DEPARTMENT OF PHYSICS

PREAMBLE

UG **:** Programme Profile and Syllabi of Courses offered in the V and VI Semesters along with Evaluation Components III & IV (With Effect from 2018-2021batch onwards)

PROGRAMME PROFILE B.Sc., PHYSICS

PROGRAMME SPECIFIC OUTCOMES (PSO)

Upon completion of the Programme, the students will be able to

- Ability to solve and apply the Concepts of Physics in various fields like Material Science, Mechanics, Thermal Physics and Electricity.
- Learning of Laboratory Skills, enabling Measurements in basic Physics and Analysis of Measurements to draw valid Conclusions.
- Developing the Problem solving Skills and Scientific Reasoning for the Prospective Physicists and Logical Reasoning.
- Analyze the behavior of Materials from Atomic Level to Macroscopic Level.

Semester	Part	Category	Course code	Course Title	Previous Course Code	Contact Hrs/week	Credit Min/ Max
I	I	Language	UTAL105/UTAL106/ UHIL101/UFRL101	Basic Tamil-I/Advanced Tamil I/Hindi/French	UTAL103/ UTAL104	4	2/3
	II	English	UENL107/UENL108	General English-I/Advanced English-I	-/UENL106	5	3/4
	III	Core I	UPHM103	Mechanics	-	5	5
	III	Core II	UPHM105	Properties of Matter	-	6	5
	III	Core Practical-I	UPHR102/UPHR202	Major Practical I		3	2
	III	Allied	UMAA114	Allied Mathematics I	UMAA104	5	5
	IV	Value Education				2	1
					TOTAL	**30**	**23/25**
II	I	Language	UTAL205/UTAL206 UHIL201/UFRL201	Basic Tamil-II/Advanced Tamil-II/Hindi/French	UTAL203/ UTAL204	4	2/3
	II	English	UENL207/UENL208	General English-II/Advanced English-II	-/UENL206	5	3/4
	III	Core III	UPHM203	Thermal and Statistical Physics	UPHM104	7	6
	III	Core Practical-II	UPHR203/UPHR101	Major Practical II	-	3	2
	III	Allied	UMAA222	Allied Mathematics II	UMAA212	5	5
	IV	NME	-	-	-	4	2
	IV	Soft Skill				2	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	UTAL303/ UTAL304	4	2/3
	II	English	UENL307/UENL308	General English-III/ Advanced English-III	-/UENL306	5	3/4

	III	Core IV	UPHM303	Electricity and Magnetism	UPHM402	6	5
		Core V	UPHM304	Mathematical Physics	UPHM509	4	3
	III	Core Practical-III	UPHR303	Major Practical III	-	3	2
	III	Allied	UCSA306	Computational Physics with Python	-	3	3
	III	Allied Practical	UCSR310	Computational Physics with Python Lab	-	3	2
	IV	Value Education	-	-		2	1
					TOTAL	**30**	**21/23**
IV	I	Language	UTAL405/ UTAL406/ UHIL401/ UFRL401	Basic Tamil-IV/Advanced Tamil-IV/Hindi/ French	UTAL403/ UTAL404	4	2/3
	II	English	UENL407/ UENL408	General English-IV/ Advanced English-IV	- /UENL406	5	3/4
	III	Core VI	UPHM406	Optics and Laser Physics	UPHM302	4	4
	III	Core VII	UPHM407	Atomic Physics	-	4	4
	III	Core Practical-IV	UPHR405	Major Practical IV	-	3	3
	III	Allied	UCHA401/ UCHA402/ UCHA403	Chemistry for Physics	-	3	3
	III	Allied Practical	UCHA402/ UCHR403	Volumetric and Organic Analysis-I	-	3	2
	III	Core XI	UPHP501/ UPHP511	Project / Instrumentation Techniques	-	2	-
	IV	Soft Skill				2	1
	V	Extension Program -me/ Physical Education/NCC				-	-/2
					TOTAL	**30**	**22/26**
V	III	Core VIII	UPHM501	Quantum Mechanics and Relativity	-	6	5
	III	Core IX	UPHM505	Basic Electronics	-	6	5
	III	Core X	UPHM506	Solid State Physics	UPHM608	6	5
	III	Core Practical-V	UPHR502	Major Practical V	-	3	3
	III	Core XI	UPHP501/ UPHP511	Project / Instrumentation Techniques	-	4	4/5
	III	Online Course		NPTEL/Spoken Tutorial		3	1
	IV	Value Education				2	1
TOTAL						**30**	**24/26**
VI	III	Core XII	UPHM609	Numerical methods and Basic Computational Physics	-	5	5
	III	Core XIII	UPHM611	Nuclear and Radiation Physics	-	5	5
	III	Core XIV	UPHM612	Material Science	-	5	5
	III	Core XV	UPHM613	Digital Electronics	-	5	4
	III	Core Practical VI	UPHR605	Major Practical VI	-	3	3
	III	Major Elective	UPHO601/ UPHO602/ UPHO603	Nanophysics/ Astrophysics/ Functional Materials	-	5	4
	III	Viva Voce	UPHM610	Comprehensive Viva Voce	-	-	1
	IV	Soft Skill				2	1
	V	Extension Program -me/Physical Education/NCC				-	-/2
TOTAL						**30**	**28/30**
GRAND TOTAL						**180**	**140/155**

LIST OF COURSES OFFERED TO OTHER DEPARTMENTS
NON-MAJOR ELECTIVES

Semester	Part	Category	Course Code	Course Title	Previous Course Code	Contact Hrs/week	Credit Min/ Max
II	IV	Non Major Elective	UPHE202	Applied Physics	-	4	2
			UPHE203	Biomedical Instrumentation	-	4	2
			UPHE204	Electrical Appliances	-	4	2
			UPHE205	Telecommunication System	UPHE304 /UPHE503	4	2
			UPHE206	Servicing and maintenance of home appliances	UPHE303	4	2

ALLIED

Semester	Part	Category	Course Code	Course Title	Previous Course Code	Contact Hrs/week	Credit Min/ Max
I	III	Allied	UPHA102	Allied Physics-I	UPHA101	3	3
I	III	Allied	UPHR103	Physics for Chemistry Practical – I	UPHR102	3	2
II	III	Allied	UPHA203	Allied Physics-II	UPHA202	3	3
II	III	Allied	UPHR202	Physics for Chemistry Practical – II	-	3	2
III	III	Allied	UPHA303	Digital Electronics	-	3	3
III	III	Allied	UPHR303	Digital Electronics Practical	-	3	2
IV	III	Allied	UPHA402	Electronics(For Mathematics major)	-	3	3
IV	III	Allied	UPHR402	Electronics Practical (For Mathematics major)	-	2	2

Inclusion of Experiential Learning

A. Experiential Learning (Mandatory)

Course Mapping				Collaborating Agency - MSME		
Semester	Course Code	Course Title	Assessment	Course Title	Hours / Days/ Month	Mode of Evaluation
IV	UPHM407	Atomic Physics	Component IV	Solar Energy	4 Days	Reflection

B. Skill Orientation Programme (Only for the interested students) – Extra Credit Earning Provision

Semester	Category	Course Code	Course Title	Collaborating Agency	Hours / Days/ Month	Mode of Evaluation	Credits (Min/Max)
V	Core	UPHT501	PCB Design	MSME	4 days	Reflection	1

QUANTUM MECHANICS AND RELATIVITY

UPHM501

Semester : V **Credit : 5**
Category : Core XI **Hours/Week: 6**
Class & Major: III B.Sc Physics **Total Hours: 78**

Objectives:
To enable the students

- Understand the basic concepts of Quantum Mechanics and Fundamental Postulates of Relativity.
- Expose the Students to the Applications of Quantum Mechanics and Relativity.

UNIT- I FOUNDATIONS OF WAVE MECHANICS 15 Hrs

Introduction–Inadequacy of Classical Mechanics – Dual Nature of Light and Matter – de Broglie wavelength–Compton Effect -Experiments of Davisson–Germer and G.P. Thomson–The Electron Microscope –Heisenberg Uncertainty Principle –Applications of Uncertainty Principle.

UNIT -II SCHRODINGER EQUATION 15 Hrs

Schrodinger Equation – Physical Interpretation of Wave function– Probability Current Density –Ehrenfest Theorem–Eigenfunction and Eigenvalue –Eigenvalue Equation – Orthogonal Eigenfunctions– Reality of Energy Equivalence.

UNIT- IIIAPPLICATIONS OF SCHRODINGER EQUATION 16 Hrs

Free Particle –Particle in a Bound State – Eigenfunctions and Eigen values of a Particle in a Rectangular Potential – Reflection and Transmission Coefficient Rectangular Potential – Particle in 1-DWell of Finite Depth –Bound States –One Dimensional Linear Harmonic Oscillator.

UNIY-IV SPECIAL THEORY OF RELATIVITY 16 Hrs

Frames of References –Inertial Frames and Non inertial frames–Galilean Transformation – Michelson-Morley Experiment –Interpretation of the Results –Postulates of Special Theory of Relativity –Lorentz Transformation Equations –Length Contraction –Time Dilation – Transformation of Velocities –Redefining Momentum –Variation of Mass with Velocity – Mass– Energy Equivalence.

UNIT-V APPLICATIONS OF QUANTUM MECHANICS 16 Hrs

Teleportation– Instantaneous Communication –Quantum Computers –Quantum Tunneling –Quantum Sensing and Imaging –Quantum Metrology –The Transistor –Energy Harvesters –Ultra Precise Thermometer – Lasers–Random less Generator–Quantum Cryptography –Ultra Price Clocks.

Text Books

- Mathews, P.M. and Venkatesan, K. (2005). *A Text Book of Quantum Mechanics*. Tata McGraw-Hill. New Delhi.
- Murugesan, R. (2008). *Modern Physics*. S. Chand & Company Ltd. New Delhi.

Reference Books

- Ghatak and Loganathan. (2004).*Introduction to Quantum Mechanics*. Macmillan India Ltd. India.
- Arthur Beiser. (2006). *Concepts of Modern Physics.* McGraw Hill. New Delhi.
- Narlikar. (2004). *Lectures on General Theory of Relativity.* Macmillan India Ltd. India.

BASIC ELECTRONICS

UPHM505

Semester : V **Credit : 5**
Category : Core XII **Hours/Week : 6**
Class & Major: III B.Sc Physics **Total Hours : 78**

Objectives:
To enable the students

- Introduce the various Principles of Analog Electronics and its Applications to various Electronic Instruments.
- Provide a Theoretical Basis for the Electronics Experiments and the Students will do in their Practical Sessions.

UNIT-I SEMICONDUCTOR DEVICES 16 Hrs

Classification of Solids in terms of Forbidden Energy Gap – Effect of Temperature on Fermi Level – Semiconductor Diode – Characteristics–Zener Diode– Working and Output Characteristics–Voltage Stabilization using Zener Diode– Transistor Construction and Working – Types of Biasing – Characteristics in CE,CB,CC mode.

UNIT-II RECTIFIERS AND MULTIVIBRATORS 16 Hrs

Half–Wave and Full–Wave Bridge Rectifiers–Output and Efficiency of Full Wave Rectifier – Expressions for Efficiency and Ripple Factor – Application: Regulated Power Supply using Zener Diode–Multivibrators – Types of Multivibrators– Astable, Monostable, Bistable Multivibrator – Circuit Details and Operations.

UNIT-III CIRCUIT ANALYSIS AND OSCILLATORS 16 Hrs

Network Analysis – Thevenin's, Norton's and Maximum Power Transfer Theorems Wave– Shaping Circuits: Differentiating Circuit – Output Waveforms – Integrating Circuit – Output Waveforms – Clipping and Clamping Circuits – Types and Applications – Fundamental Principles of Oscillators – Concept of Positive Feedback – Types of Oscillators – Hartley, Colpitts, Phase Shift and Wien Bridge Oscillators –Their Analysis.

UNIT-IV AMPLIFIERS AND POWER ELECTRONICS 15 Hrs

Voltage and Power Amplifiers– Classification of Amplifiers– RC Coupled Amplifier – Frequency Response Curve – Power Amplifier – Characteristics – Emitter Follower– FET,MOSFET,UJT and SCR – Construction and Working – Output Characteristics – Parameters of FET – SCR as Half and Full Wave Rectifiers.

UNIT-V OPERATIONAL AMPLIFIERS 15 Hrs

Introduction – Characteristics of an Ideal OP–AMP – CMRR – Slew Rate – Inverting/ Non inverting Amplifiers - Adder and Difference Amplifiers– Differential Amplifier – Integrator, Voltage Follower, Comparator.

Text Books

- Metha, V.K. (2001). *Principle of Electronics*. S. Chand & Company Ltd. New Delhi.
- Sedha, R.S. (2005). *A Text Book of Applied Electronics.* S. Chand & Company Ltd. New Delhi.

Reference Books

- Theraja, B.L. (2005).*Basic Electronics*. S. Chand & Company Ltd. New Delhi.
- Gaykwad, A. (1995). *Operational Amplifiers and Linear Integrated Circuits*. Printice Hall of India Pvt. Ltd. India.
- Millman, J. and Halkias, C. C. (1991).*Integrated Electronics*. Tata McGraw – Hill. New Delhi.

SOLID STATE PHYSICS

UPHM506

Semester : V **Credit : 5**
Category : Core X **Hours/Week: 6**
Class & Major: III B.Sc Physics **Total Hours: 78**

Objectives:

To enable the students

- Understand the basic concepts of Crystal Structure and Materials Science.
- Analyze the Mechanical Properties of Metals and Electron Theory of Metals.
- Acquire the knowledge about X – Rays and XRD Techniques.

UNIT-I CRYSTAL STRUCTURE 16 Hrs

Classification of Solids – Unit Cell – Crystal Lattice and Basis– Seven Classes of Crystals – Bravais Lattice– Miller Indices – Symmetry Operations – Point Groups and Space Groups – Types of Lattice (Plane Lattice with BCC and FCC) –Structure of Crystals: Simple Cubic, HCP, FCC and BCC– Examples: NaCl, Diamond and ZnS Structures– Crystal Imperfections – Types of Imperfections.

UNIT-II ELECTRON THEORY OF METALS 16 Hrs

Classical Free Electron Theory – Drawbacks of Classical Theory– Quantum Theory of Free Electron– Somerfield's Model for Free Electron (1D Solids, generalization for 3D Solids) – Electron Energies in a Metal – Band Theory of Solids –Energy Gaps – Density of States – Bands in Conductors, Insulators and Semiconductors – Factors Affecting Electrical Resistance of Materials.

UNIT-III (a) CLASSIFICATION OF MATERIALS **15 Hrs**

Advanced Materials and Modern Material Structure – Types of Bonds and their Energies – Bond Formation Mechanism – Ionic and Covalent Bonds– Ceramics – Thermal and Electric Properties – Uses.

(b) MECHANICAL PROPERTIES OF METALS

Elastic Deformation – Plastic Deformation – Interpretation of Tensile Stress–Strain Curves –Yield Criteria and Macroscopic Aspects of Plastic Deformation – Property Variability and Design Factor.

UNIT-IV (a) X-RAYS AND XRD **15 Hrs**

X–Rays – Absorption of X–Rays – X-Ray Spectra – Diffraction of X–Rays by Crystals – Bragg's Law– Laue Method – Rotating Crystal Method – Powder Photographic Method.

(b) NON DESTRUCTIVE TESTING

Radiographic Method – Ultrasonic Method–Equipment's used for NDT –Electron Microscope – Scanning Electron Microscope (SEM).

UNIT-V MAGNETIC MATERIALS AND DIELECTRICS **15 Hrs**

Types of Magnetic Materials – Magnetic Permeability, Magnetization, Susceptibility, Electric Current in Atoms – Bohr Magneton– Electron Spin – Magnetic Moment due to Nuclear Spin – Quantum Theory of Paramagnetism– Quantum Theory of Ferromagnetism, I-H Curve– Magnetic Moments due to Electron Spin – Ferromagnetism the Domain Structure – Soft and Hard Magnetic Materials– Polarization Electronic, Ionic, Orientation and Space Charge Polarization – Temperature and Frequency Effects – Electric Breakdown – Ferroelectric Materials.

Text Books

- Gupta, R.B. (2001). *Material Science for AMIE*. Umesh Publications.
- Pillai, S.O. (2005). *Solid State Physics*. Wiley Eastern Ltd.

Reference Books

- Kittel, C. (1996). *Introduction to Solid State Physics,* Wiley Eastern, (7^{th}ed.,).
- Narula, G.K. Narula, K.S. Gupta, V.K. (1989). *Materials Science*, Tata McGraw Hill. New Delhi.
- Raghavan, V. (1990). *Materials Science and Engineering a First Course.* Prentice Hall of India. India.

PROJECT

UPHP501

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

INSTRUMENTATION TECHNIQUES

UPHM511

Semester : V **Credit : 4**
Category : Core XI **Hours/Weeks: 6**
Class &Major: 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 Milli voltmeter–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

- Aruldas, G. (2007). *Molecular Structure and Spectroscopy*. Print Book. English. (2nd ed.,). New Delhi.
- Sawnney, A.K.(2005). *A Course in Electrical &Electronic Measurements &Instrumentation.* Dhanpat Rai & Company Ltd.

Reference Books

- Skoog, D.A. West, D.M. (2000).*Principles of Instrumental Analysis*.(2nd ed.,). Holt-Saunders.
- Cottrell, Sir A. (2000). *An Introduction to Metallurgy*. University Press.
- Brophy, J.H. Rose, R.M. Wulff, J. (2007).*The Structure & Properties of Materials*(Volume II). Wiley Eastern Ltd.

MAJOR PRACTICAL V

UPHR502

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

Objectives:

To enable the students

- Understand the Theoretical Concepts of Electronics by doing actual Experiments
- Design simple Electronics Circuits and make Measurements.
- Appreciate the Significance of Electronics in Practical Life.

1. V-I Characteristics of Zener Diode
2. Characteristics of Transistor in CE Configuration
3. Full Wave - Bridge Rectifier
4. Voltage Stabilization of using Zener Diode
5. Operational Amplifier as Adder, Subtractor, Inverting and Non-inverting Amplifier
6. Operational Amplifier as Integrator, Differentiator, and Voltage Follower
7. Differentiating, Integrating, Clipping and Clamping Circuits
8. RC Coupled Amplifier - Frequency Determination

Optional

1. Half Wave Bridge Rectifier
2. Junction Diode – Characteristics

Text Book

- Srinivasan, N. Balasubramanian, S and Ranganathan, R. (2006).*The Text Book of Practical Physics.* Sultan Chand & Sons.

Reference Books

- Ponnusamy, A. and Amalanathan, B. (2006).*Practical Physics*. Bright Publishers.
- Ouseph, C.C. Rangarajan, G. (1990).A *The Text Book of Practical Physics*. Viswanathan Publishers – Part I.

NUMERICAL METHODS AND BASIC COMPUTATIONAL PHYSICS

UPHR609

Semester : VI	**Credit : 5**
Category : Core XII	**Hours/Week : 5**
Class &Major: III B.Sc. Physics	**Total Hours : 65**

Objectives:

To enable the students

- Understand Different Numerical Methods and their Applications.
- Acquire the Knowledge about Basic Computing.
- Apply the Computational Techniques for Simple Physics Applications**.**

UNIT - I NUMERICAL SOLUTION OF LINEAR AND NONLINEAR EQUATIONS 12 Hrs

Newton –Raphson Method; Iterative Rule –Termination Criteria–Rate of Convergence – Drawbacks –Simultaneous Linear Algebraic Equations: Augmented Matrix – Gauss Elimination – Jordan's Modification– Inverse of a Matrix by Gauss– Jordan Method.

UNIT - II INTERPOLATION AND CURVE FITTING 12 Hrs

Interpolation: Newton's Interpolation – Linear Interpolation–Higher Order Polynomials – Divided Differences – Gregory–Newton Forward and Backward Interpolation Formulae – Error in Interpolation– Lagrange Interpolation.

Curve Fitting: Method Least– Squares–Normal Equations–Straight Line, Exponential Fits and Power – Law Fits.

UNIT - III NUMERICAL DIFFERENTIATION, INTEGRATION AND ODE 12 Hrs

First and Second-Order Derivatives: Central Difference Formulae **Numerical integration:** Trapezoidal, Simpson's 1/3 Rules–Truncation Error – Composite Trapezoidal, and Simpson's 1/3 Rules–**ODE:** Euler and Fourth–Order Runge – Kutta Methods for First Order ODE.

UNIT - IV PROGRAMMING IN C 14 Hrs

Programming Methodologies – Scientific Programming Languages– Programming in C– Variables– Expressions and Statement–Operators–Library Function–Data Input and Output –Structure of C Programming–Control Statements–Functions–Global Variables– Arrays– Character-Strings – Structures.

UNIT - V COMPUTATIONAL PHYSICS 15 Hrs

Developing Algorithm and C– Programming for: Motion of a Projectile Including Air Drag (Feynmen– Newton Method) –Electric Field due to a Point Charge and N Charges – Comparison between Analytical and Numerical Techniques: Curve Fitting; Principle of Least Squares and Fittinga Straight Line.

Text Books

- Harder,D.W. Khoury, R. (2010). *Numerical Analysis.* University of Waterloo.
- Burden, A.M. Burden, R.L. Faires, J.D. (2016).*Numerical Analysis.*(10^{th}ed.,).
- Balagurusamy, E. (2008).*ANSI C*.

Reference Books

- Sastry, S.S. (2003).*Introductory Methods of Numerical Analysis*. PHI, New Delhi.
- Sankara Rao, K. (2012).*Numerical Methods for Scientist and Engineers*.(3^{rd} ed.,) PHI Learning Private Limited.

NUCLEAR AND RADIATION PHYSICS

UPHM611

Semester : VI **Credit : 5**
Category : Core XII **Hours/Week: 5**
Class & Major: III B.Sc Physics **Total Hours: 65**

Objectives:
To enable the students

- Understand the Nucleus and its Various Models.
- Acquire Knowledge of the Basic Idea of Elementary Particles and Understand the Principles of Particle Accelerators and Nuclear Fission and Fusion.
- Realize the Applications of Radiations in Medical Diagnosis and Radiation Therapy.

Learning Outcomes
On completion of the course, the students will be able to

- Learned about the basics of nuclear size, properties, various nuclear models, principle and working of detectors, elementary particles, fission and fusion processes and its application.
- Recognized about the radiation therapy and safety precautions related advisory services.

UNIT –I NUCLEAR STRUCTURE **14 Hrs**

General Properties of Nucleus – Size, Mass and Charge–Proton – Electron Theory – Proton – Neutron Theory – Nuclear Size –Experimental Measurement of Nuclear Radius – Mirror Nuclei Method –Meson Theory of Nuclear Forces – Basic Ideas of Nuclear Models – Liquid Drop Model –Weizacker's Semi– Empirical Formula – Nuclear Shell Model.

UNIT –II NUCLEAR DETECTORS AND ELEMENTARY PARTICLES **14 Hrs**

Principle and Working – Solid State Detector – Proportional Counter –Wilson's Cloud Chamber – Scintillation Counter – Accelerators: Synchrocyclotron – Synchrotron – Electron Synchrotron –Proton Synchrotron –Betatron.

Elementary Particles – Types of Interactions – Classification of Elementary Particles – Particle Quantum Numbers – Baryon Number –Lepton Number – Strangeness Number – Hyper Charge –Isospin Quantum Number–Conservation of Laws.

UNIT – III NUCLEAR FISSION AND FUSION 13 Hrs

Rutherford's Experiment – Bohr's Theory of Nuclear Disintegration – Q value Equation for a Nuclear Reaction – Threshold Energy – Types of Nuclear Reaction – Energy Balance and the Q value – Threshold Energy of an Endoergic Reaction– Nuclear Fission – Bohr Wheeler Theory – Chain Reaction – Critical Size and Critical Mass – Nuclear Fission Reactor – Nuclear Fusion – Source of Stellar Energy – Carbon – Nitrogen Cycle – Proton – Proton Cycle –Thermo Nuclear Reaction – Basic Ideas of Plasma.

UNIT-IVELECTROMAGNETIC RADIATIONS 12 Hrs

Electromagnetic Spectrum–Classification – Ionizing Radiation and Nonionizing Radiation–Source of Radiation–Radio Frequency, Microwaves, Infrared, Visible, Ultraviolet andX–Ray, Gamma Ray Radiation (Qualitative)–Production –Physical Properties.

UNIT –VRADIATION INSTRUMENTATION AND RADIATION THERAPY 12 Hrs

Radiological Imaging–Digital Radiography–Computer Tomography Scanner– X – Ray Detection Method–Gamma Camera-Radiation Measurement by GM Counter.

Radiotherapy–Deep Therapy Machine–Basics of Teletherapy Units–Deep X – Ray, Telecobalt Units–Heavy Ion Therapy–Carbon Ion Therapy–Neutron Therapy.

Text Books

- Murugesha, R. and Kiruthiga, S. (2016).*Modern Physics*. S. Chand &Company Ltd. New Delhi.
- Thayalan, K. (2009).*Basic Radiological Physics.* Medical Publishing PVT, Ltd. New Delhi.

Reference Books

- Glasstone, S. (2014).*A Source Book on Atomic Energy*. Krieger Publishing Company; (3rdRevised ed.,).
- Little Field, T.A.and Thorley, N. (2013).*Atomic and Nuclear Physics*. Medtec, New Delhi.
- Srivatsava, B.N. (2011).*Basic Nuclear Physics and Cosmic Rays*. Pragti Prakashan Publishers. Meerut.
- Chandra, L. (2011).*Nuclear Medicine Physics*. Williams and Wilkins.

E-Resources

- https://www.worldscientific.com/worldscibooks/10.1142/8982
- https://www.amazon.in/Nuclear-Radiation-Physics-Ralph-Lapp/dp/013625988X
- http://www.ichtj.waw.pl/ichtj/publ/monogr/sun2017/sun-chapter1.pdf
- http://www.sfu.ca/~mxchen/phys1021003/P102LN34.pdf

MATERIALS SCIENCE

UPHM612

Semester : VI **Credit : 5**
Category : Core XIV **Hours/Week: 5**
Class &Major: III B.Sc Physics **Total Hours: 65**

Objectives:
To enable the students

- Understand about the Different Kinds of Materials.
- Gain Knowledge about the Applications of Modern Engineering Materials.

Learning outcomes
On completion of the course, the students will be able to

- Learned about the Various Kinds of Materials and its Applications.
- Realized about the Properties and Application of Modern Engineering Materials.

UNIT – ICHEMICAL BONDS **12 Hrs**

Review of Atomic Structure – Interatomic Potentials– Different Types of Chemical bonds – Ionic, Covalent Bond– Van der Waals bond –Metallic Bond –Hydrogen Bond– Binding Energy of a Crystal – Elastic Properties.

UNIT – IINANOMATERIALS **12 Hrs**

Introduction–Techniques for Synthesis of Nanophase Materials–Sol–Gel Synthesis– Electro deposition–Inert Gas Condensation–Mechanical Alloying–Properties of Nanophase Materials–Applications of Nanophase Materials, Composite Materials: Introduction-Types.

UNIT – III MAGNETIC AND DIELECTRICS MATERIALS **14 Hrs**

Introduction – Types of Magnetic Materials – Diamagnetism –Paramagnetism, Ferromagnetism – Ferrites: Preparation and their Applications – Magnetic Bubble Memory and Applications – Insulating Materials: Classification on the Basis of Temperature – Polymer Insulating Materials and Ceramic Insulating Materials – Ferro Electric Materials: Examples – Applications of Ferroelectries Materials.

UNIT – IV SUPERCONDUCTING MATERIALS **14 Hrs**

Introduction to Superconductivity–Persistent Currents– Effect of External Magnetic Field Critical Current Density–Meissner Effect– London Penetration Depth– BCS Theory Descriptive– Type of Superconductors– Josephson Effect (AC and DC)– Applications – Maglev–SQUIDS–High –Tc Superconductors.

UNIT – V ADVANCED MATERIALS **13 Hrs**

Metallic Glasses–Introduction-Composition, Properties and Applications– Shape Memory Alloys: Introduction–Examples–Application of SMA–Advantages and Disadvantages. Biomaterials: Introduction– Metals and Alloys in Biomaterials – Ceramic Biomaterials, Composite Biomaterials.

Text Books

- Frenking, G. Shaik, S. (2014). *The Chemical Bond: Fundamental Aspects of Chemical Bonding*. Wiley-VCH Verlag GmbH & Co. KGaA.
- Raghavan, V.R. (2001). *Material Science and Engineering*. Printice Hall India Ltd. India.
- Pradeep, T. (2007). *Nano: The Essentials in Understanding Nano science and Nanotechnology*. Tata McGraw Hill. New Delhi.

Reference Books

- Callister, W.D. (2014).*Materials Science and Engineering*. John Wiley & Sons, Inc.
- Bhattacharya, S. (2013).*A Text Book of Nano science and Nanotechnology*. Wisdom Press.

E-Resources

- http://www.issp.ac.ru/ebooks/books/open/Materials_Science_and_Technology.pdf
- https://www.pdfdrive.com/materials-science-and-engineering-an-introduction-e7853330.html
- https://www.pdfdrive.com/fundamentals-of-materials-science-and-engineering-e29579234.html

DIGITAL ELECTRONICS

UPHM613

Semester : VI	**Credit : 4**
Category : Core-XVI	**Hours/Week: 5**
Class & Major: III B.Sc Physics	**Total Hours: 65**

Objectives:

To enable the students

- Acquire Knowledge about the Basics of Digital Electronics and Microprocessor
- Develop a Simple Real Time Programs using Microprocessor 8085

UNIT-I FUNDAMENTALS IN LOGIC GATES 13 Hrs

Number System–Binary Number System–Decimal and Binary Conversion–Binary to Decimal Conversion–Octal Number System–Hexadecimal Number System– Codes–BCD Code–ASCII Code–Binary Arithmetic–Binary Addition–Subtraction, AND,OR Circuits using Diodes–NOT using Transistors–NAND,NOR and EXOR–Functions and their Truth Tables– NAND and NOR as Universal Gates.

UNIT-II BOOLEAN ALGEBRA AND ITS SIMPLIFICATION 13 Hrs

Boolean Algebra–De Morgan's Theorem and its Circuit–Duality Theorem, Simplification of Boolean Equations–Karnaugh Map–Pairs, Quads, Octets–Half Adder–Full Adder–Half Subtractor–Full Subtractor–Digital Computer–Parity Checker.

UNIT-III DATA PROCESSING CIRCUITS, COUNTERS AND REGISTERS 13 Hrs

Multiplexers – Demultiplexers–Decimal to BCD Encoder – Flip – Flops–RS Flip – Flops– Clocked RS Flip – Flops –D Flip – Flops–JK Flip – Flops – JK Master Slave Flip Flops – Shift registers – Counters–Asynchronous Counters–Omitted States–Modulus Counters–BCD Counters – Up Down Counters–Synchronous Counter–Decayed Counter–D/A Counter–A/D Counter.

UNIT-IV INTRODUCTION TO MICROPROCESSORS ANDPROGRAMMING TECHNIQUE 13 Hrs

Introduction to Microcomputers – Microprocessors and Assembly Languages – Microprocessor 8085 – Internal Architecture and its Operations – Programming Techniques such as Looping, Counting, and Indexing–Addressing Modes–Data Transfer Instructions–Dynamic Debugging.

UNIT-V ASSEMBLY LANGUAGE PROGRAMMING 12 Hrs

BCD to Binary and Binary to BCD Conversions–BCD to HEX and HEX to BCD Conversions–ASCII to BCD and BCD to ASCII Conversions–BCD to Seven Segment LED Code Conversions–Binary to ASCII and ASCII to Binary Conversions–Multi byte Addition–Muti byte Subtraction–BCD Addition–BCD Subtraction–Multiplication and Division.

Text Books

- Malvino and Leech. (2003). *Digital Principles and Application*. (4th ed.,). Tata McGraw Hill. New Delhi.
- Vijayendran, V. (2004). *Fundamental of Microprocessor 8085*. S.Viswanathan Publishers. Chennai.

Reference Books

- Gaonkar, R.S. (1990).*Microprocessor Architecture, Programming and Applications with 8085/8080A*. Wilwy Eastern Limited.
- Anokh Singh and Chabra, A.K. (2005).*Fundamentals of Digital Electronics and Microprocessors.* (2nd ed.,). S. Chand & Co Ltd. New Delhi.
- Metha,V.K. (2001).*Principle of Electronics*. S. Chand & Company Ltd. New Delhi.

MAJOR PRACTICAL VI

UPHR605

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

Objectives:

To enable the Students

- Understand the theoretical concepts of electronics by experiments
- Execute the simple real time programs using microprocessor 8085

1. AND, OR, NOT Gates-Verification of Truth Tables.
2. Universal Building Block NAND and NOR gates.
3. Construction of Half and Full Adders using NAND Gate - Verification of Truth Tables.
4. Construction of RS, JK and D Flip Flop.
5. Program for Code Conversion (BCD to HEXA,ASCII to BCD)using 8085.
6. Program for Code Conversion (BCD to Binary,8-bit Subtraction using 8085.
7. Program for Code Conversion (HEXA to BCD, BCD to ASCII) using 8085.
8. Program for (Binary to BCD) and 8-bit Addition using 8085.

Text Book

- Srinivasan, N.Balasubramanian, S. and Ranganathan,R. (2006).*The Text Book of Practical Physics.* Sultan Chand &Sons.

Reference Books

- Ouseph, C.C. and Rangarajan,G. (1990). *A Text Book of Practical Physics*. Viswanathan Publishers – Part I.
- Gaonkar, R.S. (1990).*Microprocessor Architecture. Programming and Applications with 8085/8080A*. Wily Eastern Limited.

NANOPHYSICS

UPHO601

Semester :VI	**Credit : 4**
Category : Core Elective	**Hours/Week : 5**
Class & Major: III B.Sc Physics	**Total Hours :65**

Objectives:

To enable the students

- Provide basic ideas on Nanotechnology and Nanoscience.
- Introduce the Potential Applications of Nanotechnology.

UNIT-I NANOSCALE SYSTEMS **13 Hrs**

Length, Energy, and Time Scales – Quantum Confinement of Electrons in Semiconductor Nanostructures: Size Effect and Properties of Nanostructures–Top Down and Bottom Up Approach.

UNIT-II QUANTUM DOTS **13 Hrs**

Excitons and Excitonic Bohr Radius – Difference between Nanoparticles and Quantum Dots – Preparation through Colloidal Methods – Epitaxial Methods– MOCVD and MBE Growth of Quantum Dots –Spectroscopy of Quantum Dots: Absorption and Emission Spectra –Photo Luminescence Spectrum –Optical Spectroscopy.

UNIT-III NANOTUBES **13 Hrs**

Single Walled and Multi Walled Nanotubes (SWNT and MWNT) –Synthesis and Purification –Synthesis of Carbon Nanotubes –Pyrolysis Technique –Arc–Discharge Method – Nanowires – Preparation – VLS mechanism of Growth –Self Assembled Monolayers – Electrochemical Techniques.

UNIT-IV CHARACTERIZATION **13 Hrs**

SEM– Principle of Transmission Electron Microscopy (TEM) and High Resolution TEM– Principle and Working of Atomic Force Microscopy (AFM) and Scanning Probe Microscopy (SPM) –Near Field Scanning Optical Microscopy –Applications to Nanostructures.

UNIT-V NANOTECHNOLOGY **13 Hrs**

Applications of Nanoparticles, Quantum Dots, Nanotubes and Nanowires for Nano device Fabrication –Nanoparticles based Solar Cells and Quantum Dots based White LEDs – CNT based Transistors.

Text Book

- Timp, G.(1999). *Nanotechnology.* AIP Press. Springer-Verlag. Editor. New York.

Reference Books

- Edelstein, A.S. (1996). *Nanomaterials Synthesis Properties and Applications.* A.S Edelstein. IOP Publishing. UK.
- Hari Singh, N. (2002). *Nano structured Materials and Nanotechnology*. Concise Edition. Academic Press. USA.
- Dinardo, J.Weinheim, (2000). *Nanoscale Characterization of Surfaces & Interfaces*. Wiley-VCH.(2nded,). Cambridge.

ASTROPHYSICS

UPHO602

Semester :VI **Credit : 4**
Category : Core Elective **Hours/Week : 5**
Class & Major: III B.Sc Physics **Total Hours :65**

Objectives:

To enable the students

- Understand basis ideas of Astrophysics and its measurements.
- Analyze the concepts of Stellar Evolution and Solar Systems.
- Acquire the knowledge of Galaxies and its Formations.

UNIT-I NATURE OF ASTROPHYSICS 13 Hrs

The Nature of Astrophysics, Scale of the Universe, Angular Measure, Parallax, Inverse Square Law of Light and the Definition of Flux, Brightness and the Magnitude system– Magnitudes and Colors, Distance Modulus, Electromagnetic Radiation, Black Body Radiation, Spectroscopy –Kirchhoff's Law.

UNIT-II SOLAR SYSTEM 12 Hrs

Surface Features of the Sun in White and Monochromatic Light, Internal Structure, Photosphere – Sunspots and Magnetic Fields on the Sun –Solar Activity, Planets and their Satellites –Surface Features, Internal Structure, Atmosphere and Magnetic Fields of Earth, Moon and Planets – Origin of Solar Systems.

UNIT-III STELLAR SPECTRA 15 Hrs

HR Diagram, HD & MK Spectra Classification of Stellar Spectra –Radiations Law and Basic Ideas of Spectral Lines Formation – Explanation of Stellar Spectra in terms of Boltzmann and Saha Equation.

UNIT-IV STELLAR EVOLUTION 12 Hrs

Stellar Structure, Nuclear Reactions, HSEQ, Radiation Transport –Stellar Evolution, Degeneracy Pressure, Mass– Limits for Stars – More Stellar Evolutions – High Mass Stars and Compact Objects, Supernova and Stellar Clusters, Inter Stellar Medium.

UNIT-V THEORIES OF UNIVERSE 13 Hrs

The Milky Way –Black Holes, White Dwarfs and Neutron Stars – Other Galaxies – Clusters of Galaxies, the Hubble Law – Cosmology and the Big Bang Theory.

Text Books

- Krishnasamy, K.S. (2002). *Astrophysics a Modern Perspectives*. Reprint New Age International (P) Ltd. New Delhi.
- Baidyanath B. (2001). *An Introduction to Astrophysics*. Prentice Hall of India Private Ltd. New Delhi. 2nd Printing.
- Murugasen, R. (2003). *Modern Physics*. S. Chand& Co Ltd. (11th Revised ed.,). New Delhi.

Reference Books

- Kumaravelu, S. (1993). *Astronomy*. Janki Calendar Corporation. Sivasakthi.
- Baker and Fredrick, (1964). *Astronomy*. (9th ed.,). Van No Strand Rein Hold &Co. New York.

FUNCTIONAL MATERIALS

UPHO603

Semester	**: VI**	**Credits**	**: 4**
Category	**: Core Elective**	**Hours/Week**	**: 5**
Class&Major:	**III B.Sc Physics**	**Total Hours**	**: 65**

Objectives:

To enable the students

- Acquire the Knowledge about the Properties of Functional Materials.
- Analyze the Properties of Different Materials.
- Apply the Concepts of Materials in Different Applications.

UNIT - I OPTICAL MATERIALS 11 Hrs

Introduction to Optical Materials – Absorption and Emission Process– Luminescence –Types of Luminescence (Qualitative) – Mechanism of Fluorescence and Phosphorescence Process – Quantum Efficiency (Statement only) - Phosphors – LED (Principle, Construction and Working) –White LED –Applications.

UNIT – II SUPERCONDUCTING MATERIALS 14 Hrs

Introduction to Superconductivity – Occurrence of Superconductivity – Transition Temperature –Properties – BCS Theory – Type I and II Superconductors – High Temperature Superconductors – Structure and Properties of $YBa_2Cu_3O_{9-X}$ and $HgBa_2CaCuO_6$Compounds – Applications – SQUID, Cryotron, Magnetic Levitation – Other Applications.

UNIT – III DIELECTRIC MATERIALS 14 Hrs

Dielectric Materials – Types – Local (Internal) Field – Classsius–Mossotti Relation– Dielectric Breakdown – Dielectric Loss – Piezoelectric, Pyroelectric, Ferroelectric, Thermoelectric Materials – Applications –Super capacitors and Transformer.

UNIT – IV BIOMATERIALS 13 Hrs

Introduction to Biomaterials – Physiochemical Parameters of Biomaterials – Concepts of Biocompatibility – Types – Biometals and Alloys – Bio Glass and Bioglass Ceramics – Biopolymer and Bio Composites – Hydroxyapatite and Tricalcium Phosphate-Properties and Application.

UNIT –V MODERN FUNCTIONAL MATERIALS **13 Hrs**

Properties and applications of Electro–Optic Materials – Magneto–Optic Materials – Photoconductive Polymers – Carbon Nanotubes (Single and Multi-Walls) – Composite Materials – Particle and Fibre Reinforced Composite Materials and its Applications.

Text Books

- Rajendiran, V. (2015). *Material Science*. Tata McGraw Hill.
- Ragavan, V. (2013). *Materials Science and Engineering*. PHI Learning Private Ltd.

Reference Books

- Kasab, S.O. (2015).*Principles of Electronic Devices.* Tata McGraw Hill.
- William D. Callister, David G. Rethwisch. (2013). *Materials Science and Engineering.* Wiley-India.
- Palanisamy, P.K. (2010).*Materials Science*. Scitech Publications (India).

III and IV EVALUATION COMPONENTS OF CIA

Semester	Category	Course Code	Course Title	Component-III	Component-IV
V	Core VIII	UPHM501	Quantum Mechanics and Relativity	Problem Solving	Problem Solving
	Core IX	UPHM505	Basic Electronics	Seminar	Model display
	Core X	UPHM506	Solid State Physics	Poster Presentation	Seminar
VI	Core XII	UPHM609	Numerical Methods and Basic Computational Physics	Assignment	Problem solving
	Core XIII	UPHM611	Nuclear and Radiation Physics	Poster Presentation	Seminar
	Core XIV	UPHM612	Material Science	Seminar	Poster Presentation
	Core XV	UPHM613	Digital Electronics	Model Display	Seminar
	Major Optional	UPHO601/ UPHO602/ UPHO603	Nanophysics/ Astrophysics/ Functional Materials	Seminar	Poster Presentation