI.
12. Analog and Digital Communication M S Roden PHI
13. Digital modulation and coding. Wilson, Pearson Education
14. Applied coding and information Theory for engineers, Wells, Pearson education.

PHY-401(B)	Nuclear and Particle Physics					L-4, T-1			4 Credits			
Pre-requisite: Understanding of Nuclear and Particle physics												
Course Objectives: The aim and objective of the course on Nuclear and Particle Physics is to familiarize the students of M.Sc. class to the basic aspects of Nuclear Physics like static properties of nuclei, radioactive decays, nuclear forces, nuclear models, and nuclear reactions so that they are equipped with the techniques used in studying these things.												
Course Outcomes: At the end of the course, the student will be able to												
CO1		Understand and compare nuclear models and explain nuclear properties using nuclear models.										
CO2		Understand structure and static properties of nuclei.										
CO3		Analyse various decay mode of nucleus.										
CO4		Use nucleon-nucleon scattering and deuteron problem to explain nature ofnuclear forces.										
CO5		Discuss the concepts of Elementary Particles										
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2
CO5	3	3	1	1	2	1	1	2	1	2	2	2

PHY 401(B): Nuclear and

Particle Physics UNIT – I:

Nuclear Forces

Characteristics of nuclear forces –Deuteron: Ground state of Deuteron (No excited S – states), Excited state of Deuteron – Low energy Neutron – Proton scattering and Proton – Proton scattering – Meson theory of nuclear forces.

UNIT – II: Nuclear Decays

Nuclear transformations – Radioactive decay – Alpha decay – Gamow's theory – Beta decay – Fermi theory –Selection rules – Interaction of gamma radiation with matter – Photo electric effect – Compton scattering – Pair production.

UNIT – III: Nuclear Reactions and Reactors

Nuclear Reactions: Types of nuclear reactions – Conservation Laws-Compound nuclear reactions – Nuclear cross section – Resonance theory – Briet Wigner formula.

Nuclear Reactors: Nuclear Fission and Fusion reactions – Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Power reactors: Liquid Fuel Reactor.

UNIT – IV: Elementary Particles

Discovery and classification of elementary particles – Types of interactions – Conservation laws – Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Search for Higg's particle – elementary ideas.

Book for Study

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
4. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).
5. Atomic and Nuclear Physics, R.C. Sharma, K. Nath & Co., Meerut (2007).
6. Nuclei and Particles, E. Segre, W A Benjamin. Inc., (1965).
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).
8. Introduction to Nuclear Physics, K.S. Krane, John Wiley & Sons (1988).

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SEMESTERS

Branch - PHYSICS

Paper code and Title

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 3 Hours

Max. Marks 70

SECTION-A

Answer any **FOUR** of the following questions. (4 ✎)
5=20 Each question carries **5** marks.

1. Unit-I
- 2.
3. Unit-II
- 4.
5. Unit-III
- 6.
7. Unit-IV
- 8.

SECTION – B

Answer **ALL** questions. Each question carries **12½** marks

(4 x 12½ = 50)

9. (a)

(b)

10. (a)

(b)

11. (a)

(b)

12. (a)

(b)

(OR) Unit-I

(OR) Unit-II

(OR) Unit-III

(OR) Unit-IV

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SEMESTERS

Branch - PHYSICS

Paper code and Title

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 3 Hours

Max. Marks 70

SECTION-A

Answer any **FOUR** of the following questions. (4 ✎
5=20) Each question carries **5** marks.

1. Unit-I
- 2.
3. Unit-II
- 4.
5. Unit-III
- 6.
7. Unit-IV
- 8.

SECTION – B

Answer **ALL** questions. Each question carries **12½** marks

(4 x 12½ = 50)

9. (a)
(b) (OR) Unit-I
10. (a)
(b) (OR) Unit-II
11. (a)
(b) (OR) Unit-III
12. (a)
(b) (OR) Unit-IV

Model Question Paper

M.Sc. DEGREE EXAMINATION – APRIL/DECEMBER
SEMESTERS

Branch - PHYSICS

Paper code and Title

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 Hours

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✎)
2=10) Each question carries **2** marks.

1. Unit-I
- 2.
3. Unit-II
- 4.
5. Unit-III
- 6.
7. Unit-IV
- 8.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✎ 10 = 40)

9. (a)
(b) (OR) Unit-I
10. (a)
(b) (OR) Unit-II
11. (a)
(b) (OR) Unit-III
12. (a)
(b) (OR) Unit-IV

MODEL QUESTION PAPERS

FIRST SEMESTER

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

FIRST SEMESTER

Branch - PHYSICS

PHY-101: Classical and Statistical Mechanics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 3 hrs

Max. Marks 70

SECTION-A

Answer any **FOUR** of the following questions.

(4 ✎)

5=20) Each question carries **5** marks.

1. What are Constraints? Classify them with some examples.
2. Obtain the equation of motion for compound pendulum using Hamiltonian's equation.
3. What are canonical transformations? Give the conditions.
4. Define Lagrange -Brackets with suitable examples.
5. Discuss about phase space and concept of ensembles.
6. Explain the concept of translation partition function.
7. Write down the expression of Maxwell -Boltzmann distribution law.
8. State the principle of equipartition of energy.

SECTION – B

Answer **ALL** questions. Each question carries **12½** marks (4 ✎ **12½ = 50**)

9. (a) Derive Lagrange's equation of motion from D'Alembert's principle. Deduce the equation of motion of a linear harmonic oscillator from Lagrange's equation?
(OR)
(b) State Hamilton's principle and derive Lagrange's equation of motion from it. How will the result be modified if the forces are non-conservative?
10. (a) Outline Hamilton-Jacobi theory and solve the problem of a harmonic oscillator.
(OR)
(b) Obtain equation of motion in Poisson Bracket form and show that Poisson's brackets are invariant under canonical transformations.
11. (a) Compare micro canonical, canonical and grand canonical ensembles. and derive an expression for canonical partition function.
(OR)
(b) Derive an expression for rotational partition function and also discuss about application of rotational partition function.
12. (a) Derive an expression for Bose-Einstein distribution and explain the significance of Einstein condensation.
(OR)
(b) Write about Fermi-Dirac distribution. Explain the magnetic susceptibility of free electron.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

FIRST SEMESTER

Branch - PHYSICS

PHY-102 (A): Solid State Physics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✖ 2 = 10)
2=10) Each question carries **2** marks.

1. Write about ionic and Vander Waal's bondings.
2. Write the properties of phonons.
3. Write the failures of Drude – Lorenz theory.
4. Write the distinction between metals and insulators in terms of band theory
5. Distinguish between Intrinsic and extrinsic semiconductors.
6. Write about Direct and Indirect band gap semiconductors.
7. Write the Meissner effect of super conductors.
8. Discuss D.C. Josephson effect.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✖ 10 = 40)

9. (a) What is lattice energy? Obtain the expression for lattice energy in ionic crystals (OR)
 (b) Obtain the dispersion relation in mono atomic one dimension infinite lattice
10. (a) Write the Kronig-Penny model in band theory of solids
 (OR)
 (b) Obtain the expression for effective mass of electron
11. (a) Obtain the expression for carrier concentration in the valence band of a intrinsic semiconductor.
 (OR)
 (b) Discuss Generation and Recombination life time of charge carriers in semiconductors.
12. (a) Explain in detail London's theory of superconductors and obtain the expression for London's penetration depth
 (OR)
 (b) Write the applications of superconductors

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

FIRST SEMESTER

Branch - PHYSICS

PHY -102 (B): Material Science

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

SECTION-A

Max. Marks 50

Answer any **FIVE** of the following questions.

(5 × 2=10)

Each question carries **2** marks.

1. Distinguish between covalent and ionic bonding in crystals with suitable examples
2. What are Miller indices? Draw neat diagrams to indicate Miller indices of (111) plane in simple cubic crystals
3. What are the assumptions of classical theory of lattice specific heat?
4. Draw Eutectic phase diagram of an alloy and explain its significance.
5. What is Fermi energy and explain the position of Fermi energy level in P-Type and N-Type semiconductors.
6. Define Hall effect.
7. What are paramagnetic and ferromagnetic materials? Give examples.
8. What is meant by magnetic anisotropy?

SECTION – B

Answer **ALL** questions. Each question carries **10** marks **(4 × 10 = 40)**

9. (a) Determine the values of packing fraction for fcc and hcp structures. Calculate the number of carbon atoms per unit cell of diamond.
(OR)
(b) Describe with suitable diagrams edge dislocation and screw dislocations in crystal lattice
10. (a) Obtain an expression for the specific heat of a solid on the basis of Einstein theory.
(OR)
(b) Write the properties of phase diagram and explain the Gibbs phase rule.
11. (a) Derive an expression for the density of electrons in the conduction band for an N- type semiconductor.
(OR)
(b) Explain various polarization mechanisms in dielectrics. Obtain a relation between the dielectric constant and atomic polarizability.
12. (a) Describe the Weiss molecular field theory of ferromagnetism and derive Curie-Weiss law.
(OR)
(b) Distinguish between Type-I and Type-II superconductors and discuss the applications of superconductors.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
FIRST SEMESTER
Branch - PHYSICS

PHY-103 (A): Electromagnetic Theory, Lasers and Modern Optics
(Common syllabus for SVU & Affiliated Colleges)
(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✖ 2=10) Each question carries 2 marks.

1. Write Maxwell's equations in differential form?
2. What is double refraction, and in which materials is it observed?
3. What is a laser? Describe its basic principle of operation.
4. Explain the concept of harmonic generation and its significance in optics
5. What is holography, and how does it differ from traditional photography?
6. What is Fourier optics, and how does it relate to the analysis of optical systems?
7. What is fiber optics, and how does it work in the context of communication?
8. What is attenuation in fiber optics, and how does it impact signal transmission?

SECTION – B

Answer **ALL** questions. Each question carries 10 marks (4 ✖ 10 = 40)

9. (a) Derive the general wave equation for electromagnetic waves from Maxwell's equations and explain its implications.
(OR)
(b) Explain the propagation of light in an isotropic dielectric medium. How does the refractive index influence its speed and direction?
10. (a) Discuss the significance of Einstein's coefficients in laser theory. How do they relate to the probability of spontaneous and stimulated emissions?
(OR)
(b) Discuss the working principle of a He-Ne laser. What makes it one of the most widely used lasers in laboratory settings?
11. (a) Discuss the basic theory of holography. Explain how interference and diffraction are used to record and reconstruct a three-dimensional image.
(OR)
(b) Discuss the relationship between spectra and correlation in Fourier optics. How do these concepts relate to the study of optical signals and imaging systems?
12. (a) What are the different modes of optical fibers? Discuss the characteristics of single-mode and multi-mode fibers, and explain their suitability for different communication applications..
(OR)
(b) How do EDFAs amplify optical signals in long-distance fiber optic communication? Systems without the need for conversion to electrical signals?

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
FIRST SEMESTER
Branch - PHYSICS

PHY -103 (B): Optical, Microwave And Satellite Communications
(Common syllabus for SVU & Affiliated Colleges)
(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✎)
2=10) Each question carries **2** marks.

1. What are the advantages of microwave transmission ?
2. Write a short note on atmospheric effects on propagation.
3. What is Radar range equation ? Explain.
4. Briefly explain the antenna parameters ?
5. What are the principles of digital communications ?
6. What is bandwidth efficiency of digital communication system ? Explain.
7. Write a short note on coherent and non-coherent detection.
8. Explain the satellite link modules.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✎ 10 = 40)

9. (a) Discuss in detail about the propagation microwaves.
(OR)
(b) Explain the working of antennae used in MW communication Systems.
10. (a) Explain the operation of a Radar with block diagram and its operating frequencies.
(OR)
(b) Explain the integration of radar pulses and Radar cross section.
11. (a) Explain frequency shift keying(FSK) in digital communications.
(OR)
(b) Discuss in detail about quadrature amplitude modulation.
12. (a) Explain the working of Optical transmitter for analog communications.
(OR)
(b) What are the orbital satellites ? Discuss about the geostationary satellites.

Model Question Paper

M.Sc DEGREE EXAMINATION, APRIL/DECEMBER

FIRST SEMESTER

Branch – PHYSICS

PHY-105 (A): Advanced Digital Electronics and Microcontrollers

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✎)
2=10) Each question carries **2** marks.

1. Explain the working of 2- bit MUX with a necessary circuit diagram.
2. Explain the working of RS flip flop with logical diagram.
3. Explain Serial-in and serial-out shift register with logic diagram.
4. Distinguish between the Asynchronous and synchronous counters.
5. Define each of the following: VOH, VIL, VOL, VIH.
6. What factors determine CMOS fan-out?
7. Discuss the directives of 8051 microcontroller.
8. Discuss the SJMP and LJMP instructions 8051 microcontroller.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✎ 10 = 40)

9. (a) With a neat logic diagram, explain the working of Decimal-to-BCD encoder.
 (OR)
 (b) With a neat logic diagram, explain the working of J-K Master Slave flip-flop.
10. (a) With a neat logic diagram, explain the working of Serial-in-parallel out shift register
 (OR)
 (b) Explain the working of Ripple counter with a neat logic diagram
11. (a) List out the difference between TTL NOR and NAND circuits. Explain current sourcing and sinking action in transistors.
 (OR)
 (b) What are the two types of MOSFETs? Give the basic functioning of a MOSFET switch.
12. (a) Explain the functional diagram of 8051 microcontroller.
 (OR)
 (b) Discuss the addressing modes of 8051 microcontroller with an examples.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

FIRST SEMESTER

Branch – PHYSICS

PHY-105 (B): Advanced Microprocessors and Applications

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✖)
2=10) Each question carriers **2** marks.

1. Discuss the interrupts of 8086 with their priorities.
2. Explain data addressing modes available in 8086 microprocessor.
3. Discuss 8086/8088 shift and rotate instructions.
4. Discuss the DATA movement instructions of 8086 microprocessor.
5. Discuss the Address decoding in 8086 microprocessor.
6. Explain the Input and Out interface.
7. Discuss the interrupt of 8086 microprocessor.
8. Explain the basic DMA operation.

SECTION – B

Answer **ALL** questions. Each question carriers **10** marks (4 ✖ 10 = 40)

9. (a) With the help of block diagram, explain the internal architecture of Intel 8086/8088 microprocessor..
 (OR)
 (b) Explain the stack memory and program memory addressing modes of 8086 microprocessor..
10. (a) Discuss the Arithmetic and Logical instructions of 8086 microprocessor.
 (OR)
 (b) Explain the Minimum mode versus Maximum modes of 8086 microprocessor.
11. (a) Explain how to interface 8088-8 bit memory device to 8086 microprocessor.
 (OR)
 (b) Explain how ADC modules can be interfaced to 8086 microprocessor with suitable diagram.
12. (a) Explain the Hardware interrupts of 8086 microprocessor.
 (OR)
 (b) Explain the function of 8237 DMA controller.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

FIRST SEMESTER

Branch - PHYSICS

PHY-106 (A): Mathematical Physics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 x 2=10)

Each question carries **2** marks.

- Define Beta and Gamma function and explain the symmetry property of Beta function.
- Using Generating function of Legendre polynomial to show that $P_n(x) = (-1)^n P_n(x)$.
- Find the Fourier transform of $e^{-|t|}$
- Explain the properties of Laplace transform.
- Solve the following equations by Gauss-Seidel method.

$$\begin{aligned} 10x+y+z &= 12 \\ x+10y+z &= 12 \\ x+y+10z &= 12 \end{aligned}$$
- Evaluate $\int_0^2 e^x dx$ by Simpson's rule for $n = 4$, correct up to 5 decimals.
- Evaluate $\int_C \frac{\sin \pi z^2 + \cos}{\pi z^2} dz$. Poles are $z = 1$ & $z = 2$.
- Find the residues of $f(z) = \frac{1}{ze^z}$ at $z = a$.

(z-a) SECTION – B

Answer **ALL** questions. Each question carries **10** marks. **(4 x 10 = 40)**

- State Beta and gamma functions. Using the relation between Beta and gamma functions, Show that $\Gamma(m) \Gamma(1-m) = \frac{\pi}{\sin m\pi}$
 - (OR)
 - Obtain the solution of Hermite differential equation $\frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} + 2ny = 0$ and show that $H_n(-x) = (-1)^n H_n(x)$ where $H_n(x)$ is the Hermite polynomial of degree "n".
- Find a series of sines and cosines of multiples of x ; which will represent $x + x^2$ in the interval $-\pi < x < \pi$. Deduce that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$
 - (OR)

- (b) Define the Laplace Transform of periodic Function. Find the Laplace transform of the waveform $f(t) = \frac{2t}{3} \quad (0 \leq t \leq 3)$
11. (a) Write a note on Newton –Raphson’s method to find roots of an equation. Using Newton- Raphson’s method, find the real root of $x^2 - 4\sin x = 0$ up to four decimals.
- (OR)
- (b) Use Runge - Kutta method to solve the equation $\frac{dy}{dx} = x+y$ with initial conditions $x_0 = 0; \quad y_0 = 1$ from $x = 0$ to $x = 0.4$ with interval $h = 0.1$.
12. (a) State and prove Cauchy’s integral formula. Evaluate the integral $\oint_C \frac{dz}{z^2+z}$ where C is a circle defined by $|z| > 1$.
- (OR)
- (b) State and prove Cauchy’s Residue theorem. Find the residue of $\frac{z^3}{(z-1)^4(z-2)(z-3)}$ at $z = 1$

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

FIRST SEMESTER

Branch - PHYSICS

PHY-106 (B): Computational Methods and Programming

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. **(5 x 2=10)**
Each question carries **2** marks.

1. Explain the identifiers and keywords in C language with examples.
2. Explain the precedence of arithmetic operators.
3. Distinguish between While and Do-while statements.
4. What is an array ? Explain two-dimensional arrays.
5. Explain the form of C functions.
6. Distinguish between Pointers and Arrays.
7. Explain the Bisection method.
8. Write the algorithms for Gauss elimination method.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks **(4 x 10 = 40)**

9. (a) Explain defining symbolic constants and conditional operators.
(OR)
(b) Write a “C” program TO CONVERT Fahrenheit temperature to Celsius temperature.
10. (a) Write a C –program to find the average of a set of 15 numbers by using while statement.
(OR)
(b) Write a C –program for matrix multiplication.
11. (a) Write a program to read information for one person from the keyboard and print the same on the screen (struct person contain person name, date of joining and salary).
(OR)
(b) Explain how structures defined.
12. (a) Explain how to find the solution of non-linear equations using Newton Rhapson method. Write an algorithm.
(OR)
(b) Explain how to find the solution of linear equations using Gauss –Seidel iterative method. Write an algorithm.

MODEL QUESTION PAPERS
SECOND SEMESTER

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER

Branch - PHYSICS

PHY-201: Quantum Mechanics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 3 hrs

Max. Marks 70

SECTION-A

Answer any **FOUR** of the following questions

(4 ✖ 5=20)

Each question carries **5** marks.

1. Discuss the postulates of quantum mechanics.
2. Write the properties of Hermitian operator.
3. Write the time development of quantum system in Schrodinger picture.
4. Write the properties of commutator brackets.
5. Discuss the time independent perturbation theory for non-degenerate levels.
6. What is Fermi – Golden rule and write its significance.
7. Discuss the Quantum theory of scattering.
8. Write the Validity of Born approximation.

SECTION – B

Answer **ALL** questions. Each question carries **12½** marks

(4 ✖ 12½ = 50)

9. (a) What is Bra and Ket notations and discuss its properties.
(OR)
(b) Obtain the expressions for reflection and transmission coefficients to a single step barrier.
10. (a) Show interaction picture is equivalence of Schrodinger picture and Heisenberg picture.
(OR)
(b) Obtain the Eigen values and Eigen functions to simple harmonic oscillator by operator method.
11. (a) Discuss the time dependent perturbation theory and obtain an equation for the probability of transition.
(OR)
(b) Obtain ground state energy of helium atom corrected up to first order perturbation by variation method.
12. (a) Discuss the method of partial waves to explain scattering phenomena and obtain an equation for scattering cross-section.
(OR)
(b) Write in detail optical theorem.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER

Branch - PHYSICS

PHY-202 (A): Condensed Matter Physics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 ✎)

2=10) Each question carries **2** marks.

1. Discuss homogeneous and heterogeneous nucleations.
2. Write the classification of imperfections.
3. Define dipole moment, polarization and dielectric constant of dielectric materials.
4. Distinguish between dielectrics and ferroelectrics.
5. Write about magnetic bubbles.
6. Discuss the structure of ferrite.
7. Discuss the band structure amorphous solids.
8. Write optical properties of liquid crystals.

SECTION – B

Answer **ALL** questions. Each question carries **10** Marks (4 ✎ 10= 40)

9. (a) Distinguish between Bridgeman and Czochralski techniques. Write in detail the growth of single crystals by using Czochralski technique.
(OR)
(b) Derive an expression for Schottky defect concentration in ionic crystal.
10. (a) Discuss Electronic, ionic and orientation polarizations. Write the application of dielectrics.
(OR)
(b) Write the oxygen ion displacement theory of BaTiO₃.
11. (a) Write the draw backs of Weiss molecular field theory. Discuss how the Heisenberg model explains the internal field in ferromagnetic materials.
(OR)
(b) Write the two sub lattice model of anti-ferromagnetic materials.
12. (a) Write the classification of liquid crystals.
(OR)
(b) Discuss the classification and applications of polymers.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER

Branch - PHYSICS

PHY-202 (B): Nanomaterials and Devices

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 ✎)

2=10) Each question carries **2** marks.

1. What is quantum confinement?
2. Discuss density functional theory.
3. What is a top down approach and what is bottom up approach.
4. Give the basic structure of CVD method.
5. Write the nature of bond in C₆₀.
6. Give the structure of Graphene.
7. What is photo lithiography.
8. Write a note of fuel cells.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) Write the classification of Zero, One and two dimensional materials.
(OR)
(b) Write the dimensionality effect on electrical, optical and mechanical properties.
10. (a) Write the synthesis of nano materials by Sol-Gel and electrospinning.
(OR)
(b) Explain the synthesis of nano materials by molecular beam epitaxy and sputtering.
11. (a) Explain the Synthesis of bucky balls and write its Applications.
(OR)
(b) Describe the fabrication of Carbon Nanotubes and write its electrical and mechanical Properties.
12. (a) Write the working of Single Electron Transistor and Solar Cell.
(OR)
(b) Discuss the working of light Emitting diodes and Gas Sensors.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER

Branch - PHYSICS

PHY-203 (A): Applied Spectroscopy

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 ✎)

2=10) Each question carries **2** marks.

1. What is Fortrat diagram?
2. What is meant by predissociations energy?
3. What is the rule of mutual exclusion principle?
4. Write a brief note on surface enhanced Raman spectroscopy.
5. Define and state the Beer-Lambert's law and write their applications.
6. What are the essential parts in a UV-Vis spectrophotometer? Explain them in detail.
7. Distinguish between normal fluorescence and resonance fluorescence.
8. Briefly explain the phosphorescence and nature of triplet states.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) What are combination relations in Rotational spectra? How do you obtain rotational constants from combination relations?
(OR)
(b) What is meant by potential energy curve, how do you obtain dissociation energy from potential energy curves.
10. (a) Discuss the classical theory and quantum theory of Raman effect.
(OR)
(b) Obtain the energy expression for rotational Raman spectrum for linear and symmetric top molecules.
11. (a) Write about instrumentation and working of UV-Visible Absorption Spectrophotometer with a neat diagram.
(OR)
(b) Explain in detail the working principle of FTIR spectrometer with neat diagram and their applications.
12. (a) Explain in detail about Fluorescence Spectroscopy and its applications.
(OR)
(b) Discuss about Time resolved emission spectroscopy and applications of phosphorescence.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER

Branch - PHYSICS

PHY-203 (B): Solid State Spectroscopy

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 ✎)

2=10) Each question carries **2** marks.

1. State the concept of ligand field theory.
2. Draw the Tanabe Sugano diagram for d^2 configuration in octahedral field.
3. What are the characteristics of laser activate crystals?
4. Write a brief note on lifetime of an activated state.
5. Briefly explain the Matrix Isolation Spectroscopy.
6. How does Phase sensitive detector work.
7. Explain the concept of Two photon absorption.
8. What is the principle of photoacoustic spectroscopy?

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) Explain the quantitative basis for crystal fields.
(OR)
(b) Evaluate the parameter $10Dq$ and discuss the effect of weak field on S, P, D and F terms.
10. (a) Explain how Judd-Ofelt theory is useful for the evaluation of JO parameters as well as the radiative properties of rare earth ions.
(OR)
(b) Describe the possible mechanisms of energy transfer and discuss the process of IR to Visible conversion.
11. (a) Discuss Laser Optogalvanic Spectroscopy with neat diagram.
(OR)
(b) Give an account on Laser cooling and write its applications.
12. (a) Write the experimental details to study the Two photon absorption.
(OR)
(b) Give an account on applications of photon acoustic spectroscopy.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
SECOND SEMESTER
Branch - PHYSICS
PHY-205 (A): Photonics
(Common syllabus for SVU & Affiliated Colleges)
(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions. (5 ✎)
2=10 Each question carries **2** marks.

1. What is the active medium in a CO₂ laser?
2. What is Q switching in lasers?
3. Why is proper fiber end preparation essential for optical connectivity?
4. Explain the working principle of a star coupler.
5. How does a channel waveguide differ from a planar waveguide?
6. What is the primary application of integrated photodiodes?
7. What are photonic crystals, and how do they manipulate light?
8. How does the periodic structure of photonic crystals affect light propagation?

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✎ 10 = 40)

9. (a) Explain the excitation mechanism and operation of an Argon-ion laser. What are its major uses?
(OR)
(b) Describe the concept of mode locking in lasers. Explain the methods of mode locking and their applications in generating ultrafast pulses.
10. (a) Compare and contrast mechanical splicing and fusion splicing techniques. Highlight their advantages, disadvantages, and applications.
(OR)
(b) Describe the concepts of wavelength division multiplexing (WDM) and time division multiplexing (TDM). Compare their advantages, limitations, and applications.
11. (a) Discuss the fundamental principles of planar waveguides. Explain their construction, operation and applications in optical communication systems.
(OR)
(b) Describe the differences between prism couplers and grating couplers. Analyze their advantages and disadvantages in coupling light into optical waveguides.
12. (a) Explain the importance of theoretical modeling in the study of photonic crystals. Discuss common approaches used in their modeling.
(OR)
(b) How do photonic crystals enhance wavelength division multiplexing (WDM) and other? Multiplexing techniques?

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

SECOND SEMESTER

Branch – PHYSICS

PHY-205 (B): Vacuum and Thin Film Technology

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
Each question carries **2** marks.

(5 ✕ 2=10)

1. Explain the working principle of Pirani gauge.
2. What are the various sources of Leaks in vacuum systems.
3. Discuss the preparation thin films by resistive heating method.
4. Write the working principle of quartz crystal thickness monitor.
5. Explain temperature coefficient of resistance in metal films.
6. Write short notes on optical filters.
7. Write a brief note on antireflection coatings.
8. What are Tribological coatings? Explain with examples.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✕ 10 = 40)

9. (a) Describe the principle and working of diffusion pump.
(OR)
(b) Discuss the construction of high vacuum coating system with various pumping Combinations.
10. (a) Explain deposition of thin films by electron beam evaporation and its Advantages and disadvantages.
(OR)
(b) Discuss the preparation of thin films by chemical vapour deposition method.
11. (a) Explain the Fuchs – Sondhemier theory.
(OR)
(b) Explain the reflection phenomenon by single film and how can you determine optical constants by ellipsometry method.
12. (a) Discuss the principle of photolithography in pattern generation and write a brief note on thin film resistors.
(OR)
(b) Discuss the working principle and fabrication thin film solar cells.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

SECOND SEMESTER

Branch – PHYSICS

PHY-206 (A): Advanced Embedded Systems

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10 Each question carries **2** marks.

(5 ✎)

1. Explain the Status Register in 16F84 A PIC microcontroller.
2. Discuss the Configuration Word of 16F84A PIC microcontroller.
3. Explain the INTCON register in 16F84 A PIC microcontroller.
4. Discuss the concept of Watchdog Timer in 16F84A PIC microcontroller.
5. What is basic idea of Programming.
6. Write an Assembler Format.
7. Explain briefly about the Program memory of PIC 16F 873A.
8. Draw the PIC 16F 873A interrupt structure.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks **(4 ✎ 10 = 40)**

9. (a) Discuss the internal functional diagram of PIC 16F84A microcontroller.
(OR)
(b) Discuss the Memory Organization of PIC 16F84A microcontroller.
10. (a) Discuss the interrupt structure of PIC 16F84A microcontroller.
(OR)
(b) Discuss the Timer 0 module of PIC 16F84A microcontroller.
11. (a) Discuss the PIC 16 series Embedded Controller Instruction set.
(OR)
(b) Discuss on building Structured Programs.
12. (a) Sketch the Block diagram of 16F873A and explain.
(OR)
(b) Write briefly about the data memory and configuration word of PIC 16F 873A.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

SECOND SEMESTER

Branch – PHYSICS

PHY-206 (B): Solar Energy- Thermal Aspects

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. What is solar constant? Give its value.
2. Explain direct and diffuse radiation.
3. Explain temperature distribution in flat plate collector.
4. Write a note on evacuated tube collectors.
5. Define aperture and rim angle.
6. Explain acceptance angle.
7. Discuss passive space heating.
8. Briefly explain solar cooker.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✎ 10 = 40)

9. (a) Explain the measurement of beam radiation using Pyrheliometer.
(OR)
(b) Discuss the measurement of thermal emittance of a selective surface.
10. (a) Draw the diagram of flat plate collector and describe the different parts.
(OR)
(b) Explain in detail various heat losses in a flat plate collector.
11. (a) Give the types of concentrating collectors. Explain single and two axis tracking. (OR)
(b) Discuss the construction and working of a linear parabolic trough collector.
12. (a) Explain natural circulation type solar water heating system.
(OR)
(b) Explain the principle and working of a solar drier.

MODEL QUESTION PAPERS

THIRD SEMESTER

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
THIRD SEMESTER
Branch - PHYSICS
PHY-301: Advanced Quantum Mechanics
(Common syllabus for SVU & Affiliated Colleges)
(w.e.f.2024-2025)

Time : 3 hrs

SECTION-A

Max. Marks 70

Answer any **FOUR** of the following questions
Each question carries **5** marks.

(4 × 5=20)

1. Discuss the indistinguishability of identical particles.
2. Write a note on ortho and para hydrogen.
3. Obtain the commutation relations of $[L_x, L_y]$ and $[x, p_x]$.
4. Write about spin angular momentum.
5. What is the probability current density?
6. Write note on negative energy states.
7. What is the second quantization?
8. What are the N-representations?

SECTION – B

Answer **ALL** questions. Each question carries **12½** marks **(4 × 12½ = 50)**

9. (a) What are called the identical particles? Explain the Pauli's exclusion principle related to identical particles.
(OR)
(b) Construct the symmetric and anti-symmetric wave functions for three particle system.
10. (a) Obtain eigen values and eigen functions to L^2 .
(OR)
(b) What are Clebsch-Gordan coefficients? Obtain Clebsch – Gordan coefficients to $j_1 = j_2 = 1/2$.
11. (a) Obtain Klein – Gordan equation in Co-variant form.
(OR)
(b) Derive the Dirac's Relativistic Equation for a free particle.
12. (a) What is field quantization? Write the Lagrangian formulation of the field.
(OR)
(b) Discuss the significance in the study of systems identical particles consisting of either Fermions or Bosons.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER

THIRD SEMESTER

Branch - PHYSICS

PHY-302(A): Physics of Semiconductor Devices*(Common syllabus for SVU & Affiliated Colleges)*

(w.e.f.2024-2025)

Time : 2 hrs**Max. Marks 50****SECTION-A**

Answer any **FIVE** of the following questions. (5 ✕ 2 = 10)
 2=10) Each question carries 2 marks.

1. What is a Tunnel diode ? Explain its I-V Characteristics.
2. What are the Solar cell parameters ?
3. What are the Ebers-Moll equations ?
4. Write short note on base resistance..
5. What is Surface field effect ?
6. Write a short note Charge Coupled Devices (CCD)
7. Write a short note on Neutron Transmutation Doping
8. What is Vapor Phase Epitaxy (VPE)?

SECTION – B

Answer **ALL** questions. Each question carries **10** marks (4 ✕ 10 = 40)

9. (a) What are the avalanche transit devices ? Explain the operation of IMPATT diode.
 (OR)
 (b) What is Semiconductor lasers ? Explain it's principle of operation.
10. (a) Explain the principle of operation of a BJT.
 (OR)
 (b) What is Real transistor ? Explain the carrier recombination in the Emitter-Base junction depletion region.
11. (a) What is MOS capacitor? Explain the energy band diagrams of MOS capacitor for different bias conditions.
 (OR)
 (b) What is JFET. Explain it's Principle of operation.
12. (a) Describe the planar technology for fabrication of planar n-p-n transistor.
 (OR)
 (b) What are the Crystal Growth Methods. Describe the Float zone process.

Model Question Paper

M.Sc. DEGREE EXAMINATION - APRIL/DECEMBER
THIRD SEMESTER

Branch - PHYSICS

PHY -302 (B): IC Fabrication Techniques

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
=10) Each question carries 2 marks.

(5 ✕ 2

1. What is Wafer? Explain its orientation.
2. Write a Short note on Sawing and polishing.
3. What are the recent advances in oxidation technology ?
4. Briefly discuss on anodic oxidation.
5. What is impurity? Explain the significance of it.
6. Write a shout note on idea of diffusion.
7. What are the requirements of metallization ?
8. What are the deposition techniques?

SECTION – B

Answer **ALL** questions. Each question carriers 10 marks

(4 ✕ 10 = 40)

9. (a) Discuss the Silicon crystal growth.
(OR)
(b) Describe the growth of Epitaxial layer.
10. (a) What is the equipment required for thermal oxidation. Discuss.
(OR)
(b) Discuss the redistribution of dopant atoms during thermal oxidation
11. (a) How to diffuse the impurity using ion implementation ?
(OR)
(b) Explain the diffusion analysis of an impurity.
12. (a) Describe the generation of a Photo mask.
(OR)
(b) Discuss in detail about the vacuum deposition cycle.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-303 (A): Advances in Physics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. What are nanomaterials and define the classification of nanomaterials.
2. Discuss briefly about Quantum Confinement.
3. Discuss the BALL milling method for synthesis of nano materials.
4. Discuss the Sol-Gel process for synthesis of nano materials.
5. Discuss briefly the basic structures of MEMS.
6. Draw the fabrication steps for micromachined pressure sensor.
7. Discuss the concepts of remote sensing.
8. Explain the electromagnetic radiation effect on remote sensing.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) Explain the Zero and One dimensional nanostructures.
(OR)
(b) Discuss briefly about the Fullerenes and Graphene.
10. (a) Explain in detail about Molecular Beam Epitaxy technique and write the applications of nanomaterials.
(OR)
(b) Write about Chemical Vapour Deposition technique used for nanomaterial fabrication.
11. (a) Discuss the pressure sensor with the help of neat diagram.
(OR)
(b) Discuss the quantum well device.
12. (a) Discuss about the remote sensing systems and platforms.
(OR)
(b) Discuss about land and mineral resources.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-303 (B): Physics of Advanced Materials

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. Relate stress and strain in terms elastic constants
2. Write the principle of pulse echo method
3. Write the an harmonicity of solids
4. Write the expression of the Gruinisen parameter and explain the terms in it.
5. Write the properties of Fermi surface
6. What is anomalous skin effect.
7. Write the processes of photo conductivity
8. Discuss chemi luminescence

SECTION – B

Answer **ALL** questions. Each question carriers **10** marks

(4 ✎ 10 = 40)

9. (a) Discuss the reduction of elastic constants in cubic crystals
(OR)
(b) Obtain the expression for velocity of elastic waves along [100] and [110] direction
10. (a) Discuss the Debye theory of specific heat
(OR)
(b) Obtain the expression for thermal conductivity of solid
11. (a) Discuss the Augmented Plane Wave method in studying the energy bands of solids
(OR)
(b) Write in detail the de Haas van Alphen effect in studying the Fermi surface of a solid
12. (a) Write in detail Thermo luminescence, Electro luminescence and Photoluminescence,
(OR)
(b) Describe excitation, emission and Decay mechanisms

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-305 (A): Advanced Characterization Techniques

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.

(5 ✖ 2 =10)

Each question carries **2** marks.

1. Describe principle of Laue method of X-ray diffraction
2. Explain tunnelling phenomena
3. Compare Auger and X-ray photoelectron spectroscopy
4. Write the applications of Energy dispersive spectroscopy.
5. Write short notes on spin-spin interaction
6. Discuss about recoilless emission and absorption.
7. Write any four applications of NMR
8. Explain half integral and integral spins.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✖ 10 = 40)

9. (a) Discuss about principle, construction and working of transmission electron microcopy with the help of block diagram.
(OR)
(b) Explain working of scanning tunneling microscope and its applications.
10. (a) Describe principle and working of X-ray photoelectron spectroscopy with neat diagram.
(OR)
(b) Explain Auger electron spectroscopy for characterization of materials and its applications.
11. (a) Discuss about electron spin resonance theory, experimental methods and applications.
(OR)
(b) Discuss about working of Mossbauer spectroscopy and its applications.
12. (a) Explain principle, construction and working of NMR spectroscopy with the help of block diagram
(OR)
(b) Discuss about instrumentation, working and applications of NQR.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-305 (B): Sensors and Transducers

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

SECTION-A

Max. Marks 50

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. Define the role of a sensor and transducer.
2. Write the working principle of a thermocouple.
3. Write the working principle of capacitance displacement transducer
4. What are the applications of a strain gauge?
5. What is the working principle of photomultiplier cells?
6. Describe the working principle of a photo diode.
7. Write a note on active filters.
8. What is isolation amplifier?

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) What are the significant parameters of transducer? Describe the principle and working of Platinum Resistance Thermometer.
(OR)
(b) Based on the measuring parameter, Classify transducers. Describe with suitable diagram the working principle of a thermistor.
10. (a) Describe the principle and working of a strain gauge. What are the materials employed in strain gauge.
(OR)
(b) Write the working principle of inductance based displacement transducers and describe the construction and working of a linear voltage differential transformer.
11. (a) What is photovoltaic effect? Describe the construction and working of a photovoltaic cell.
(OR)
(b) Describe the construction and working of light emitting diode. Explain the working principle of laser diode.
12. (a) Explain the working of integrator and differentiator active filters with circuit diagrams.
(OR)
(b) With a neat circuit diagram, explain the working of Lock in amplifier.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-306 (A): Introduction to VLSI design

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. Discuss the overview of VLSI.
2. How MOSFETs can be used as switches.
3. Discuss the designing of FET arrays.
4. Discuss the design rules for CMOS ICs.
5. Explain FET RC model.
6. Discuss the current-voltage characteristics of nFET.
7. Discuss the DC characteristics of the CMOS inverter.
8. Explain the transient response of NOR gate in CMOS.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) Discuss the design of basic and complex gates in CMOS.
(OR)
(b) Describe the clocking and data flow control in MOSFETS.
10. (a) Explain in detail about lithography of CMOS ICs.
(OR)
(b) Discuss the CMOS process flow.
11. (a) Discuss the FET sizing and unit transistor.
(OR)
(b) Discuss the physical design of logic gates.
12. (a) Explain the switching characteristics and power dissipation of NAND and NOR gates.
(OR)
(b) Discuss the analysis of complex logic gates and gate design for transient performance in CMOS.

Model Question Paper

M.Sc DEGREE EXAMINATIONS, APRIL/DECEMBER

THIRD SEMESTER

Branch – PHYSICS

PHY-306 (B): Solar Energy – Photovoltaics

(Common syllabus for SVU & Affiliated Colleges)

(w.e.f.2024-2025)

Time : 2 hrs

Max. Marks 50

SECTION-A

Answer any **FIVE** of the following questions.
2=10) Each question carries **2** marks.

(5 ✎)

1. Explain the different types of interfaces.
2. Discuss the effect of series and shunt resistances on cell efficiency
3. Distinguish between metallurgical and solar grade silicon.
4. Write a note on EFG growth of silicon.
5. Give the differences between crystalline and amorphous silicon.
6. Draw the configuration of CdTe/CdS solar cell.
7. Explain the series connection of solar modules.
8. Discuss the importance of bypass diode.

SECTION – B

Answer **ALL** questions. Each question carries **10** marks

(4 ✎ 10 = 40)

9. (a) What is photovoltaic effect? Discuss the cell output parameters using equivalent circuit.
(OR)
(b) Give the selection criteria of absorber and window layers of heterojunction solar cell.
10. (a) Discuss the Czochralski method of producing single crystal silicon.
(OR)
(b) Explain the growth of single crystal silicon using float zone process.
11. (a) Discuss in detail the deposition of a-Si by glow discharge method.
(OR)
(b) Discuss the techniques used in the fabrication of CIGS/CdS solar cell.
12. (a) Describe the different steps involved to fabricate a solar module.
(OR)
(b) Explain the various components of a PV system in detail.