KOLHAN UNIVERSITY, CHAIBASA
JHARKHAND

Revised Curriculum and Credit Frame Work
For Sem – I
As Per FYUGP, NEP – 2020
(U.G. Physics – 2022 Onward)

University Department of Physics
Kolhan University, Chaibasa
West Singhbhum, Jharkhand - 833202

KOLHAN UNIVERSITY, CHAIBASA
FYUGP (NEP 2020)
COURSE & EXAMINATION STRUCTURE

SEMESTER – 1 SUBJECT – PHYSICS

SUB. CODE	PAPER NAME	CREDIT	MARKS		UNIVERSITY END SEM EXAM		INTERNAL EXAM.			UNIVERSITY PRACTICAL EXAM.		
			FULL MARKS	PASS MARKS	FULL MARKS	PASS MARKS	YES/ NO	FULL MARKS	PASS MARKS	YES/ NO	FULL MARKS	PASS MARKS
AEC - 1	Language and Communication Skills(MIL-1)	2	50	20	50	20	No	---	---	No	---	---
VAC - 1*	Understanding of India	2	50	20	50	20	No	---	---	No	---	---
		2	50	20	50	20	No	---	---	No	---	---
SEC – 1**	Digital Education	3	75	30	75	30	No	---	---	No	---	---
MDC – 1	Introduction to Physics	3	75	30	75	30	No	---	---	No	---	---
MN – 1A	Mechanics + Labs	4	100	40	60	24	Yes	15	06	Yes	25	10
MJ - 1	Mechanics + Labs	4	100	40	60	24	Yes	15	06	Yes	25	10

*VAC-1 1. Understanding India 2. Environmental Science/Education 3. Digital technology solution 4. Health and wellness, Yoga education, Yoga education, sports and fitness 5. Global citizenship 6. Community engagement (NCC/NSS/Adult Education)

** SEC -1 1. Digital Education 2. Mathematical and computational thinking

Multi Disciplinary Course –I (MDC-I)

Natural Science: Elements of Modern Physics

(i) Course learning outcome:

- Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.
- Understand the theory of quantum measurements, wave packets and uncertainty principle.
- Understand the central concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, skill development on problem solving e.g. one dimensional rigid box, tunneling through potential barrier, step potential, rectangular barrier.
- Understanding the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
- Ability to calculate the decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrinos and its properties and role in theory of beta decay.
- Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
- Understand various interactions of electromagnetic radiation with matter. Electron positron pair creation.
- Understand the spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing.
- In the laboratory course, the students will get opportunity to perform the following experiments
- Measurement of Planck's constant by more than one method.
- Verification of the photoelectric effect and determination of the work Function of a metal.

(ii) **Broad contents of the course:**

1. One dimensional potential problem of bound states and scattering.
2. Elementary introduction of nuclear physics with emphasis on
(i) Nuclear Structure
(ii) Nuclear Forces
(iii) Nuclear Decays
(iv) Fission and Fusion

3. Introduction to Lasers.
Skills to be learned
Comprehend the failure of classical physics and need for quantum physics. Formulate the basic theoretical problems in one, two and three dimensional physics and solve them.
Learning to apply the basic skills developed in quantum physics to various problems in
(i) Nuclear Physics (ii) Atomic Physics (iii)Laser Physics

4. Learn to apply basic quantum physics to Ruby Laser, He-Ne Laser.

MDC-I: ELEMENTS OF MODERN PHYSICS
(Credits: Theory-03 Theory: 45 Lectures)

Unit - I: Nature of Light

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

(10 Lectures)

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Energy-time uncertainty principle-application to virtual particles and range of an interaction.

(5 Lectures)

Unit – II: Introductory Quantum Theory & Laser

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

(10 Lectures)

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.

(5 Lectures)

Unit – III: Introductory Nuclear Physics

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, NZ graph, binding energy, Fission and fusion- mass deficit, relativity and generation of energy.

(8 Lectures)

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

(7 Lectures)

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Additional Books for Reference

1. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
2. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
4. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.

5. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

6. Quantum Mechanics, R. Eisberg and R. Resnick, John Wiley & Sons.