Draft Syllabus

for

Four-Year (Eight Semester)

Undergraduate Program

in

Physics

Multidisciplinary Course

(as per NEP 2020)

(Effective from Academic Session 2024-25)

University of Gour Banga

Malda-732103

West Bengal

Name of MDC Papers

Semester	Course Code	Course Name
I.	PHS-MDC -101	Physics for everyone
II.	PHS-MDC-201	Environmental Physics
III.	PHS-MDC-301	Medical Physics

Semester – I

Syllabus for Physics (MDC)

Title of the Course: Physics for Everyone

Paper Code: PHS-MDC-101

Learning Objectives:

To introduce key ideas such as motion, energy, forces, quantum mechanics, cosmology in a way that is understandable **without advanced math**. It will help them to understand the relevance of physics in daily life, from how household appliances work to natural phenomena.

Learning Outcomes:

Upon completing a "Physics for Everyone" course, students can expect the following outcomes:

1. **Basic Understanding of Physics Principles**: Students will have a foundational grasp of key physics concepts, such as Newton's laws, energy, forces, and waves.
2. **Enhanced Scientific Literacy**: Students will be able to understand and interpret everyday phenomena through the lens of physics.
3. **Updated with recent advancements in science:** They will be able to grasp the basic knowledge of advanced physics in a nutshell. Moreover, students will be able to know India's fundamental contribution in advanced physics, especially in the space sector.

Course Content

Physics for everyoneCredits – 3

Module: -1

(a)Physical quantities and units (SI system), Dimensional analysis, Buoyancy, Newton's Laws of Motion, Force, friction, and tension, Circular motion and gravitation, Central force.
(b) States of matter (solids, liquids, gases, plasma), Elasticity and material properties, Fluid dynamics (Bernoulli's principle).

Module: -2

(a)Types of waves (mechanical, electromagnetic), Properties of waves (frequency,wavelength,
speed),Sound waves and resonance, The electromagnetic spectrum, Doppler effect, Ultrasonic, Radio wave,LASER.

(b) Introduction to quantum mechanics (basic concepts only) -Failure of Newtonian Physics, Wave particle duality, Uncertainty Principles, Motion of electron in atom, Bohr's theory, De Broglie hypothesis, Davison Germer's experiment.

Module: -3

(a) History of radioactivity, contribution of pioneer scientists' (Henry Becquerel, Marie Curie, J.J Thomson, James Chadwick, Rutherford etc.] Fission, Fusion, Manhattan project, Nuclear medicine in diagnosis and cancer treatment.
(b) Limitations of Newtonian Physics, Introduction to Special Theory of Relativity (space-time, time dilation, mass-energy equivalence)
(c) Stars, galaxies and the universe, White dwarf, Neutron star, supernova, Black hole, The Big Bang and the expansion of the universe, Chronological history of India's space research.

Suggestive Readings:

- A History of Physics over the Last Two Centuries byMario Gliozzi & Alessandra Gliozzi; Cambridge Scholar Publishing
- Concept of Modern Physics by Arthur Beiser; McGraw-Hill Publishing
- Principles of Physics by David Halliday, Robert Resnick;Willey Publishing
- Nuclear Physics by S. N Ghoshal;S. Chand Publishing
- Physics of Atoms and Molecules by B.H. Bransden and C. J Joachain; Pearson

Semester – II

Syllabus for Physics (MDC)

Title of the Course: Environmental Physics

Paper Code: PHS-MDC-201

Learning Objectives:

To gain a foundational understanding of key physical principles related to environmental science, including energy transfer, thermodynamics, and wave mechanics.

1.To study the physical processes governing environmental systems, such as climate dynamics, water cycles, and atmospheric phenomena.

2. To explore various energy sources, including fossil fuels and renewables, and understand their environmental impacts and efficiencies

3. To gain insights into physics of plant-soil-water interface determining ecosystem processes

4. To study the physics of resource management, including water, soil, and minerals, and evaluate sustainable practices.

Learning Outcomes:

After studying this course, students will be able to -

1. Apply principles of physics to manage natural resources in extreme environment.

2. Evaluate different energy sources and their environmental impacts, including renewable and non-renewable options.

3. Assess the sources, effects, and control measures of pollution, and propose solutions based on physical principles.

4. Integrate physics principles into sustainability practices and contribute to efforts aimed at promoting sustainable development.

Course Content

Environmental Physics Credits – 3

Module: -1

Chapter 1a: Laws of Physics and Human Environment

First, second and third law of thermodynamics, laws of thermodynamics and the human body, energy and metabolism, energy transfers, convection, Newton's law of cooling, survival in cold climates, survival in hot climates etc.

Chapter 1b: Atmosphere, Ocean and radiation

Atmosphere temperature, pressure, circulation, precipitation and other features, atmospheric aerosol, photochemical pollution, ozone, ozone hole, ozone in polar region, oceanic waves and circulation, radiation, terrestrial radiation, earth as a black body, greenhouse effect, global warming. Remote sensing and its application in environmental monitoring and management.

Module: -2

Chapter 2a: The Physics of water, wind and solids

Hydrosphere, water in the atmosphere, physics of cloud formation, thunderstorms, physics of wind creation, principal forces acting on air masses- gravitational force, coriolis force, frictional force etc. , cyclones and anticyclones, global convection, global wind patterns, soil and hydrologic cycle, surface tension and soils, soil temperature and heat flow etc.

Chapter 2b: Ecophysics

Solid-plant-water relations, water entry into soil, water and energy balance, plant uptake and water use efficiency, Macroscopic flow o matter and energy etc.

Module: -3

Chapter 3a: Energy resources for mankind

Fossil fuels, nuclear power, renewable and sustainable energy resources- hydroelectric power, tidal power, wind power, ocean power, biomass, solar power, solar photovoltaic; energy demand and conservation of energy, use of green energy and sustainable energy resources etc.

Chapter 3b: Environment pollution and sustainable development

Water pollution, air pollution, soil pollution, noise pollution etc, pollution controls and acts, pollution and human health, green city, space environment, environmental safety measures etc.

Suggestive Readings:

- Mason, N & Hughes, P. 2001. : Introduction to Environmental Physics: Planet Earth, Life and Climate, Taylor and Francis
- Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climat Change. Wiley.
- Borghese, F., Denti, P. and Saija, R., 2007. Scattering from Model Nonspherical Particles: Theory and Applications to Environmental Physics. Springer Science & Business Media.
- Forinash, K. 2010. Foundation of Environmental Physics. Island Press.
- Monteith, J. and Unsworth, M., 2013. Principles of Environmental Physics: Plants, Animals, and the Atmosphere. Academic Press.
- Smith, C., 2004. Environmental Physics. Routledge.

Semester – III

Syllabus for Physics (MDC)

Title of the Course: Medical Physics

Paper Code: PHS-MDC-301

Learning Objectives:

1. To provide education for undergraduate students in preparation for careers in Medical Physics.

2. To make the students aware of the applications of Physics in the medical profession

3. To impart knowledge of the normal structure and function of the human body and its major organ systems.

4. To impart basic ideas about X rays and the huge application of X rays in the medical field.

5. To impart knowledge on the applications of Medical Physics

6. To impart knowledge about the Medical imaging techniques like MRI, NMR, Ultrasound

Learning Outcomes:

1. Describe the fundamental theories, principles, and concepts that underlie the field of medical physics.

2.Identify and categorize the diverse processes, materials, techniques, practices and terminology relevant to the field of medical physics.

3.Elucidate the biological effects of radiation and its practical applications in both radiation safety and radiation treatment.

4. Students will be able to correlate the adverse effects of radiation on human body and its remedies.

Course Content

Medical Physics Credits: 3

Module: -1

a) Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms like- Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal.

b)Mechanics of the body: Skeleton, forces and body stability. Muscles and dynamics of body movement. Physics of Locomotors Systems: joints and movements, Stability and Equilibrium

c)Energy household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation

d) Pressure system of body: Physics of breathing, Physics of cardiovascular system.

e)Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound.

f) Optical system of the body: Physics of the eye.

g)Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer.

Module: -2

a) **X-RAYS:** Electromagnetic spectrum, production of x-rays, x-ray spectra, Bremsstrahlung, Characteristic x-ray.

Coolidge tube, Rotating anode x-ray tube,quality and intensity of x-ray,

X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, types of X-Ray Generator, high frequency generator, exposure timers and switches.

b) **Radiation Physics**: Radiation units exposure, absorbed dose, units: rad, gray, relative biological effectiveness, effective dose, inverse square law. Interaction of radiation with matter Compton & photoelectric effect, Rem & Sievert, linear attenuation coefficient.

c)**Radiation Detectors**: Thimble chamber, condenser chambers, Geiger Muller counter, Scintillation counters and Solid-State detectors, ionization chamber, Dosimeters.

Module: -3

a) Evolution of Medical Imaging, X-ray diagnostics and imaging,

b) Physics of nuclear magnetic resonance (NMR), NMR imaging

c) MRI Radiological imaging, Ultrasound imaging

d) Physics of Doppler with applications and modes, Vascular Doppler.

e) Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy

f)Computed tomography scanner- principle & function, display, generations, mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display).

g) Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea andCpap Machines, Ventilator and its modes.

Suggestive Readings:

- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Medical Physics, J.R.Cameronand J.G.Skofronick,Wiley(1978)
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of the human body, Irving P. Herman, Springer (2007).
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
- Handbook of Physics in Diagnostic Imaging: R.S. Livingstone: B.I. Publication Pvt Ltd.
- The Physics of Radiology-HE Johns and Cunningham