240/PHY/MD101-A

Multidisciplinary Course

Course ID - 240/P[illegible]
Health Physics

Marks (Theory): 50 **Credits:3 (45 lectures)**
Marks (Internal Assessment) : 25 **Time : 3 Hrs**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20 % numerical problems in the relevant papers.

Course Objective: The course is designed to introduce some of the important physics applications in medical physics.	**Course Outcome:** After completing this course, students will be able to understand the interaction of energetic radiation with biological material. Various applications of radiation and nuclear techniques must be clear to them.

Unit-I

Radiation units: exposure, Absorption dose, Rad, Gray, relative biological effectiveness, effective dose—Rem & Sievert, inverse square law. Interaction of radiation with matter: Compton & photoelectric effect, linear attenuation coefficient. Working principle of Radiation Detectors: Geiger Muller counters, Scintillation counters, Solid-State detectors

Unit-II

X-Rays: Electromagnetic spectrum, production of X-rays, X-ray spectra, Brehmsstrahlung, Characteristic X-ray. X-ray tubes & types, Evolution of Medical Imaging, X-ray diagnostics and imaging

Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy. Computed Tomography scanner- principle and function

Unit-III

Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler, Gamma camera (Only Principle, function, and display).

Unit-IV

Application of radioactive substances in the diagnosis, Positron Emission Tomography (PET), Nuclear medicine therapy, Interventional Nuclear medicines, Common nuclear medicines and their applications

References:

240/PHY/MD102-A

1. Health Physics: Radiation-Generating Devices, Characteristics, and Hazards, Joseph John Bevelacqua, Wiley-VCH Verlag GmbH & Co. KGaA
2. Radiation Detection and Measurements, G F Knoll
3. Introduction to Health Physics, T.E. Johnson, McGraw-Hill, NY

Course ID-240/PE[illegible]2
Rational Thinking and Science

Marks (Theory): 50 **Credits:3 (45 lectures)**
Marks (Internal Assessment) : 25 **Time : 3 Hrs**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: To develop critical thinking and scientific reasoning skills by exploring the principles of rational thought, the scientific method, and landmark discoveries that reshaped our understanding of the natural world.	**Course Outcome:** By the end of this course, learners will be able to apply rational thinking and the scientific method to evaluate claims, distinguish evidence-based reasoning from biases/myths, and appreciate how foundational scientific discoveries transformed human understanding.

Unit-I

Scientific Approach and Rational Thinking: Fundamentals of rational thinking, faith vs belief, the scientific method: observation, hypothesis, experimentation, and conclusion, origin of science through curiosity and inquiry, myth-busting discoveries in physics: 1) Heliocentrism (Copernicus, Galileo), 2) Gravity and motion (Newton), 3) Theory of relativity (Einstein), 4) Nature of lightning (Benjamin Franklin), 5) Vacuum and air pressure (Evangelista Torricelli, Otto von Guericke)

Unit-II

Myths and Scientific Thinking: Science vs faith, science vs pseudoscience, definition, origin, and types of myths and beliefs, evolution of myths and misconceptions in explaining natural phenomena, influence of cultural and social beliefs on scientific progress, Darwin's theory as a case study in scientific thinking

Unit-III

The Paradox of Science & Technology: Distinction between science and technology, understanding the science-technology acceptance paradox, case studies: 1) acceptance and rejection of new technologies, 2) rejection and resistance to scientific ideas, the future of Artificial Intelligence (AI) and its societal acceptance, potential problems in AI

Unit-IV

Challenges in Promoting Rational Thinking: Barriers to rational thinking, role of education and media in promoting or hindering rationality, scientific temper, and constitutional duty: relevance in Indian context (Article 51A(h)), case studies: superstition and blind beliefs (e.g., astrology, miracle claims), science communication: importance of clear communication of science to the public

References:

1. Mythakon Se Vigyan Tak by Gauhar Raza, Penguin Random House India
2. The Scientific Attitude: Defending Science from Denial, Fraud, and Pseudoscience by Lee McIntyre, The MIT Press, Cambridge
3. In Search of Superstitions by Narendra Nayak, Mythri Books

Skill Enhancement Course

Course ID - 240/PHYP/SE101
BASICS OF INSTRUMENTATION SKILLS

Marks (Theory): 35 **Credits:2 (30 lectures)**
Marks (Internal Assessment): 15 **Time: 3 Hrs**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of seven short answer type questions. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The course imparts practical knowledge about commonly used electronic instruments, including a multimeter, cathode ray oscilloscope, and LCR circuit, to undergraduate physics students.	**Course Outcome:** After completing this course, students will be able to understand the basic equipment used in a physics laboratory.

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, Resolution range, etc. Errors in measurements and loading effects, Random and systematic errors, Error propagation Multimeter: Principles of measurement of DC voltage and DC current, AC voltage, AC current and resistance. Specifications of a multimeter and their significance.

UNIT-II

Electronic Voltmeter and their Advantage for voltage measurement w.r.t. input impedance and sensitivity, Principles of current & voltage measurement, Electronic Voltmeter/Multimeter and their significance