DEPARTMENT OF PHYSICS

PREAMBLE

UG: Programme Profile and Syllabi of Courses offered in the V Semester along with Evaluation Components III & IV (With effect from 2021-2024 batches onwards)

PROGRAM PROFILE: B.Sc., Physics

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO No. Upon completion of these courses the undergraduate would have

PSO-1 Understand, identify basic principles and concepts of various branches of Physics, correlate and solve the problems in the field of core and applied Physics.

PSO-2 Demonstrate the acquired knowledge of Physics on various scientific issues.

PSO-3 Design various experiments, electronic circuits investigate and become capable problem solvers, using mathematical, conceptual and hands on skills.

PSO-4 Apply analytical abilities acquired from the classroom / laboratory and promote scientific ideas, harness renewable and nonconventional energy resources.

PSO-5 Appreciate their experiential learning beyond the classroom; construct logical arguments, using technical language, develop programming skills, approach open-ended problems and innovate solutions.

PSO-6 Secure jobs in banks, in the field of Education, and in industries which require Scientific and Engineering knowledge.

PSO-7 Gain knowledge and skill about the electric & electronic circuits design development.

Semester	Part	Category	Course code	Course Title	Previous Course Code	Contact Hours/ Week	Credit Min/Max
I	I	Languages / AECC – II Tamil/ Hindi/ French	UTAL107/ UTAL108	Basic Tamil I/ Advanced Tamil I	UTAL105/ UTAL106/ UHIL101/ UFRL101	5	3/4
	II	Communicative English /AECC – I	UENL109/ UENL110	English for Communication (Stream – I)/ English for Communication (Stream – II)	UENL107/ UENL108	5	3/4
	III	Major Core (DSC) – I	UPHM106	Properties of Matter	-	4	4
		Major Core (DSC) – II	UPHM107	Mechanics	UPHM103	5	5
		Major Core (DSC) – III	UPHR102/ UPHR202	Major Practical I	-	3	2
		Allied (GE) – I	UMAA114	Allied Mathematics I	UMAA104	6	5
		PE	UPEM101	Professional English I	-	6	4
	IV	Value Education (SEC)			-	2	1
					TOTAL	**36**	**27/29**

II	I	Languages / AECC – II Tamil/ Hindi/ French	UTAL20/ UTAL208	Basic Tamil I/ Advanced Tamil I	UTAL205/ UTAL206 UHIL201/ UFRL201	5	3/4
	II	Communicative English /AECC – I	UENL209/ UENL210	English for Communication (Stream – I)/ English for Communication (Stream – II)	UENL207/ UENL208	5	3/4
	III	Major Core (DSC) – IV	UPHM204	Thermal and Statistical Physics	UPHM203	4	4
	III	Major Core (DSC) – V	UPHM205	Optics	UPHM302/ UPHM406	4	4
	III	Major Core (DSC) – VI	UPHR203/ UPHR101	Major Practical II	-	3	2
	III	Allied (GE) - I	UMAA222	Allied Mathematics II	UMAA212	6	5
	III	PE	UPEM201	Professional English I	-	6	4
	III	Internship	UPHI201	Internship / Field Work / Field Project	-	30 Hours	-/1
	IV	NME (Skill Enhancement Course)			-	3	2
	V	Extension Programme/ Physical Education/NCC	-	-	-	-	1/2
					TOTAL	**36**	**28/32**
III	I	Languages / AECC – II Tamil/ Hindi/ French	UTAL307/ UTAL308	Basic Tamil I/ Advanced Tamil I	UTAL305/ UTAL306/ UHIL301/ UFRL301	5	3/4
	II	Communicative English /AECC – I	UENL309/ UENL310	English for Communication (Stream – I)/ English for Communication (Stream – II)	UENL307 / UENL308	5	3/4
	III	Major Core (DSC) – VII	UPHM305	Electricity and Magnetism	UPHM402	5	4
	III	Major Core (DSC) – VIII	UPHM304	Mathematical Physics	UPHM509	4	3
	III	Major Core (DSC) – IX	UPHR305	Major Practical III	-	3	2
	III	Allied (GE) - III	UCSA306	Computational Physics with Python	-	3	3
	III	Allied (GE) - IV	UCSR310	Computational Physics with Python Lab	-	3	2
	IV	Value Education (SEC)	-	-	-	2	1
					TOTAL	**30**	**21/23**

IV	I	Languages / AECC – II Tamil/ Hindi/ French	UTAL407/ UTAL408	Basic Tamil I/ Advanced Tamil I	UTAL405/ UTAL406/ UHIL401/ UFRL401	5	3/4
	II	Communicative English /AECC – I	UENL409/ UENL410	English for Communication (Stream – I)/ English for Communication (Stream – II)	UENL407/ UENL408	5	3/4
	III	Major Core (DSC) – X	UPHM407	Atomic Physics	-	6	4
	III	Major Core (DSC) – XI	UPHR405	Major Practical IV	-	3	3
	III	Allied (GE) -V	UCHA401/ UCHA402/ UCHA403	Chemistry for Physics	-	3	3
	III	Allied (GE) - VI	UCHA402/ UCHR403	Volumetric and Organic Analysis-I	-	3	2
	III	Internship	UPHI401	Internship / Field Work / Field Project	-	30 Hours	-/1
	IV	NME (Skill Enhancement Course)			-	3	2
	IV	Soft Skill (SEC)			-	2	1
	V	Extension Programme/ Physical Education/NCC			-	-	-/2
					TOTAL	**30**	**21/26**
V	III	Major Core (DSC) – XII	UPHM507	Quantum Mechanics and Relativity	UPHM501	5	5
	III	Major Core (DSC) – XIII	UPHM508	Basic Electronics	UPHM505	4	4
	III	Major Core (DSC) – XIV	UPHM509	Solid State Physics	UPHM506/ UPHM608	4	4
	III	Major Elective (Discipline Specific Elective) - XV	UPHO501/ UPHO502	Medical Physics / Energy Physics	-	4	4
	III	Major Core Practical (DSC) – XVI	UPHR503	Major Practical V	-	3	3
	III	Major Core (DSC) – XVII	UPHP501/ UPHP502	Project / Instrumentation Techniques	-	5	4/5
	III	Online Course		NPTEL	-	3	½
	IV	Value Education (SEC)			-	2	1
					TOTAL	**30**	**26/28**

VI	III	Major Core (DSC) – XVIII	UPHM609	Numerical methods and Basic Computational Physics	-	5	4
	III	Major Core (DSC) – XIX	UPHM611	Nuclear and Radiation Physics	-	5	4
	III	Major Core (DSC) – XX	UPHM612	Material Science	-	5	4
	III	Major Core (DSC) – XXI	UPHM613	Digital Electronics	-	5	4
	III	Major Core (DSC) – XXII	UPHR605	Major Practical VI	-	3	3
	III	Major Elective (Discipline Specific Elective) - XXIII	UPHO601/ UPHO603/ UPHO604	Nanophysics/ Functional Materials/ Astrophysics and Special Theory of Relativity	-	5	4
	III	Viva Voce	UPHM610	Comprehensive Viva Voce	-	-	1
	III	Internship	UPHI601	Internship / Field Work / Field Project	-	30 Hours	-/1
	IV	Soft Skill (SEC)			-	2	1
	V	Extension Program - me/Physical Education/NCC			-	-	-/2
	V	Extension Programme	UROX601	Rural Outreach Programme	-	30 Hours	-/1
					TOTAL	**30**	**25/29**
					GRAND TOTAL	**192**	**148/167**

LIST OF COURSES OFFERED TO OTHER DEPARTMENTS

NON-MAJOR ELECTIVES

Semester	Part	Category	Course Code	Course Title	Previous Course Code	Contact Hours/ Week	Credit Min/Max
II	IV	Non Major Elective (Skill Enhancement Course)	UPHE202	Applied Physics	-	3	2
			UPHE203	Biomedical Instrumentation	-	3	2
			UPHE204	Electrical Appliances	-	3	2
			UPHE205	Telecommunication System	UPHE304/ UPHE503	3	2
			UPHE206	Servicing and maintenance of home appliances	UPHE303	3	2

COURSES OFFERED TO OTHER DEPARTMENTS

Semester	Part	Category	Course Code	Course Title	Previous Course Code	Contact Hours/ Week	Credit Min/ Max
III	III	Allied(GE) – V	UPHA305	Electronics for Computer Science	-	3	3
III	III	Allied(GE) – VI	UPHR305	Electronics Practical for Computer Science	-	3	2
IV	III	Allied(GE) – VII	UPHA402	Electronics for Mathematics	-	3	3
IV	III	Allied(GE) – VIII	UPHR402	Electronics Practical for Mathematics	-	2	2
IV	III	Allied (GE) – IX	UPHA403	Digital Electronics for Computer Science	-	3	3
IV	III	Allied (GE) – X	UPHR403	Digital Electronics Practical for Computer Science	-	3	2

Experiential Learning (Mandatory)

Course Mapping				Collaborating Agency - MSME		
Semester	**Course Code**	**Course Title**	**Assessment**	**Course Title**	**Hour / Days/ Month**	**Mode of Evaluation**
IV	UPHM508	Basic Electronics	Component IV	PCB Designing	4 Days	Reflection

QUANTUM MECHANICS AND RELATIVITY

UPHM507

Semester : V **Credit : 5**
Category : Major Core (DSC) – XII **Hours/Week :5**
Class & Major: III B.Sc Physics **Total Hours : 65**

Course Objectives

CO No.	To enable the students
CO-1	Understand the concept of quanta and its consequences in the microscopic world.
CO-2	Familiarize the new mathematical tools such as operators and linear vector space required for venturing into the realm of quantum mechanics and to introduce Schrodinger wave equation.
CO-3	Integrate the use of Schrodinger wave equation through some simple one-dimensional problems and their solutions.
CO-4	Know the concepts of Special Theory of Relativity.
CO-5	Expose the Applications of Quantum Mechanics and Relativity.

UNIT- I FOUNDATIONS OF WAVE MECHANICS **12 Hours**

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

UNIT -II SCHRODINGER EQUATION **13 Hours**

Schrodinger Equation – Physical Interpretation of Wavefunction– Probability Current Density –Expectation Values–Ehrenfest Theorem –Eigenfunction and Eigenvalue –Eigenvalue Equation –Orthogonal and Normalized Wavefunction.

UNIT- III APPLICATIONS OF SCHRODINGER EQUATION **14 Hours**

Free Particle –Particle in a Bound State – Eigenfunctions and Eigenvalues 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 RELATIVITY THEORY **13 Hours**

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 –Variation of Mass with Velocity – Mass– Energy Equivalence – Introduction to General Theory of Relativity.

UNIT-V APPLICATIONS OF QUANTUM MECHANICS **13 Hours**

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

Text Books

- Murugeshan, R. & Sivaprasath Kiruthiga. (2017). *Modern Physics. (18th Ed.).* S.Chand & Company Ltd. New Delhi.
- G. Aruldhas. (2008). *Quantum Mechanics* – (2nd Ed). PHI.
- Hugh D. Young and Roger A. Freedman. (2015). *Sears & Zemansky's University Physics with Modern Physics. (14th Ed.).*
- Steven Weinberg. (2021). *Foundations of Modern Physics*. Cambridge University Press.
- Mathews, P.M. (2010). *A Text Book of Quantum Mechanics*, Tata McGraw-Hill. New Delhi.

Reference Books

- Albert Maxwell, Quantum Mechanics, *Independently Published, paperback – Large Print*, September 6, 2021, ISBN-13 : 979-8472288415.
- Jacob Dunningham, and Vlatko Vedral. (2010). *Introductory Quantum Physics and Relativity. World Scientific*.
- Ghatak and Loganathan, (2004). *Introduction to Quantum Mechanics*. Macmillan India Ltd. India.
- P.M. Mathews and K. Venkatesan. (2010). *A Textbook of Quantum Mechanics. (2nd Ed).* Tata McGraw Hill. PVT.
- K.D. Krori. (2012). *Fundamentals of Special and General Relativity*, PHI.

e-Resources

- https://www.fisica.net/mecanica-quantica/Griffiths%20-%20Introduction%20to%20quantum%20mechanics.pdf
- https://www.amazon.in/Relativity-Quantum-Mechanics-Principles-Universe/dp/1925729338

Course Outcomes:

CO No.	On completion of the course the student will be able to	Bloom's Level
CO-1	Acquire fundamental knowledge of quanta of the microscopic world.	K1 & K2
CO-2	Understand the Mathematical Tools into the realm of Wave mechanics.	K3
CO-3	Integrate the use of Schrodinger wave equation through some simple one-dimensional problems and their solutions.	K4
CO-4	Expose the Applications of Quantum Mechanics and Relativity.	K1 & K3
CO-5	Adopt the concepts of Special Theory of Relativity.	K6

BASIC ELECTRONICS

UPHM508

Semester : V **Credit : 4**
Category : Major Core (DSC) – XII **Hours/Week : 4**
Class & Major: III B.Sc Physics **Total Hours : 52**

Course Objectives:

CO No.	To enable the students
CO-1	Understand the concepts of semiconductor devices.
CO-2	Realize the behavior of special purpose of Transistors.
CO-3	Demonstrate the Circuits for Rectifiers and Multivibrators.
CO-4	Verify the Circuits of Oscillators using basic Components.
CO-4	Explore the Construction and Working of an Operational Amplifier.

UNIT I INTRODUCTION TO SEMICONDUCTOR **10 Hours**

Classification of Solids in terms of Forbidden Energy Gap –Semiconductor Diode – Characteristics–Zener Diode– Working and Output Characteristics–Voltage Stabilization using Zener Diode.

UNIT II TRANSISTOR CIRCUITS **10 Hours**

Transistor CB, CE, CC Configurations-Common Emitter Transistor as an Amplifier - DC and AC Load Line Analysis - Transistor Biasing - Stabilization - Base Resistor Method- Feedback Resistor Method - Voltage Divider Bias Method.

UNIT III RECTIFIERS AND MULTIVIBRATORS **11 Hours**

Half–Wave and Full–Wave Bridge Rectifiers–Output and Efficiency of Full Wave Rectifier – Expressions for Efficiency and Ripple Factor –Multivibrators – Types of Multivibrators– Astable, Monostable, Bistable Multivibrator – Circuit Details and Operations.

UNIT IV CIRCUIT ANALYSIS AND OSCILLATORS **11 Hours**

Wave– Shaping Circuits: Differentiating Circuit – Output Waveforms – Integrating Circuit – Output Waveforms – Clipping and Clamping Circuits–Fundamental Principles of Oscillators – Concept of Positive Feedback – Types of Oscillators – Hartley, Colpitts, Phase Shift and Wien Bridge Oscillators.

UNIT V OPERATIONAL AMPLIFIERS **10 Hours**

Introduction – Characteristics of an Ideal OP–AMP – CMRR – Slew Rate – **Input/Output Offset Voltages** - Inverting/Noninverting Amplifiers - Adder and Difference Amplifiers– Differential Amplifier – Integrator, Voltage Follower, Comparator.

Text Books

- Hugh D. Young and Roger A. Freedman. (2015). *Sears & Zemansky's University Physics with Modern Physics. (14th Ed.).*
- Chattopadhyay, D. & Rakshit, P.C. (2015). *Foundations of Electronics*, New Age International Publishers.
- Murugeshan, R. & Sivaprasath Kiruthiga. (2017). *Modern Physics. (18th Ed.).* S.Chand & Company Ltd. New Delhi.

Reference Books

- Gupta & Kumar. (2012). *Hand book of Electronics*. Pragati Prakhasan, Meerut.
- Theraja, B.L. (2016). *Basic Electronics.(Solid State)* in multicolor ed., S. Chand & Company Ltd. New Delhi.
- Ramakant A. Gayakwad. (2015). *Operational Amplifiers and Linear Integrated Circuits*. Pearson Education. (4th Ed.). India.
- Jacob Millman; Christos C Halkias; Chetan D Parikh. (2010). *Millman's Integrated Electronics : Analog and Digital Circuits and Systems. (2nd Ed.).* Tata McGraw – Hill Education. New Delhi.

e-Resources

- https://books.google.co.in/books?id=GyZyhuY4SngC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
- Basic-Electronics-D-P-Kothari/dp/9332901589

Course Outcomes

CO No.	On completion of the course the student will be able to	Bloom's Level
CO – 1	Attain basic concepts of semiconductors.	K1 & K2
CO – 2	Understand the transistor and its types.	K3 & K4
CO – 3	Establish Rectifier and Multivibrator.	K1 & K3
CO – 4	Display transistors in circuit, Oscillator.	K5
CO – 5	Execute the Differentiator, Integrator, Adder, Subtractor using Operational Amplifier.	K4 & K6

SOLID STATE PHYSICS

UPHM509

Semester : V **Credit : 4**
Category : Major Core (DSC) – XIV **Hours/Week : 4**
Class & Major : III B.Sc Physics **Total Hours : 52**

Course Objectives:

CO No.	To enable the students
CO – 1	Demonstrate an understanding of the crystal lattice and how the main lattice types are described.
CO – 2	Formulate the theory of X-ray diffraction in the reciprocal lattice (k-space) formalism and apply this knowledge to generalize the formulation for matter waves.
CO – 3	Analyze the Electron Theory of Metals and its Applications.
CO – 4	Classify the Mechanical Properties of Metals with Merits and Demerits.
CO – 5	Expose the concept of Magnetic and Dielectric Materials.

UNIT-I (a) CLASSIFICATION OF MATERIALS **10 Hours**

Classification of Solids – Types of Bonds and their Energies – Bond Formation Mechanism – Ionic and Covalent Bonds – Thermal and Electric Materials – Smart Materials.

(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 II CRYSTAL STRUCTURE **10 Hours**

Basics of Crystallography – 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.

UNIT III DIFFRACTOMETRY **11 Hours**

X ray Spectrum - Moseley's Law - Diffraction of X-Rays by Crystals - Bragg's Law in One Dimension - Experimental Method in X-ray Diffraction – Laue's Method, Rotating Crystal Method - Powder Photograph Method – Reciprocal Lattice – Brillouin Zone.

UNIT-IV ELECTRON THEORY OF METALS **10 Hours**

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-V MAGNETIC MATERIALS AND DIELECTRICS **11 Hours**

Types of Magnetic Materials – Magnetic Permeability, Magnetization, Susceptibility, Electric Current in Atoms – Bohr Magneton– Electron Spin – Magnetic Moment due to Nuclear Spin – 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

- Hugh D. Young and Roger A. Freedman. (2015). *Sears & Zemansky's University Physics with Modern Physics. (14th Ed.).*
- Pillai, S.O. (2020). *Solid State Physics*, New Age International Private Limited.
- Gupta,R.B. (2001). *Material Science for AMIE*, Umesh Publications.
- Arumugam, M. (2018). *Material Science*, Anuradha Agencies.

Reference Books

- Kittel, C. (2012). *Introduction to Solid State Physics*, Wiley. (8thEd.).
- S.O. Pillai. (2012). *Rudiments of Materials Science*, New Age International Private Limited.
- Raghavan, V. (2015), *Materials Science and Engineering a First Course*, Prentice Hall of India. Learning private Limited (6th ed.)

e-Resources

- http://metal.elte.hu/~groma/Anyagtudomany/kittel.pdf
- https://www.wiley.com/en-us/Introduction+to+Solid+State+Physics%2C +8th+Edition-p-9780471415268

Course Outcomes:

CO No.	On completion of the course the student will be able to	Bloom's Level
CO – 1	Know the types of materials and mechanical properties of metals.	K1 & K2
CO – 2	Understand the basic concepts of Crystal structures.	K3
CO – 3	Recognize the Importance of X-Ray and diffraction concept.	K4
CO – 4	Analyze the effect of electrons in different kind of materials using various theories like classical, quantum.	K1 & K5
CO – 5	Manage the magnetic and dielectric materials with its uses.	K4 & K6

MEDICAL PHYSICS
UPHO501

Semester : V **Credit : 4**
Category : Major Elective (DSE) - XV **Hours/Week : 4**
Class & Major: III B.Sc Physics **Total Hours : 52**

Course Objectives:

CO No.	To enable the students
CO – 1	Understand the basics of X-rays and its Applications.
CO – 2	Realize the importance of radiation effect and safety.
CO – 3	Investigate the components of biomedical instrumentation and its Applications.
CO – 4	Categorize the image processing for medical physics.
CO – 5	Interpret the application of Laser in Medical field.

UNIT-I: X-RAYS PRODUCTION **10 Hours**

Introduction to X-Ray - X-ray tube design - tube cooling - stationary mode - Rotating anode X-ray tubes - Tube rating - quality and intensity of X-ray. X-ray generator circuits - half wave and full wave rectification - filament circuit - kilo voltage circuit - high frequency generator - exposure timers - HT cables.

UNIT –II: RADIATION SAFETY **12 Hours**

Introduction to Radioactivity-Artificial and natural - radioactivity -Physical features of radiation-units of radiation- conventional sources of radiation, Interaction of different types of radiation with matter -penetration power in living cells-radiation damage to the cell-effect of radiation on cells -radiation dosimetry.

UNIT –III: BIOMEDICAL INSTRUMENTATION **10 Hours**

Development of biomedical instrumentation-biometrics-introduction to the man-instrument system-components of man-instrument system-transducers for biomedical applications-biomedical computer applications-computer analysis of ECG-computerized axial tomography (CAT) Scanners.

UNIT-IV: MEDICAL IMAGING PHYSICS **10 Hours**

Radiological imaging - Radiography - Filters - grids - cassette - X-ray film - fluoroscopy - computed tomography scanner - principle function -display - generations – mammography-ultrasound imaging - magnetic resonance imaging.

UNIT-V LASERS IN MEDICINE **10 Hours**

Production of laser- effects of laser radiation on tissues - photo thermal effects-photochemical effects –photodynamic therapy-Laser applications in therapy and diagnosis-opthalmology-Fibreoptic endoscopy and dentistry-Laser as a beautician's tool-laser hazards-biological effects.

Text Books

- Ervin B. Podgorsak, (2016). *Radiation Physics for Medical Physicists (Graduate Texts in Physics)*, (3rd Ed.). Springer.
- P.K. Bajpai. (2010). *Biological Instrumentation and Methodology*, S. Chand & Co.
- K. Thayalan, (2017), *Basic Radiological Physics*, Jayapee Brothers Medical Publishers Pvt. Ltd. New Delhi.
- Bushberg, J.T., Anthony Seibert .J, Leidholdt, E.M, Bonne J.M *The Essential Physics of Medical Imaging: Lippincot*, Williams and Wilkins. Second Edition (2011).
- John G. Webster. and A.J. Nimunkar (2020), *Medical Instrumentation Applications and Design*, John Wiley and Sons. (5th Ed.).

Reference Books

- Biomedical instrumentation-Leslie Cromwell, Fred J. Weibel-Erich (2021) A.Pfeiffer-Pearson Publications (2nd Ed.).
- R.W. Wayanant. (2001). Lasers in Medicine. (1st Ed.). Plenum Publishing Co.
- Leslie Cromwell. (2010). Biomedical Instrumentation and Measurements. PHI Learning. (2nd Ed.).
- Ramesh Chandra, (2011). *Nuclear Medicine Physics: The Basics – Lippincot*, Williams and Wilkins.

e- Resources

- https://link.springer.com/book/10.1007/978-3-319-61540-0
- https://www.routledge.com/Medical-Physics-and-Biomedical-Engineering/Brown-Smallwood-Barber-Lawford-Hose/p/book/9780750303682

Course Outcomes:

CO No.	On completion of the course the student will be able to	Bloom's Level
CO – 1	Attain basic concepts of X-Ray in circuits.	K1 & K2
CO – 2	Understand the effect of radiation in living systems.	K3
CO – 3	Establish the biomedical instrumentation in ECG, CAT.	K1 & K3
CO – 4	Demonstrate the various scanning process in medical fields.	K5
CO – 5	Build the concept of laser application, hazards and biological systems.	K6

ENERGY PHYSICS
UPHO502

Semester : V **Credit : 4**
Category : Major Elective (DSE) - XV **Hours/Week : 4**
Class & Major: III B.Sc Physics **Total Hours : 52**

Course Objectives:

CO No.	To enable the students
CO – 1	Remember the concept of energy sources and its applications.
CO – 2	Understand the working principles of solar energy.
CO – 3	Integrate the photovoltaic generation, limitation and efficiency.
CO – 4	Detect the concepts of biomass energy in plant.
CO – 5	Expose the Applications of wind energy and other energy resources.

UNIT I INTRODUCTION TO ENERGY SOURCES 10 Hours

World's reserve of Commercial energy sources and their availability-India's production and reserves-Conventional and non-conventional sources of energy, comparison – Coal- Oil and natural gas –applications - merits and demerits – Renewable and Non-Renewable energy sources.

UNIT II SOLAR THERMAL ENERGY 10 Hours

Solar constant -Solar spectrum-Solar radiations outside earth's atmosphere –at the earth surface- on tilted surfaces -Solar Radiation geometry-Basic Principles of Liquid flat plate collector –Materials for flat plate collector -Construction and working- Solar distillation–Solar disinfection - Solar drying-Solar cooker (box type)-Solar water heating systems – Swimming pool heating.

UNIT III PHOTOVOLTAIC SYSTEMS 10 Hours

Introduction-Photovoltaic principle-Basic Silicon Solar cell- Power output and conversion efficiency-Limitation to photovoltaic efficiency-Basic photovoltaic system for power generation-Advantages and disadvantages-Types of solar cells-Application of solar photovoltaic systems.

UNIT IV WIND ENERGY AND TIDAL ENERGY 12 Hours

Wind Energy Conversion-Classification and description of wind machines, wind energy collectors-Energy storage- Energy from Oceans and Chemical energy resources-Ocean thermal energy conversion-tidal power, advantages and limitations of tidal power generation-Energy and power from waves- wave energy conversion devices.

UNIT V BIOMASS ENERGY 10 Hours

Introduction-Biomass classification- Biomass conversion technologies-Bio-gas generation-Factors affecting bio-digestion -Working of biogas plant- floating and fixed dome type plant -advantages and disadvantage of -Bio-gas from plant wastes-Methods for obtaining energy from biomass- Thermal gasification of biomass-Working of downdraft gasifier-Advantages and disadvantages of biological conversion of solar energy.

Text Books

- Rai G. D. (2021). *Solar Energy Handbook*. MLI Handbook Series.
- S. P. Sukhatme, J K. Nayak.(2017). *Solar Energy*. TMH. (4th Ed.).
- Kothari, D.P., K.C. Singal and Rakesh Ranjan. (2008). *Renewable Energy Sources and Emerging Technologies.* Prentice Hall of India.
- Kalogirou, S.A. (2013). *Solar Energy Engineering: Processes and Systems.* (2nd Ed.). Academic Press.

Reference Books

- Mukund R. Patel, Omid Beik. (2021). *Wind and Solar Power Systems: Design, Analysis, and Operation.* (3rd Ed.). CRC Press.
- Chetan Singh Solanki, (2011). *Solar Photvoltaics Fundamentals, Technologies and Applications.* (2nd Ed.). PHI Learning Private Limited.
- Rai G. D. (2010). *Non Conventional Energy Sources. 4th Edition,* Khanna Publishers.
- Jeffrey M. Gordon. (2013). *Solar Energy: The State of the Art. Earthscan*.
- Zobaa A.F. and Ramesh Bansal. (2011). *Handbook of Renewable Energy Technology. World Scientific.*

e- Resources

- https://www.routledge.com/The-Physics-of-Solar-Energy-Conversion/Bisquert/p/book/9781138584648
- https://www.google.co.in/books/edition/Renewable_Energy_Conversion_Transmission/lE1e4chSiSsC?hl=en&gbpv=1&printsec=frontcover

Course Outcomes:

CO No.	On completion of the course the student will be able to	Bloom's Level
CO – 1	Acquire fundamental knowledge of energy resources.	K1 & K2
CO – 2	Understand the solar thermal energy with its applications.	K3
CO – 3	Integrate the uses of photovoltaic solar cell.	K4
CO – 4	Expose the limitation, advantages, and applications of wind energy.	K1 & K3
CO – 5	Review the ideas of biomass energy using various methods.	K6

MAJOR PRACTICAL V

UPHR503

Semester : V **Credit : 3**
Category : Major Core Practical (DSC) – XVI **Hours/Week : 3**
Class & Major: III B.Sc Physics **Total Hours : 39**
Course Objectives:

CO No.	To enable the students
CO – 1	Know the concept of the Electronically equipments from experimental vision.
CO – 2	Tabulate the electronically experiments and its characteristics.
CO – 3	Compare the operational amplifier adder, subtractor, integrator and differentiator for day today life application.
CO – 4	Display the frequency characteristics by the RC coupled amplifier.
CO – 5	Experiment the uniqueness of the clipping and clamping circuits.

List of Experiments

1. Construct the V-I Characteristics of Zener Diode.
2. Verify the Characteristics of Transistor in CE Configuration.
3. Design Full Wave - Bridge Rectifier.
4. Construct the Voltage Stabilization of using Zener Diode.
5. Design the Operational Amplifier as Adder and Subtractor.
6. Design the Operational Amplifier as Integrator, Differentiator, and Voltage Follower.
7. Construct the NOR as Universal Gate.
8. Verify the Single stage Amplifier - Frequency Determination.
9. Demonstrate the Half Wave Bridge Rectifier.
10. Construct the Junction Diode – Characteristics.
11. Construct the NAND as a Universal Gate.
12. Construct the Half Adder and Full Adder.
13. Design the Clipping and Clamping Circuits.
14. Design the Operational Amplifier as Inverting and Non-Inverting Amplifier.
15. Demo on UV-Visible Spectrometer.
16. Demo on FT-IR Spectrometer.

Text Books

- Srinivasan, N. Balasubramanian, S and Ranganathan, R. (2006). *The Text Book of Practical Physics,* Sultan Chand & Sons.
- Andy Cooper. (2016). *Practical Electronics: A Complete Introduction. Teach Yourself*.
- S.L. Gupta and V.Kumar. (2017). *Practical Physics. Pragati Prakashan Meerut.*
- Dr Arunadevi Shantappa Birajdar. (2019). Text Book for UV-Visible Spectroscopy. Mahipublication.

Reference Books

- Ponnusamy, A. and Amalanathan, B. (2006). *Practical Physics.* Bright Publishers.
- Ian Sinclair. (2006). *Practical Electronics Handbook.* (6th Ed.). Elsevier.

- Ouseph, C.C. Rangarajan, G. (1996). *A The Text Book of Practical Physics*. Viswanathan Publishers.
- Sivasankar, B. (2012). *Instrumental Methods of Analysis*. Oxford University Press. New Delhi.
- Peter R. Griffiths. James A. De Haseth. James D. Winefordner. (2007). Fourier Transform Infrared Spectrometry. (2nd Ed.). Wiley-Interscience.

e-Resources

- https://www.niser.ac.in/sps/sites/default/files/basic_page/P242_BasicElectronics_Lab.pdf
- https://books.google.co.in/books/about/ELECTRONICS_LAB_MANUAL_VOLUME_2.html?id=Li57DwAAQBAJ&redir_esc=y

Course Outcomes:

CO No.	On completion of the course the student will be able to	Bloom's Level
CO – 1	Acquire the basics of Amplifier, Diode and Transistor.	K1 & K3
CO – 2	Demonstrate the Zener Diode, PN Junction and Rectifier.	K3
CO – 3	Apply the Significance of Electronical experiments in Practical Life.	K4
CO – 4	Integrate the idea of the Voltage stabilization and I-V characteristics.	K5
CO – 5	Manage the consequence of Junction Diode in day today life.	K3 & K6

PROJECT

UPHP501

Semester : V **Credit : 4**
Category : Major Core (DSC) – XVII **Hours/Weeks: 2 + 4**
Class &Major: III B.Sc Physics **Total Hours : 78**

Guidelines

- This course is offered as group project
- No. of students is limited from 3 to 4

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, Research proposal	10	-
3	Collection of Data / Experimentation & Analysis of Data / Experimentation result, Preparation of report	10	-
4	Research Publication	30	-
5	Project report	-	30
6	Viva voce	-	10
	Total	**60**	**40**

INSTRUMENTATION TECHNIQUES

UPHP502

Semester : V **Credit : 5**
Category : Major Core (DSC) – XVII **Hours/Weeks : 5**
Class & Major : III B.Sc Physics **Total Hours : 65**

Objectives:
To enable the students

- Understand the Concepts of Electromagnetic Radiation.
- Apply the Knowledge in Different Techniques.

UNIT- I ELECTROMAGNETIC RADIATION 13 Hours

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 12 Hours

IR Absorption – Spectroscopy –RAMAN Spectroscopy – Instrumentation Techniques for Analyzing Solid, Liquid and Gaseous samples – sample handling Techniques.

UNIT- III DIFFRACTION TECHNIQUES 13 Hours

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 14 Hours

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 13 Hours

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 & Co.

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.

III AND IV EVALUATION COMPONENTS OF CIA

Semester	Category	Course Code	Course Title	Component-III	Component-IV
V	Major Core (DSC) – XII	UPHM507	Quantum Mechanics and Relativity	Problem Solving	Seminar
	Major Core (DSC) – XIII	UPHM508	Basic Electronics	Seminar	Model Display
	Major Core (DSC) – XIV	UPHM509	Solid State Physics	Poster Presentation	Seminar
	Major Elective (Discipline Specific Elective) - XV	UPHO501	Medical Physics	Seminar	Poster Presentation
	Major Elective (Discipline Specific Elective) - XV	UPHO502	Energy Physics	Seminar	Model Display