



**ANNAVARAM SATHYAVATHI DEVI GOVERNMENT DEGREE COLLEGE  
FOR WOMEN**

(An Autonomous Institute accredited with NACC with "B" Grade in Cycle III)  
Church Square Park, Jagannaickpur, Kakinada, Andhra Pradesh

**Department of Physics**  
**SYLLABUS-AY 2023-24**

S. No	Semester	Paper	Title of the Paper
1	1	C-1	Essentials and Applications in Mathematical, Physical & Chemical Sciences
2	1	C-2	Advances in Mathematical, Physical & Chemical Sciences
3	2	C-3	Mechanics & Properties of Matter
4	2	C-4	Waves & Oscillations
5	3	III	Heat and Thermodynamics
6	4	IV	Electricity, Magnetism & Electronics
7	4	V	Modern Physics
8	5	VIB	Low Temperature Physics & Refrigeration
9	5	VIIB	Solar Energy & Applications
10	6		Long Internship

# DAPARTMENT OF PHYSICS

2023-24

## B.Sc. Honours Course Syllabus (Single Major) (w.e.f:2023-24A.B)

### SEMESTER-I

#### **COURSE I: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCE**

**Course Code: BSCM24101**

**Theory Credits: 3**

**3 hrs./week**

**COURSE OBJECTIVE:** The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

#### **Learning outcomes:**

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.
2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations
3. To Explain the basic principles and concepts underlying a broad range of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.
- 5 To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

**UNIT I: ESSENTIALS OF MATHEMATICS:** Complex Numbers: Introduction of the new symbol  $i$  – General form of a complex number – Modulus-Amplitude form and conversions  
Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles  
Vectors: Definition of vector addition – Cartesian form – Scalar and vector product and problems  
Statistical Measures: Mean, Median, Mode of a data and problems

**UNIT II: ESSENTIALS OF PHYSICS:** Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behavior of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

**UNIT III: ESSENTIALS OF CHEMISTRY:** Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

**UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:** Applications of Mathematics in Physics & Chemistry: Calculus , Differential Equations & Complex Analysis Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies. Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

**UNIT V: ESSENTIALS OF COMPUTER SCIENCE:** Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications. Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection

Recommended books:

1. Functions of one complex variable by John.B.Conway, Springer- Verlag.
2. Elementary Trigonometry by H.S.Hall and S.R.Knight
- 3.Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.
- 4.Basic Statistics by B.L.Agarwal, New age international Publishers
5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman
6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker
7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.

8. Physics for Technology and Engineering" by John Bird

9. Chemistry in daily life by Kirpal Singh

10. Chemistry of bio molecules by S. P. Bhutan 1

1. Fundamentals of Computers by V. Raja Raman

12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

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## SEMESTER-I

### COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

**Theory Credits: 4**

**5 hrs/week**

#### UNIT I:

**ADVANCES IN BASICS MATHEMATICS** Straight Lines: Different forms – Reduction of general equation into various forms – Point of intersection of two straight lines Limits and Differentiation: Standard limits – Derivative of a function – Problems on product rule and quotient rule Integration: Integration as a reverse process of differentiation – Basic methods of integration Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose of a matrix and determinants

#### UNIT II:

**ADVANCES IN PHYSICS:** Renewable energy: Generation, energy storage, and energy-efficient materials and devices. Recent advances in the field of nanotechnology: Quantum dots, Quantum Communication recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

#### UNIT III:

**ADVANCES IN CHEMISTRY:** Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

#### UNIT IV:

**ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY** Mathematical Modelling applications in physics and chemistry Application of Renewable energy: Grid Integration and Smart Grids, Application of nanotechnology: Nanomedicine, Application of biophysics: Biophysical Imaging, Biomechanics, Neuro physics, Application of medical physics: Radiation Therapy, Nuclear medicine Solid waste management, Environmental remediation- Green Technology, Water treatment.

#### UNIT V:

**Advanced Applications of computer Science** Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

**Recommended books:**

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah
11. Environmental Chemistry by Anil.K.D.E.
12. Digital Logic Design by Morris Mano
13. Data Communication & Networking by Bahrouz Forouzan.

## SEMESTER-II

### COURSE 3: MECHANICS AND PROPERTIES OF MATTER

2023-24

Theory Credits: 3

3 hrs./week

**COURSE OBJECTIVE:** The course on Mechanics and Properties of Matter aims to provide students with a fundamental understanding of the behaviour of physical systems, both in terms of mechanical motion and in terms of the properties of matter.

#### UNIT-I VECTOR ANALYSIS

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

#### UNIT-II MECHANICS OF PARTICLES

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

**UNIT-III MECHANICS OF RIGID BODIES AND CONTINUOUS MEDIA** Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, Precession of a top, Gyroscope, Precession of the equinoxes. Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio. Classification of beams, types of bending, point load, distributed load.

#### UNIT-IV CENTRAL FORCES

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equations of motion under a central force . Derivation of Kepler's laws. Motion of satellites

#### UNIT-V SPECIAL THEORY OF RELATIVITY

Galilean relativity, Absolute frames. Michelson-Morley experiment, The negative result, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.

#### REFERENCE BOOKS:

- 1) BSc Physics -Telugu Academy, Hyderabad
- 2) Mechanics - D.S. Mathur, Sulthan Chand & Co, New Delhi
- 3) Mechanics - J.C. Upadhyaya, Ramprasad & Co., Agra
- 4) Properties of Matter - D.S. Mathur, S.Chand & Co, New Delhi ,11th Edn., 2000 5. Physics Vol. I - Resnick-Halliday-Krane ,Wiley, 2001
- 5) Properties of Matter – Brijlal & Subrmanyam, S. Chand &Co. 1982
- 6) Dynamics of Particles and Rigid bodies– Anil Rao, Cambridge Univ Press, 2006 8. Mechanics-EM Purcell, Mc Graw Hill
- 7) University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
- 8) 10. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House. 11. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.

**SEMESTER-II**  
**COURSE 3: MECHANICS AND PROPERTIES OF MATTER**

**Practical Credits: 1 2hrs/week**

**Minimum of 6 experiments to be done and recorded**

1. Viscosity of liquid by the flow method (Poiseuille's method)
2. Young's modulus of the material of a bar (scale) by uniform bending
3. Young's modulus of the material a bar (scale) by non- uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle's viscometer method
7. Bifilar suspension –moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)



## SEMESTER-II

### COURSE 4: WAVES AND OSCILLATIONS

Theory Credits: 3

3hrs/week

#### UNIT-I

**Simple Harmonic oscillations** Simple harmonic oscillator and solution of the differential equation- Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of 'g', Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures

#### . UNIT-II

**Damped and forced oscillations** Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance

#### UNIT-III

**Complex vibrations** Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evolution of Fourier coefficients.

#### UNIT-IV

**Vibrating Strings and Bars** Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance. Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

#### UNIT-V

**Ultrasonics:** Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magneto strictive methods, detection of ultrasonics, determination of wavelength of ultrasonic waves. Applications and uses of ultrasonic waves.

## REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
3. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
4. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
5. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004
6. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

## SEMESTER-II

### COURSE 4: WAVES AND OSCILLATIONS

**Practical Credits: 1**

**2hrs/week**

. Minimum of 6 experiments to be done and recorded

Experiments

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

# **B.Sc. PHYSICS SYLLABUS UNDER CBCS**

## **For Mathematics Combinations**

[2022-25 Batch onwards]

### **II BSc – III SEMESTER**

#### **COURSE-III HEAT AND THERMIDYNAMICS**

**Work load:60 hrs per semester**

**4 hrs/week**

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#### **Course outcomes:**

*On successful completion of this course, the student will be able to:*

- ❖ *Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases*
- ❖ *Gain knowledge on the basic concepts of thermodynamics, the first and the second law of thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations.*
- ❖ *Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency*
- ❖ *Develop critical understanding of concept of Thermodynamic potentials, the formulation of Maxwell's equations and its applications.*
- ❖ *Differentiate between principles and methods to produce low temperature and liquefy air and also understand the practical applications of substances at low temperatures.*
- ❖ *Examine the nature of black body radiations and the basic theories.*
- ❖

#### **UNIT-I: Kinetic Theory of gases:**

**(12 hrs)**

Kinetic Theory of gases-Introduction, Maxwell's law of distribution of molecular velocities (qualitative treatment only) and its experimental verification, Mean free path, Degrees of freedom, Principle of equipartition of energy (Qualitative ideas only), Transport phenomenon in ideal gases: viscosity, Thermal conductivity and diffusion of gases.

**UNIT-II: Thermodynamics:****(12hrs)**

Introduction- Isothermal and Adiabatic processes, Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature and its identity with perfect gas scale, Second law of thermodynamics: Kelvin's and Clausius statements, Principle of refrigeration, Entropy, Physical significance, Change in entropy in reversible and irreversible processes; Entropy and disorder-Entropy of Universe; Temperature-Entropy (T-S) diagram and its uses ; change of entropy when ice changes into steam.

**UNIT-III: Thermodynamic Potentials and Maxwell's equations:****(12hrs)**

Thermodynamic potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Applications to (i) Clausius-Clayperon's equation (ii) Value of  $C_P - C_V$  (iii) Value of  $C_P/C_V$  (iv) Joule-Kelvin coefficient for ideal gases.

**UNIT-IV: Low temperature Physics:****(12hrs)**

Methods for producing very low temperatures, Joule Kelvin effect, Porous plug experiment , Joule expansion, Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Liquefaction of air by Linde's method, Production of low temperatures by adiabatic demagnetization (qualitative), Practical applications of substances at low temperatures.

**UNIT-V: Quantum theory of radiation:****(12 hrs)**

Black body and its spectral energy distribution of black body radiation, Kirchoff's law, Wein's displacement law, Stefan-Boltzmann's law and Rayleigh-Jean's law (Noderivations), Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh-Jean's law from Planck's law, Solar constant and its determination using Angstrompyroheliometer, Estimation of surface temperature of Sun.

**REFERENCE BOOKS:**

- ❖ BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- ❖ Thermodynamics, R.C.Srivastava, S.K.Saha&AbhayK.Jain, Eastern Economy Edition.
- ❖ Unified Physics Vol.2, Optics & Thermodynamics, Jai PrakashNath&Co.Ltd., Meerut
- ❖ Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
- ❖ Heat and Thermodynamics -N BrijLal, P Subrahmanyam, S.Chand& Co.,2012
- ❖ Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
- ❖ University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

### **Practical Course-III: Heat and Thermodynamics**

**Work load: 30 hrs**

**2 hrs/week**

#### **Minimum of 6 experiments to be done and recorded**

1. Specific heat of a liquid –Joule’s calorimeter –Barton’s radiation correction
2. Thermal conductivity of bad conductor-Lee’s method
3. Thermal conductivity of rubber.
4. Measurement of Stefan’s constant.
5. Specific heat of a liquid by applying Newton’s law of cooling correction.
6. Heating efficiency of electrical kettle with varying voltages.
7. Thermo emf- thermo couple - Potentiometer
8. Thermal behavior of an electric bulb (filament/torch light bulb)
9. Measurement of Stefan’s constant- emissive method
10. Study of variation of resistance with temperature - Thermistor.

# **B.Sc. PHYSICS SYLLABUS UNDER CBCS**

## **For Mathematics Combinations**

[2020-21 Batch onwards]

### **II Year B.Sc.-Physics: IV Semester**

#### **Course-IV: ELECTRICITY, MAGNETISM AND ELECTRONICS**

**Work load:60 hrs per semester**

**4 hrs/week**

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#### **Course outcomes:**

*On successful completion of this course, the students will be able to:*

- ❖ *Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.*
- ❖ *Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.*
- ❖ *Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.*
- ❖ *Develop an understanding on the unification of electric and magnetic fields and Maxwell's equations governing electromagnetic waves.*
- ❖ *Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits.*
- ❖ *Describe the operation of p-n junction diodes, zener diodes, light emitting diodes and transistors*
- ❖ *Understand the operation of basic logic gates and universal gates and their truth tables.*

## UNIT-I

### 1. Electrostatics: (6hrs)

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere and (ii) an infinite conducting sheet of charge, Deduction of Coulomb's law from Gauss law, Electrical potential–Equipotential surfaces, Potential due to a (i) uniformly charged sphere

### 2. Dielectrics: (6 hrs)

Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, Dielectric strength, Capacitance of a parallel plate condenser with dielectric slab between the plates, Electric displacement D, electric polarization P, Relation between D, E and P, Dielectric constant and electric susceptibility.

## UNIT-II

### 3. Magnetostatics: (6 hrs)

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and its application to Solenoid, Hall effect, determination of Hall coefficient and applications.

### 4. Electromagnetic Induction: (6 hrs)

Faraday's laws of electromagnetic induction, Lenz's law, Self induction and Mutual induction, Self inductance of a long solenoid, Mutual inductance of two coils, Energy stored in magnetic field, Eddy currents.

## UNIT-III

### 5. Alternating currents: (6 hrs)

Alternating current - Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

### 6. Electromagnetic waves-Maxwell's equations: (6 hrs)

Idea of displacement current, Maxwell's equations-Derivation, Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof), velocity wave equation using Maxwell's relations in vacuum.

## **Practical CourseIV:Electricity, Magnetism and Electronics**

**Work load: 30 hrs**

**2 hrs/week**

### **Minimum of 6 experiments to be done and recorded**

1. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –Sonometer.
4. Verification of Kirchoff's laws and Maximum Power Transfer theorem.
5. Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.
6. PN Junction Diode Characteristics
7. Zener Diode –V-I Characteristics
8. Zener Diode as a voltage regulator
9. Transistor CE Characteristics- Determination of hybrid parameters
10. Logic Gates- OR,AND,NOT and NAND gates. Verification of Truth Tables.
11. Verification of De Morgan's Theorems.
12. Construction of Half adder and Full adders-Verification of truth tables



## **B.Sc. PHYSICS SYLLABUS UNDER CBCS**

### **For Mathematics Combinations**

[2020-21 Batch onwards]

### **II Year B.Sc.-Physics: IV Semester**

#### **Course V: MODERN PHYSICS**

**Work load:60hrs per semester**

**4 hrs/week**

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#### **Course outcomes:**

*On successful completion of this course, the students will be able to:*

- ❖ *Develop an understanding on the concepts of Atomic and Modern Physics, basic elementary quantum mechanics and nuclear physics.*
- ❖ *Develop critical understanding of concept of Matter waves and Uncertainty principle.*
- ❖ *Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.*
- ❖ *Examine the basic properties of nuclei, characteristics of Nuclear forces, salient features of Nuclear models and different nuclear radiation detectors.*
- ❖ *Classify Elementary particles based on their mass, charge, spin, half life and interaction.*
- ❖ *Get familiarized with the nano materials, their unique properties and applications.*
- ❖ *Increase the awareness and appreciation of superconductors and their practical applications.*

#### **UNIT-I :**

##### **1. Atomic and Molecular Physics:(12 hrs)**

Vector atom model and Stern-Gerlach experiment, Quantum numbers associated with it, Angular momentum of the atom, Coupling schemes, Spectral terms and spectral notations, Selection rules, Intensity rules, Fine structure of Sodium D-lines, Zeeman effect, Experimental arrangement to study Zeeman effect; Raman effect, Characteristics of Raman effect, Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect.

## **UNIT-II:**

### **2. Matter waves & Uncertainty Principle: (12 hrs)**

Matter waves, de Broglie's hypothesis, Wave length of matter waves, Properties of matter waves, Davisson and Germer's experiment, Phase and group velocities, Heisenberg's uncertainty principle for position and momentum & energy and time, Illustration of uncertainty principle using diffraction of beam of electrons (Diffraction by a single slit) and photons (Gamma ray microscope), Bohr's principle of complementarity.

## **UNIT-III:**

### **3. Quantum (Wave) Mechanics:(12 hrs)**

Basic postulates of quantum mechanics, Schrodinger time independent and time dependent wave equations-Derivations, Physical interpretation of wave function, Eigen functions, Eigen values, Application of Schrodinger wave equation to (i) one dimensional potential box of infinite height (Infinite Potential Well).

## **UNIT-IV:**

### **4. Nuclear Physics:(12 hrs)**

*Nuclear Structure:* General Properties of Nuclei, Mass defect, Binding energy; *Nuclear forces:* Characteristics of nuclear forces- Yukawa's meson theory; *Nuclear Models:* Liquid drop model, The Shell model, Magic numbers; *Nuclear Radiation detectors:* G.M. Counter, Cloud chamber, Solid State detector; *Elementary Particles:* Elementary Particles and their classification.

## **UNIT-V:**

### **5. Nano materials:(7hrs)**

Nanomaterials – Introduction, Electron confinement, Size effect, Surface to volume ratio, Classification of nano materials– (0D, 1D, 2D); Quantum dots, Nano wires, Fullerene, CNT, Graphene (Mention of structures and properties), Distinct properties of nano materials (Mention-*mechanical, optical, electrical, and magnetic properties*); Mention of applications of nano materials: (*Fuel cells, Phosphors for HD TV*),

## **UNIT-5**

### **6. Superconductivity: (5 hrs)**

Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect, Isotope effect, Type I and Type II superconductors, BCS theory (elementary ideas only), Applications of superconductors

## REFERENCE BOOKS

- ❖ BSc Physics, Vol.4, Telugu Akademy, Hyderabad
- ❖ Atomic Physics by J.B. Rajam; S.Chand& Co.,
- ❖ Modern Physics by R. Murugesan and Kiruthiga Siva Prasath. S. Chand & Co.
- ❖ Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
- ❖ Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
- ❖ S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publ.Co.)
- ❖ K.K.Chattopadhyay&A.N.Banerjee, Introd.to Nanoscience and Technology(PHI LearningPriv.Limited).
- ❖ Nano materials, A K Bandopadhyay. New Age International Pvt Ltd (2007)
- ❖ Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, Baldev Raj, BB Rath and J Murday-Universities Press-IIM

## Practical Course V:Modern Physics

Work load: 30 hrs

2 hrs/week

### Minimum of 6 experiments to be done and recorded

1.  $e/m$  of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Determination of the Planck's constant using LEDs of at least 4 different colours.
5. Determination of work function of material of filament of directly heated vacuum diode.
6. Study of absorption of  $\alpha$ -rays.
7. Study of absorption of  $\beta$ -rays.
8. Determination of Range of  $\beta$ -particles.
9. Determination of M & H.
10. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
11. Energy gap of a semiconductor using junction diode.
12. Energy gap of a semiconductor using thermistor
13. GM counter characteristics

**A.S.D. Government Degree College for Women (A) Kakinada**  
**Department of Physics**  
**Semester-wise Revised Syllabus under CBCS, 2020-21**  
**Three-year B.Sc.**  
**Semester – V or VI**

Max Marks: 100+50

**Course 6B: LOW TEMPERATURE PHYSICS & REFRIGERATION**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:** Students after successful completion of the course will be able to

1. Identify various methods and techniques used to produce low temperatures in the Laboratory.
2. Acquire a critical knowledge on refrigeration and air conditioning.
3. Demonstrate skills of Refrigerators through hands on experience and learns about refrigeration components and their accessories.
4. Understand the classification, properties of refrigerants and their effects on environment.
5. Comprehend the applications of Low Temperature Physics and refrigeration.

**II. Syllabus:** *(Total Hours: 90 including Teaching, Lab, Field Training, Unit tests etc.)*

**UNIT-I PRODUCTION OF LOW TEMPERATURE (10 hrs)**

Production of low temperatures-Introduction, Freezing mixtures, Joule-Thomson effect, Regenerative cooling, Different methods of liquefaction of gases, liquefaction of air, Production of liquid hydrogen and nitrogen, Adiabatic demagnetization, Properties of materials at low temperatures, Superconductivity

**UNIT-II MEASUREMENT OF LOW TEMPERATURE (10 hrs)**

Gas thermometer and its correction and calibration, Secondary thermometers, resistance thermometers, thermocouples, Vapour pressure thermometers, Magnetic thermometers, Advantages and drawbacks of each type of thermometer.

**UNIT-III PRINCIPLES OF REFRIGERATION (10 hrs)**

Introduction to Refrigeration- Natural and artificial refrigeration , Stages of refrigeration, Types of refrigeration - Vapor compression and vapor absorption refrigeration systems, Refrigeration cycle and explanation with a block diagram, Introductory ideas on air-conditioning.

Refrigerants-Introduction, Ideal refrigerant, Properties of refrigerant, Classification of refrigerants, commonly used refrigerants, Eco-friendly refrigerants

**UNIT-IV COMPONENTS OF REFRIGERATOR (10 hrs)**

Refrigerator and its working, Block diagram, Coefficient of Performance (COP), Tons of refrigeration (TR) and Energy Efficiency Ratio (EER), Refrigerator components: Types of compressors, evaporators and condensers and their functional aspects, defrosting in a refrigerator, Refrigerant leakage and detection.

## **UNIT-V APPLICATIONS OF LOW TEMPERATURE & REFRIGERATION (10 hrs.)**

*Applications of Low temperatures:* Preservation of biological material, Food freezing, liquid nitrogen and liquid hydrogen in medical field, Superconducting magnets in MRI- Tissue ablation (cryosurgery) - Cryogenic rocket propulsion system.

*Applications of refrigeration:* Domestic refrigerators, Water coolers, Cold storages, Ice plants, Food preservation methods, Chemical and Process industries, Cold treatment of metals, Construction field, Desalination of water, Data centers.

### **References**

1. Heat and Thermodynamics by Brij Lal & N. Subramanyam, S. Chand Publishers.
2. Thermal Physics by S C Garg, R M Bansal & C K Ghosh, McGrawHill Education, India
3. Heat and Thermodynamics by M Zemansky, McGrawHill Education (India).
4. Low-Temperature Physics by Christian E. & Siegfried H., Springer.
5. Thermal Engineering by S. Singh, S. Pati, Ch:18 Introduction to Refrigeration.
6. The Physics Hyper Text Book. Refrigerators. <https://physics.info/refrigerators/>
7. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
8. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
9. [https://trc.nist.gov/cryogenics/Papers/Review/2017-Low\\_Temperature\\_Applications\\_and\\_Challenges.pdf](https://trc.nist.gov/cryogenics/Papers/Review/2017-Low_Temperature_Applications_and_Challenges.pdf)
10. <https://nptel.ac.in/content/storage2/courses/112105129/pdf/RAC%20Lecture%203.pdf>
11. Other Web sources suggested by the teacher concerned and the reading material.

<https://nptel.ac.in>

## **Course 6B: Low Temperature Physics & Refrigeration**

### **PRACTICAL SYLLABUS** (30 Hrs. Max Marks: 50)

#### **III. Practical (Laboratory) Syllabus:** (30 hrs. Max marks: 50))

1. Record the Principles and applications of Refrigerators and Freezers.
2. Measure the temperatures below Melting point of Ice using a thermometer available in the Lab.
3. Make a freezing mixture by adding different salts viz., Sodium chloride, Potassium Hydrate (KOH), Calcium chloride to ice in different proportions and observe the temperature changes.
4. Study the operation of a refrigerator and understand the working of different parts.
5. Study the properties of refrigerants like chlorofluorocarbons-hydrochlorofluoro- carbons and record the lowest temperatures obtained.
6. Consider a simple faulty refrigerator and try to troubleshoot the simple problems by understanding its working.
7. Understand the practical problem of filling the Freon Gas into the Refrigerator.
8. Get the Liquid Nitrogen or Liquid Helium from nearby Veterinary Hospital and measure their temperatures using chromel-alumel thermocouple or mercury thermometer and observe their physical properties like colour, smell etc and precautions to be taken for their safe handling.
9. Preparation of freeze drying food with Dry ice and liquid nitrogen
10. Preparation of freeze drying food with liquid nitrogen

**A.S.D.Govt Degree College for Women (A) Kakinada**  
**Department of Physics**  
**Semester-wise Revised Syllabus under CBCS, 2020-21**  
**Three-year B.Sc.**  
**Semester – V or VI**

Max Marks: 100+50

**Course 7B: SOLAR ENERGY AND APPLICATIONS**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Syllabus:** (Total Hours: 90 including Teaching, Lab, Field Training, Unit tests etc.)

**Unit - I: BASIC CONCEPTS OF SOLAR ENERGY (10hrs)**

Spectral distribution of solar radiation, Solar constant, zenith angle and Air-Mass, standard time, local apparent time, equation of time, direct, diffuse and total radiations. Pyrheliometer - working principle, direct radiation measurement, Pyrometer-working Principle, diffuse radiation measurement, Distinction between the two meters.

**Unit - II: SOLAR THERMAL COLLECTORS (10hrs)**

Solar Thermal Collectors-Introduction, Types of Thermal collectors, Flat plate collector – liquid heating type, Energy balance equation and efficiency, Evacuated tube collector, collector overall heat loss coefficient, Definitions of collector efficiency factor, collector heat-removal factor and collector flow factor, Testing of flat-plate collector, solar water heating system, natural and forced circulation types, Concentrating collectors, Solar cookers, Solar dryers, Solar desalinators.

**Unit - III: FUNDAMENTALS OF SOLAR CELLS (10hrs)**

Semiconductor interface, Types, homo junction, hetero junction and Schottky barrier, advantages and drawbacks, Photovoltaic cell, equivalent circuit, output parameters, conversion efficiency, quantum efficiency, Measurement of I-V characteristics, series and shunt resistance, their effect on efficiency, Effect of light intensity, inclination and temperature on efficiency

**Unit -IV: TYPES OF SOLAR CELLS AND MODULES (10 hrs)**

Types of solar cells, Crystalline silicon solar cells, I-V characteristics, poly-Si cells, Amorphous silicon cells, Thin film solar cells-CdTe/CdS and CuInGaSe<sub>2</sub>/CdS cell configurations, structures, advantages and limitations, Multi junction cells – Double and triple junction cells. Module fabrication steps, Modules in series and parallel, Bypass and blocking diodes

**Unit – V: SOLAR PHOTOVOLTAIC SYSTEMS (10hrs)**

Energy storage in PV systems, Energy storage modes, electrochemical storage, Batteries, Primary and secondary, Solid-state battery, Molten solvent battery, lead acid battery and dry batteries, Mechanical storage – Flywheel, Electrical storage –Super capacitor



## References:

1. Solar Energy Utilization by G. D. Rai, Khanna Publishers
  2. Solar Energy- Fundamentals, design, modelling and applications by G.N. Tiwari, Narosa Publications, 2005.
  3. Solar Energy-Principles of thermal energy collection & storage by S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
  4. Science and Technology of Photovoltaics, P. Jayarama Reddy, CRC Press (Taylor & Francis Group), Leiden &BS Publications, Hyderabad, 2009.
  5. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
  6. Web sources suggested by the teacher concerned and the college librarian including reading material.
- [https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar\\_energy\\_v1.1.pdf](https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf)

## **Course 7B: Solar Energy and Applications – Practical (lab) work (30 hrs, Max Marks:50)**

### **Practical (Laboratory) Syllabus: (30 hrs) (Max.50 Marks)**

1. Measurement of direct radiation using pyrhelimeter.
2. Measurement of global and diffuse radiation using pyranometer.
3. Evaluation of performance of a flat plate collector
4. Evaluation of solar cell / module efficiency by studying the I – V measurements.
5. Determination of series and shunt resistance of a solar cell / module.
6. Determination of efficiency of two solar cells / modules connected in series.
7. Determination of efficiency of two solar cells / modules connected in parallel.
8. Study the effect of input intensity on the performance of solar cell / module.
9. Study the influence of cell / module temperature on the efficiency.
10. Study the effect of cell / module inclination on the efficiency.

