



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

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

Department of Physics
SYLLABUS-AY 2024-25

S. No.	Semester	Paper	Title of the Paper
1	1	C-1	Essentials and Applications in Mathematical, Physical & Chemical Sciences (Course code: BSCM24101)
2	1	C-2	Advances in Mathematical, Physical & Chemical Sciences (Course code: BSCM24102)
3	2	C-3 & M-1	Mechanics & Properties of Matter (Course code: PHY 24201)
4	2	C-4	Waves & Oscillations (Course code : PHY 24202)
5	3	C-5 &M-2	Optics (Course code: PHY 23301)
6	3	C-6	Heat and Thermodynamics (Course code: PHY 23302)
7	3	C-7	Electronic Devices and Circuits (Course code : PHY 23303)
8	3	C-8	Analog and Digital Electronics (Course code: PHY 23304)
9	4	C-9 & M-3	Electricity, Magnetism & Electronics (Course code: PHY 23401)
10	4	C-10 &M-4	Modern Physics (Course code: PHY 23402)
11	4	C-11	Introduction to Nuclear and Particle Physics (Course code: PHY23403)
12	5	VIB	Low Temperature Physics & Refrigeration (Course code: PHY 205303-6B)
13	5	VIIB	Solar Energy & Applications (Course code : PHY 205304-7B)
14	6		Long Internship

Semester 5		
Course code: PHY 205303-6B		
Low Temperature Physics & Refrigeration		
S. No.	CO	Description
1	1	Identify various methods and techniques used to produce low temperatures in the Laboratory.
2	2	Acquire a critical knowledge on refrigeration and air conditioning.
3	3	Demonstrate skills of Refrigerators through hands on experience and learns about refrigeration components and their accessories.
4	4	Understand the classification, properties of refrigerants and their effects on environment.
5	5	Comprehend the applications of Low Temperature Physics and refrigeration.

Semester 5		
Course code : PHY 205304-7B		
Solar Energy and Applications		
S. No.	CO	Description
1	1	Understand Sun structure, forms of energy coming from the Sun and its measurement.
2	2	Acquire a critical knowledge on the working of thermal and photovoltaic collectors.
3	3	Demonstrate skills related to PV cells through hands on experience.
4	4	Understand testing procedures and fault analysis of thermal collectors and PV modules.
5	5	Comprehend applications of thermal collectors and PV modules



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Semester – V

Course 6B: LOW TEMPERATURE PHYSICS & REFRIGERATION

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

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
- 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)

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

Semester – V

Course 7B: SOLAR ENERGY AND APPLICATIONS

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

Course code: PHY 205303-6B

Unit-I: BASIC CONCEPTS OF SOLAR ENERGY

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

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 CuInGaSe₂/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 McGraw 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.
- 7) 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.