DEPARTMENT OF PHYSICS

SRI Y. N. COLLEGE (AUTONOMOUS)

(Affiliated to Adikavi Nannaya University)
Accredited by NAAC with 'A' grade with a CGPA of 3.40
Recognized by UGC as 'College with Potential for Excellence'

NARSAPUR-534275, W.G.Dist. AP

For 2023-2024 Admitted Batch [2020-21 Admitted Batch onwards]

PROGRAMME OUTCOMES (PO's)

After completion of the Programme, the students would be able to acquire

PO 1	**Conceptual and In-depth Knowledge:** Students get equipped with the conceptual and in-depth knowledge of the domain subjects.
PO 2	**Analysis and Evaluation Techniques:** Students would be able to understand, analyse and evaluate various aspects pragmatically.
PO 3	**Decision making and Entrepreneurial Skills:** Students would acquire decision making skills and entrepreneurial abilities.
PO 4	**Communication and Soft Skills:** Students would be able to express their thoughts and ideas confidently to impart their knowledge efficiently by making useof the Soft Skills they have learnt.
PO 5	**Life Skills:** Students would be able to design appropriate solutions to various problems they may encounter in their personal and professional lives.
PO 6	**Usage of ICT Tools:** Students would be able to make use of ICT tools effectively and they would be able to make use of technology to meet the local, regional and national needs.
PO 7	**Eco-friendly and Environment sustainability practices:** Students would be able to adopt eco-friendly practices for environmental sustainability.
PO 8	**Team Spirit:** Student would function effectively as an individual and work with harmony and integrate diverse teams.
PO 9	**Employability Skills and Leadership traits:** Student would learn the required Employability Skills and become competent to face the competitive world and can be assured of good careers.
PO 10	**Human values and Professional Ethics:** Students would emerge as vibrant, ethical and socially responsible citizens.

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For 2023-2024 Admitted Batch [2020-21 Admitted Batch onwards]

B.Sc. Mathematics, Physics & Computer Science (MPCs)

PROGRAMME SPECIFIC OUTCOMES (PSO's)

These are statements that define the outcomes of a Programme which makes students realize the fact that the knowledge and techniques learnt in this Programme will have direct implication for the betterment of society.

PSO 1	**Proficiency in high level Numerical methods:** Students would develop proficiency in high level Mathematical methods. They would also acquire Analytical and Logical thinking skills.
PSO 2	**Knowledge in Experimentation:** The students would acquire necessary skills to carry out experiments in order to verify the laws and concepts of Physics.
PSO 3	**Problem Solving and Programming Skills:** Students would get hands-on experience in various practical aspects. They would also learn problem solving and programming techniques.

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B.Sc. Mathematics, Physics & Chemistry (MPC)

PROGRAMME SPECIFIC OUTCOMES (PSO's)

PSO 1	Becomes professionally skilled for higher studies in research institutions and to work in chemical industries.
PSO 2	In-depth knowledge helps to qualify in competitive exams.
PSO 3	Gains complete knowledge about all fundamental aspects of Chemistry.
PSO 4	Understands the background of organic reaction mechanisms, complex chemical Structures, and instrumental method of chemical analysis, molecular rearrangements and separation techniques.
PSO 5	Ability to interlink the skills and knowledge in mathematics, physics and chemistry and develop an aptitude to address the problems in various fields.
PSO 6	Analyse the concepts of mathematics, physics and chemistry and understand the relation among them like physical chemistry, mathematical modelling of physics and chemistry problems.
PSO 7	Understand the theoretical concepts of physical and chemical properties of materials and the role of importance.

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B.Sc. Mathematics, Physics & Electronics (MPE)

PROGRAMME SPECIFIC OUTCOMES (PSO's)

PSO 1	To prepare students to excel in postgraduate programs or to succeed in industry/technical profession through global and comprehensive education.
PSO 2	To provide students with a solid foundation in scientific and quantitative electronics fundamentals required to solve technical problems and also to pursue higher studies.
PSO 3	To train students with good technical and scientific breadth so as to comprehend, analyze, design and create novel products and solutions for real life problems.
PSO 4	To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach and an ability to relate Science and engineering issues to broader social context.
PSO 5	To prepare student with an academic environment aware of excellence, leadership, written ethical codes and guidelines and the life-long learning needed for a successful professional career.

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COURSE OUTCOMES (CO's)

Program objectives, outcomes, co-curricular and assessment methods

1. Aim and objectives of UG program in Subject:To align with emerging and employment areas.
2. Course outcomes of Subject

BSc	Semester: I	Credits: 4
Course: 1	Mechanics, Waves and Oscillations	Hrs/Wk: 4

Semester - 1: Paper-I : Mechanics, Waves & Oscillations

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

- Understand Newton's laws of motion and motion of variable mass system and its application to rocket motion and the concepts of impact parameter, scattering cross section.
- Apply the rotational kinematic relations, the principle and working of gyroscope and it applications and the processional motion of a freely rotating symmetric top.
- Comprehend the general characteristics of central forces and the application of Kepler's laws to describe the motion of planets and satellite in circular orbit through the study of law of Gravitation.
- Understand postulates of Special theory of relativity and its consequences such as length contraction, time dilation, relativistic mass and mass-energy equivalence.
- Examine phenomena of simple harmonic motion and the distinction between undamped, damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.
- Appreciate the formulation of the problem of coupled oscillations and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.
- Figure out the formation of harmonics and overtones in a stretched string and acquire the knowledge on Ultrasonic waves, their production and detection and their applications in different fields.

B Sc	Semester: 2	Credits: 4
Course: 2	Wave Optics	Hrs/Wk: 4

Semester - 2: Paper II: Wave Optics:

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

- Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.
- Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.
- Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.
- Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity..
- Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers andtheir applications in different fields.3
- Explain about the different aberrations in lenses and discuss the methods of minimizing them.
- Understand the basic principles of fibreoptic communication and explore the field of Holography and Nonlinear optics and their applications.

B Sc	Semester: 3	Credits: 4
Course: 3	Heat and thermodynamics	Hrs/Wk: 4

Semester-3: Paper III: Heat and Thermodynamics:

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, thethermodynamic 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 Thermodynamicpotentials, the formulation of Maxwell's equations and its applications.
- Differentiate between principles and methods to produce low temperature and liquefy airandalso understand the practical applications of substances at low temperatures.
- Examine the nature of black body radiations and the basic theories.

B Sc	Semester: 4	Credits: 4
Course: 4	Electricity, Magnetism & Electronics	Hrs/Wk: 4

Semester - 4: Paper IV: Electricity, Magnetism and Electronics:

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 inductionand 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- 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.

B Sc	Semester: 4	Credits: 4
Course: 5	Modern Physics	Hrs/Wk: 4

Semester - 4: Paper V: Modern Physics:

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

- Develop an understanding on the concepts of Atomic and Modern Physics, basicelementary 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 ofSchrodinger wave equation and its applications.
- Examine the basic properties of nuclei, characteristics of Nuclear forces, salientfeatures 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 practicalapplications.

B Sc	Semester: 5	Credits: 3
Course: 6	Low Temperature Physics & Refrigeration	Hrs/Wk: 3

Semester - 5: Paper VI: Low Temperature Physics & Refrigeration

Course 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.

Course Outcomes: On completion of practical course, student shall be able to

6. List out, identify and handle equipment used in refrigeration and low temperature lab.
7. Learn the procedures of preparation of Freezing Mixtures.
8. Demonstrate skills on developing various Freezing mixtures and materials and theirapplications in agriculture, medicine and day to day life.
9. Acquire skills in observing and measuring various methodologies of very low temperatures
10. Perform some techniques related to Refrigeration and Freezing in daily life.

B Sc	Semester: 5	Credits: 3
Course: 7	Solar Energy and Applications	Hrs/Wk: 3

Semester - 5: Paper VII: Solar Energy and Applications

Course Outcomes: After successful completion of the course, the student will be able to:

1. Understand Sun structure, forms of energy coming from the Sun and its measurement.
2. Acquire a critical knowledge on the working of thermal and photovoltaic collectors.
3. Demonstrate skills related to callus culture through hands on experience
4. Understand testing procedures and fault analysis of thermal collectors and PV modules.
5. Comprehend applications of thermal collectors and PV modules.

Course Outcomes: On successful completion of this practical course, studentshall be able to:

1. List out and identify various components of solar thermal collectors and systems, solarphotovoltaic modules and systems.
2. Learn the procedures for measurement of direct, global and diffuse solar radiation, I -V characteristics and efficiency analysis of solar cells and modules.
3. Demonstrate skills acquired in evaluating the performance of solar cell / module inconnecting them appropriately to get required power output.
4. Acquire skills in identification and elimination of the damaged panels without affectingthe output power in a module / array.
5. Perform procedures and techniques related to general maintenance of solar thermal andphotovoltaic modules.

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COURSE OUTCOMES (CO's)

Details of course-wise Course Outcomes

BSc	Semester: I	Credits: 4
Course: 1	Mechanics, Waves and Oscillations	Hrs/Wk: 4

Course Outcomes:

- To understand basic theories related with properties of matter and its applications to determine values of various physical quantities associated with matter.
- Be able to apply knowledge of the properties of matter to explain natural physical processes and related technological advances.
- To learn about fundamentals of verbal and mathematical concepts of waves and oscillations
- We should make the students to know their skills required to get the information from the syllabus and use them in a proper way.

Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on: Motion of a rocket, Multistage rocket, Rutherford scattering-Derivation. Precession of a spinning top, Gyroscope, Precession of the equinoxes, Kepler's laws of planetary motion-Proofs, Motion of satellites, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity, Lorentz transformation, Simple harmonic oscillator and solution of the differential equation, Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Transverse wave propagation along a stretched string, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics, Coupled Oscillators
2. Student seminars (Individual presentation of Courses) on topics relating to: Motion of variable mass system, Motion of a rocket, Multistage rocket, Rutherford scattering-Derivation. Rigid body, rotational kinematic relations, Equation of motion for a rotating body. Central Forces- Kepler's laws, Special theory of relativity, Michelson Morley experiment, Lorentz transformation, Simple Harmonic Motion, Coupled Oscillators, Ultrasonics,

Quiz Programmes on: Rutherford Scattering, Mechanics of rigid bodies, Kepler's laws, Special theory of relativity, SHM, Ultrasonics

3. Individual Field Studies/projects:

4. Group discussion on: Newton's Laws of Motion, Motion of satellites, Basic idea of Global Positioning System (GPS),Special theory of relativity, SHM
5. Group/Team Projects on: Motion of a rocket, Multistage rocket, Concept of impact parameter, Central forces, Kepler's laws of planetary motion-Proofs, Motion of satellites, Basic idea of Global Positioning System (GPS), weightlessness. Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics

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COURSE OUTCOMES (CO's)

B Sc	Semester: 2	Credits: 4
Course: 2	Wave Optics	Hrs/Wk: 4

Course Outcomes:

- Understand the nature of light and principles of Laser and holography.
- Analyse the intensity variation of light due to interference, diffraction and polarization.
- Solve problems in Optics by selecting the appropriate equations and performing numerical or analytical calculations.
- Student can able to operation of optical devices including polarizers, interferometers, and Lasers.

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying fromtext book or from others' work and shall encourage self/independent and group learning)

B. Measurable:

5. Assignments on: Lloyd's single mirror, Interference in thin films: Plane parallel and wedge- shaped films, colours in thin films, Newton's rings in reflected light-Theory and experiment, Determination of wavelength of monochromatic light, Michelson interferometer and determination of wavelength. Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit, Plane diffraction grating, Determination ofwavelength of light using diffraction grating, Zone plate, comparison of zone plate with convex lens. Brewster's law, Malus law, Nicol prism, Nicol prism as polarizer and analyzer, Quarter wave plate, Half wave plate, spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance. Laser principle, Einstein coefficients, Types of lasers-He-Ne laser, Ruby laser, Applications of lasers; Holography:
6. Student seminars (Individual presentation of Courses) on topics relating to: Intereference, Abberations, Optical fiber communication, Holography, Diffraction, Polarization, Lasers.
7. Quiz Programmes on: Interference, Diffraction, Polarization, Optical fibers, Lasers,Abberations
8. Individual Field Studies/projects:
9. Group discussion on: Interefernce, Diffraction, Polarization
10. Group/Team Projects on: Lasers, Optical fibers.

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COURSE OUTCOMES (CO's)

B Sc	Semester: 3	Credits: 4
Course: 3	Heat and thermodynamics	Hrs/Wk: 4

Course Outcomes:

- Students will be able to Perform experiments and interpret the results of observation, includingmaking an assessment of experimental uncertainties.
- They develop the ability to apply the knowledge acquired in the classroom and laboratories tospecific problems in theoretical and experimental Physics.
- To apply the theories learnt and the skills acquired to solve real time problems
- To understand the concepts and significance of the various physical phenomena.

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent andgroup learning)

C. Measurable:

Assignments on: Maxwell's law of distribution of molecular velocities, Transport phenomenon in ideal gases: viscosity, Thermal conductivity and diffusion of gases. Introduction- Isothermal and Adiabatic processes, Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature, Thermodynamic potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations fromthermodynamic potentials, 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

9. Student seminars (Individual presentation of Courses) on topics relating to: Kinetic Theory of Gases, Carnot's Engine and its efficiency, Carnot Theorem, Entropy, Maxwell Thermodynamic Equations, Joule Kelvin effect, Production of low temperatures, PlankRadiation law, Wein's law, Pyrometers,
10. Quiz Programmes on: Kinetic theory of gases, Heat and Temperature entropy, Isothermal and Adiabatic process, Thermodynamic Potentials, Low temperature Physics , Thermal Radiation.
11. Individual Field Studies/projects: Carnot's Engine, Pyrometers, Adiabatic demagnetization, Porus plug experiment. Liquification of gases.
12. Group discussion on: Kinetic theory of gases, Quantum theory of Radiation, Low temperature physics and thermodynamic potentials,
13. Group/Team Projects on: Carnot's Engine, Pyrometers, Adiabatic demagnetization, Porus plug experiment. Liquification of gases.

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COURSE OUTCOMES (CO's)

B Sc	Semester: 4	Credits: 4
Course: 4	Electricity, Magnetism & Electronics	Hrs/Wk: 4

Course Outcomes:

- To learn about Gauss law and solve the electric field and magnetic field for various geometric objects and to learn basic electronic concepts in analog and digital theory.
- To be Explain all the topics of Experiments, Concepts and Derivations to the student
- Apply the principles of electronics in day to day life.
- Encourage all the students to study higher educational courses in reputed institutes and to enrich the students with creative, logical and analytical skills and to motivate the students towards research side.

Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

D. Measurable:

1. **Assignments on**: Gauss's law-Statement and its proof, Electric field intensity due to uniformly charged solid sphere and Potential due to a uniformly charged sphere.
2. **Student seminars (Individual presentation of Courses) on topics relating to**:
3. 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. **Quiz Programmes on**: PN junction diode, Zener diode and Light Emitting Diode (LED) and their I-V characteristics, Zener diode as a regulator- Transistors and its operation, CB, CE and CC configurations
5. **Individual Field Studies/projects**: Maxwell's equations-Derivation, Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof)
6. **Group discussion on:** Number systems, Conversion of binary to decimal system and vice versa, Binary addition & Binary subtraction (1's and 2's complement methods), Laws of Boolean algebra
7. **Group/Team Projects on**: Alternating current - Relation between current and voltage in L,C, R, LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power factor.

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B Sc	Semester: 4	Credits: 4
Course: 5	Modern Physics	Hrs/Wk: 4

Course Outcomes:

- To create awareness on the topics of Atomic & Molecular Physics, Quantum mechanics, NuclearPhysics, and Solid state physics.
- To be Explain all the topics of Experiments, Concepts and Derivations to the student.
- Explain the basic principles of quantum mechanics and apply to Atomic, Molecular structure ofenergy levels etc..
- Motivate all the students to pursue PG courses in reputed institutes and to endow the students withcreative and analytical skills; this will equip them to become entrepreneurs.

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

I. Measurable:

Assignments on: Stern-Gerlach experiment, Quantum numbers associated with it, Angular momentum of the atom, Coupling schemes, Experimental arrangement to study Zeeman effect; Raman effect, Characteristics of Raman effect. Experimental arrangement to study Raman effect, Applications of Raman effect, Wave length of matter waves,; *Nuclear Radiation detectors*: G.M. Counter, Cloud chamber, Solid State detector, Classification of nano materials– (0D, 1D, 2D); Quantum dots, Nano wires, Fullerene, CNT,Graphene(Mention of structures and properties),

Student seminars (Individual presentation of Courses) on topics relating to: Stern-Gerlach experiment, Zeeman effect, Raman effect. Davisson and Germer's experiment, , Heisenberg's uncertainty principle Schrodinger time independent and time dependent wave equations-Derivations, , The Shell model, Magic numbers;,

8. **Quiz Programmes on**: Zeeman effect, Matter waves, de Broglie's hypothesis, Heisenberg's uncertainty principle for position and momentum& energy and time, Schrodinger time independent and time dependent wave equations-Derivations.
9. **Individual Field Studies/projects**: *Nuclear Radiation detectors*: G.M. Counter, Cloud chamber, Solid State detector, Liquid drop model, Distinct properties of nano materials
10. **Group discussion on:** Properties of matter waves, Davisson and Germer's experiment, Eigen functions, Eigen values, Application of Schrodinger wave equation to (i) one dimensional potential box of infinite height (Infinite Potential Well), Liquid drop model, The Shell model, Magic numbers
11. **Group/Team Projects on**: Basic postulates of quantum mechanics, Schrodinger time independent and time dependent wave equations-Derivations, Physical interpretation of wave function.

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COURSE OUTCOMES (CO's)

B Sc	Semester: 5	Credits: 3
Course: 6	Low Temperature Physics & Refrigeration	Hrs/Wk: 3

Course VI: LOW TEMPERATURE PHYSICS & REFRIGERATION

(Skill Enhancement Course (Elective), Credits: 03+02)

II. Course 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.

Course VI: Low Temperature Physics & Refrigeration
PRACTICAL SYLLABUS *(30 Hrs. Max Marks: 50)*

I. Course Outcomes: On completion of practical course, student shall be able to

1. List out, identify and handle equipment used in refrigeration and low temperature lab.
2. Learn the procedures of preparation of Freezing Mixtures.
3. Demonstrate skills on developing various Freezing mixtures and materials and theirapplications in agriculture, medicine and day to day life.
4. Acquire skills in observing and measuring various methodologies of very low temperatures
5. Perform some techniques related to Refrigeration and Freezing in daily life.

II. 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 it's 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

III. Co-Curricular Activities:

(a) Mandatory:(*Training of students by teacher in field related skills: (lab:10 + field: 05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for a total of not less than 15 hours on the techniques/skills of Low Temperature Production, methods used and applications of Low temperatures and refrigeration in day to day life and other applications in medicine and industry.
2. **For Student**: Student shall (individually) visit (i) a small ice plant or a cold storage plant (ii) Air Conditioner (AC) repair shop or (iii) Refrigerator repair shop to understand the construction, working principle and the trouble shooting of these devices after interacting with the technicians. **Or** Student shall observe the various thermodynamic processes taking place while working with the refrigerator and observe the leak detection in refrigeration system by different methods, air removal and charging of a refrigeration unit and testing of a refrigeration system to find out the Refrigerating capacity/Ton of refrigeration (TR) and the Power input. **Or** Student shall identify the refrigerant cylinder by color coding and standing pressure. **Or** Student shall visit the freezer aisle of a supermarket and observes the bags of different frozen fruits. Student shall write the observations and submit a hand-written Fieldwork/Projectwork not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/Project work: 05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page,details of place visited, observations, findings and acknowledgements*.
5. Unit tests (IE).

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COURSE OUTCOMES (CO's)

B Sc	Semester: 5	Credits: 3
Course: 7	Solar Energy and Applications	Hrs/Wk: 3

Course VII: Solar Energy and Applications
[Skill Enhancement Course (Elective), Credits: 03+02]

II. Course Outcomes: After successful completion of the course, the student will be able to:

1. Understand Sun structure, forms of energy coming from the Sun and its measurement.
2. Acquire a critical knowledge on the working of thermal and photovoltaic collectors.
3. Demonstrate skills related to callus culture through hands on experience
4. Understand testing procedures and fault analysis of thermal collectors and PV modules.
5. Comprehend applications of thermal collectors and PV modules.

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

III. Course Outcomes : On successful completion of this practical course, student shall be able to:

6. List out and identify various components of solar thermal collectors and systems, solarphotovoltaic modules and systems.
7. Learn the procedures for measurement of direct, global and diffuse solar radiation, I -V characteristics and efficiency analysis of solar cells and modules.
8. Demonstrate skills acquired in evaluating the performance of solar cell / module inconnecting them appropriately to get required power output.
9. Acquire skills in identification and elimination of the damaged panels without affectingthe output power in a module / array.
10. Perform procedures and techniques related to general maintenance of solar thermal andphotovoltaic modules.

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

1. Measurement of direct radiation using pyrheliometer.
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.

V. Co-curricular Activities:

(a) Mandatory: (*Training of students by teacher in field related skills: (lab:10 + field: 05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for not less than 15 hours on the field techniques/skills related to measurement of direct,

diffused and global solar radiation; demonstration of procedures used in the performance evaluation of solar flat plate collectors, solar photovoltaic cells and modules measurement of different parameters in the calculation of efficiency.

2. **For Student**: Students shall visit to solar thermal and photovoltaic laboratories in universities/research organizations/ nearby industries to observe and understand the techniques and procedures used for evaluation of solar collector, solar cell and module efficiencies. They shall write their observations and submit to the teacher hand-written Fieldwork/Project work not exceeding 10 pages in the given format.

3. Max marks for Fieldwork/Project work: 05.

4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page, details of place visited, observations, findings and acknowledgements*.

5. Unit tests (IE).

(b) Suggested Co-Curricular Activities

Training of students by related industrial/ technical experts using guest lectures/ invited talks.

1. Assignments (including technical assignments like identifying components of a solar hot water and solar photovoltaic systems and their handling, operational techniques and maintenance procedures with safety and security)
2. Seminars, Group discussions, Quiz, Debates etc. on related topics.
3. Preparation of videos on thermal and photovoltaic systems and technical procedures.
4. Collection of brochures/figures/photos related to products and applications of solar energy and organizing them in a systematic way in a file.
5. Making a (i) solar panel (ii) solar light (iii) solar cooker (iv) solar oven (v) solar inverter atHome.
7. Visits to nearby solar thermal system as well as solar photovoltaic power stations, firms,research organizations etc.