DEPARTMENT OF PHYSICS

PREAMBLE

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

PG: Course profile and syllabi of courses offered in III and IV semesters along with evaluation components III & IV (With effect from 2018-2020 batch onwards) are presented in this booklet.

PROGRAMME 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**
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
		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**
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 XI	UPHP501/UPHP502	Project / Instrumentation Techniques	2	-	-
	IV	Soft Skill			2	1	1
	V	Extension Programme/ Physical Education/NCC			-	-	2
				TOTAL	**30**	**22**	**26**
V	III	Core VIII	UPHM501	Quantum Mechanics and Relativity	6	5	5
	III	Core IX	UPHM505	Basic Electronics	6	5	5
	III	Core X	UPHM506/UPHM608	Solid State Physics	6	5	5
	III	Core Practical-V	UPHR502	Major Practical V	3	3	3
	III	Core XI	UPHP501/UPHP502	Project / Instrumentation Techniques	**4**	**4**	**5**

	III	Online Course		NPTEL/Spoken Tutorial	3	1	2
	IV	Value Education			2	1	1
				TOTAL	**30**	**24**	**26**
VI	III	Core XII	UPHM609	Numerical methods and Basic Computational Physics	5	5	5
	III	Core XIII	UPHM611	Nuclear and Radiation Physics	5	5	5
	III	Core XIV	UPHM612	Material Science	5	5	5
	III	Core XV	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/NCC			-	-	2
				TOTAL	**30**	**28**	**30**
				GRAND TOTAL	**180**	**140**	**155**

UPHM303/UPHM402 ELECTRICITY & MAGNETISM

Semester: III **Credit : 5**
Category: Core IV **Hours/week : 6**
Class &Major: II B.Sc. Physics **Total Hours : 78**

Objectives
To enable the students

- Understand basic laws & definition of Electricity and Magnetism.
- Analyze inter-relationship between Electricity and Magnetism.
- Apply the basic ideas to various concepts of Electricity and Magnetism.

UNIT-I: Electrostatics **15 Hrs**

Electrostatic potential- Electric potential as line integral of electric field - Relation between electric potential and electric field in vector form - Poisson's and Laplace's equations –Capacitance - Spherical and cylindrical capacitor- Energy of a charged capacitor - Energy density - Loss of energy due to sharing of charges. Electrometers - Kelvin's attracted disc electrometer.

UNIT-II: Current Electricity And Thermo Electricity **16 Hrs**

Carey Foster bridge - Theory - Determination of temperature coefficient of resistance. Calibration of ammeter and voltmeter using a potentiometer - Seebeck, Peltier and Thomson effects- Laws of thermoelectric circuits - Peltier coefficient- Thomson coefficient- Application of thermodynamics to a thermocouple and expressions for Peltier and Thomson coefficients - Thermoelectric diagrams and uses.

UNIT- III: Chemical Effects And Magnetic Effects Of Electric Current 15 Hrs

Electrical conductivity of an electrolyte - Faraday's laws of electrolysis - Determination of specific conductivity of an electrolyte (Kohlraush bridge) – Gibbs-Helmholtz equation for the emf of a reversible cell- Calculation of emf of a Daniel cell- Helmholtz Galvanometer - Theory of moving coil Ballistic Galvanometer- Damping correction- Absolute capacitance of a capacitor.

UNIT-IV: Electromagnetic Induction And Transient Currents 16 Hrs

Faraday's laws of electromagnetic induction in vector form- Determination of self-inductance by Anderson's bridge method and absolute mutual inductance by BG - Growth and decay of current in a circuit containing resistance and inductance. Growth and decay of charge in a circuit containing resistance and capacitor - Measurement of high resistance by leakage - Growth and decay of charge in a LCR circuit - Condition for the discharge to be oscillatory- Frequency of oscillation**.**AC generator two phase and three phase.

UNIT-V: Magnetic Properties of Materials and Maxwell's Equations 16 Hrs

Susceptibility – Permeability - Intensity of magnetization and their relationship - Properties of dia, para and ferro magnetic materials- Langevin's theory of diamagnetism and paramagnetism- Weiss theory of ferromagnetism - Antiferrimagnetism and ferrimagnetism.

Text Books

- R Murugeshan , *Electricity and magnetism*, 8th edition, S Chand & Co, New Delhi, 2006.
- M Narayanamurthy & N Nagarathnam, *Electricity & Magnetism,* 6th edition, National Publishing Co, Meerut, 2009.
- Brijlal N Subramanyan and Jivan Seshan, *Mechanics and Electrodynamics*, Eurasia Publishing House (Pvt.) Ltd, New Delhi, 2005.

Reference Books

- Sehgal D L, Chopra K L, Sehgal N K , *Electricity and magnetism,* Sultan Chand & Sons, New Delhi, 2007.
- David J Griffiths, *Introduction to Electrodynamics*, 3nd edition, Prentice Hall of India Pvt Ltd, New Delhi, 2007.

K K Tewari, *Electricity & Magnetism*, S Chand & Co, 4th edition, 2005.

UPHM304/UPHM509 - MATHEMATICAL PHYSICS

Semester : III **Credit : 3**
Category : Core V **Hours/Weeks : 4**
Class & Major: II B.Sc. Physics **Total Hours : 52**

Objectives

To enable the students

- Important mathematical knowledge for the description of physical phenomenon.
- Enhance basic skills of learning and appreciating Physics through Mathematics.

UNIT I APPLICATION OF VECTOR 16 Hrs

Vector Algebra - Divergence, Gradient and Curl and their physical significances - Simple Problems – Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem (statement and proof only). Particle motion in a potential field using gradient, Faraday law based on the Stokes theorem, Conservation of Electrical Charges using divergence.

UNIT II DIFFERENTIAL EQUATION AND APPLICATIONS 16Hrs

Linear Ordinary Differential Equations - First order – solution by Separable Equations. Initial Value Problem - Theorem for Initial value problems. Boundary Conditions - Applications of Differential Equations: General Solution of Wave Equation in one dimension, Newton law of Cooling, Rate of Decay of Radioactive materials.

UNIT III COMPLEX ANALYSIS 16Hrs

Brief Review of Complex Numbers and their Graphical Representation. De Moivre's theorem - Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions- Examples of analytic functions. Application of analytic function to Flow Problems.

UNIT IV FOURIER SERIES AND ITS APPLICATIONS 16 Hrs

Periodic functions. Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions. Simple applications of Fourier series: Half and full wave rectifiers.

.UNIT V BASIC MATHEMATICAL STATISTICS 14 Hrs

Importance of statistics, concepts of statistical population and a sample - quantitative and qualitative data - collection of primary and secondary data. Univariate Statistics – Mean, Median, Mode, Standard deviation, Dispersion, Skewness and Kurtosis – Frequency Distribution-Graphical representation of frequency distribution – Normal Distribution-Characteristics and Applications.

Text Books

- Sathyaprakash, *Mathematical Physics*,S-Chand Publishers, New Delhi, 2010
- R. Murugesan,*Mechanics and Mathematical Methods* –. S-Chand Publishers, New Delhi, 2010
- P.R. Vittal, *Allied Mathematics* –. Margham Publishers, Chennai -2010.
- Vitaly Bychkov, *Examples on use of vector analysis in physics* - www.umu.se/digitalAssets/141/141566_vector-analysis-in-physics-vbyv.pdf

Reference Books

- B.S. Grewal, *Higher Engineering Mathematics*, 43rd Edition, Khanna Publishers, New Delhi, 2014
- M. D. Greenberg, *Advanced Engineering Mathematics,* Pearson Education Publishers (Singapore), 2nd Edition, 2010
- Tail.Chow, *Mathematical Methods for Physicist: A concise Introduction*, Cambridge University Press, 2003.

UPHR303 MAJOR PRACTICAL III

Semester	**: III**	**Credit**	**: 3**
Category	**: Core Practical III**	**Hours/Week**	**: 3**
Class & Major: II B.Sc. Physics		**Total Hours**	**: 39**

Objectives

To enable the Students

- Apply the concepts of Electricity and Magnetism through direct experiment
- Analyze the experimental errors on various techniques of electricity and magnetism
- Operate these techniques to make error free measurements.

Lab Exercise

1. Calibration of Low range Voltmeter – Potentiometer
2. Calibration of High range Ammeter – Potentiometer
3. Field along axis of the coil – Vibration Magnetometer
4. Figure of a merit – Ballistic Galvanometer
5. Determination of m and B_H – TAN C position
6. Carey Foster's Bridge – Resistance and Specific resistance
7. Deflection Magnetometer Using TAN A
8. Deflection Magnetometer Using TAN B

Optional

1. Calibration of High range Voltmeter – Potentiometer
2. Calibration of Low range Ammeter – Potentiometer
3. Absolute Determination of Mutual inductance – B.G
4. Carey Foster's Bridge – Temperature Co-efficient
5. Absolute capacitance of a capacitor using Ballistic Galvanometer.
6. Comparison of mutual inductance – BG.
7. Self – inductance of a coil – Anderson's Method

Text Book

- N.Srinivasan, S.Balasubramaniam & R.Ranganathan, *The text book of practical Physics*, Sultan Chand & Sons, 2006.

Reference Books

- A.Ponnusamy & B. Amalanathan, *Practical Physics,* Bright Publishers, 2000.
- C.C.Ouseph,G.Rangarajan, A text book of Practical physics Viswanatha Publishers, 2000.
- C.S. Barrett & T. B. Massalski, *Structure of metals*, McGraw-Hill Book Company, 2012.

E – Books

- https://www.worldcat.org/title/electromagnetic-radiation/oclc/1083096643
- https://www.Structure-Analysis-Electron-Diffraction-Vainshtein-ebook/dp/B01DRXHOA0
- https://www.Electronic-Instrumentation-Measurement-Rohit-Khurana-ebook/dp/B01HI93MGY

UPHM406/UPHM302 OPTICS AND LASER PHYSICS

Semester: III **Credit : 4**
Category: Core VI **Hrs/Week : 4**
Class: II B.sc. physics **Total Hours : 52**

Objectives
To enable the students

- To understand the concepts of dispersion of light, interference, diffraction and polarization of light waves and their applications in day-to-day life
- To study the working principle of laser and to apply the knowledge to industry, engineering, medicine
- To study fibre optic communication and its applications in different fields

UNIT-I GEOMETRICAL OPTICS **10 Hrs**

Fermat's principle - dispersion of light - dispersive power - Cauchy's formula - deviation without dispersion - dispersion without deviation - cardinal points of an optical system and their relationships, thick lens and combinations- aberrations - spherical aberration - methods of minimizing spherical aberrations - chromatic aberrations in lens - condition for achromatism of two thin lenses in contact and without contact – eyepieces – Huygen's and Ramsden's eyepieces with comparison.s

UNIT-II INTERFERENCE **11 Hrs**

Introduction - condition for sustained interference of light - Young's experiment – theory of interference fringes - Fresnel's biprism - experimental determination of 'λ' of monochromatic light and thickness of sheet - colour of thin films – airwedge - experiment to measure the diameter of the wire - Newton's rings - determination of wavelength of sodium light by Newton's rings - determination of 'μ' of liquid –Michelson's interferometer - theory – applications.

UNIT-III DIFFRACTION **10 Hrs**

Introduction - Fresnel and Fraunhoffer diffraction - construction of half-period zones - zone plate - principle – theory - diffraction at a circular aperture - Fraunhoffer diffraction at a single slit - plane transmission diffraction grating - dispersive power of a grating - determination of wavelength of light using transmission grating (normal incidence).

UNIT-IV POLARISATION **11 Hrs**

Polarisation of light - Brewster's law - double refraction - Nicol prism - quarter wave plate - half wave plate - production and detection of plane, circularly and elliptically polarized light - optical activity -specific rotation - Laurent's half-shade polarimeter.

UNIT-V LASER,OPTICALFIBREANDHOLOGRAPHY **10 Hrs**

Laser: Introduction - characteristics of laser light- spontaneous and stimulated emission- population inversion-pumping - lasing action - Ruby laser - He-Ne laser –

applications. **Optical Fibre:** Introduction - modes of propagation of a light - acceptance angle - numerical aperture - types of optical fibres - optical sources and detectors - optical communication - optical fibre sensors - medical applications. **Holography**: Introduction - principle – important properties of hologram – recent advances - applications.

Text Books

- Optics and Spectroscopy, R. Murugeshan , Kiruthiga Sivaprasath, S. Chand & Company Ltd, New Delhi ,7th revised edition 2010(Unit I,II,III, IV)
- A Text Book of Optics , Brijlal ,N. Subramaniam, S. Chand & Company Ltd, New Delhi ,2008

Reference Books

- Halliday D. Resnick , Walker,*Fundamentals of Physics ,* J 6th Edition, NY , Wiley 2006
- Ajoy Ghatak , *Optics* , Tata Mc Graw ,Hill Publishing Company , New Delhi 1993
- S.L.Kakani , K.C. Bhandari, *A Text Book of Optics* S. Chand & Company Ltd, New Delhi ,2002
- B.B. Laud, *Lasers and Non-Linear Optics,*, New Age InternationalPublishers,2009
- A.K.Ghatak and K. Thyagarajan, *Lasers - Principles and Applications*, Tata- Mc-Graw Hill
- Subir Kumar Sarkar, *Optical Fibers and Fibre Optic Communication Systems,* S. Chand & Company Ltd, New Delhi,2004
- R. P. Feynman, R B Leighton and M Sands, *The Feynman Lectures on Physics,* Vols. I, II, and IIINarosa, New Delhi, 1998.

UPHM407 ATOMIC PHYSICS

Semester : IV **Credit : 4**
Category : Core VII **Hours/week : 4**
Class and major: II-B.Sc Physics **Total Hours : 52**

Objectives
To enable the students

- Understand the fundamental properties of atom and atomic models.
- Solve the problems related to physics of materials on the atomic and molecular scales.
- Compare the spectrum of different atoms and their transitions.

UNIT -I BASIC PROPERTIES OF ATOMS 11 Hrs

Positive rays – Discovery – Properties – Positive ray analysis - Thompson parabola method – Determination of e/m - Determination of mass – Discovery of stable isotopes – Limitations –Dempster's mass spectrograph - Aston's mass spectrograph – Mass defect and packing fraction. Critical potentials - Methods of excitations of atoms – Experimental determination of critical potentials - Frank and Hertz's experiment- Davis and Goucher's method

UNIT-II THE PHOTOELECTRIC EFFECT **10 Hrs**

Photoelectric emission – Laws - Lenard's experiment - Richardson and Compton experiment-Einstein's photoelectric equation - Experimental verification by Millikan's experiment - photo electric cell.

UNIT-III ATOMIC MODELS **11 Hrs**

The Bohr atom Sommerfelds relativistic model – Vector atom model – Quantum numbers associated with vector atom model - Coupling schemes (LS, JJ coupling) Pauli's exclusionprinciple – Periodic classification of elements. Magnetic dipole moment due to orbital motion of electron - Magnetic dipole moment due to spin- Stern and Gerlach experiment.

UNIT-IV ATOMIC STRUCTURE **10 Hrs**

Optical spectra - Spectral terms and their notations - Fine structure of sodium D-lines –Alkali spectra-Spectrum of Helium- Zeeman effect-Experiment - Expression for the Zeeman shift -Larmor's theorem - Quantum mechanical explanation for the normal Zeeman effect - Anomalous Zeeman effect - Paschen Back effect - Stark effect.

UNIT-V ATOMS AND ELECTROMAGNETIC RADIATION **10 Hrs**

X- Rays – Production and detection of X-rays - Continuous and characteristic X-ray spectra - Moseley's law- Absorption of X- rays by matter – Bragg's law – The Bragg X-ray spectrometer - Compton effect – Change of wavelength – Experimental determination - Industrial and Medical application of X-rays.

Text Books

- R. Murugesan, *Modern physics* S.Chand & Co, 2008.
- J.B.Rajam*, Atomic Physics*, S. Chand & Co, 1986.
- Arthur Beiser*, Concept of Modern Physics*, Tata McGraw-Hill edition, 2006.

References Books

- N.Subramaniam and Brij Lal, *Atomic and Nuclear physics*, S.Chand, 2003.
- Gupta. A. B. and Dipak , *Atomic Physics*, Ghosh-Books & Allied publisher.
- Sehgal and Chopra, *Modern physics*, McGraw Hill Publication, 1996.

UPHR405 MAJOR PRACTICAL IV

Semester : IV **Credit : 3**
Category : Core practical-IV **Hours/Week : 3**
Class &major: II B.Sc. Physics **Total hours : 39**

Objectives

To enable the students

- Gain the practical knowledge of optics
- Understand the concepts of optical devices and principles.

Lab Exercise

1. Focal length of lens –uv method, auxiliary method,μ of a lens.
2. Air wedge – thickness of a wire.
3. Newton's ring – radius of curvature of convex lens.
4. Spectrometer –angle and 'μ' of a prism.

5. Spectrometer- Dispersive power of a prism.
6. Spectrometer-grating –λ of mercury light-normal incidence.
7. Spectrometer-Cauchy's constant.
8. Spectrometer – i-d curve.

Optional

1. Spectrometer- i-i' curve.
2. Spectrometer-grating –'λ' of LASER light(gas)
3. Spectrometer – grating -'λ' of LASER light (solid state)
4. Planck's constant- using LASER Light.
5. Laser Light –Numerical aperture (NA) of optical fiber.
6. Spectrometer-Auto collimated lens using LASER Light.

Text Books

- Srinivasan M. N.,Balasubramanian S., Ranganathan R., *The Text book of practical physics,*Sultan chand &sons, new delhi,2006
- Ouseph C.C.,Rangarajan G., *A text book of practical physics* Part-I,S.Viswanathan publisher,1990.

Reference Books

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

UPHP501 PROJECT

Semester : IV&V **Credit : 4**
Category : Core XI **Hours/Weeks: 2 + 4**
Class &Major: II & III B.Sc Physics **Total Hours : 78**

Guidelines

- This course is offered as group project
- No. of students is limited from 5 to 6

Project Evaluation

S.No.	Criteria		Evaluation	
			CIA (Valuation by Faculty Guide)	ESE (Average of Internal &External marks)
1	Choice of the problem & Defining the problem		10	-
2	Review of literature		10	-
3	Research proposal		10	-
4	Collection of Data / Experimentation		10	-
5	Analysis of Data / Experimentation result		10	-
6	Preparation of report	I Draft II Draft III Draft Final Draft	10	-
7	Project report		-	30
8	Viva voce		-	10
Total			**60**	**40**

UPHP502 INSTRUMENTATION TECHNIQUES

Semester : IV&V **Credit : 4**
Category : Core XI **Hours/Weeks : 6**
Class &Major : II & III B.Sc. Physics **Total Hours : 78**

Objectives
To enable the students

- Understand the concepts of electromagnetic radiation.
- Apply the knowledge in different techniques.

UNIT- I ELECTROMAGNETIC RADIATION 16 Hrs

Electromagnetic radiation–Different regions, their wavelengths, frequencies and energies–interaction of EM radiations with matter – atomic, molecular, electronic interaction–Basic principles of spectroscopy –emission and absorption of radiations–radiation sources – dispersing and resolving techniques – detectors – typical atomic emission and absorption spectrographs in the UV and visible region.

UNIT- II MOLECULAR SPECTRA 14 Hrs

IR absorption – spectroscopy –RAMAN spectroscopy – Instrumentation techniques for analyzing solid, liquid and gaseous samples – sample handling techniques.

UNIT- III DIFFRACTION TECHNIQUES 16 Hrs

Microstructure characterization Diffraction techniques: interpretation of single crystal and powder crystal X-RAY diffraction patterns, Identification & quantitative estimation of unknown samples by X-ray powder diffraction technique and fluorescent analysis – Theory and method of particle size analysis.

UNIT-IV ELECTRON MICROSCOPY TECHNIQUES AND ELCTRONIC INSTRUMENTS 16 Hrs

Electron Microscopy techniques related to nanomaterials SEM, TEM& AFM (instrumentation and working only).

Digital voltmeters and multimeters–electronic counters–AC millivoltmeter–wave analyzers and spectrum analyzers–frequency synthesizers –lock in amplifier–frequency response analyzer phase meter.

UNIT- V ELECTRONIC RECORDERS AND DISPLAYS 16 Hrs

Standard lab Equipments–signal generator–pulse generator–CRO–VTVM–wave analysis recorders–analog recorders–XY – recorders–stripe chart recorder–oscilloscope recorder–digital recorder– digital readout CRO.

Text Books

- H.H. Willard, L.L.Jr. Merritt, J.A. Dean, F.A.Jr. Settle*, Instrumental methods of analysis,* 7th edition, Wadsworth Publishing Company, *1989.*

- G. Aruldas, *Molecular structure and spectroscopy*, Print *book*. English. 2nd ed. New Delhi, 2007.
- B. E. Warren, *X-ray diffraction*, Addison-Wesley Publishing Co.2012.
- R. W. James, *The optical principles of the diffraction of X-rays*, G. Bell & Sons Ltd. 2005.
- D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 2001.

Reference Books

- D.A. Skoog and D.M. West, *Principles of instrumental analysis*, 2nd edition, Holt-Saunders, 2000.
- Sir A. Cottrell, *An introduction to metallurgy*, University Press, 2000.
- J.H. Brophy, R. M. Rose and J. Wulff, *The structure & properties of materials* (Volume II), Wiley Eastern Ltd.2007.

III and IV Evaluation components of CIA

Semester	Category	Course Code	Course Title	Component-III	Component-IV
III	Core IV	UPHM303/UPHM402	Electricity and Magnetism	Working model (Generation of electricity)	Usage of magnetic materials in day today life (Poster presentation)
	Core V	UPHM304/UPHM509	Mathematical Physics	Problem solving	Seminar
IV	Core VI	UPHM406/UPHM302	Optics and Laser Physics	Simple optics experiment-Model display	Seminar-Recent trends in laser
	Core VII	UPHM407	Atomic physics	Non working model(atomic structure)	PPT(various spectroscopic techniques)
	Core XI	UPHP502	Instrumentation techniques	Seminar	Working Model

PROGRAMME PROFILE: M.Sc. Physics

PSO 1: 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.

PSO 2: Learning of laboratory skills, enabling measurements in a physics and electronics laboratory and analysis of the measurements to draw valid conclusions.

PSO 3: Operation of the different electronic and physical devices such as microprocessor, microcontroller, laser, linear and nonlinear optical instruments in atomic scale.

PSO 4: 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 IX	PPHM207/ PPHM302	Solid State Physics I	5	3	3
	Core Practical I	PPHR202	General practical –I	5	3	3
	NME			5	4	4
	Service Learning	PPHX201	Energy Audit	-	1	1
			TOTAL	**30**	**24**	**24**
III	Core X	PPHM301	Quantum Mechanics II	6	5	5
	Core XI	PPHM303	Microprocessor and Microcontroller	6	4	4
	Core XII	PPHM305	Material Science	**6**	**4**	**4**
	Project	PPHP401	Project	2	-	-
	Core Practical- II	PPHR402	General practical –II	5	3	3
	Core XIII	PIDM301	Sustainable Materials And Technologies	**5**	**5**	**5**
			TOTAL	**30**	**21**	**21**
IV	Core XIV	PPHM406/ PPHM304	Laser and nonlinear optics	5	3	3
	Core XV	PPHM402	Nuclear and Particle Physics	6	4	4
	Core XVI	PPHM403	Solid State Physics-II	5	4	4
	Core XVII	PPHM405	Crystal growth and Thin Films	**5**	**4**	**4**
	Core Practical-II	PPHR402	General Practical-II	5	3	3
	Project	PPHP401	Project	4	4	4
			TOTAL	**30**	**22**	**22**
			GRAND TOTAL	**120**	**90**	**90**

PPHM301 QUANTUM MECHANICS II

Semester : III **Credit : 5**
Category : Core X **Hours/Weeks : 6**
Class & Major: II M.Sc. Physics **Total Hours : 78**

Objectives
To enable the students

- Understand the time perturbation effects in quantum mechanics.
- Examine the scattering and semi classical theory of quantum particles.
- Understand about Quantum field theory.

UNIT- I TIME DEPENDENT PERTURBATION THEORY 15Hrs

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation- Collision-Adiabatic and Sudden Approximation- A Charged Particle in an Electromagnetic Field.

UNIT -II SCATTERING THEORY 16Hrs

Scattering theory- Scattering of a particle by a fixed centre of force. Scattering amplitude differential and total cross sections. Method of partial waves. Phase shifts. Optical theorem. Scattering by a hard sphere and potential well. Integral equation for potential scattering. Green's function. Born approximation. Yukawa and Coulomb potential.

UNIT- III SEMI-CLASSICAL THEORY OF RADIATION 16Hrs

Application of the time dependent perturbation theory to semi-classical theory of radiation –Einstein's coefficients –absorption -induced emission-spontaneous emission - Einstein's transition probabilities-dipole transition -selection rules –forbidden transitions.

UNIT-IV QUANTUM FIELD THEORY 16Hrs

Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation - Field Quantization of the Non-Relativistic Schrodinger Equation-Creation-Quantization of Electromagnetic Field Energy and Momentum.

UNIT- V GENERALISED ANGULAR MOMENTUM 15Hrs

Infinitesimal rotation, Generator of rotation, Commutation rules, Matrix representation of angular momentum operators, Spin, Pauli spin matrices, Rotation of spin states, Coupling of two angular momentum operators, Clebsch Gordon co-efficients-Applications.

Text Books

- P.M.Mathew & K.Venkatesan,*Text Book of Quantum Mechanics* Tata McGraw Hill 2010.
- G Aruldhas, *Quantum Mechanics*,Prentice Hall of India, 2006.
- David J.Griffith, *Introduction to Quantum Mechanics*, Pearson Prentice Hall, 2006.

Reference Books

- A Devanathan , *Quantum Mechanics*, Narosa Publishing-New Delhi, 2006.
- L.I Schiff , *Quantum Mechanics*, McGraw Hill, 1968.
- A.K. Ghatak and S. Loganathan , *Quantum Mechanics,* McMillan India, 2006.
- R.Shankar, *Principles of Quantum Mechanics*, Springer, 2005.

PPHM303 MICROPROCESSOR AND MICROCONTROLLER

Semester : III	**Credit : 4**
Category : Core XI	**Hours/week : 6**
Class &Major : II M.Sc Physics	**Total Hours :78**

Objectives

To enable the students

- Plan the internal organization of microprocessor and microcontroller.
- Design the microprocessor and microcontroller based systems.
- Apply the interfacing system in applications.

UNIT- I MICROPROCESSOR 8085 16 Hrs

Internal Architecture of 8085- Addressing Modes-Direct-Indirect-register addressing-register indirect addressing-Immediate addressing-Instruction Set-Programming techniques-interrupts of 8085.

UNIT- II PROGRAMMING WITH 8085 14 Hrs

Addition-Subtraction and Multiplication-square and square root-BCD to Binary Conversion-Binary to BCD conversion-Bubble Sort Method-largest and smallest-Ascending and Descending Order-Sum of Series-Time delay subroutine-Clock Program.

UNIT -III INTERFACING MEMORY AND PERIPHERALS 16 Hrs

Basic interfacing concepts-Peripheral I/O instructions-Device select and data transfer-I/O mapped I/O-Memory mapped I/O-Interfacing of ROM, RAM and EPROM Chips-Interfacing of 8255.

UNIT-IV INTERFACING APPLICATIONS 16 Hrs

Seven Segment Display Interface-Keyboard Interface-Interfacing to Digital to Analog Converter(DAC)-Analog to Digital Converter(DAC)-Stepper Motor Interface-Hardware Controlled Serial I/O using programmable chip 8251(USART).

UNIT- V MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING 13Hrs

Architecture of 8051-Key features of 8051-Memory Organization-Program Memory (internal and external ROM)data memory-Internal RAM organization-special function registers-addressing modes-instruction set-data instructions-arithmetic instructions-logical instructions-Rotate and Swap operations-simple programs.

Text Books

- Ramesh Goankar-*Microprocessor Architecture programming and applications with the 8080A/8085*, Pen ram International Ltd, 2000.

- Doughlas V.Hall-*Microprocessor Interfacing Programming and Hardware* 2nd edition Tata McGraw Hill Publishing Co.Ltd, 1991.

Reference Books

- Mohammed Rafiquzzaman-*Microprocessor and Microcomputer based system*, Universe Verlag Biefield, 2002.
- Kenneth J. Ayala *The 8051 Microcontroller Architecture, Programming and Applications*, edition 2 Penram International Ltd, 2000.

PPHM305 MATERIAL SCIENCE

Semester : III **Credit : 4**
Category : Core XII **Hours/Weeks : 6**
Class & Major : II M.Sc Physics **Total Hours : 78**

Objectives

To enable the students

- Understand the theoretical concepts of Materials.
- Apply the knowledge on different properties of materials with examples.
- Analyze the different methods available for characterizing the materials.

UNIT– I IONIC CONDUCTIVITY AND SOLID ELECTROLYTES 16Hrs

Types of ionic crystals-alkali halides-silver chloride- alkaline earth fluorides -simple stoichiometric oxides. Types of ionic conductors-halide ion conductors-oxide ion conductors-solid electrolytes-applications of solid electrolytes. Electrochemical cell-principles-Batteries, sensors and fuel cells-crystal defects. Electronic properties and band theory; metal, semiconductors-Inorganic solids-colour, magnetic and optical properties.

UNIT– II MAGNETIC MATERIALS 15Hrs

Introduction-types of magnetic materials-diamagnetism-paramagnetism, ferromagnetism. Ferrites: Preparation and their applications in micro wave-floppy disk-magnetic bubble memory and applications. Insulating materials: classification on the basis of temperature –Polymer insulating materials and ceramic insulating materials. ferrro electric materials: examples-applications of ferro electrics.

UNIT–III NANOPHASE MATERIALS 16Hrs

Introduction-techniques for synthesis of nanophase materials-sol-gel synthesis-electro deposition-inert gas condensation-mechanical alloying (Ball milling method)-properties of nanophase materials-applications of nanophase materials, Basics of composite materials.

Metallic glasses: composition, properties and applications. Shape memory alloys: application of SMA-Advantages and Disadvantages. Biomaterials: metals and alloys in biomaterials-ceramic biomaterials, composite biomaterials.

UNIT– IV OPTICAL AND DIELECTRIC PROPERTIES OF MATERIALS 15 Hrs

Theory of electronic polarization and optical absorption, ionic polarization, orientational polarization. Optical phonon model in an ionic crystal; Interaction of

electromagnetic waves with optical modes, polarization, Dispersion curves of transverse optical (TO) phonon and optical photon in a diatomic ionic crystal, LST relation; Metal-insulator transition. Optical properties of metals & nonmetals- Luminescence, photoconductivity.

UNIT– V THERMAL PROPERTIES OF METALS & ALLOYS 16 Hrs

Temperature effects on the intensities of Bragg reflections. Influence of temperature on diffraction of X-rays: Normal coordinates of lattice vibration and X-ray scattering from a vibrating lattice and origin of thermal diffuse spots. First order TDS. Debye-Waller factor' Debye's method of calculating isotropic temperature factor for a cubic crystal. DTA, TGA, DSC (Outline only).

Annealing processes, Heat treatment of steels, mechanism of hardening-Quenching, thermal stresses.

Text Books

- V.R. Raghavan*, Material science and engineering*, Printice Hall India Ltd., 2001.
- V. Rajendran, *Materials science*, Tata Mcgraw-Hill Education, 2011.

Reference Books

- *E. J. Mittemeijere and P. Scardi*, *Diffraction analysis of the microstructure of materials*, Springer, 2004.
- W.D. Callister, *Materials science & engineering*, John Wiley & Sons, Inc. 2014.
- *D. P. Woodruff & T. A. Delchar*, *Modern techniques of surface science*, Cambridge University Press, 2016.
- T. Pradeep*, Nano*: *The essentials in understanding nanoscience and nanotechnology*, Tata McGraw Hill, New Delhi, 2007.

E – Books

- https://www.pdfdrive.com/materials-science-and-engineering-an-introduction-e7853330.html
- https://www.pdfdrive.com/fundamentals-of-materials-science-and-engineering-e29579234.html
- https://www.pdfdrive.com/an-introduction-to-materials-engineering-and-science-for-chemical-and-materials-engineers-e185424520.html

PIDM301 SUSTAINABLE MATERIALS AND TECHNOLOGIES

Semester : III **Credit : 5**
Category : Core XIII **Hours/week : 5**
Class & Major: II - M.Sc Physics & Chemistry **Total Hours : 65**

Objectives

To enable the students

- Learn the concept of sustainable materials.
- Understand about green chemistry strategies for designing the chemical synthesis.
- Explore the theoretical knowledge of physical and chemical properties.

UNIT– I INTRODUCTION TO MATERIALS 13 Hrs

Concept of Sustainable materials, Classification of materials: Crystalline & amorphous materials, high Tc superconductors, alloys & composites, semiconductors, solar energy materials, luminescent and optoelectronic materials, Polymer, Liquid crystals and quasi crystals, Ceramics.

UNIT– II GREEN CHEMISTRY 14 Hrs

Introduction: Prospects and future of Green Chemistry - Twelve guiding principles of green chemistry - Concept of atom economy - Green starting materials, Green reagents, Green solvents and reaction conditions, Green synthesis - Real world cases (Traditional Vs. Green processes) Synthesis of Ibuprofen, Adipic acid - Biomimetic, multifunctional reagents; Combinatorial green chemistry; Non-covalent derivatization.

UNIT– III GREEN TECHNOLOGIES 13Hrs

Green Solvents: Enhancement of selectivity, efficiency, and industrial applicability - Ionic liquids-Supercritical fluids - Solvent free neat reactions in liquid phase - Flourous phase reactions Green Catalysis: Heterogeneous catalysis: Use of zeolites, silica, alumina, clay, polymers, cyclodextrins, and biocatalysts.

UNIT– IV CHARACTERIZATION TECHNIQUES RELATED TO NANOMATERIALS 13 Hrs

Electron Microscopy techniques: Scanning Electron Microscope, Transmission Electron Microscope, Field emission scanning electron microscopy, Atomic Force Microscopy, X-ray photoelectron spectroscopy (XPS), Energy Dispersive X-Ray Analysis (EDX).

UNIT– V APPLICATION OF NANOMATERIALS 12 Hrs

Overview of nanomaterials properties and their applications, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics – Photovoltaic cells- Nano structures as single electron transistor.

Text Books

- J.George, Marcel Dekker, *Preparation of thin films*, Inc., New York. 2005.
- Rashmi Sanghi & M. M. Srivastava, *Green chemistry – Environment friendly alternatives*, Narora Publishing House, 2003.
- Elson Longo, Felipe de Almeida La Porta*, Recent advances in complex functional materials,* Springer, 2017.

Reference Books

- K. Barriham, D.D. Vvedensky*, Low dimensional semiconductor structures: fundamental and device applications*, Cambridge University Press, 2001.
- V.K. Ahluwalia, *Methods and reagents of green chemistry: An introduction by green chemistry*, Ane Books India, 2006.
- Bontempi, Elza, *Raw materials substitution sustainability*, Springer International Publishing, 2017.
- Xiaobo Chen, Samuel S. Mao, *Titanium dioxide nanomaterials: Synthesis, properties, modifications, and applications,* Chem. Rev. 2007, 107, 2891-2959.
- G. Cao, *Nanostructures & nanomaterials: Synthesis, properties & applications,* Imperial College Press, 2004.

e – Books

- https://www.elsevier.com/books/introduction-to-materials-science/mercier/978-2-84299-286-6
- https://onlinelibrary.wiley.com/doi/book/10.1002/9780470988305
- http://www.mrforum.com/product/9781945291739/
- https://doi.org/10.1016/j.aca.2015.11.008
- https://www.taylorfrancis.com/books/9781315153285

PPHM304 LASER AND NONLINEAR OPTICS

Semester : III **Credit : 3**
Category : Core XIV **Hours/Weeks : 5**
Class & Major : II M.Sc Physics **Total Hours : 65**

Objectives
To enable the students

- Compare the different types of laser.
- Define the field of non linear optics.
- Study the working function of fiber optics.

UNIT -I LASERS **13 Hrs**

Gas lasers – He-Ne, Ar^+ ion lasers – Solid state lasers – Ruby – Nd: YAG, Ti Sapphire –Organic dye laser – Rhodamine – Semiconductor lasers – Diode laser, p-n-junction laser, GaAs Laser.

UNIT- II INTRODUCTION TO NONLINEAR OPTICS **13 Hrs**

Refractive index – frequency dependent and intensity dependent refractive index - Wave propagation in an anisotropic crystal – Polarization response of materials to light – Second harmonic generation – Sum and difference frequency generation – Phase matching – four wave mixing - Third harmonic generation – self focusing – Parametric amplification - bistability

UNIT- III MULTIPHOTON PROCESSES **13 Hrs**

Two photon process – Theory and experiment – Three photon process parametric generation of light – Oscillator – Amplifier – Stimulated Raman scattering – Intensity dependent refractive index optical Kerr effect – photorefractive, electron optic effects

UNIT- IV NONLINEAR OPTICAL MATERIALS **13 Hrs**

Basic requirements – Inorganics – Borates(Sodium and potassium penta borates) – Organics – Urea, Nitro aniline – Semi organics – Thiourea complex – X-ray diffraction, FTIR and FT-NMR qualitative study – Kurtz test – Laser induced surface damage threshold

UNIT -V FIBER OPTICS **13 Hrs**

Step – Graded index fibers – wave propagation – Fiber modes – Single and multimode fibres – Numerical aperture – Dispersion – Fiber bandwidth – Fiber loss – Attenuation coefficient – Material absorption

Text Books

- B.B. Laud *Lasers and Nonlinear Optics* 4th edition. New Age International (P) Ltd New Delhi 2010.
- Robert W. Boyd, *Nonlinear Optics*, 3rd edition Academic Press, New York, 2012.

Reference Books

- Govind P. Agarwal, Fiber-Optics Communication Systems, 3rd edition John Wile & Sons, Singapore 2003.
- William T. Silvast, Laser Fundamentals, Cambridge University Press, Cambridge, 2013.
- D.L. Mills,*Nonlinear Optics – Basic Concepts*, Springer, Berlin, 2005.

PPHM402 NUCLEAR AND PARTICLE PHYSICS

Semester : IV **Credit : 4**
Category : Core XV **Hours/week : 6**
Class & Major : II M.Sc Physics **Total Hours : 78**

Objectives

To enable the students

- Understand the nuclei model and its associated particles.
- Acquire the working process of nuclear reactor and detectors.
- Compare the different elementary particles

UNIT- I STATIC PROPERTIES OF NUCLEI AND NUCLEAR MODEL 15 Hrs

Nuclear size-determination from electron scattering-nuclear form factors-angular momentum-spin and moments of nuclei-nuclear model reactions-shall model-Nilsson model-physical concept of the unified model.

UNIT-II TWO NUCLEAN SYSTEM AND NUCLEAR FORCES 16 Hrs

Dipole and quadruple moments of the deuteron- central and tensor forces-ecridenced for saturation property-neutron-proton scattering-exchange character-spin dependence (ortho anpara-hydragen) –charge independence and charge symmetry. Iso spin formalism-general form of the nucleon-nucleon force-S-wave effective range theory-proton-proton scattering-evidence for hard core potential.

UNIT-III NUCLEAR DECAYS AND REACTIONS 15 Hrs

Electromagnetic decays: selection rules-Fermi theory of beta decay-kurie plot-Fermi and Gamow – teller transitions-parity violation in beta decay-introduction to nuclear reactions.

UNIT-IV NUCLEAR DETECTORS 16 Hrs

Interactions of radiations with matter-Ge and Si solid state detectors-colorimeter and the use for measuring get energies-syndication and Cerenkov counters-quantization ideas-hybrid detectors.

UNIT-V ELEMENTARY PARTICLES **16 Hrs**

Relativistic kinemetics-classification spin and parity determination of pions and strange particles –Gelmann nishijima scheme-properties of quark and their classification-elementary ideas of Su(2) and Su(3)-symmetric groups and hadron classification-introduction to the standard model-electro weak interactions-W and Z Bosons.

Text Books

- Krane. K.S *Introducing nuclear physics*, Wiley India, 2008.
- Roy R Rand Nigam B.P *Nuclearphysics Theory and experiment* New Age International 2005.
- Tayal. D.C*Nuclear physics* Himalaya Publication 1997.
- Sathiya prakash Nuclear Physics Pragati Prakashan Publication 2011.

Reference Books

- D.Griffith, *Introduction to elementary particles* Academic press 2 nd edition 2008.
- A. Nutshell by C.A.Bertulani *Nuclear physics* 1st edition Princeton University press 2007.
- B.L.Cohen, *Concept of Nuclear physics*, McGraw-Hill, 2003.

PPHM403 SOLID STATE PHYSICS -II

Semester : IV **Credit : 4**
Category : Core XVI **Hours/week : 5**
Class & Major: II - M.Sc Physics **Total Hours : 65**

Objectives
To enable the students

- Understand the concept of modern solid state physics.
- Develop the basic frameworks of solid state physics.
- Explore the theoretical understanding of various physical properties of condensed matter.

UNIT- I SEMI CONDUCTING PROPERTIES **14Hrs**

Carrier concentration in semiconductors-Fermi level-mobility of charge carriers-effect of temperature on mobility-electrical conductivity of semi conductors-Hall effect in semi conductors-junction properties: metal-metal junction, metal-semiconductor junction, semiconductor-semiconductor junction.

UNIT- II DIELECTRIC PROPERTIES **13Hrs**

Dipole moment-polarisation-electric field of a dipole-polarisability-classical theory of electronic polarisation-polarisability, Dielectric constant and polarisability – Clausius Mossotti equation- piezo, pyro and ferroelectric properties of crystals-anti Ferro electricity and ferric electricity

UNIT- III OPTICAL PROPERTIES **12Hrs**

Classical model drude model- optical refractive index and relative dielectric constant - colour centres (types and generation) – Luminescence-Photoconductivity

UNIT -IV MAGNETIC PROPERTIES 13Hrs

classification of magnetic materials-atomic theory of magnetism-Langevin's classical theory of diamagnetism and para magnetism-quantum theory of magnetism ferromagnetism-Weiss molecular field theory-ferromagnetic domains-domain theory-anti ferromagnetism, ferrimagnetisms.

UNIT -V SUPERCONDUCTING PROPERTIES 13Hrs

Sources of superconductivity-Meissner effect-thermodynamics of superconducting transition-isotope effect-London penetration depth-coherence length-band gapelements of BCS theory-flux quantisation-Josephson effect-High Tc superconductivity.

Text Books

- M.A.Wahab, *Solid state physics, Structure and properties of materials*,2nd edition, Narosa publishing house, 2005.
- Micea S.Rogalski and Stuart.B.Palmer, *Solid state physic,* Gordon and Breach science publishing, 2001.
- R.K.Puri and V.K.Babbar, *Solid state physics*, third edition, S.Chand and company Ltd, 2005.
- P.K.Palanisamy, *Solid state physics*, Scitech publications (India). Ltd ,2003.

Reference Books

- Charles Kittel, *Introduction to solid state physics,* Wiley eastern limited, 7th edition 2000.
- Ajay Kumar Saxena, *Solid state physics*, MacMillan Publishers, 2006.
- J.S.Blackmore *Solid state physics*, second edition-Cambridge university press, 1974.
- N.W.Ashcroft and N.D.Mermin, *Solid state physics,* CBS publishing Asia Ltd, 1988.

PPHM405 CRYSTAL GROWTH AND THIN FILMS

Semester : IV **Credit : 4**
Category : Core XVII **Hours/week : 5**
Class and Major: II M.Sc Physics **Total hours : 65**

Objectives

To enable the students

- Interpret different techniques of crystal growth.
- Apply the characterization in the single crystals.
- Analyze the different methods in thin film growth process.

UNIT–I NUCLEATION 11Hrs

Nucleation concept – Kinds of nucleation – Classical theory of nucleation - Induction period – Measurement – Homogeneous Nucleation – Energy of formation of a critical spherical nucleus – critical radius – Nucleation rate.

UNIT-II CRYSTAL GROWTH FROM SOLUTION 15Hrs

Low temperature solution growth – Solution and Solubility – Preparation of solution - Principle of low temperature solution growth - Mier's solubility diagram – Measurement of solubility – Achievement of super saturation**.**

Crystal Growth methods – Slow cooling method – Holden's rotary crystallizer - Slow evaporation method – Johnson's rotating crystal method - Temperature gradient method – Kruger and Fink U tube method.

UNIT- III MELT GROWTH, GEL GROWTH AND FLUX GROWTH 13Hrs

Growth of crystal from melt – Bridgman method – Czochralski method – LEC growth of III – V materials - Verneuil method. Gel growth – Different gel medium – Specific gravity – Silica gel – Agar gel – Basic growth procedure – Single diffusion technique – Double diffusion technique – Reaction method – Chemical reduction method.

Principle of flux growth – Slow cooling method – Slow evaporation method – Top seeded solution.

UNIT– IV PREPARATION AND DEPOSITION TECHNIQUES OF THIN FILM 13Hrs

Nature of Thin Film-Deposition Technology-Distribution of Deposit-Resistance Heating-Thermal Evaporation-Flash Evaporation.

Electron Beam Method-Cathodic Sputtering-Glow Discharge Sputtering-Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition.

UNIT - V THIN FILM GROWTH PROCESS 13 Hrs

Epitaxy-Thin Film Structure-Substrate Effect-Epitaxial Deposit-Twinning and Multi twinning-Phase Transition-Dissociations-Film Thickness Effect-Crystal Growth Process

Text Books

- P. Santhana Raghavan and P. Ramasamy *Crystal growth processes and methods*, KRU Publications, 2000.
- K.L. Chopra, *Thin film phenomena,* McGraw-Hill, 1969.
- K.L. Chopra, *Thin film device applications*, Springer Science & Business Media, 2012.
- L.T. Meissel & R. Glang-McGraw Hill - *Handbook of thin film technology*, 2006.

Reference Books

- A. Goswami, *Thin film fundamentals*, New Age International – New Delhi, 2008.
- H. Komatsu, *Studies and concepts in crystal growth*, Pergamon Press, Oxford, 1993.
- K.L. Chopra, S.R. Das, *Thin film solar cells*, Springer Science & Business Media, 1983.
- J. Hans Scheel, *Crystal growth technology book*, Originally published,2003.

e– Books

- https://www.Handbook-Crystal-Growth-Films-Epitaxy-ebook/dp/B00PC556NE
- https://www.springer.com/gp/book/9781468491470
- https://www.elsevier.com/books/handbook-of-crystal-growth/kuech/978-0-444-63304-0

PPHR402 PHYSICS PRACTICAL - II

Semester : III&IV **Credit : 3**
Category : Core practical-II **Hours/Week : 5**
Class and Major: II M.Sc. Physics **Total Hours :65**

Objectives

To enable the students

- Program a microcontroller to perform various tasks.
- Design and implement microprocessor based embedded system.

MICROPROCESSORAND MICROCONTROLLER

1. Selection of largest element of an array.
2. Selection of smallest element of an array.
3. Square of a single byte Hex number.
4. Square root.
5. Ascending order.
6. Descending order.
7. Arithmetic progression.
8. Clock program.
9. Code conversion.
10. ADC interface.
11. Interfacing of 8255.
12. Digital to Analog conversion.
13. Continuous Anticlockwise Rot-Stepper Motor.
14. Rotation through required angle.
15. Keyboard Interface.
16. Study of seven segment display.
17. Timer interface
18. Parallel interface
19. Microprocessor 8085 – solving equation.
20. Microprocessor 8085 – waveform generation

Optional

1. Temperature conversion- 8085.
2. Traffic control system using microprocessor.
3. Microprocessor 8085- Interface (A/D counter).

Text Books

- Ghosh P. K.Sridhar P. R., "*Introduction to Microprocessors for Engineers and Scientists"*, Prentice- Hall of India, New Delhi,2nd edition, 2001.
- Yu-Cheng Liu,Glenn A.Gibson, "*Microcomputer Systems*:8086/8088 Family, Prentice-Hall of India, New Delhi,2nd edition, 1994.
- Barry B.Brey, "*The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486*, *Prentice-Hall of India*, New' Delhi, 3rd edition, 1995.
- Brian W. Kernighan, Dennis M. Ritchie, "*The C Programming Language*", Prentice-Hall of India, New Delhi, 2nd edition,1993.

III and IV Evaluation Components of CIA

Semester	Category	Course Code	Course Title	Component-III	Component-IV
III	Core X	PPHM301	Quantum Mechanics II	Problem solving	PPT
	Core XI	PPHM303	Microprocessor and Microcontroller	Assignment	Seminar
	Core XII	PPHM305	Material Science	Poster Presentation	Seminar
	Core XIII	PIDM301	Sustainable Materials and Technologies	Poster Presentation	Seminar
IV	Core XIV	PPHM406/ PPHM304	Laser and nonlinear optics	Seminar	Working model of laser
	Core XV	PPHM402	Nuclear and particle physics	Assignment	PPT
	Core XVI	PPHM403	Solid state physics -II	Journal review	Poster presentation
	Core XVII	PPHM405	Crystal Growth and Thin Films	Characterization Techniques analysis	Seminar