DEPARTMENT OF PHYSICS

PREAMBLE

UG : Course profile, list of courses offered to other department and the syllabi of courses offered in the first two semesters along with evaluation components III & IV (With effect from 2018-2021 batch onwards)

PG : Course profile, list of courses offered to other department and the syllabi of courses offered in the first two semesters along with evaluation components III & IV (With effect from 2018-2020 batch onwards)

M.Phil : Course Profile and the syllabi of courses offered in the two semesters (with effect from 2018-2019 batch onwards) are presented in this booklet.

COURSE PROFILE: B.Sc., (Physics)

PSO1: Application of the knowledge in the principles of nature and ability to solve and apply the concepts of physics in various fields including Material Science, Mechanics, Thermal Physics and Electricity.

PSO2: Learning of laboratory skills, enabling measurements in basic physics and analysis of measurements to draw valid conclusions.

PSO3: Development of the skills for problem solving and scientific reasoning for the prospective physicists and logical reasoning.

PSO4: Analysis of the behavior of materials from atomic level to macroscopic level.

Semester	Part	Category	Course code	Course Title	Contact Hrs/week	Credit	
						Min	Max
I	I	Language	UTAL105,UTAL106/ UHIL101/UFRL101	Basic Tamil-I/Advanced Tamil I/Hindi/French	4	2	3
	II	English	UENL107,UENL108	General English-I/ Advanced English-I	5	3	4
	III	Core I	UPHM103	Mechanics	5	5	5
	III	Core II	UPHM105/UPHM202	Properties of Matter	6	5	5
	III	Core Practical-I	UPHR102/UPHR202	Major Practical I	3	2	2
	III	Allied	UMAA104	Algebra, Differential Calculus and Trigonometry	5	5	5
	IV	Value Education			2	1	1
TOTAL					**30**	**23**	**25**
II	I	Language	UTAL205,UTAL206 UHIL201/UFRL201	Basic Tamil-II/Advanced Tamil-II/Hindi/French	4	2	3
	II	English	UENL207,UENL208	General English-II/ Advanced English-II	5	3	4
	III	Core III	UPHM104/UPHM203	Thermal and Statistical Physics	7	6	6
	III	Core Practical-II	UPHR203/UPHR101	Major Practical II	3	2	2
	III	Allied	UMAA212	Integral Calculus, Laplace Transform and Ordinary Differential equation	5	5	5
	IV	NME	-	-	4	2	2
	IV	Soft Skill			2	1	1

	V	Extension Programme/ Physical Education/NCC	-	-	-	1	2
				Total	**30**	**22**	**25**

Semester	**Part**	**Category**	**Course Code**	**Course Title**	**Contact Hrs/week**	**Credit**	
						Min	**Max**
III	I	Language	UTAL305,UTAL306/ UHIL301/UFRL301	Basic Tamil-III/Advanced Tamil-III/Hindi/ French	4	2	3
	II	English	UENL307,UENL308	General English-III/Advanced English-III	5	3	4
	III	Core IV	UPHM303/UPHM402	Electricity and Magnetism	6	5	5
	III	Core V	UPHM304/ UPHM509	Mathematical Physics	4	3	3
	III	Core Practical-III	UPHR303	Major Practical III	3	2	2
	III	Allied	UCSA306	Computational Physics with Python	3	3	3
	III	Allied Practical	UCSR310	Computational Physics with Python Lab	3	2	2
	IV	Value Education	-	-	2	1	1
				TOTAL	**30**	**21**	**23**

Semester	Part	Category	Course Code	Course Title	Contact Hrs/week	Credit	
						Min	Max
IV	I	Language	UTAL405,UTAL406/ UHIL401/UFRL401	Basic Tamil IV /Advanced Tamil - IV/Hindi/ French	4	2	3
	II	English	UENL407, UENL408	General English-IV/Advanced English-IV	5	3	4
	III	Core VI	UPHM406/UPHM302	Optics and Laser Physics	4	4	4
	III	Core VII	UPHM407	Atomic Physics	4	4	4
	III	Core Practical-IV	UPHR405	Major Practical IV	3	3	3
	III	Allied	UCHA401/UCHA402/ UCHA403	Chemistry for Physics	3	3	3
	III	Allied Practical	UCHA402/UCHR403	Volumetric and Organic Analysis-I	3	2	2
	III	Core VIII	UPHP401/UPHP402	Project / Instrumentation Techniques	2	-	-
	IV	Soft Skill			2	1	1
	V	Extension Programme/Physical Education			-	-	2
				TOTAL	**30**	**22**	**26**

Semester	Part	Category	Course Code	Course Title	Contact Hrs/week	Credit	
						Min	Max
V	III	Core IX	UPHM501	Quantum Mechanics and Relativity	6	5	5
	III	Core X	UPHM505	Basic Electronics	6	5	5
	III	Core XI	UPHM506/UPHM608	Solid State Physics	6	5	5
	III	Core Practical-V	UPHR502	Major Practical V	3	3	3

	III	Core XII	UPHP501/UPHP502	Project / Instrumentation Techniques	4	4	4
	IV	Online Course		NPTEL/Spoken Tutorial	3	1	2
	IV	Value Education			2	1	1
				TOTAL	**30**	**24**	**25**

Semester	**Part**	**Category**	**Course Code**	**Course Title**	**Contact Hrs/week**	**Credit**	
						Min	**Max**
VI	III	Core XIV	UPHM609	Numerical methods and Basic Computational Physics	5	5	5
	III	Core XV	UPHM611	Nuclear and Radiation Physics	5	5	5
	III	Core XVI	UPHM612	Material Science	5	5	5
	III	Core XVII	UPHM613	Digital Electronics	5	4	4
	III	Core Practical VI	UPHR605	Major Practical VI	3	3	3
	III	Major Elective	UPHO601/ UPHO602/UPHO603	Nanophysics/ Astrophysics/Functional Materials	5	4	4
	III	Viva Voce	UPHM610	Comprehensive Viva Voce	-	1	1
	IV	Soft Skill			2	1	1
	V	Extension Programme/Physical Education			-	-	2
				TOTAL	**30**	**28**	**30**
				GRAND TOTAL	**180**	**140**	**154**

ALLIED

Semester	**Part**	**Category**	**Course Code**	**Course Title**	**Contact Hrs /week**	**Credit**	
						Min	**Max**
I	III	Allied	UPHA102	Allied Physics-I	3	3	3
I	III	Allied	UPHR103	Physics for Chemistry Practical -I	3	2	2
II	III	Allied	UPHA203	Allied Physics-II	3	3	3
II	III	Allied	UPHR202	Physics for Chemistry Practical-II	3	2	2
III	III	Allied	UPHA303	Digital Electronics	3	3	3
III	III	Allied	UPHR303	Digital Electronics Practical	3	2	2

NON-MAJOR ELECTIVES

Semester	**Part**	**Category**	**Course Code**	**Course Title**	**Contact Hrs/ week**	**Credit**	
						Min	**Max**
II	IV	Non Major elective	UPHE202	Applied physics	4	2	2
			UPHE203	Biomedical instrumentation			
			UPHE204	Electrical appliances			
III	IV	Non Major Elective	UPHE304/ UPHE503	Telecommunication System	4	2	2
			UPHE303	Servicing and maintenance of home appliances			

IV	III	Allied	UPHA402	Electronics(For Mathematics major)	3	3	3
IV	III	Allied	UPHR402	Electronics(For Mathematics major) Practical	2	2	2

EXTRA CREDIT EARNING PROVISION

Semester	Part	Category	Course Code	Course Title	Hrs/week	Credit	
						Min	Max
II	III	Core VI	UPHI201	Summer Internship	-	-	1

UPHM103 MECHANICS

Semester : I **Credit : 4**
Category : Core II **Hours/week : 5**
Class & major : I B.Sc., Physics **Total hours : 65**

Objectives
To enable the students

- Apply the knowledge of different types of motion and gravitation
- Identify the dynamics of rigid bodies in terms of moment of inertia
- Understand the basics of classical mechanics and its applications

UNIT – I LAWS OF MOTION **13 Hrs**

Newton's laws of motion-conservation of energy-conservation forces-conservation of linear momentum-center of mass – angular momentum – conservation of angular momentum – relation between torque and angular momentum. Rocket motion – principle- theory – velocity of the rocket at any instant – rocket propulsion system – multi stage rocket – shape of the rocket – artificial satellites.

UNIT – II GRAVITATION **15 Hrs**

Kepler's law – Newton's law of gravitation - determination of G by Boy's method – density of earth – mass of the earth and sun – gravitational field – intensity of the field – gravitational potential – potential energy – inertial and gravitational masses – escape and orbital velocity – acceleration due to gravity – value of 'g' at the poles and at the equator – variation of 'g' with latitude, altitude & depth. Compound pendulum – radius of gyration – determination of 'g' by compound pendulum.

UNIT – III CIRCULAR MOTION **13 Hrs**

Angular displacement – angular velocity – relation between linear velocity and angular velocity – acceleration in uniform circular motion – centripetal force and centrifugal force – applications – condition for skidding and overturning of a car taking a turn – motion in horizontal circle – friction present on the road – motion in vertical circle – centrifuge.

UNIT – IV MOMENT OF INERTIA **10 Hrs**

Rigid body – moment of inertia – parallel axes theorem – perpendicular axes theorem. Moment of inertia of a thin rod, solid cylinder, and solid sphere – hollow sphere with external and internal radii – kinetic energy of rotation.

UNIT – V LAGRANGIAN AND HAMILTONIAN MECHANICS **14 Hrs**

Mechanics of a system of particle – degrees of freedom – constrains – generalized coordinates – principles of virtual work – D' Alembert's principle – derivation of Lagrange's equation of motion – applications of Lagrange's equation to simple pendulum and linear harmonic oscillator – Hamiltonian function 'H' – Hamiltonian equation – physical significance of 'H' – applications of Hamiltonian equations to simple pendulum and linear harmonic oscillator.

Text Books

- Murugeshan.R, *Mechanics and Mathematical Physics*, S. Chand & Company Ltd, New Delhi, 2008.
- Brijlal, Subramaniam, *Properties of Matter*, Eurasia publishing house, New Delhi, 1993.
- Narayanamoorthy, M., *Mechanics and Properties of Matter*, National Publishing House, New Delhi,1995.

Reference Books

- Halliday D, Resnick, walker.J *Fundamentals of Physics*, willey, 6th edition, New York, 2006.
- Richard P. Feyman, R .B .Leighton & Mathew sands, *Feyman Lecture on Physics Series*, vol. 1,2 & 3, Narosa Publishing, 8th reprint, New Delhi, 1995.
- Mathur D.S, *Mechanics*, S.Chand & Company Ltd, New Delhi, 2005.
- Halliday D, Resnick, Walker. J *Fundamentals of Physics*, Willey, 6th edition, New York, 2006.

UPHM105/UPHM202 PROPERTIES OF MATTER

Semester : I **Credit : 4**
Category : Core -II **Hours/Week : 6**
Class & Major: I B.Sc., Physics **Total Hours : 78**

Objectives

To enable the students

- Understand the basics of elasticity and its importance in beams and griders
- Comprehend the concepts of surface tension, viscosity and their applications
- Examine the knowledge of diffusion, Bernoulli's theorem, ultrasonic and their applications

UNIT – I ELASTICITY **16 Hrs**

Introduction – stress, strain, Hooke's law – types of elasticity – Poisson's ratio – workdone due to strain – relation between the elastic moduli – torsion – torsional oscillations of a body – rigidity modulus by torsion pendulum – bending of beams – expression for the bending

moment – cantilever – uniform bending – pin and microscope – non uniform bending – scale and telescope.

UNIT – II SURFACE TENSION **16 Hrs**

Introduction – explanation of surface tension in kinetic theory – surface energy – angle of contact – express pressure inside a liquid drop and soap bubble – variation of surface tension with temperature – drop weight method of determination the S.T of a liquid – interfacial tension-experiment to determine the interfacial tension between water and kerosene.

UNIT – III VISCOSITY **15 Hrs**

Introduction – streamline and turbulent flow – determination of critical velocity – Poiseuill's formula – correction – Poiseuill's method for determination coefficient of a liquid – terminal velocity – Stoke's formula – Stoke's method for determination the coefficient of viscosity of a liquid – variation of viscosity with temperature and pressure – friction and lubrication.

UNIT – IV DIFFUSION AND HYDRODYNAMICS **15 Hrs**

Diffusion: Introduction – Fick's law of diffusion – analogy with heat conduction – experimental determination of coefficient of diffusion - Hydrodynamics:equation of continuity – energy of the liquid – Bernoulli's theorem – proof – applications of Bernoulli's theorem – Venturimeter – Pitot's tube.

UNIT – V ACOUSTICS **16 Hrs**

Forced vibrations – damped vibrations – resonance – intensity of sound – noise pollution – transverse vibration of a stretched string – expression for the velocity of transverse vibration of a stretched string – expression for the transverse vibration of a stretched string – laws of vibration of strings-A.C.freuency measurement using sonometer. Ultrasonics-production of ultrasonic waves-use of ultrasonics.

Text Books

- Murugeshan.R, Kiruthiga Sivaprasath, *Properties of Matter and Acoustics*, S.Chand and Company Ltd, New Delhi, 2010.
- Murugeshan R., *A textbook of Sound*, S.Chand and Company Ltd, New Delhi, 2008.

Reference Books

- Halliday D.Resnick,Walker.J, *Fundamentals of Physics*, Wiley,6th Edition, New York, 2006.
- Murugeshan.R, *Waves and Oscillations*, S.Chand and Company Ltd, New Delhi, 2005.

UPHR202/UPHR102 MAJOR PRACTICAL-I

Semester : I **Credit : 2**
Category : Core Practical I **Hours/Weeks : 3**
Class & Major : I B.Sc., Physics **Total Hours : 39**

Objectives
To enable the students

- Understand the theory of the application of subject knowledge
- Determine the techniques of handling equipments
- Compute error free measurements and error analysis

1. Young's Modulus-Cantilever Depression Using Scale and Telescope.
2. Young's Modulus-Uniform Bending-Scale and Telescope.
3. Young's Modulus-Non Uniform Bending-Pin and Microscope.
4. Rigidity Modulus –Torsion Pendulum-(with and without masses).
5. Surface Tension-Capillary rise method-(Radius using Vernier Microscope).
6. Surface Tension and Interfacial Tension-S.T by Drop Weight Method.
7. Co-efficient of Viscosity of a Liquid-Constant Pressure Head.
8. Sonometer-Frequency of Tuning Fork.

Optional

1. Young's Modulus-Uniform Bending-Koenig's Method.
2. Rigidity Modulus- Static Torsion.
3. Co-efficient of Viscosity of a Liquid-Stokes Method.
4. Sonometer - A.C. Frequency-Steel and Brass Wire.

Text Books

- Srinivasan M.N., Balasubramanian S.,Ranaganathan R.,*The Text Book of Practical Physics*, Sultan Chand and Sons, New Delhi, 2006.
- Ouseph C.C., Ranagarajan G., *A Textbook of Practical Physics Part-I*, S.Viswanathan Publisher, 1990.

Reference Book

- Gupta S.L and Kumar V, *Practical Physics*, Pragathi Prakashan.25th edition, 2002.

UPHM104/UPHM203 THERMAL AND STATISTICAL PHYSICS

Semester : II **Credit : 6**
Category : Core III **Hours/Week: 7**
Class & major: I B.Sc., Physics **Total hours : 91**

Objectives
To enable the students

- Understand the basics principles of heat and laws of thermodynamics
- Acquire knowledge of Maxwell's thermodynamics relations
- Summarize the concepts of statistical physics and its applications

UNIT – I THERMOMETRY **19Hrs**

Definition of temperature – platinum resistance thermometer – construction & working – thermistor – specific heat capacity – Dulong and Petit's law – calorimeter – specific heat of a gas – relation between specific heat of a gas – Mayer's expression – Jolly's differential steam calorimeter for finding C_V - Callendar and Barne's continuous flow method – basis of kinetic theory – Maxwell's laws of velocity of distribution – experimental verification of Maxwell Boltzmann distribution – degrees of freedom – mean free path.

UNIT – II TRANSMISSION OF HEAT **18Hrs**

Introduction – coefficient of thermal conductivity – Lee's disc method – convection – applications of convection – central heating system – thermopile – radiation – thermal radiation – Black body – Stefan's law- experimental verification of Stefan's law- distribution of energy in black body spectrum – Wien's law – Rayleigh – Jeans law – Newton's law of cooling – experimental verification of Newton's law of cooling – Planck's radiation law – solar constant – temperature of the sun – Angstrom's pyrheliometer.

UNIT – III THERMO DYNAMICS **18Hrs**

Thermodynamics system – zeroth, first, second and third laws of thermodynamics – isothermal and adiabatic process – reversible and irreversible process – heat engine – efficiency of a Carnot's engine – Carnot's cycle - Carnot's Theorem - Entropy – temperature – entropy diagram – Maxwell's thermodynamic relations – Clapeyron's latent heat equation.

UNIT – IV LIQUEFACTION OF GASES AND SUPER CONDUCTIVITY **18Hrs**

Introduction – cooling by adiabatic expression – Joule – Thomson expression – liquefaction of gases – principle of regenerative cooling – liquefaction of Helium – He I & II- peculiar properties of He II - Adiabatic demagnetization – superconductivity – Meissner effect – applications.

UNIT – V STATISTICAL PHYSICS **18 Hrs**

Introduction – micro and macro states – thermodynamic probability – ensembles – derivation of Maxwell – Boltzmann distribution law – application of M-B law to ideal gas – identical particles – derivation of Bose-Einstein distribution law – application of B-E statistics – derivation of Fermi-Dirac distribution law – applications of F-D statistics – comparison of three statistics.

Text Books

- Mathur.D.S, *Heat and Thermodynamics*, S.Chand & Company Ltd, New Delhi, 2010.
- Brijlal, Subramaniam, P.S. Hemne, *Heat Thermodynamics and Statistical Physics*, S Chand & Company ltd, New Delhi, 2010.
- Murugesan R., Krithika Sivaprasath.S, *Thermal Physics*, S.Chand & Company Ltd, New Delhi, 2008.

Reference Books

- Chakrabati, P.K. *Theory and Experiments on Thermal Physics*, new central book agency (P) Ltd, Kolkata, 2006.
- Rajam.J.B and Arora.C.L, *Heat and Thermodynamics*, S.Chand & Company Ltd, New Delhi, 2004.

UPHR101/UPHR203 MAJOR PRACTICAL-II

Semester : I **Credit : 2**
Category : Core Practical-II **Hours/Week: 3**
Class & major: I B.Sc Physics **Total Hours : 39**

Objectives
To enable the students

- Understand the theory of the application of subject knowledge in practical
- Demonstrate the techniques of handling equipments
- Make error free measurements and error analysis

1. Compound pendulum-acceleration due to gravity 'g' and radius of gyration.
2. Bifilar pendulum-verification of M.I theorem.
3. Specific heat capacity – Newton's law of cooling.
4. Lee's disc – thermal conductivity of card board.
5. Specific heat of a liquid – verification of Newton's law of cooling.
6. Thermistor – temperature coefficient ''a'' – multimeter.
7. Thermocouple – temperature coefficient ''a'' – multimeter.
8. P.O box – temperature coefficient of thermistor.

Optional

1. Sonometer – measurement sun radiation.
2. Bifilar pendulum – Determination of earth's gravitation field.
3. Measurement of Stefan's constant.
4. Measurement of 'g' by falling plate.

Text books

- Srinivasan.M.N., Balasubramanian S.Ranganathan R., *The Text book of Practical Physics*, Sulthan Chand & Sons, New Delhi, 2006.
- Ouseph.C.C., Rangarajan G., *A Text book of practical of Physics Part – I*, S.Vishvanathan Publisher, 1990.

Reference book

- Gupta.S.L, Kumar.V, *Practical Physics*, Pragathi Prakashan, 25th edition, 2002.

UPHA102 ALLIED PHYSICS-I

Semester : I **Credit : 3**
Category : Allied I **Hours/Week: 3**
Class & Major :I B.Sc Chemistry **Total Hours : 39**

Objectives

To enable the students

- Gain knowledge of basics of particle dynamics and properties of matter
- Understand diffraction and polarization of light waves
- Acquire knowledge on crystal diffraction

UNIT – I Particle Dynamics **7 Hrs**

Displacement, velocity and acceleration – distance-time graph – velocity-time graph – projectile motion – uniform circular motion – tangential acceleration in circular motion – relative velocity and acceleration.

UNIT – II Gravitation **7 Hrs**

Kepler's laws - Newton's law of gravitation – 'g' and measurement – earth-moon system - earth satellites – parking orbit – earth density – mass of the sun – gravitational potential – velocity of escape – satellite potential and kinetic energy.

UNIT – III Properties of matter **9 Hrs**

Elastic properties: Elastic limit – Hooke's law – moduli of elasticity – Poission's ratio – relation between q,n,k – force in a bar due to contraction or expansion – energy stored in a wire – rigidity modulus – torsion in a wire – static torsion and torsional oscillations method.

Viscosity and surface tension: Newton's formula – Stoke's formula – Poiseuille's flow –molecular theory of surface tension – excess pressure over curved surface – spherical and cylindrical drops – surface energy – capillary rise – Quincke's method for mercury.

UNIT – IV Optics **9 Hrs**

Diffraction: Fresnel and Fraunhoffer diffractions – Fraunhoffer diffraction at a single slit - diffraction at multiple slits - plane diffraction grating – determination of wavelength of a spectral line of a Hg lamp.

Polarisation: Double refraction of crystals – geometry of Nicol prism – Huygen's theory – polaroid – circular and elliptical polarization – quarter and half wave plates – production and analysis of polarized beams – optical activity.

UNIT – V Crystal Physics **7 Hrs**

Crystal structures: Introduction – crystal lattice – unit cell – classification of crystals – Bravais lattice in three dimensions –crystal planes and Miller indices – simple crystal structures.

Crystal diffraction: Bragg's law – experimental X-ray diffraction methods - Laue method – rotating crystal method – powder method

Text Books

- Narayanamurthy M and N.Nagararathnam, *Dynamics*, National Publishing House, New Delhi, 2004.
- Mathur D.S., *Properties of Matter*, S.Chand and Company, New Delhi, 2012.
- Murugesan R., Kiruthiga Sivaprasath, *Modern Physics*, S.Chand & Company Ltd, New Delhi, 2006.

Reference Books

- Halliday D and R.Resnick , *Fundamentals of Physics*, Wiley, 6th edition, New York, 2006.
- Brijlal, N. Subramaniam, *A Text book of optics*, S. Chand & company Ltd, New Delhi, 2008.

UPHR103 PHYSICS FOR CHEMISTRY PRACTICAL – I

Semester : I **Credit : 2**
Category : Allied Practical I **Hours/Week : 3**
Class & Major : I B.Sc Chemistry **Total Hours : 39**

Objectives

To enable the students

- Understand the theory of the application of subject knowledge in practical
- Understand the techniques of handling equipments
- Make error free measurements and error analysis

1. Young's Modulus by Strenching – Vernier microscope.
2. Rigidity Modulus – Torsional Pendulum.
3. Surface Tension and Interfacial Tension – Method of Drops.
4. Surface Tension – Capillary Rise.
5. Viscosity – Capillary Flow.
6. Specific heat of Liquid – Newton's law of cooling.
7. Sonometer – verification of Laws of Vibration.
8. Compound bar Pendulum –Determination of 'g' and Radius of Gyration.

Optional

1. Specific Heat of Liquid – Electrical Heating.

Text Books

- Srinivasan M.N., Balasubramanian S.,Ranaganathan R.,*The Text Book of Practical Physics*, Sultan Chand and Sons, New Delhi, 2006.
- Ouseph C.C., Ranagarajan G., *A Textbook of Practical Physics Part-I*, S.Viswanathan Publisher, 1990.

Reference Book

- Gupta S.L and Kumar V, *Practical Physics*, Pragathi Prakashan.25th edition, 2002.

UPHA203 ALLIED PHYSICS -II

Semester : II **Credit : 3**
Category : Allied II **Hours/week : 3**
Class & Major : I B.Sc Chemistry **Total Hours : 39**

Objectives
To enable the students

- Be aware of semiconductor devices and their working principle
- Study the basic number system, digital gates, flip flops, counters and registers
- Acquire the knowledge of atom model, quantum numbers and periodic table

UNIT – I Semiconductor devices **8 Hrs**

Semiconductor- intrinsic and extrinsic semiconductor - Fermi level-mechanism of current conduction- PN - junction diode - Zener diode-LED- Solar cell. Transistor: construction-mechanism of amplification- current components- modes of operation-transistor amplifier.

UNIT – II Digital electronics **7 Hrs**

Number system- binary – octal-hexadecimal-digital gates-Boolean Algebra – K-map-RS-flip flop-JK- flip flop- shift register- full and half adder-binary counter-modulus counter-decade counter

UNIT –III Atomic Physics **8 Hrs**

Atomic Physics: Bohr's atom model- hydrogen spectrum-fine structure splitting- sodium doublet-quantum numbers- Pauli's exclusion principle-periodic table.

X-ray and photoelectric effect: Production of X- ray – continuous and characteristics – X-ray spectra – industrial and medical applications of X-rays. Law of photoelectric emission-Einstein's photoelectric equation- Millikan's experiment-photoelectric cells (emissive, electric and voltaic) –Photo multiplier tubes.

UNIT –IV Nuclear physics **7 Hrs**

General properties of nuclei: Nuclear mass and binding energy –BE/A versus A curve- nuclear spin and magnetic moment- mass, half life and spin of neutron-semi empirical mass formula- nuclear models and elementary particles – nuclear reactions: cross section- nuclear fission- liquid drop model- nuclear forces-elementary particles: classification- quarks and lepton

UNIT –V Mechanical waves **9 Hrs**

Waves in strings and pipes: velocity of a transverse wave along a stretched string – velocity of sound in gases- Newton's formula for velocity of sound-effect of temperature, pressure, humidity and density of medium on sound

Ultrasonic and acoustics: Ultrasonics - Piezo electric effect-detection of ultrasonic's-applications- reverberation time and Sabine's law- measurement of noise – reduction and sound insulations.

Text books

- Brijlal and Subramaniyam, *Electricity and Magnetism*, Ratan Prakash Mandir Publisher, 1995.
- Mani H.S. and Mehta, *Introduction to Modern Physics*, G.K publication, Affiliated East-West Press Ltd, New Delhi, 1998.

Reference Books

- Richard P. Feynman, R.B.Leighton and Mathew Sands, *Feynman Lectures on Physics Series*,Vol, 1,2 and 3,Narosa Publishing ,8th reprint, New Delhi, 2005.
- Khanna R and Bedi R.S, *Text Book of Sound*, Atma ram and sons, New Delhi, 1985.

UPHR202 PHYSICS FOR CHEMISTRY PRACTICAL – II

Semester : I **Credit : 2**
Category : Allied Practical I **Hours/week: 3**
Class & Major : I B.Sc Chemistry **Total Hours: 39**

Objectives:
To enable the students

- Understand the theory of the application of subject knowledge in practical.
- Understand the techniques of handling equipments.
- Make error free measurements and error analysis.

1. Determination of Young's Modulus (Non-uniform Bending) – Pin and Microscope.
2. Determination of Rigidity Modulus (pointer method) – Static Torsion.
3. Determination of Focal Length – Concave and Convex Lenses.
4. Determination of Thickness of Wire – Air Wedge.
5. Universal Building Block – NAND Gates.

6. Determination of Wavelengths (Grating) – Hg Spectrum.
7. LCR Parallel Resonant Circuit.
8. Characteristics of Zener Diode.

Optional

1. Construction of Half and Full Adders – Digital Gates.
2. Determination of Velocity of Sound Waves – Melde' String.

Text books

- Srinivasan.M.N., Balasubramanian S.Ranganathan R., *The Text book of Practical Physics*, Sulthan Chand & Sons, New Delhi, 2006.
- Ouseph.C.C., Rangarajan G., *A Text book of practical of Physics Part – I*, S.Vishvanathan Publisher, 1990.

Reference book

- Gupta.S.L, Kumar.V, *Practical Physics*, Pragathi Prakashan, 25th edition, 2002.

III and IV Evaluation components of CIA

Semester	Category	Course Code	Course Title	Component-III	Component-IV
I	Core II	UPHM103	Mechanics	Seminar - Power Point Presentation	Working Models
	Core IV	UPHM105	Properties of Matter	Assignment (Collection of real time examples of elasticity)	Seminar(Statistical analysis(Noise pollution)
	Allied	UPHA101	Allied Physics - I	Assignment	Poster presentation
II	Core III	UPHM104/ UPHM203	Thermal and Statistical Physics	Poster Presentation	Simple Heat experiments(Model display)
	Allied	UPHA202	Allied Physics - II	Seminar	PPT

COURSE PROFILE M.Sc., (Physics)

PSO1: Proficiency in various mathematical concepts for the proper understanding of application in all physical systems especially in electronics, electromagnetism, material science, classical and quantum mechanics.

PSO2: Learning of laboratory skills, enabling measurements in a physics and electronics laboratory and analysis of the measurements to draw valid conclusions.

PSO3: Operation of the different electronic and physical devices such as microprocessor, microcontroller, laser, linear and nonlinear optical instruments in atomic scale.

PSO4: Ability to synthesis crystals and nanomaterials for various technological applications.

Semester	Category	Course Code	Course Title	Contact Hrs/week	Credit	
					Min	Max
I	Core I	PPHM101	Mathematical Physics I	5	4	4
	Core II	PPHM102	Classical Mechanics	5	4	4
	Core III	PPHM105	Electronics	5	4	4
	Core IV	PPHM104	Electromagnetic Theory	5	4	4
	Core V	PPHM106/ PPHM203	Molecular Spectroscopy	5	4	4
	Core Practical I	PPHR202	General practical –I	5	3	3
Total				**30**	**23**	**23**
II	Core VI	PPHM205/ PPHM401	Mathematical Physics II	5	4	4
	Core VII	PPHM201	Quantum Mechanics I	5	5	5
	Core VIII	PPHM202	Statistical Mechanics	5	4	4
	Core Elective -I	PPHM207/ PPHM302	Solid State Physics I	5	3	3
	Core Practical I	PPHR202	General practical –I	5	3	3
	NME			5	4	4
Total				**30**	**23**	**23**
III	Core IX	PPHM301	Quantum Mechanics II	6	5	5
	Core X	PPHM302	Microprocessor and Microcontroller	6	4	4
	Core XI	PPHM305	Material Science	6	4	4
	Project	PPHP301		2	-	-
	Core Practical- II	PPHR402	General practical –II	5	3	3
	Core XII	PIDM301	Sustainable Materials And Technologies	5	5	5
Total				**30**	**21**	**21**
IV	Core Elective-II	PPHM406/ PPHM303	Laser and nonlinear optics	5	3	3
	Core XIII	PPHM402	Nuclear and Particle Physics	6	4	4
	Core XIV	PPHM403	Solid State Physics-II	5	5	5
	Core Elective -II	PPHM405	Crystal growth and Thin Films	5	4	4

	Core Practical-II	PPHR402	General practical –II	5	3	3
	Project	PPHP401		4	4	4
TOTAL				**30**	**23**	**23**
GRAND TOTAL				**120**	**90**	**90**

PPHM101 MATHEMATICAL PHYSICS-I

Semester : I **Credit : 4**
Category : Core I **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives
To enable the students

- Acquire mathematical knowledge and apply it to various physical phenomena
- Develop problem solving ability related to physical problems
- Enhance basic skills of learning and appreciating physics through mathematics

UNIT – I VECTOR ANALYSIS 13 Hrs

Concept of vector and scalar fields – Gradient, divergence, curl and Laplacian – Vector identities – Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke's theorem and applications – Orthogonal curvilinear coordinates – Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates - Definitions – Linear independence of vectors – Schmidt's orthogonalisation process – Schwartz inequality.

UNIT – II COMPLEX ANALYSIS 12 Hrs

Functions of complex variables – Differentiability - Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and singularities - Cauchy's residue theorem – Evaluation of definite integrals - Derivatives of analytic functions -calculus of residues.

UNIT – III FOURIER SERIES AND LAPLACE TRANSFORMS 13Hrs

Fourier Series-Dirichlet‟s Theorem-Change of Interval-Complex Form-Fourier Series in the Interval $(0, \infty)$ - Uses of Fourier Series-Laplace Transform-Definition-Properties-Translation Property-Inverse Laplace Transform-Properties, example problems.

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS 14Hrs

Homogeneous and non-homogeneous equations of first and second order partial differential equations separation of variables technique-solution by Fourier series-use of double Fourier series. Applications: (1) One dimensional wave equation (2) one dimensional heat flow equation (separation of variables and use of Fourier series) (3) two dimensional Laplace's equation in Cartesian coordinate (separation of variables and double Fourier series.)

UNIT – V SPECIAL FUNCTIONS 13 Hrs

Sturm-Liouville problem – orthogonal functions - Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations: series solution – Rodriguez formula –

Generating functions – Orthogonality relations – Important recurrence relations- Gamma and Beta functions.

Text Books

- Erwin Kreyzig, *Advanced Engineering Mathematics*, Publishers-John Wiley & Sons, Inc, 8th edition, 2005.
- Michael Tinkham, *Group Theory and Quantum Mechanics*, Tata McGraw-Hill Co. Ltd, TMH edition,1974.
- Joshi A.W., *Group Theory for Physicists* Wiley Eastern Limited, 2nd Edition,1997.
- Spiegel. M.R., *Theory and Problems of Fourier Analysis*, Schaum's outline series,2000.

Reference Books

- Murray R. Spiegel, *Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems*, Mchraw Hill Book Company, 2000.
- Sankara Rao K., *Introduction to Partial Differential Equations*, Prentice Hall of India, 2nd Edition, 2005.
- Greenberg M. D, *Advanced Engineering Mathematics*, Publishers-Pearson Education (singapore) pvt. Ltd, 2nd edition, 2002.

PPHM102 CLASSICAL MECHANICS

Semester : I **Credit : 4**
Category : Core II **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives
To enable the students

- Understand the fundamental principles of classical mechanics and their applications
- Develop familiarity with the physical concepts and facility with the mathematical methods of Classical Mechanics.
- Examine different formulations on classical dynamics with their applications.

UNIT – I FUNDAMENTAL PRINCIPLES AND MATHEMATICAL FORMULATION **13 Hrs**

Mechanics of a particle and system of particles – Conservation laws – Constraints – Generalized coordinates – D' Alembert's principle and Lagrange's equation – Hamilton's principle –Lagrange's equation of motion – conservation theorems and symmetry properties – Motion under central force : General features.

UNIT – II LAGRANGIAN AND HAMILTONIAN FORMULATIONS **13 Hrs**

Hamilton's variational principle - Lagrange's equations of motion –Conservation theorems and symmetry properties – Cyclic coordinates - Application of Lagrange's equation; Linear harmonic oscillator, particle moving under a central force, Atwood's machine - Hamilton's equations of motion - Application of Hamiltonian's equations of motion; Particle moving in an electromagnetic field - Phase space - Principle of least action Lagrange and Poisson brackets – Hamilton – Jacobi method – Action angle variables – Kepler problem in action – angle variables.

UNIT – III TWO-BODY CENTRAL FORCE PROBLEMS 12 Hrs

Equations of motion and first integrals – The equivalent one – dimensional problem and classification of orbits – The Keplar problem – Inverse square law of force, the Laplace Runge-Lanz Vector – Scattering in a central force field – Scattering in laboratory and centre of mass frames.

UNIT - IV RIGID BODY DYNAMICS AND OSCILLATORY MOTION 13 Hrs

Euler angles – Moments and Products of Inertia – Euler's equations – symmetrical top – applications – theory of small oscillations and normal modes – frequencies of free vibration and normal coordinates – Linear triatomic molecule.

UNIT - V RELATIVISTIC MECHANICS 14 Hrs

Algebra of tensors – quotient law – fundamental tensor – Cartesian tensors – four vectors in special theory of relativity – Lorentz transformations in real four dimensional spaces, Covariant four dimensional formulations – force and energy equations in relativistic mechanics – Lagrangian and Hamiltonian formulation of relativistic mechanics.

Text Books

- Goldstein H., Poole C., Safko J., *Classical Mechanics*, Addison Wesley, New Delhi, 2002.
- Upathaya J. C., Classical Mechanics, *Mimalgya publishing house*, Mumbai,2005.
- Gupta, Kumar, Sharma, *Classical Mechanics*, 22nd Edition, Pragati Bhawan, Meerut, 2006.

Reference Book

- Rana N.C. and Joag P.S., *Classical Mechanics*, Tata McGraw Hill, New Delhi, 1991.

PPHM105 ELECTRONICS

Semester : I **Credit : 4**
Category : Core III **Hours/Weeks : 5**
Class & Major: I M.Sc., Physics **Total Hours : 65**

Objectives
To enable the students

- Understand basic and advanced electronic concepts
- Understand how to design circuits which can process digital data
- Establish the various principles of analog electronics and its applications

UNIT – I OPERATIONAL AMPLIFIERS 13 Hrs

Ideal Op-Amp-inverting, non-inverting, logarithmic, summing and difference amplifiers-integrator - differentiator- comparator-CMRR – Op-Amp Applications- summing amplifiers-Application of summing amplifiers.

UNIT – II UJTS AND THYRISTORS 14 Hrs

Operational Principle of UJT- Characteristics- SCR- V-I Characteristics –TRIAC-Thyristors: Basic Parameters- Current Controllable Devices- Thyristors in Series and Parallel-

Applications of Thyristors - TRIAC based AC power control. Bistable Multivibrator, Half and Full Wave Controlled Rectifier.

UNIT – III DIGITAL INTEGRATED CIRCUITS 12 Hrs

7400 TTL- TTL Parameters; TTL-MOSFET - CMOS FET - Three State TTL Devices- External drive for TTL Loads - TTL Driving External Loads-74C00 CMOS- CMOS Characteristics- TTL to CMOS Interface- CMOS to TTL interface- Current Tracers.

UNIT – IV ANALOG INTEGRATED CIRCUITS 13 Hrs

Electronic Analog Computation- Active Filters- High/Low Pass Filter-Band Pass Filter-Band Reject Filter- Delay Equalizer- Switched Capacitor Filters; Comparators- Sample and Hold Circuits- Waveform Generators- Square Wave Generator- Triangle wave Generator-Sawtooth Generator.

UNIT-V INTEGRATED CIRCUITS AS DIGITAL SYSTEM 13 Hrs

Binary Adders- Half / Full Adder- - MSI Adder-Serial/Parallel Operation-Decoder/Demultiplexer- BCD to Decimal Decoder-4-to-16 line Demultiplexer- Data Selector/Multiplexer-16-to-1 Multiplexer; Encoder; ROM:Code Converters-Programming the ROM-Applications-Basic RAM Elements-Bipolar RAM-Static and Dynamic MOS RAM-Ladder Type D/A Converter-Multiplying D/A Converter.

Text Books

- Chattopadhyay S., *Text Book of Electronics*, New Central Book Agency P.Ltd., Kolkata, 2006.
- Malvino A.P., D.P. Leach, *Digital Principles and Applications*, Tata McGraw-Hill, Publishing Co., New Delhi, 2005.

Reference Books

- Bhattacharya A.B., *Electronics Principles and Applications*, New Central Book Agency P.Ltd., Kolkata, 2007
- Jacob Millman, Christos C Halkins and Chetan Parikh, *Integrated Electronics Analog and Digital Circuits and Systems* , 2nd Edition, Tata McGraw Hill Educatio Private Limited, New Delhi, 2010.
- Anil K. Maini and VarshaAgarwal, *Electronic Devices and Circuits*, Wiley India Pvt. Ltd., New Delhi, 2009.

PPHM104 ELECTROMAGNETIC THEORY

Semester : I **Credit : 4**
Category : Core IV **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives

To enable the students

- Understand the law and their applications associated with electrostatics and magneto statics
- Explain the laws associated with electromagnetic and its applications
- Compare the production of electromagnetic waves and its propagation in different media

UNIT – I ELECTROSTATICS **13 Hrs**

Coloumb's law- electric field- Continuous charge distribution- Gauss Law and its application –Electric potential-Poisson & Laplace equations- boundary value problems-Dielectrics-Polarization and Displacement vectors-Boundary conditions-Dielectric sphere in a uniform field- Molecular polarisability and electric susceptibility

UNIT – II MAGNETOSTATICS **12 Hrs**

Biot-Savart's law-Divergence and curl of magnetic induction-magnetic vector potential-Ampere's circuital law-Ampere's law in magnetized materials-Effect of magnetic field in atomic orbits –Magnetic field inside matter-Linear and nonlinear media-Magnetic susceptibility and permeability

UNIT – III ELECTRODYNAMICS **14 Hrs**

Electromotive force-Ohms law- faradays law-Electromagnetic induction- Maxwell's equations in free space and linear isotropic media- -Magnetic charge-Maxwell equations in matter- Boundary conditions- Conservation laws – Conservation of energy – Poynting's theorem - conservation of momentum-Scalar and vector potentials- Gauge invariance-Dynamics of charged particles in static and uniform electromagnetic fields.

UNIT – IV WAVE PROPAGATION **13 Hrs**

Electromagnetic waves in free space- Reflection and refraction, Fresnel's law, interference, coherence, and diffraction non conducting medium-conducting medium-skin depth-reflection and transmission at dielectric boundaries-polarization-Guided waves-Wave guides-Propagation of waves in a rectangular wave guide-inhomogeneous wave equation and retarded potentials-Radiation- from moving charges and dipoles and retarded potentials.

UNIT – V APPLICATIONS – PLASMA PHYSICS **13 Hrs**

Plasma – Plasma criteria – plasma oscillations-plasma behavior in a magnetic field-Dispersion relations in plasma. Debye shielding problem- plasma confinement in a magnetic field- pinch effect- magneto hydrodynamic waves- Alfven waves.

Text Books

- David J. Griffiths, *Introduction to Electrodynamics*, Prentice Hall of India, New Delhi, 1995.
- Laud B.B., *Electromagnetics*, New Age International Pvt., Ltd., New Delhi, 2005.
- Chopra and Agarwal, *Electromagnetic Theory*, Kadernath and Ramnath & Co. Meerut, 2005.
- Sathya Prakash, *Electromagnetic Theory and Electrodynamics*, Kadernath Ramnath & Co., Meerut, 2007.

Reference Books

- Jackson J.D., *Classical Electrodynamics*, Wiley Eastern, 1998.
- Balmain K.G., *Electromagnetic Waves and Radiating System*, Prentice Hall of India, 1995.

- Edward C. Jordan, Keith G. Balmain, *Electromagnetic waves and Radiating system*, Second Edition, Prentice Hall of India, New Delhi, 2001.

PPHM106/PPHM203 MOLECULAR SPECTROSCOPY

Semester : I **Credit : 4**
Category : Core V **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives
To enable the students

- Acquire the knowledge of interaction electromagnetic radiation with atoms and molecules and study the different types of spectra
- Know the spectroscopic techniques to use in finding the molecular structure, bond angles, bond length etc.
- Explain use of spectroscopic methods for qualitative and quantitative analysis.

UNIT – I MICROWAVE SPECTROSCOPY 13 Hrs

Rotation of molecules-Rotational spectra-Rigid and non-rigid diatomic rotator-Intensity of spectral lines-Isotopic substitution-Poly atomic molecules (Linear and symmetric top)-Hyperfine structure and quadrupole effects-Inversion spectrum of ammonia-Chemical analysis by microwave spectroscopy-Techniques and instrumentation.

UNIT – II VIBRATIONAL SPECTROSCOPY 14 Hrs

Infrared spectroscopy-Vibration of molecules-Diatomic vibrating rotator-vibrational rotational spectrum-Interactions of rotations and vibrations-Influence of rotation on the vibrational spectrum of linear and symmetric top and poly atomic molecules-Analysis by infrared techniques-Instrumentation-FTIR spectroscopy -Raman spectroscopy: Classical and quantum mechanical picture of Raman effect-Pure rotational Raman spectrum -Raman activity of vibrations of CO_2 and H_2O Rule of mutual exclusion- Vibrations of spherical top molecule-structural determination from IR and Raman spectroscopy techniques and instrumentation-FT Raman Spectroscopy

UNIT – III ELECTRONIC SPECTROSCOPY 12 Hrs

Electronic spectra-Frank-Condon principle-Dissociation energy and dissociation products-Fortrat diagram- predissociation-shapes of some molecular orbits- Chemical analysis by electronic spectroscopy-Techniques and instrumentation-Mass spectroscopy-ESR spectroscopy-Introduction-techniques and instrumentation-Double resonance

UNIT – IV NUCLEAR RESONANCE SPECTROSCOPY 13 Hrs

Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field-population of energy levels- Larmor precession-Relaxation times-Chemical shift and its measurement-Coupling constant-coupling between several nuclei-quadrupole effects-C^{13} NMR spectroscopy-Mossbauer spectroscopy: Principle-instrumentation-Effect of electric and magnetic fields.

UNIT - V SURFACE SPECTROSCOPY **13 Hrs**

Electron energy loss spectroscopy (EELS)-Reflection absorption spectroscopy (RAIRS)-Photoelectron spectroscopy (PES)- XPES, UPES-Auger electron spectroscopy (AES) X-ray Fluorescence spectroscopy (XRF)-SIMS.

Text Book

- Colin N. Banwell and Elaine M. *Fundamentals of Molecular Spectroscopy* (5th Edition Tata McGraw-Hill Publishing Company limited), 2013.

Reference Book

- Jack D.Graybeal, *Molecular Spectroscopy*, Mc Graw Hill Education, 2014

PPHM205/PPHM401 MATHEMATICAL PHYSICS-II

Semester : II **Credit : 4**
Category : Core VI **Hours/Weeks : 5**
Class & Major : II M.Sc., Physics **Total Hours : 65**

Objectives

To enable the students

- Understand the various mathematical representations
- Acquire knowledge about the tensor analysis
- Formulate the Greens function and probability

UNIT- I PROBABILITY **13Hrs**

Probability - Addition rule of Probability - Multiplication Law of Probability - Probability Distributions - Binomial distribution - mean Binomial distribution - Standard deviation of binomial distribution - Poisson distribution - Normal distribution - characteristics of normal distribution - Applications of normal distribution.

UNIT- II APPLICATION IN MATRICES AND DETERMINANTS **13Hrs**

Properties of matrix addition and multiplication – different type of matrices and their properties – Rank of a Matrix and some of its theorems – Solution to linear homogeneous and non-homogeneous equations – Cramer's rule – eigenvalues and eigenvectors of matrices – differentiation and integration of matrix.

UNIT - III ROLE OF GROUP THEORY IN PHYSICS **13Hrs**

Definition of Group – Subgroup invariant group abelian group orthogonal and unitary groups - Homomorphism, isomorphism - Reducible and irreducible representations -generators of Continuous groups.

UNIT – IV TENSOR ANALYSIS **13Hrs**

Definition of Tensor – coordinate transformation - Summation convention - Contravariant, covariant and mixed tensors – rank of tensor – addition and subtraction of Tensors –Symmetry and antisymmetry Tensor – Contraction of tensor – product rule and Quotient rule-invariant tensors – Kronecker delta and Levi-Civita Symbol - irreducible tensors.

UNIT –V GREEN'S FUNCTIONS **13Hrs**

Green's function - One dimensional Green function – boundary conditions – Eigen function - expansion of the Green's function- Reciprocity theorem – Sturm Liouville type equations in one dimension and their Green's functions.

Text Books

- Arfken & Weber, *Mathematical Methods for Physicists* - Elsevier 7th edition, US, 2012.
- Joglekar S.D., *Mathematical Physics* - Universities Press Pvt. Ltd. 1st edition, Hydrabad, 2005.
- Satya Prakash, *Mathematical Physics*, Sultan Chand & Sons, 6th Revised Edition, New Delhi, 2014.

Reference Books

- Dass H.K. and Verma R., *Mathematical Physics*, S. Chand & Company, 4th edition, 2011.
- Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley Eastern, 10th edition, 2010.
- Gupta B.D., *Mathematical Physics*, Vikas Publishing House Pvt.Ltd, 3rd edition, 2006.
- A.W.Joshi , *Elements of Group Theory of Physicists*, Wiley Eastern Ltd, 2010.

PPHM201 QUANTUM MECHANICS I

Semester : II **Credit : 5**
Category : Core VII **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives

To enable the students

- Understand basic idea of Dirac formalism to Quantum Mechanics.
- Apply the same formalism to study the angular momentum concept, scattering of fundamental particles and necessary relativistic modification in particle behavior.
- Understanding of similarities between classical and quantum mechanics.

UNIT – I SCHRÖDINGER EQUATION AND GENERAL FORMULATION 14 Hrs

Schrödinger Equation – Physical meaning and conditions on the wave function – Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutator relations - Uncertainty relation - Bra and ket vectors - Hilbert space – Schrödinger, Heisenberg and interaction pictures. Linear Vector Space- Linear Operator- Eigen Functions and Eigen values- Postulates of Quantum Mechanics- Simultaneous Measurability of Observables - Dirac's Notation- Equations of Motion; Schrodinger, Heisenberg and Dirac representation- momentum representation.

UNIT – II QUANTUM MECHANICS IN THREE DIMENSION 12 Hrs

Schrodinger equation in spherical co-ordination- Separation of variable-Angular equation- Hydrogen Atom- Radial Wave equation- Spectrum of Hydrogen.

UNIT - III ANGULAR MOMENTUM 13 Hrs

The angular momentum operator – eigenvalues and eigen functions of L_2 – The commutation relations – angular momentum and rotations – ladder operators – the constants C+ and C- angular momentum matrices corresponding to j = ½ and j = ½ - Pauli spin matrices –

Pauli wave function and Pauli equation – addition of angular momenta – Clebsh – Gordan Coefficients – concept of isospin.

UNIT – IV APPROXIMATION METHODS 13 Hrs

Time independent perturbation theory: Non-degenerate and degenerate perturbation theories -Stark effect – WKB Approximation- Application to tunneling problem and quantization rules. Time dependent perturbation theory: Harmonic Perturbation - Transition probability.

UNIT – V RELATIVISTIC WAVE EQUATIONS 13 Hrs

The Klein – Gordan equation – the Dirac Equation – Dirac's a and b matrices – the continuity equation – the free particle solutions– the hole theory – spin of the Dirac electron – magnetic dipole moment of the electron – the velocity operator – expectation value of the velocity – relativistic invariance of Dirac equation.

Text Books

- Griffths, *Quantum Mechanics,* 2nd edition, Dorling Kindersley India (Pvt), New Delhi, 2005.
- Ghatak and Lokanathan S., *Quantum Mechanics,* Macmillam India Ltd., New Delhi, 2005.
- Devanathan V., *Quantum Mechanics,* Narosa Publishing House, New Delhi, 2006.

Reference Book

- Ajoy Ghatak, Lokanathan S., *Quantum Mechanics,* 5th Edition, Macmillan Publishers India Ltd, 2013.

PPHM202 STATISTICAL MECHANICS

Semester : II **Credit : 4**
Category : Core VIII **Hours/Weeks : 5**
Class & Major : I M.Sc., Physics **Total Hours : 65**

Objectives

To enable to the students

- Review the fundamental concepts of thermodynamics in order to understand Statistical Mechanics.
- Understand the principles of classical statistical mechanic and its application to compute the various parameters of molecules.
- Apply techniques from statistical mechanics to a range of situations

UNIT – I INTRODUCTION 13 Hrs

Phase Space-Ensemble-Ensemble average-Liouville Theorem-Equation of motion-Equal-a priori-probability-Statistical equilibrium-Micro canonical ensemble-Entropy of an ideal Boltzmann gas using micro canonical ensemble-Gibb's paradox- MB, BE and FD statistics-various distributions using micro canonical ensemble.

UNIT - II CANONICAL AND GRAND CANONICAL ENSEMBLES 13 Hrs

Entropy of a system in contact with a heat reservoir-Ideal gas in canonical ensemble-Maxwell velocity distribution-Equipartition of energy-photons. Grand canonical ensemble-Ideal gas in grand canonical ensemble-Canonical partition function-Harmonic oscillator in canonical ensemble and grand canonical ensemble.

UNIT – III BOSE-EINSTEIN STATISTICS 13 Hrs

Bose-Einstein distribution-Bose-Einstein condensation- Thermodynamic properties of an ideal BE gas-Liquid Helium-Landau spectrum of Phonons and Rotons- Helium 4 and Helium 3 mixtures-Superfluid phases of Helium 3.

UNIT – IV FERMI-DIRAC STATISTICS 13 Hrs

Fermi-Dirac distribution-degeneracy-Thermionic emission-White dwarfs-Nuclear matter-Quantum Hall effect-Specific heat of an electron gas-One-dimensional metal- Effect of Periodic structures.

UNIT - V FLUCTUATIONS 13 Hrs

Introduction-mean square deviation-Fluctuations in ensembles-Concentration fluctuations in quantum statistics-One dimensional random walk-Brownian motion-Fourier analysis of a random function-Electrical noise.

Text Books

- Agarwal .B.K. and Melvin Eisner, *Statistical Mechanics*, New Age International Limited, 2nd edition, 2003.
- Bhattacharjee, *Statistical Mechanics*, Allied Publishers Limited,1996.
- Pathria R. K. and Paul D. Beale, *Statistical Mechanics*, Butterworth-Heinemann print 3rd Edition, New Delhi, 2011 .

Reference Books

- Donald A. McQuarrie, *Statistical Mechanics*, Viva Books Private Limited, 2003.
- Silvio. R.A Salinas, *Introduction to Statistical Physics*, Springer, 2004.

PPHM207/PPHM302 SOLID STATE PHYSICS -I

Semester : II **Credit : 3**
Category : Core IX **Hours/Week : 5**
Class and Major: I M.Sc., Physics **Total Hours : 65**

Objectives
To enable the students

- Understanding of the structural aspects and physical properties of condensed matter.
- Evaluate about nature of the materials.
- Describe basic experimental measurements, to show typical data sets and to compare these with theory.

UNIT- I CRYSTAL STRUCTURE 13Hrs

Crystal classes and symmetry – 2D, 3D lattices - Ewald's sphere construction – Bragg's law – Systematic absences – Atomic scattering factor – Diffraction – Structure factor –

Experimental techniques – Laue, Powder, Rotation methods – Phase problem – Electron density distribution (elementary ideas only).

UNIT -II LATTICE VIBRATION AND THERMAL PROPERTIES 13Hrs

Dynamics of a chain of identical atoms - dynamics of a diatomic linear chain

anharmonicity and thermal expansion-thermal conductivity-phonon-phonon interaction-normal and Umklapp processes heat capacity-density of phonon states-Dulong Pities' law – Einstein specific heat- Debye's model of specific heat.

UNIT - III ELECTRON THEORY OF METALS 13Hrs

Electron moving in a one - dimensional well - density of states in three dimension - Fermi-Dirac statistics - effect of temperature on Fermi distribution function - electronic heat capacity-electrical resistivity - Ohm's law-Widemann - Franz law-Hall effect.

UNIT- IV FREE ELECTRON THEORY 13Hrs

Bloch's theorem-Kronig - Penney model-construction of Brillouin zones-extended, reduced and periodic zone schemes - effective mass of an electron-nearly free electron model-conductors, semiconductors and insulator.

UNIT- V FERMI SURFACE 13Hrs

Fermi surface and Brilloiun zones - Harrison's method of constructing Fermi surface in 2Delectron, hole and open orbits - characteristics of Fermi surface - effects of electric field on the Fermi surface - effect of magnetic field on the Fermi surface - quantization of electron orbits-experimental study of Fermi surface.

Text Books

- Wahab, M.A. *Solid state physics, Structure and properties of materials,* 2nd edition Narosa Publishing House, 2005.
- Micea S Rogalski and Stuart B.Palmer *Solid State Physics* Gordon and Breach Science Publishing, 2001.
- Puri R.K. and V.KBabbar, *Solid State Physics*,3rd edition, S.Chand and Company Ltd, 2005.
- Palanisamy P.K., *Solid State Physics,* Scitech publications (India). Ltd, 2003.

Reference Books

- Charles Kittel, *Introduction to Solid State Physics*, Wiley Eastern Limited,7th edition, 2008.
- Ajay Kumar Saxena, *Solid State Physics,* MacMillan Publishers, 2006.

PRACTICALS
PPHR202 GENERAL PRACTICAL - I

Semester : I & II **Credit : 3+3**
Category : Core practical-I **Hours/Week : 5+5**
Class & Major : I M.Sc., Physics

Objectives
To enable the students

- Understand the theory of the application of subject knowledge in practical
- Understand the techniques of handling equipments
- Make error free measurements and error analysis

A. GENERAL EXPERIMENTS

1. Determination of q, n, b by elliptical fringes method
2. Determination of q, n, b by hyperbolic fringes method
3. Determination of Planck's constant
4. Determination of Stefan's constant
5. Determination of wavelength and thickness of a film by using Michelson Interferometer
6. Identification of prominent lines by spectrum photography – Copper spectrum
7. Identification of prominent lines by spectrum photography – Iron spectrum
8. Determination of Hall effect.
9. Dielectric constant of material to study the susceptibility of material
10. Hydrogen spectrum-Rydberg constant

Optional

1. Determination of e/m of an electron by Thomson's method
2. Determination of wavelength of monochromatic source using biprism.
3. Determination of refractive index of liquids using biprism (by scale & telescope method).
4. Determination of Laser beam parameter
5. Air method- Co-efficient of linear expansion

B. ELECTRONICS EXPERIMENTS

1. Design and study of monostable multivibrator and Schmitt trigger.
2. Design and study of Wein bridge Oscillator (Op-amp).
3. Design and study of phase shift Oscillator (Op-amp).
4. IC 555 timer – Schmitt trigger.
5. IC 555 Timer Astable multivibrator.
6. Operational amplifier wave generator.
7. OP-Amps phase shift oscillator.
8. Digital to Analog converter.
9. Solving simultaneous equation using IC 741.
10. Op-Amp Design of active filter.

Optional

1. Common source amplifier using FET.
2. Construction of an Instrumentation amplifier.
3. BCD to seven segment display using 7447.

4. AC to DC converter using Power Supply.
5. Half wave and Full-wave rectifier.

Text Book

- Srinivasan.M.N., Balasubramanian.S., Ranaganathan.R., *The Text Book of Practical Physics*, Sultan Chand and Sons, New Delhi,2006.

Reference Book

- Gupta S.L. and Kumar V, *Practical Physics*, Pragathi Prakashan.25th edition,2002.

Evaluation: III and IV components of CIA-PG

Semester	Category	Course Code	Course Title	Component-III	Component-IV
I	Core I	PPHM101	Mathematical Physics- I	Seminar - Power Point Presentation	Problem solving
	Core II	PPHM102	Classical Mechanics	Poster Presentation	Assignment
	Core III	PPHM105	Electronics	Poster Presentation	Simple experiments(Model display)
	Core IV	PPHM104	Electromagnetic Theory	Assignment	Poster presentation
	Core V	PPHM106/ PPHM203	Molecular Spectroscopy	Poster Presentation	Model display
II	Core VI	PPHM205/ PPHM401	Mathematical Physics II	Problem solving	Assignment
	Core VII	PPHM201	Quantum Mechanics I	Assignment	PPT
	Core VIII	PPHM202	Statistical Mechanics	Seminar	Statistical Analyses (Noise Pollution)
	Core Elective - I	PPHM207/ PPHM302	Solid State Physics I	Assignment	Seminar

Semester	Category	Course Code	Course Title	Credit	
				Min	Max
II	PG Service learning	PHYX201	Energy Audit	-	1

PHYX201- ENERGY AUDIT

Semester : II **Credit : 1**
Category : PG Service Learning **Total Hours : 40 hrs**
Class & Major: M. Sc Physics

Objectives
To enable the students

- Understand about the Energy audit and its measurements.
- Acquire the knowledge about the practical auditing methodology.
- Interpret the power optimization.

INTRODUCTION TO ELECTRICAL POWER AND ELECTRICITY

Electrical parameters - definitions - resistive, inductive, capacitive loads - active power - reactive power - apparent power - power factor - linear and non-linear loads – electricity demand (kVA/kW) calculation - electricity tariff.

ELECTRICAL DISTRIBUTION SYSTEM

HT supply – control - distribution transformer - power control centre (PCC) - captive generator - power cables - motors - LT power capacitors - lighting – UPS - servo stabilizer - electrical measuring instruments - importance of measurements - types of meters - instantaneous measuring meter

Activity

Purpose: To gain the basic knowledge and understanding about audit the energy for electrical consumption.

1. To study and analyze the power utilization for the given building area/room.
2. To measure and calculate the voltage/current of an available electrical system (Lights and Fans) and equipments.
3. To analyze the power utilization and make the strategy for power consumption in the electrical items.
4. To submit the detailed report with the conclusion made during the audit.

References

- Muthuvelan M and Balasubramanian H, *A practical guide to reactive power management in industry*, 2012, SITRA publication, Coimbatore-641014, email:info@sitra.org.in, www.sitra.org.in
- Wayne C Turner, *Energy Management Handbook*, The Fairmount Press, Inc., 1997.
- IEEE Recommended practice for energy management in industrial and commercial facilities, IEEE STD 739-1995 (Bronze Book).
- TERI, *Handbook on energy audit & Management*, TERI Press, New Delhi.
- Francisco C.DE LA ROSA, *Harmonics and Power systems*, Indian edition, CRC press, 2010.
- Ramasamy Natarajan, *Power system capacitors*, Indian edition, CRC press, 2010.
- Ewald F.Fuchs, Mohammad A.S.Masoum, *Power quality in power systems and electrical machines*, Indian edition, Elsevier Inc, 2008.

COURSE PROFILE M.Phil., (Physics)

Semester	Category	Course code	Course Title	Hours per week	Credit	
					Min	Max
I	Core 1	MPHM101	Research Methodology	6	5	5
	Core II	MPHM102	Advanced Material Science	6	5	5
	Core III	MPHM103	Special area study	6	5	5
II	Core IV	MPHM201	Dissertation and viva voce	30	15	15
TOTAL				**48**	**30**	**30**
Paper presentation (minimum one) and / or publication of articles in journals (minimum one) is mandatory for submission of dissertation.						

MPHM101 RESEARCH METHODOLOGY

Semester : I **Credit : 5**
Category : Core I **Hours/ Week : 6**
Class & Major : M.Phil Physics **Total Hours :78**

Objectives

To enable the students

- Enhance the knowledge on research and its methodologies
- Expose the student with various mathematical methods for numerical analysis and use of computation tools
- Impart the knowledge on data and property analysis and programming concepts

UNIT – I Techniques for Research **15 Hrs**

Identification of the problem–determining mode of attack–literature survey– references – awareness of current status of the art - abstraction of a research paper – possible ways of getting abreast of current literature – Role of scholar and guide.

UNIT – II Techniques of Scientific Writing **15 Hrs**

Scientific Writing - definition – organizing a scientific paper – Title – listing of authors and address – abstract – introduction – materials and methods section – results section – discussion section – acknowledgement – references – design of effective tables – effective illustrations – manuscript – submission – review process – publishing process – reprints – review paper – conference report – oral and poster presentation – thesis — usage of English.

UNIT- III Numerical Methods **16 Hrs**

System of linear equations – Gauss-Jordan elimination method – iterative method – Newton – Raphson method – Numerical integration – Simpson's 1/3 rule – Simpson's 1/8 rule – Gauss – Legendre quadrature – Solution of differential equations – Runge-Kutta Method – Eigen values and Eigen vectors – Power method — Jacobi's method.

UNIT- IV Programming in C **16 Hrs**

Basic structure of C programming – Character set – constants – keywords and identifiers – variables – data declaration of variables – assigning values to variables – defining symbolic constants. Operators (Arithmetic, relational, logical, assignment, increment, decrement, conditional and special) type conversion in expressions.

UNIT- VAdvanced Analytical techniques **16 Hrs**

Analytical Technique – principles of single crystal and powder X-ray diffraction , FT-IR, Raman and UV-visible spectrometers – SEM, TEM, EDAX, AFM, EPMA – Instrumentation – Sample preparation – Analysis of materials – study of dislocation – ion implantation uses.

Text Books

- Singh, Y.K., *Fundamentals of Research Methods and Statistics*. New Age International (P) Ltd, New Delhi, 2007.
- Kothari, C.R. and Gourav G, *Research Methodology*, Third Edition, New Age International Publication, New Delhi, 2014.
- Peter Deuflhard Andreas Hohmann, *Numerical Analysis in Modern Scientific Computing*: An Introduction, Springer New York, 2003.
- Balagurusamy, E, *Programming in ANSI C*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

Reference Books

- Kothari C.R., *Research methodology: Methods and Techniques*, New age International, New Delhi, 2006.

- Jain, N.K., Iyengar, S.R.K., and Jain, R.K. *Numerical methods for scientific and Engineering Computation* – New Age International Publisher, New Delhi, 2004.
- Mahinder K J, *Numerical Methods: For Scientific and Engineering Computation*, New Age International Publication, New Delhi, 2012.
- Willard, Merritt, Dean and Settle, *Instrumental Methods of Analysis*, CBS Publishers, New Delhi, 2012.

MPHM102 ADVANCED MATERIALS SCIENCE

Semester : I **Credit : 5**
Category : Core II **Hours/ Week : 6**
Class & Major : M.Phil Physics **Total Hours : 78**

Objectives
To enable the students

- Apply the knowledge of different techniques about crystal growth and nanotechnology
- Understand the nonlinear optics, electrical and thermal analysis properties
- Import the knowledge on solar cell concepts and its applications

UNIT – I Crystal Growth 16 Hrs

Introduction to various crystal growth techniques – Classification of growth processes, kinetics of growth – nucleation, diffusion and surface migration, dislocation, theory of interface stability, Bulk crystal growth methods; Kyropolous, Bridgeman – Stockbargar, CZ, Growth of III –V and II – VI compounds; high pressure techniques, chemical vapour deposition: molecular beam epitaxy, liquid and vapour phase epitaxy, MOCVD.

UNIT – II Nanotechnology 16 Hrs

Introduction to Nanotechnology – The Nanoscale – Consequences of the Nanoscale for technology and society. Beyond Moore's law –Visualisation, manipulation and characterization at the Nanoscale Proximal probe technologies. Nanomanipulation – Nanolithography – Nanocomposites – Quantum wells, Wires, Dots and nanoparticles – Applications.

UNIT – III Electrical and thermal Analysis 16 Hrs

Principles and experimental techniques – Vanderpauw method, Hall Effect measurement, Thermoelectric power measurement, Magnetoresistance measurement, Photoconductivity measurement – Applications. Differential scanning calorimetry and Differential analysis – Thermogravimetry – Differential thermal analysis – Thermo mechanical analysis.

UNIT – IV Energy storage and solar applications 14 Hrs

Types of energy storage Thermal storage Latent heat storage – Electrical storage Principle of operation of solar ponds –Solar cells for direct conversion of solar energy to electric powers – Solar cell parameter – Solar cell electrical characteristics – Efficiency – Applications of solar energy: Solar water heating – space heating and space cooling – solar photo voltaics – agricultural and industrial process heat.

UNIT – V Nonlinear Optics **16 Hrs**

Introduction to Non-linear optics – Propagation of electromagnetic waves in nonlinear optical media. Second harmonic generation, phase matching techniques, efficiency, Quantum mechanical description of Raman Scattering. Electromagnetic theory of Stimulated Raman Scattering, Optical Kerr effect – Acousto optic materials and acousto optic modulators.

Text books

- Peter E. Powers, Joseph W. Haus, *Fundamentals of Nonlinear Optics*, Taylor and Francis Group, Boca Raton, 2017.
- Tiwari G. N, Solar Energy: *Fundamentals, Design, Modeling and Application* (Revised Edition), Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
- Ohring M, *Materials Science of Thin Films*, Academic Press, Boston, 2001.
- Paul G, *Principles and Applications of Thermal analysis*, Blackwell Publishing Ltd, UK, 2008.

References books

- Mullin, J.M., *Crystallisation*, 4th Edition, Butterworth Heinemann, Oxford, UK, 2001.
- Laud, B. B., *Lasers and Non-Linear Optics*, New Age International Private Ltd, New Delhi, 2011.
- Sauter, E. G. *Nonlinear Optics* (Wiley Series in Microwave and Optical Engineering), Wiley-Interscience, New York, 2008.
- Rai G.D., *Solar Energy Utilization*, Khanna Publications, New Delhi, 2004.

III and IV Evaluation components of CIA - M.Phil

Semester	Category	Course Code	Course Title	Component-III	Component-IV
I	Core I	MPHM101	Research Methodology	Seminar	Term paper
	Core II	MPHM102	Advanced Material Science	Seminar	Term paper