SYLLABI

	Sri ASNM GDC(A) PALAKOL	Program & Semester **Eg:** I B.Sc. (I Sem)			
Course Code PHY-119	**MECHANICS, WAVES AND OSCILLATIONS**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Linear Kinematics, Vector Algebra, Center of mass, Coordinate systems, Second order differential equation solutions, Properties of sound waves.	60	0	-	3

Course Objectives:

1. *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.*
2. *Apply the rotational kinematic relations, the principle and working of gyroscope and it applications and the precessional motion of a freely rotating symmetric top.*
3. *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.*
4. *Understand postulates of Special theory of relativity and its consequences such as length contraction, time dilation, relativistic mass and mass-energy equivalence.*
5. *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.*
6. *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.*
7. *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.*

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Students would learn about motion of variable mass system, Collisions in two and three dimensions, Rutherford scsttering problem. Students would learn about rotational kinematics of rigid body, Moment of inertia tensor, Euler equations, Precision of top, equinoxes and Gyroscope
CO2	Students would learn about conservative forces, relation between conservative force and potential, equation of motion under central forces, Keppler's laws and Coriolis force.
CO3	Students would learn about Galelian-Lorentz frames of references, Lorentz transformations, Michelson-Morley experiment, Postulates of special theory of relativity, length contraction, time delation, addition of masses, mass energy relation.
CO4	Students would learn about physical properties of Simple Harmonic Motion (SHM), Lissajous figures.Students would also solve the diffreential equations for forced harmonic oscillator and damped harmonic oscillator and and compare the results with simple harmonic oscillator. They would also learn about Coupled oscillators and their normal modes
CO5	Students would solve the wave equation for vibrating strings and study various parameters like modes, overtones, energy transport, transverse impedance etc. They would also learn about basics of ultrasonics, production detection of ultrasonics, measurement of frequency and velocity of ultrasonics and the applications of ultrasonics.

UNIT-I:

1. Mechanics of Particles **(5 hrs)**

Review of Newton‟s Laws of Motion, Motion of variable mass system, Motion of a rocket, Multistage rocket, Concept of impact parameter, scattering cross-section, Rutherford scattering-Derivation.

2. Mechanics of Rigid bodies **(7 hrs)**

Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum and Moment of inertia tensor, **Energy stored in flywheel***,Euler equations, Precession of a spinning top, Gyroscope, Precession of atom and nucleus in magnetic field, Precession of the equinoxes

Unit-II:

3. Motion in a Central Force Field **(12hrs)**

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, Equation of motion under a central force, Kepler‟s laws of planetary motion- Proofs, Motion of satellites, Basic idea of Global Positioning System (GPS), weightlessness, Physiological effects of astronauts,

UNIT-III:

4. Relativistic Mechanics **(12hrs)**

Introduction to relativity, Frames of reference, Galilean transformations, absolute frames, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction, variation of mass with velocity, Einstein‟s mass-energy relation,

Unit-IV:

5. Undamped, Damped and Forced oscillations: (07 hrs) Simple harmonic oscillator and solution of the differential equation, **Lissajous figures**, Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor.

6. Coupled oscillations: **(05 hrs)**

Coupled oscillators-Introduction, Two coupled oscillators, Normal coordinates and Normal modes- N-coupled oscillators and wave equation

Unit-V:

7. Vibrating Strings: **(07 hrs)**

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, Melde‟s strings, **Vibrating bars (Conceptual)*.**

8. Ultrasonics: **(05 hrs)**

Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics, Applications of ultrasonic waves, SONAR

TEXT BOOKS:

- B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
- Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
- Unified Physics - Waves and Oscillations, Jai PrakashNath&Co.Ltd.
- Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy,

Orient Longman.

REFERENCE BOOKS

- University Physics-FW Sears, MW Zemansky& HD Young,Narosa Publications, Delhi
- Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
- Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.
- The Physics of Waves and Oscillations, N.K.Bajaj, Tata McGraw Hill
- Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

Web Links:

1. https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/syllabus/
2. https://ocw.aprende.org/courses/physics/8-01sc-physics-i-classical-mechanics-fall-2010/
3. https://onlinecourses.nptel.ac.in/noc21_ph32/preview
4. https://nptel.ac.in/courses/115/105/115105098/
5. https://ocw.mit.edu/courses/physics/8-03sc-physics-iii-vibrations-and-waves-fall-2016
6. https://nptel.ac.in/courses/115/106/115106119/
7. https://nptel.ac.in/courses/122/105/122105023/
8. https://onlinecourses.nptel.ac.in/noc19_ph18/preview

TOPICS INCLUDED UNDER AUTONOMOUS SET UP

CLASS : I B.Sc.,

SEMESTER : I

COURSE : I

TITLE OF THE PAPER : MECHANICS, WAVES AND OSCILLATIONS

ADDITIONAL TOPICS	JUSTIFICATION
1. Energy stored in Flywheel:	1. This is the recent energy harvesting system based on moment of inertia concept
2. Lissajous figures	2. This gives a better understanding of application of SHM
3. Vibrating bars	3. This gives a comparative understanding of other type of continuous statement. of vibrations.

	Sri ASNM GDC(A) PALAKOL	Program & Semester I B.Sc. (I Sem)			
Course Code PHY-119P	**MECHANICS,** **WAVES AND OSCILLATIONS**				
Teaching	Hours Allocated: 30 (**Practicals**)	L	T	P	C
Pre-requisites:	Screw gauge, Vernier Calipers, Stop watch, Graph plotting basics, MATLAB	-	0	30	2

Course Outcomes:

1. Perform experiments on Properties of matter such as the determination of moduli of elasticity *viz.*, Young‟s modulus, Rigidity modulus of certain materials; Surface tension of water , Coefficient of viscosity of a liquid , Moment of inertia of some regular bodies by different methods and compare the experimental values with the standard values.
2. Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.
3. Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively.
4. Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration.
5. Demonstrate the formation of stationary waves on a string in Melde‟s string experiment.
6. Observe the motion of coupled oscillators and normal modes.

Minimum of 6 experiments to be done and recorded:

1. Young‟s modulus of the material of a bar (scale) by uniform bending
2. Young‟s modulus of the material a bar (scale) by non- uniform bending
3. Surface tension of a liquid by capillary rise method
4. Viscosity of liquid by the flow method (Poiseuille‟s method)
5. Bifilar suspension –Moment of inertia of a regular rectangular body.
6. Fly-wheel -Determination of moment of inertia
7. Rigidity modulus of material of a wire-Dynamic method (Torsional pendulum)
8. Volume resonator experiment
9. Determination of „g‟ by compound/bar pendulum
10. Simple pendulum- normal distribution of errors-estimation of time period and

the error of the mean by statistical analysis

11. Determination of the force constant of a spring by static and dynamic method.
12. Coupled oscillators
13. Verification of laws of vibrations of stretched string –Sonometer
14. Determination of frequency of a bar –Melde‟s experiment.
15. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
16. Verification of Kepler‟s third law for planets in solar system
17. Plotting Kepler orbits for various eccentricities.
18. Plotting Rocket velocity/displacement as a function of time
19. Plotting Lissajous figures

Virtual Lab Links:

1. https://vlab.amrita.edu/
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html
3. https://www.myphysicslab.com/

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity)
- Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams)
- Field studies (individual observations and recordings as per syllabus content and

related areas (Individual or team activity)

- Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

- Group Discussion
- Visit to Research Stations, Science Museum Centres to understand the basic principles of mechanics with live examples and related industries
- Visit to Satellite launching station at Sri Harikota.

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- The oral and written examinations (Scheduled and surprise tests)
- Problem-solving exercises
- Practical assignments and Observation of practical skills
- Individual and group project reports
- Efficient delivery using seminar presentations
- Viva voce interviews.

	Sri ASNM GDC(A) PALAKOL	Program & Semester I B.Sc. (I Sem)			
Course Code	**ELECTRICAL APPLIANCES (SKILL DEVELOPMENT COURSES)**				
Teaching	Hours Allocated: 30 (**Theory**)	L	T	P	C
Pre-requisites:	List of house hold electrical appliances	30	0	-	2

Course Objectives:

1. *Acquire necessary skills/hand on experience/ working knowledge on multimeters, galvanometers, ammeters, voltmeters, ac/dc generators, motors, transformers, single phase and three phase connections, basics of electrical wiring with electrical protection devices.*
2. *Understand the working principles of different household domestic appliances.*
3. *Check the electrical connections at house-hold but will also learn the skill to repair the electrical appliances for the general troubleshoots and wiring faults.*

SYLLABUS:

UNIT-I **(6 hrs)**

Voltage, Current, Resistance, Capacitance, Inductance, Electrical conductors and Insulators, Ohm's law, Series and parallel combinations of resistors, Galvanometer, Ammeter, Voltmeter, Multimeter, Transformers, Electrical energy, Power, Kilowatt hour (kWh), consumption of electrical power

UNIT-II **(10 hrs)**

Direct current and alternating current,RMS and peak values, Power factor, Single phase and three phase connections , Basics of House wiring , Star and delta connection , Electric shock, First aid for electric shock, Overloading , Earthing and its necessity, Short circuiting , Fuses , MCB , ELCB, Insulation, Inverter, UPS

UNIT-III **(10 hrs)**

Principles of working, parts and servicing of Electric fan, Electric Iron box, Water heater; Induction heater, Microwave oven; Refrigerator, Concept of illumination, Electric bulbs, CFL, LED lights, Energy efficiency in electrical appliances, IS codes & IE codes.

Co-curricular Activities (Hands on Exercises): (04 hrs)

[Any four of the following may be taken up]

1. Studying the electrical performance and power consumption of a given number of bulbs connected in series and parallel circuits.
2. Measuring parameters in combinational DC circuits by applying Ohm‟s Law
3. Awareness of electrical safety tools and rescue of person in contact with live wire.
4. Checking the specific gravity of lead acid batteries in home UPS and topping-up with distilled water.
5. Identifying Phase, Neutral and Earth on power sockets.
6. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers.
7. Observing the working of transformer under no-load and full load conditions.
8. Observing the response of inductor and capacitor with DC and AC sources.
9. Observing the connections of elements and identify current flow and voltage drops.
10. Studying electrical circuit protection using MCBs, ELCBs
11. Assignments, Model exam etc.

Reference Books:

1. A Text book on Electrical Technology, B.L.Theraja, S.Chand& Co.,
2. A Text book on Electrical Technology, A.K.Theraja.
3. Performance and design of AC machines, M.G.Say, ELBSEdn.,
4. Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications
5. Consumer Electronics, S.P.Bali, Pearson
6. Domestic Appliances Servicing, K.P.Anwer, Scholar Institute Publications

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	Sri ASNM GDC(A) PALAKOL	**Program & Semester** I B.Sc. (II Sem)			
Course Code PHY-120 P	**WAVE OPTICS**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Wave equation solutions, Geometrical identities, Classification of theories of light, Image formation with mirrors and lenses, Properties of light.	60	0	0	3

Course Objectives:

1. 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*

2. *Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.*

3. *Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.*

4. *Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity..*

5. *Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their*

applications in different fields.

6. *Explain about the different aberrations in lenses and discuss the methods of minimizingthem.*
7. *Understand the basic principles of fibreoptic communication and explore the field of Holography and Nonlinear optics and their applications.*

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Students would learn about principle of superposition, coherence, Interference by division of wavefront and amplitude, Fresnel's bi-prism, Lloyd's mirror, thin film interference, wedge shaped film interference, Newton's rings, Michelson's interferometer and their applications to sodium D lines and thickness of thin film.
CO2	Students would learn about Fresnel and Fraunhoffer diffraction, Fraunhoffer diffrraction due to circular apperture, single slit, double slit, N-slit, grating. They would also learn about Fresnel's half period zones, zone plate, phase reversal zone plates, comparison of zone plate & convex lens, interference & diffraction.
CO3	Students would learn about methods of polarization, Brewster's law, Malus law, Nicol prism, Quarter wave plate, half wave plate, babinet's compensator and optical activity analysis by Laurent's half shade polarimeter..

CO4	Students would learn about about various monochromatic and chromatic aberations and their removal techniques. They would also learn about fiber optics types and applications
CO5	Students would learn about principles of LASER, He-Ne laser, Ruby laser, applications of laser, Principles of optical fiber communication, classification of optical fibers, applicat ions of optical fiers, principles of holography, limitations of Gabor's hologram and applications of holography

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development			Employability			Entrepreneurship	

UNIT-I Interference of light: (12hrs)

Introduction, Conditions for interference of light, Interference of light by division of wave front and amplitude, Phase change on reflection- Stokes‟ treatment, 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, **Mach-Zender interferometer***

UNIT-II Diffraction of light:(12hrs)

Introduction, Types of diffraction: Fresnel and Fraunhoffer diffractions, Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit, Plane diffraction grating, Determination of wavelength of light using diffraction grating, Resolving power of grating, **XRD,***Fresnel‟s half period zones, Explanation of rectilinear propagation of light, Zone plate, comparison of zone plate with convex lens.

UNIT-III Polarisation of light:(12hrs)

Polarized light: Methods of production of plane polarized light, Double refraction, Brewster‟s law, Malus law, Nicol prism, Nicol prism as polarizer and analyzer, Quarter wave plate, Half wave plate, Plane, Circularly and Elliptically polarized light-Production and detection, Optical activity, Laurent‟s half shade polarimeter: determination of specific rotation, Basic principle of LCDs, **Principle of antiglare glasses*.**

UNIT-IV Aberrations and Fibre Optics:(12hrs)

Monochromatic aberrations, Spherical aberration, Methods of minimizing 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.

Fibre optics: Introduction to Fibers, different types of fibers, rays and modes in an optical fiber,

Principles of fiber communication (qualitative treatment only), Advantages **and Applications*** of fiber optic communication. **Attenuation in optical fibers***

UNIT-V Lasers and Holography:(12hrs)

Lasers: Introduction, Spontaneous emission, stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Types of lasers-He-Ne laser, Ruby laser, Applications of lasers; Holography: Basic principle of holography, Applications of holography, **Laser cavity modes***

TEXT BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
- Unified Physics Vol.IIOptics, Jai PrakashNath&Co.Ltd., Meerut

REFERENCE BOOKS:

- Optics-Murugeshan, S.Chand& Co.
- Optics,F.A. Jenkins and H.G.White, McGraw-Hill
- Optics, AjoyGhatak,TataMcGraw-Hill.
- Introduction of Lasers – Avadhanulu, S.Chand& Co.
- Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Web Links:

1. https://nptel.ac.in/courses/122/107/122107035/
2. https://nptel.ac.in/courses/115/105/115105083/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2014
4. https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2009
5. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/

TOPICS INCLUDED UNDER AUTONOMOUS SET UP

CLASS : I B.Sc.,

SEMESTER : II

COURSE : II

TITLE OF THE PAPER : WAVE OPTICS

ADDITIONAL TOPICS	JUSTIFICATION
1. Mach Zender interferometer	1. This is more experimentally applicable interferometer
2. Bragg's law and XRD	2. An introduction to most useful characterization technique is more apt
3. Principle of antiglare glasses.	3. This is the day to day application of polarization of light.
4. Applications of optical fibers	4. Without this topic, the chapter may not be complete.
5. Attenuation in optical fiber	5. This is the most important parameter that controls the optical fiber communication.
6. Cavity modes	6. This is the most fundamental concept, knowledge of which is essential for effective understanding of lasers..

	Sri ASNM GDC(A) PALAKOL	**Program & Semester** I B.Sc. (II Sem)			
Course Code PHY-120 P	**WAVE OPTICS PRACTICALS**				
Teaching	Hours Allocated: 30 (**Practicals**)	L	T	P	C
Pre-requisites:	Spectrometer, Travelling microscope, Laser safety operation.	0	0	30	2

Course Objectives:

1. Gain *hands-on experience of using various optical instruments like spectrometer, polarimeter and making finer measurements of wavelength of light using Newton Rings experiment, diffraction grating etc.*

2. Understand the principle of working of polarimeter and the measurement of specific rotatory power of sugar solution

3. Know the techniques involved in measuring the resolving power of telescope anddispersive power of the material of the prism.

4. Be familiar with the determination of refractive index of liquid by Boy's methodandthe determination of thickness of a thin wire by wedge method.

Minimum of 6 experiments to be done and recorded

1. Determination of radius of curvature of a given convex lens-Newton‟s rings.
2. Resolving power of grating.
3. Study of optical rotation –polarimeter.
4. Dispersive power of a prism.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Resolving power of a telescope.
8. Refractive index of a liquid-hollow prism
9. Determination of thickness of a thin wire by wedge method
10. Determination of refractive index of liquid-Boy‟s method.
11. Determination of thickness of wire using laser diffraction.
12. Reflection grating – determination of grating element width on metal scale.

Virtual Lab Links:

1. https://ocw.mit.edu/resources/res-6-006-video-demonstrations-in-lasers-and-optics-spring-2008/

2. https://nptel.ac.in/courses/115/105/115105120/

3. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/engg_physics/labs/exp1/simulation/simulator.html
4. https://vlab.amrita.edu/

TOPICS INCLUDED UNDER AUTONOMOUS SET UP

CLASS : I B.Sc.,

SEMESTER : II

COURSE : II

TITLE OF THE PAPER : WAVE OPTICS LAB

Additional topic	Justification
1. Determination of thickness of wire using laser diffraction. 2. Reflection grating – determination of grating element width on metal scale.	Laser based characterization techniques are more accurate and simplified. I would be useful if students are introduced with these techniques.

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity)
- Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams)
- Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

- Group Discussion
- Visit to Research Stations/laboratories and related industries

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- The oral and written examinations
- Practical assignments and laboratory reports,
- Efficient delivery using seminar presentations,
- Viva voce interviews.

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	Sri A S N M GDC (A) PALAKOL	**Program & Semester** I B.Sc. (II Sem)			
Course Code	**SOLAR ENERGY (SKILL DEVELOPMENT COURSES)**				
Teaching	Hours Allocated: 30 (**Theory**)	L	T	P	C
Pre-requisites:	Solar energy applications in daily life.	30	0	-	2

1. Acuire knowledge on solar radiation principles with respect to solar energy estimation.

2.Get familiarized with various collecting techniques of solar energy and its storage

3.Learn the solar photovoltaic technology principles and different types of solar cells forenergy conversion and different photovoltaic applications.

4.Understand the working principles of several solar appliances like Solar cookers, Solar hotwater systems, Solar dryers, Solar Distillation, Solar greenhouses

SYLLABI:

UNIT-I – Solar Radiation: **(6 hrs)**

Sun as a source of energy, Solar radiation, Solar radiation at the Earth"s surface, Measurement of Solar radiation-Pyroheliometer, Pyranometer, Sunshine recorder, Prediction of available solar radiation, Solar energy-Importance, Storage of solar energy, Solar pond

UNIT-II – Solar Thermal Systems: **(10 hrs)**

Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion: Flat plate collectors and Concentrating collectors, Solar Thermal Power Plant, Solar cookers, Solar hot water systems, Solar dryers, Solar Distillation, Solar greenhouses.

UNIT-III – Solar Photovoltaic Systems: **(10 hrs)** Conversion of Solar energy into Electricity - Photovoltaic Effect, Solar photovoltaic cell andits working principle, Different types of Solar cells, Series and parallel connections,Photovoltaic applications: Battery chargers, domestic lighting, street lighting and waterpumping

Co-curricular Activities (Hands on Exercises): (04 hrs)

[Any four of the following may be taken up]

1. *Plot sun chart and locate the sun at your location for a given time of the day.*
2. *Analyse shadow effect on incident solar radiation and find out contributors.*
3. *Connect solar panels in series & parallel and measure voltage and current.*
4. *Measure intensity of solar radiation using Pyranometer and radiometers.*
5. *Construct a solar lantern using Solar PV panel (15W)*
6. *Assemble solar cooker*
7. *Desigining and constructing photovoltaic system for a domestic house requiring 5kVApower*
8. Assignments/Model Exam.

Reference Books:

1. Solar Energy Utilization, G. D. Rai, Khanna Publishers

1. Solar Energy- Fundamentals
2. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme, Tata Mc-Graw

Hill Publishers, 1999.

3. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
4. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 2004.

Web Links:

1.

	SRI AS NM GDC(A) PALAKOL	**Program & Semester** II B.Sc. (III Sem)			
Course Code PHY-121	**HEAT AND THERMODYNAMIC**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Drift, Diffusion, Laws of thermodynamics, Heat capacities, Gas laws, Heat transfer methods, Statistics (mean, mode, median, Standard deviation, errors)	60	0	-	3

COURSE OUT COMES:

1. *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*

2. *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.*

3. *Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency*

4. *Develop critical understanding of concept of Thermodynamic potentials,theformulation of Maxwell's equations and its applications.*

5. *Differentiate between principles and methods to produce low temperature and liquefy air and also understand the practical applications of substances at low temperatures.*

6. *Examine the nature of black body radiations and the basic theories.*

Course Outcomes:

On Completion of the course, the students will be able to-

CO1	Students would learn about Kinetic Theory of gases, Maxwell's law of distribution of molecular velocities and its experimental verification, Mean free path, Degrees of freedom, Transport phenomenon viscosity, Thermal conductivity and diffusion of gases
CO2	Students would learn about Various thermodynamic processes, entropy changes in various processes and heat engines.
CO3	Students would learn about various thermodynamic potentials and joule kelvin cooling concepts using thermodynamic potentials.
CO4	Students would learn about various methods for producing very low temperatures and theory of Joule Kelvin effect.
CO5	Students would learn about Blackbody and its spectral energy distribution of black body radiation, Various theories of Black body radiation, usage of various radiation measuring instruments.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development			Employability			Entrepreneurship	

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 and Van der Waals‟ 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)

Blackbody 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 (No derivations), 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 Angstrom pyroheliometer, Estimation of surface temperature of Sun.

TEXT BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- Heat and Thermodynamics -N BrijLal, P Subrahmanyam, S.Chand& Co.,2012
- Unified Physics Vol.2, Optics & Thermodynamics, Jai PrakashNath&Co.Ltd., Meerut

REFERENCE BOOKS:

- Thermodynamics, R.C.Srivastava, S.K.Saha&AbhayK.Jain, Eastern Economy Edition.
- University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi
- Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
- Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000

Web Links:

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-00-thermodynamics-of-materials-fall-2002

2. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008
3. https://onlinecourses.nptel.ac.in/noc20_me51/preview
4. https://nptel.ac.in/courses/112/108/112108148/

	SRI ASNM GDC(A) PALAKOL	**Program & Semester** II B.Sc. (III Sem)			
Course Code PHY-121 P	**Heat and Thermodynamics**				
Teaching	Hours Allocated: 30 (**Practicals**)	L	T	P	C
Pre-requisites:	Volt meter, Ammeter, Rheostat, steam generators, Thermometer types.	0	0	30	2

COURSE OUTCOMES:

- *Perform some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, variation of thermo-emf of thermocouple with temperature difference at its two junctions, calibration of a thermocouple and Specific heat of a liquid.*

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. Thermoemf- 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.

Virtual Lab Links:

1. https://vlab.amrita.edu/
2. http://physics.bu.edu/~duffy/classroom.html
3. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html&sort=alpha&view=grid

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity))
- Field studies (individual observations and recordings as per syllabus content andrelated areas (Individual or team activity)

- Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

- Group Discussion
- Visit to Research Stations/laboratories and related industries
- Others

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- The oral and written examinations (Scheduled and surprise tests),
- Problem-solving exercises,
- Efficient delivery using seminar presentations,
- Viva voce interviews.

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	SRI ASNM GDC(A) PALAKOL	Program & Semester II B.Sc. (IV Sem)			
Course Code PHY-122	**ELECTRICITY, MAGNETISM AND ELECTRONICS**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Differentiation, line, surface and volume integration, Coulomb‟s law, AC, DC, VC, RMS Value, Classification of materials based on electrical conductivity, Introduction to semiconductors.	60	0	-	3

CourseObjectives:

1. understand the Gauss law and

formulate the relationship between electric displacement vector, electric polarization,

Susceptibility, Permittivity and Dielectric constant.

2. Distinguish between the magnetic effect of electric current and electromagnetic inductionand apply the related laws in appropriate circumstances.

3. Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.

4. Develop an understanding on the unification of electric and magnetic fields and Maxwell's equations governing electromagnetic waves.

5. Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Powerfactor and the comparative study of series and parallel resonant circuits.

6. Describe the operation of p-n junction diodes, zener diodes, light emitting diodes andtransistors

7. Understand the operation of basic logic gates and universal gates and their truth tables.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Students would able to learn about the concepts of electric field and electic potential due to point charge,solid sphere,cylinder.these concepts will enhance the student towards the problems come across in the real life. Students would also able to learn about the concept of dielectrics and its applications
CO2	Students would able to learn about the concepts of Biot savart's law,Faraday's law and it's applications. Students would also able to learn about Faradays laws and their applications in daily life like solinoid
CO3	Students would able to learn about different combinations of Inductor, capacitance and resistor and also their performance characteristics. Students would also able to learn about mathematical description of Electromagnetic Waves ie Maxwell's equations
CO4	Students would able to learn about Semiconductor devices ie PN junction diode, Zener diode and transistors and their characteristics so that the student can able to use appropriately
CO5	Students would able to learn about number system ,Boolean algbra, basic logic gates which are more useful in digital world

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

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) dipole (ii)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, Divergence and curl of magnetic field, 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 and Electromagnetic damping

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: (6hrs)

Idea of displacement current, Maxwell‟s equations-Derivation, Maxwell‟s wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof)

UNIT-IV

7. Basic Electronic devices: (12 hrs)

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, Input and output characteristics of a transistor in CE mode, Relation between alpha, beta and gamma; Hybrid parameters, Determination of hybrid parameters from transistor characteristics; Transistor as an amplifier.

UNIT-V:

8. Digital Electronics: (12 hrs)

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, DeMorgan‟s laws-Statements and Proofs, Basic logic gates, NAND and NOR as universal gates, Exclusive-OR gate, Half adder and Full adder circuits.

TEXT BOOKS

- BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
- Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
- Unified Physics Vol.3, ELECTRICITY, MAGNETISM AND ELECTRONICS, Jai PrakashNath&Co.Ltd., Meerut

REFERENCE BOOKS:

- Electricity and Magnetism, B.D.Duggal and C.L.Chhabra. Shobanlal& Co.
- Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
- Electricity and Magnetism, R.Murugeshan, S. Chand & Co.
- Principles of Electronics, V.K. Mehta, S.Chand& Co.,
- Digital Principles and Applications, A.P. Malvino and D.P.Leach, McGrawHill Edition.

Web Links:

1. https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007
2. http://physics.bu.edu/~duffy/classroom.html
3. https://nptel.ac.in/courses/115/106/115106122/

	SRI ASNM GDC(A) PALAKOL	Program & Semester II B.Sc. (IV Sem)			
Course Code PHY-122P	**ELECTRICITY, MAGNETISM AND ELECTRONICS**				
Teaching	Hours Allocated: 30 (**PRACTICALS**)	L	T	P	C
Pre-requisites:	Multimeter, Bread board, Active, passive components, Power supply, Function generator, Electrical appliances safety operation.	-	0	30	2

CourseObjectives:

1. *Measure the current sensitivity and figure of merit of a moving coil galvanometer.*
2. *Observe the resonance condition in LCR series and parallel circuit*
3. *Learn how a sonometer can be used to determine the frequency of AC-supply.*
4. *Observe the variation of magnetic field along the axis of a circular coil carrying current using Stewart and Gee's apparatus.*
5. *Understand the operation of PN junction diode, Zener diode and a transistor and their V-I characteristics.*
6. *Construct the basic logic gates, half adder and full adder and verify their truth tables. Further, the student will understand how NAND and NOR gates can be used as universal building blocks.*

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

Virtual Lab Links:

1. https://vlab.amrita.edu/
2. http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedtour/GuidedTour.htm

3. http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedTour.htm
4. http://physics.bu.edu/~duffy/classroom.html

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity))
- Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams)
- Field studies (individual observations and recordings as per syllabus content and related areas (Individual or team activity)
- Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

- Group Discussion
- Visit to Research Stations/laboratories and related industries
- Others

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- The oral and written examinations (Scheduled and surprise tests),
- Practical assignments and laboratory reports,
- Observation of practical skills,
- Efficient delivery using seminar presentations,
- Viva voce interviews.

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	SRI ASNM GDC(A) PALAKOL	**Program & Semester** II B.Sc. (IV Sem)			
Course Code PHY-123	**MODERN PHYSICS**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Atomic models, Types of spectra, Matrices, Types of forces in nature, Electrical conductivity.	60	0	-	3

CourseObjectives :

1. Develop an understanding on the concepts of Atomic and Modern Physics, basicelementary quantum mechanics and nuclear physics.

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

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Students would able to learn about the concepts of atomic models and their drawbacks.students would also learn about Stern & Gerlach experiment Vector atom model, this model gives the exitance of spin of an electron.Study of fine spectra and Zeeman effect on various elements.
CO2	Students would able to learn about the importance of Quantum mechanics, study the basic concepts involved in the origin of quantum mechanics like uncertainty principle, De-Broglie matter waves, and experiments that confirm wave nature of matter and particle nature of radiation.
CO3	Students would able to learn about the importance of Heisenberg's uncertainty principle for position and momentum. Students would able to learn Schrodinger time independent and time dependent wave equations. Wave function properties Significance. Basic postulates of quantum mechanics. from these we can predict the position of a particle at future specific time
CO4	Students would learn about basic properties*of nucleus*, elementary particles in nucleus ,binding energy, nuclear forces and nuclear models. Elementary particles and counters

CO5	Students would learn about basics of nonmaterial's, classification, properties. Students would also learn about Introduction to Superconductivity, types and applications.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development			Employability			Entrepreneurship	

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 complementarily.

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) and (ii) one dimensional harmonic oscillator

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)

Nano materials – 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, Next Generation Computer chips, elimination of pollutants, sensors*)

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

TEXT BOOKS

- BSc Physics, Vol.4, Telugu Akademy, Hyderabad
- Atomic Physics by J.B. Rajam; S.Chand& Co.,
- Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
- Unified Physics Vol.3, ELECTRICITY, MAGNETISM AND ELECTRONICS, Jai PrakashNath&Co.Ltd., Meerut

REFERENCE BOOKS

- 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

Web Links:

1. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008
2. https://nptel.ac.in/courses/115/105/115105083/
3. https://ocw.mit.edu/courses/physics/8-02t-electricity-and-magnetism-spring-2005
4. https://nptel.ac.in/courses/115/103/115103108/
5. https://nptel.ac.in/courses/118/102/118102003/
6. https://nptel.ac.in/courses/115/104/115104096/

	Sri ASNM GDC(A) PALAKOL	**Program & Semester** II B.Sc. (IV Sem)			
Course Code PHY-123 P	**MODERN PHYSICS**				
Teaching	Hours Allocated: 60 (**Practicals**)	L	T	P	C
Pre-requisites:	Radiation safety, Handling electrical equipment andmagnets, Safety measures.	-	0	30	2

1

Course Objectives :

1.Measure charge of an electron and e/m value of an electron by Thomson method.

2. Understand how the Planck's constant can be determined using Photocell and LEDs.

3. Study the absorption of α-rays and β-rays, Range of β-particles and the characteristicsof GM counter

4. Determine the Energy gap of a semiconductor using thermistor and junction diode.

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 photocell.
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 α-rays.
7. Study of absorption of β-rays.
8. Determination of Range of β-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

Virtual Lab Links:

1. https://vlab.amrita.edu/
2. http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedtour/GuidedTour.htm
3. http://physics.bu.edu/~duffy/classroom.html

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity)

- ❖ Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams))
- ❖ Field studies (individual observations and recordings as per syllabus content and related areas (Individual or team activity)
- ❖ Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

- ❖ Group Discussion
- ❖ Visit to Research Stations/laboratories and related industries
- ❖ Others

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- ❖ The oral and written examinations (Scheduled and surprise tests),
- ❖ Practical assignments and laboratory reports,
- ❖ Efficient delivery using seminar presentations,
- ❖ Viva voce interviews.

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A.P. STATE COUNCIL OF HIGHER EDUCATION

Semester-wise Revised Syllabus under CBCS, 2020-21

Four-year B.Sc. (Hons) Domain Subject**: Physics**

IV Year B. Sc.(Hons) – Semester – V

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 REFIGERATOR (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.

III. 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 MZemansky,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)*

IV. Learning 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 their applications 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.

V. 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

VI. Lab References:

1. Experimental techniques in low temperature physics by Guy White, PhilipMeeson.
2. Experimental low-temperature physics by A. Kent, Macmillan physical science series
3. Physics and Chemistry at Low Temperatures by Leonid Khriachtchev.
https://www.routledge.com/Physics-and-Chemistry-at-Low-Temperatures/Khriachtchev/p/book/9789814267519
4.Practical Cryogenics .http://research .physics illinois.edu /bezryadin /links/ practical%20Cryogenics.pdf
5. Freeze-Drying, 3rd Edition by Peter Haseley, Georg-Wilhelm Oetjen, Wiley (e-Book)
6. Web sources suggested by the teacher concerned.

VII. 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/Project work 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).

(b) <u>Suggested Co-Curricular Activities</u>

1. Training of students by related Factory, industrial experts.
2. Assignments (including technical assignments like identifying tools in Refrigerators,Freezers and their handling, operational techniques with safety and security)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in Low Temperatures and applications.
5. Collection

of material/figures/photos related to substances used in Freezing Mixtures, their Properties and availability etc., writing and organizing them in a systematic wayin a file.

6. Visits to Ice plants and labs in universities, research organizations, private firms, etc.
7. Making your own mini refrigerator at home
8. Build your own water cooler with the materials available at home.
9. Making hand launched liquid nitrogen rockets
10. Experiments with Liquid nitrogen and strawberry/ banana/ lemon/ onion/ mushroom/egg etc. (*To be tried under professional supervision only*).
11. Invited lectures and presentations on related topics by field/industrial experts
12. Identification of different Ozone-depleting substances (ODS) that damage the ozone layer in the upper atmosphere.
13. Demonstration to illustrate the greenhouse effect and the role of carbon dioxide as a greenhouse gas using plastic water bottles, flood light lamp, beakers and temperature sensors and observe the temperature changes.

https://edu.rsc.org/experiments/modelling-the-greenhouse-effect/1543.article
https://sealevel.jpl.nasa.gov/files/archive/activities/ts1hiac1.pdf

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A.P. STATE COUNCIL OF HIGHER EDUCATION

Semester-wise Revised Syllabus under CBCS, 2020-21

Four-year B.Sc. (Hons) Domain Subject**: Physics**

IV Year B. Sc.(Hons) – Semester – V

Max Marks: 100+50

Course 7B: Solar Energy and Applications

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

I. Learning 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.

II. **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 SOLARCELLS 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

III. 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.
(a) https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf
(b) https://www.sku.ac.ir/Datafiles/BookLibrary/45/John%20A.%20Duffie,%20William%20A.%20Beckman(auth.)-Solar%20Engineering%20of%20Thermal%20Processes,%20Fourth%20Edition%20(2013).pdf

Course 6B: Solar Energy and Applications – Practical (lab) work *(30 hrs, Max Marks:50)*

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

1. List out and identify various components of solar thermal collectors and systems, solar photovoltaic 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 in connecting them appropriately to get required power output.
4. Acquire skills in identification and elimination of the damaged panels without affecting the output power in a module / array.
5. Perform procedures and techniques related to general maintenance of solar thermal and photovoltaic modules.

V. 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.

VI. Lab References:

1. Solar Photo voltaic- Alab training manual, C.S. Solanki et al., Foundation Books Publishers, 2012.
2. Laboratory Manual on Solar thermal experiments, HP Garg, TC Kandpal, Narosa Publishing House 2000.
3. Web sources suggested by the teacher concerned.
https://renewablelab.niu.edu/experiments/solarPanel
Development of simple solar hot water collector:
https://www.youtube.com/watch?v=WP8H5IOTwYU
https://www.instructables.com/Solar-Water-Heater-From-Scratch/

VII. 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

1. Training of students by related industrial/ technical experts using guest lectures/ invited talks.
2. 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)
3. Seminars, Group discussions, Quiz, Debates etc. on related topics.
4. Preparation of videos on thermal and photovoltaic systems and technical procedures.
5. Collection of brochures/figures/photos related to products and applications of solar energy and organizing them in a systematic way in a file.
6. 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.

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