केंद्रीयजनजातीयविश्वविद्यालयआंध्रप्रदेश

CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH

(A CENTRAL UNIVERSITY ESTABLISHED BY AN ACT OF PARLIAMENT)

CURRICULUM & SYLLABUS

Minor in Physics for UG programs

(As per National Education Policy 2020)

w.e.f. 2023-24 admitted batch

DEPARTMENT OF CHEMISTRY
SCHOOL OF SCIENCES
CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH
VIZIANAGARAM – 535003, A.P.

MINOR COURSES IN PHYSICS

(Offered to other Departments)

SEMESTER	COURSE CODE	TITLE OF COURSE	CREDITS	CONTACT HOURS/ WEEK	LEVEL
SEMESTER-I	PHY121	Mechanics	3	3	100
	PHY131	Mechanics Practicum	1	2	100
SEMESTER-II	PHY171	Waves and Oscillations	3	3	100
	PHY181	Waves and Oscillations Practicum	1	2	100
SEMESTER-III	PHY221	Modern Optics	3	3	100
	PHY231	Modern Optics Practicum	1	2	100
SEMESTER-IV	PHY271	Thermodynamics and Quantum Theory of Radiation	3	3	200
	PHY281	Thermodynamics and Quantum Theory of Radiation Practicum	1	2	200
SEMESTER-V	PHY321	Electricity and Magnetism	3	3	200
	PHY331	Electricity and Magnetism Practicum	1	2	200
SEMESTER-VI	PHY371	Elements of Modern Physics	3	3	200
	PHY381	Elements of Modern Physics Practicum	1	2	200

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY121	**MECHANICS**	**3**	**I**

Course objective: The objective of this course is to teach the students fundamentals of Mechanics, rigid body dynamic, concept of inverse square force and the special theory of relativity.

UNIT-I

Conservation Laws: Conservation of Energy, Conservative forces, Internal forces and conservation of linear momentum, Centre of mass, systems with variable mass, Space- Vehicle Problem. Conservation of Angular Momentum, Internal torques, Angular Momentum about the Centre of mass,

UNIT-II

Elastic and Inelastic Scattering: Types of scattering and conservation laws, Laboratory and centre of mass systems, collision of particles which stick together, General elastic collision of particles of different mass, Cross-section of elastic scattering, Rutherford scattering.

UNIT-III

Dynamics of Rigid Bodies: Equation of motion, angular momentum and kinetic energy of a Rotating Body, Moment of Inertia and Radius of Gyration, Rotation of about fixed axes time dependence of motion, cylinder on an accelerated rough plane

UNIT-IV

Relativity: Postulates of special theory of relativity, Michelson-Morley experiment, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, mass-energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum.

Text Books:

1. Unified Physics, Vol. 1, S.L. Gupta & S. Guptha, Jai Prakash Nath& Co, Meerut
2. Mechanics: R.K. Shukla and Anchal Srivastava.

Reference Books:

1. Mechanics (Berkeley) Physics Course I: Charles Kittle, Walter D. Knight, M. Alvin and A. Ruderman (Tata McGraw Hill), 1981.
2. Mechanics: H.S. Hans and S.P. Puri (Tata McGraw Hill), 2003.
3. Introduction to Classical Mechanics: R.G. Takwale & P.S.Puranik (Tata-McGraw-Hill), 2000.
4. Physics Part -1: Resanick and Halliday.
5. Mechanics: D. S. Mathur
6. Concept in Physics Vol. 1: H.C.Verma
7. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY131	**MECHANICS PRACTICUM**	**I**	**I**

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

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY171	**WAVES AND OSCILLATIONS**	**3**	**II**

Course oobjectives: The objective of this course is to introduce the basics of Waves & oscillations and their applications.

UNIT-I

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

UNIT-II

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

UNIT-III

Vibrating strings and Bars: Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics.

UNIT-IV

Waves in Media: Wave motion in one dimension, Transverse and longitudinal Waves, progressive harmonic waves and their energy, Transverse waves on a string, Longitudinal waves on a rod, Electrical transmission lines.

Text Books:

1. Waves and Oscillations. N. Subramanyam and Brijlal, Vikas Pulications.
2. Unified Physics, Vol. 1, S.L. Gupta & S. Gupta, Jai Prakash Nath& Co, Meerut.

Reference Books

1. Vibrations and Waves: S.P. Puri (Macmillan India), 2004.
2. The Physics of Vibrations and Waves: H.J. Pain (Wiley and ELBS), 1976.
3. Fundamentals of Physics. Halliday/Resnick/Walker, Wiley India Edition 2007.
4. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy,Orient Longman.
5. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY181	**WAVES AND OSCILLATIONS PRACTICUM**	**I**	**II**

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

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY221	**MODERN OPTICS**	**3**	**III**

Course objectives: The objective of this course is to introduce the basics of modern optics and their applications

UNIT-I

Interference: Principle of superposition - coherence-temporal coherence and spatial coherence-conditions for interference of light. -change of phase on reflection. Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (cosine law) - colours of thin films- Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's rings in reflected light. Michelson interferometer, Determination of wavelength of monochromatic light using Newton's rings

UNIT-III

Diffraction: Introduction, Fresnel's diffraction, Zone Plate, diffraction due to straight edge, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction -Diffraction due to single slit-Fraunhoffer diffraction due to double slit-Fraunhoffer diffraction pattern with N slits (diffraction grating). Resolving power of grating, Determination of wavelength of light in normal incidence

UNIT-III

Polarisation: Polarized light: methods of polarization polarization by reflection, refraction, double refraction, scattering of light-Brewster's law-Mauls law-Nicol prism polarizer and analyzer- Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by polarimeter-– idea of elliptical and circular Polarization,

UNIT-IV

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion, Laser principle-Einstein coefficients-Types of lasers-He-Ne laser, Ruby laser- Applications of lasers and Holography

Fiber Optics: Introduction- different types of fibers, rays and modes in an optical fiber, fiber material, principles of fiber communication (qualitative treatment only), advantages of fibreoptic communication.

Text Books:

1. A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
2. Introduction of Lasers - Avadhanulu, S.Chand & Co.
3. B B Laud, Lasers and Non-Linear optics. New Age International Pvt Ltd Publishers (2011).

Reference Books:

1. Optics, F. A. Jenkins and H.G. White, Mc Graw-Hill
2. Optics, Ajoy Ghatak, Tata Mc Graw-Hill.
3. Principles of Optics- BK Mathur, Gopala Printing Press, 1995
4. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (1994)
5. AK Ghatak and K Thyagarajan, Contemporary Optics, Macmillan/Premium Publishing Corp (1978)
6. Unified Physics, Vol. 2, "Thermodynamics and Optics" S.L. Gupta & S. Gupta, Jai Prakash Nath& Co, Meerut.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY231	**MODERN OPTICS PRACTICUM**	**1**	**III**

1. Determination of radius of curvature of a given convex lens-Newton's rings.
2. Resolving power of grating.
3. Study of optical specific rotation of sugar solution -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.
7. Refractive index of a liquid-hallow prism
8. Determination of thickness of a thin wire by wedge method
9. Determination of refractive index of liquid-Boy's method.
10. Determination of wavelength of sodium yellow line by Fresnel's Biprism.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY271	**THERMODYNAMICS AND QUANTUM THEORY OF RADIATION**	**3**	**IV**

Course oobjectives: The course on thermal physics is framed with the objective that students are able to understand basic concepts of thermo-dynamical systems. Students will be able to understand heart, work, temperature, entropy and the laws of thermodynamics. Quantum theory of radiation is also been included**.**

UNIT-I

Kinetic theory of gases: Introduction -Deduction of Maxwell's law of distribution of molecular speeds, experimental verification. Transport phenomena Mean free path Viscosity of gases- thermal conductivity- diffusion of gases.

UNIT-II

Thermodynamics: Introduction-Isothermal and adiabatic process- Reversible and irreversible processes- Carnnot's engine and its efficiency-Carnot's theorem -Second law of thermodynamics. Kelvin's and Claussius statements -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.

UNIT-III

Thermodynamic potentials and Maxwell's equations: Thermodynamic potentials-Derivation of Maxwell's thermodynamic relations-Clausius- Clayperon's equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas.

UNIT-IV

Quantum theory of radiation: Blackbody-Ferry's black body-distribution of energy in the spectrum of black body-Wein's displacement law, Wein's law, Rayleigh-Jean's law-Quantum theory of radiation-Planck's law-Measurement of radiation-Types of pyrometers- determination of solar constant, Temperature of Sun.

Text Books:

1. Unified Physics, Vol. 2, "Thermodynamics and Optics" S.L. Gupta & S. Gupta, Jai Prakash Nath & Co, Meerut.
2. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
3. Heat and Thermodynamics - D S Mathur, S Chand& Co, New Delhi, 5th Edition (2004).

Reference Books:

1. Thermodynamics, R.C.Srivastava, S.K.Saha & Abhay K. Jain, Eastern Economy Edition.
2. Fundamentals of Physics. Halliday/Resnick/Walker. C. Wiley India Edition 2007
3. Heat, Thermodynamics and Statistical Physics-N Brij Lal, P Subrahmanyam, PS Hemne, Chand& Co., 2012.
4. Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
5. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi.
6. A Treatise on Heat: M.N. Saha and B.N. Srivastava (Indian Press, Allahabad), 1972.
7. Thermal Physics: S.C. Garg, R.M.Bansal&C.K.Ghosh (Tata McGraw Hill), 2000.
8. Fundamentals of Physics- R.Resnik, D. Halliday and Walker; Wiley 6ed(2001)
9. Concepts of Physics Vol (1)-H C Verma, BharathiBhavan Publishers, 2004 Edition

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY281	**THERMODYNAMICS AND QUANTUM THEORY OF RADIATION PRACTICUM**	**1**	**IV**

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

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY321	**ELECTRICITY AND MAGNETISM**	**3**	**V**

Course objectives: The course on Electricity and Magnetism deals with Coulomb's law, Electric field, potential formulation of electrostatic, Capacitors, Magnetism and magnetic materials along with the applications of these concepts.

UNIT-I

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell. Electric potential as line integral of electric field, potential due to a point charge, electric dipole.

UNIT-II

Capacitance and dielectrics: Electric capacitance - Derivation of expression for capacity of (i) a parallel plate capacitor (ii) a spherical capacitor. Dielectrics- effect of dielectric on the capacity of a condenser, Energy stored in a capacitor. Electric dipole moment and molecular polarizability- Electric displacement D, electric polarization P relation between D, E and P- Dielectric constant and susceptibility.

UNIT-III

Magnetism and Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferromagnetic materials.

UNIT-IV

Electromagnetic Induction and Electromagnetic waves: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium.

Text Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY331	**ELECTRICITY AND MAGNETISM PRACTICUM**	**1**	**V**

1. Figure of merit of 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
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics - Determination of hybrid parameters
9. To study B-H curve for different ferromagnetic materials using C.R.O
10. Determination of given inductance by Anderson's bridge
11. To determine the value of an air capacitance by de-Sauty Method and to find permittivity of air. Also, to determine the dielectric constant of a liquid
12. To measure thermo e.m.f. of a thermocouple as a function of temperature and find inversion temperature.

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY371	**ELEMENTS OF MODERN PHYSICS**	**3**	**VI**

Course Objectives: Students lean the foundation of quantum mechanics, Schrodinger equation and its applications.

UNIT-I

Fundamentals of Quantum Mechanics: Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment.

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

UNIT-II

Uncertainty principle and Schrodinger's wave equation: Position measurement- gamma-ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- Position-momentum uncertainty principle, Energy-time uncertainty principle.

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization;

UNIT-III

Applications of Schrodinger's wave equation: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

UNIT-IV

General properties of Nuclei and Radioactivity: Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, semi-empirical mass formula and binding energy, stability of nucleus; Law of radioactive decay; Mean life & half-life; a-decay; ß-decay - energy released- Fission and fusion-

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning

COURSE CODE	TITLE OF PAPER	CREDITS	SEMESTER
PHY381	**ELEMENTS OF MODERN PHYSICS PRACTICUM**	**1**	**VI**

1. e/m of an electron by Thomson method
2. Determination of Planck's constant (photocell)
3. Verification of inverse square law of light using photovoltaic cell
4. Study of absorption of a-rays
5. Study of absorption of B-rays
6. Determination of Range of B-particles
7. Determination of M & H
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals
9. Energy gap of a semiconductor using junction diode
10. Energy gap of a semiconductor using thermistor
11. To study the characteristics of LED and Photodiode
12. To study the variation of the magnetoresistance of a sample with the applied magnetic field
13. Study of excitations of a given atom by Franck Hertz set up