

Questionnaire (version of October 2023)

## Natural-Science Disarmament Courses

### Course Description

Time when course was/is given (years)	July 2024
Lecturer(s)	M.Mohamed Sheik Sirajuddeen
Institution (department, university)	Department of Physics, B.S.Abdur Rahman Crescent Institute of Science and Technology, Chennai, India
Course Title	<b>Nuclear Hazard and Disarmament</b>
Type (lecture, seminar ...)	Lecture
Language(s)	English
Time (number of hours (45 or 60 minutes?) per week, no. of weeks, no. of days if block, how often per year)	45 Periods ( One period equivalent to 50 mins)
Audience (students of which disciplines, interdisciplinarity)	Post graduate students, Ph.D course-work students and Undergraduate students
Credits given	3 credit
- for what (oral/written exam ...)	2-assessment exams and 1- end semester exam
Status in department/university/ field of study, obligatory or voluntary	Open elective course for UG, PG and research students
Connection with other course(s)/ integration in field of study	Offered as an Open elective course to students of UG, PG Physics, PG Chemistry, PG- Mechanical Engg.
Additional activities/material (Model UN, visits, invited speakers, videos, ...)	Value added lectures in the field of nuclear science may be offered by experts from Nuclear power plant( Indira Gandhi Centre for Atomic Research-IGCAR), Kalpakkam,TN, India
Presentations/papers available, to whom	Course Teacher
Internet site of course	Under preparation ( will be available during the forthcoming academic year 2024-25)
Curriculum/list of units (add below or attach)	5 units-Course
Filled in by	M.Mohamed Sheik Sirajuddeen
Date	19/07/2024
Agreement to publish this	Approved by Board of Studies & Academic Council of University

### Course : **NUCLEAR HAZARD AND DISARMAMENT**

#### Units/Modules

**MODULE 1 NUCLEAR HAZARDS**

**MODULE 2 RADIOLOGICAL PROTECTION, EVALUATION & CONTROL**

**MODULE 3 TYPES OF NUCLEAR WEAPON**

**MODULE 4 NUCLEAR WEAPON DISARMAMENT**

**MODULE 5 NUCLEAR WASTE MANAGEMENT AND SAFETY**

**COURSE OBJECTIVES:**

**COB1:** To help the students comprehend the basics of nuclear hazard.

**COB2:** To describe the principles of radiological protection, hazard evaluation and control.

**COB3:** To acquire the knowledge of various types and characteristics of nuclear weapons

**COB4:** To understand the importance of nuclear disarmament.

**COB5:** To get the insights into the various aspects of nuclear waste management and disposals.

**MODULE 1 NUCLEAR HAZARDS****9**

Interaction of charged particles and Radiation with matter - Photon interactions with matter- biological effects of radiation, Radiation damage - Molecular level & Cellular level, Deterministic effects, Stochastic effects-nuclear emergencies, nuclear explosions, radiation exposure effects, power plant accidents, transportation accidents involving radiation, radiation hazards in health care, nuclear winter.

**MODULE 2 RADIOLOGICAL PROTECTION, EVALUATION & CONTROL****9**

Radiation Quantities and Units - Dose, equivalent dose and effective dose – ALI & DAC Radiological protection – Optimization of protection – Dose limits for radiation workers – internal exposure, Occupational exposure and members of public - Occupational exposure levels - Radiation hazards evaluation - Specific Gamma constant - Principles to control external hazards - Radiation shield.

**MODULE 3 TYPES OF NUCLEAR WEAPON****9**

Fission and fusion theory, thermonuclear reactions, fusion power, fissionable material, Types of fission and thermonuclear bombs, conventional nuclear bomb, radiation enhanced neutron bomb, yield of a nuclear weapon, strategic and tactical weapon system, nuclear thermal output, radiation output

**MODULE 4 NUCLEAR WEAPON DISARMAMENT****9**

Disarmament- Purpose & Objectives, disarmament of weapons: Nuclear weapons, Other Weapons of Mass destruction, Outer space disarmament aspects, conventional weapons, International and regional efforts on security, UN-system of disarmament machinery, UN security council on disarmament, IAEA-efforts, Organization for prohibition of chemical

weapons(OPCW), Treaty on Prohibition of Nuclear weapons(TPNW), Comprehensive Test Ban Treaty(CTBT) commission, Non Proliferation Treaty(NPT) and International Campaign to Abolish Nuclear weapons(ICAN).

## **MODULE 5 NUCLEAR WASTE MANAGEMENT AND SAFETY**

**9**

Types of Nuclear Waste: Spent nuclear fuel, high-level radioactive waste, low-level radioactive waste, Waste Treatment and Conditioning: Techniques for volume reduction and preparation for storage or disposal with safety as a priority. Long-Term Storage Strategies: Dry cask storage and geological repositories Transportation Safety: Regulations and protocols for safe transportation of nuclear waste. The Future of Nuclear Power: Ethical considerations and policy debates on balancing energy needs with safety and environmental concerns.

**L – 45Hours**

**Total Hours : 45**

(L-Lecture T-Tutorial P-Practical C-Credit)

### **COURSE OUTCOMES:**

Upon completion of this course, the students will be able to

**CO1:** explain the effects and implications of nuclear hazards to human beings and to the environment.

**CO2:** describe the fundamental principles underlying the radiological hazard evaluation and the means to control it

**CO3:** deliver the knowledge about the types of nuclear weapons and materials needed for the nuclear weapons.

**CO4:** describe the key instruments in the area of nuclear non-proliferation, disarmament and the efforts of the United Nations in enhancing disarmament initiatives

**CO5:** describe the key instruments in the area of nuclear non-proliferation, disarmament and the efforts of the United Nations in enhancing disarmament initiatives

### **TEXT BOOKS:**

1. Nuclear Materials Science (2nd Ed.), Karl Whittle, Published in 2020, IOP Publishing Ltd 2020.
2. Nuclear Materials, Pavel V. Tsvetkov, Published in 2021, IntechOpen Limited (Open access DOI: 10.5772/intechopen.83315).
3. Physics and Technology of Nuclear Materials, IOAN URSU, Published in 1985, Elsevier Ltd.

4. Glenn F. Knoll 'Radiation Detection and Measurement', John Wiley & Sons Inc. 2010 Edition.

**REFERENCES:**

1. Physicist guide to nuclear weapons, IOP Publishing Ltd 2016  
Online ISBN: 978-0-7503-1308-7 • Print ISBN: 978-0-7503-1309-4.
2. James Saling and Audeen W. Fentiman, "Radioactive Waste Management", CRC Press (2018).
3. Samuel Glasstone and Alexander Sesonske, "Nuclear Reactor Engineering", Springer (1994).
4. John R. Lamarsh and Anthony J. Baratta, "Introduction to Nuclear Engineering", Pearson (2018).

**Board of Studies (BoS):**

**Academic Council:**

14<sup>th</sup> meeting of BOS held on 07/06/2024

**Course Outcome mapped against Program outcome**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO2	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO3	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO4	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO5	H	H	M	H	L	M	L	L	L	H	H	M	H	M	H

**Satisfies following Sustainable Development Goals:**

**SDG3:** Ensure healthy lives and promote wellbeing for all at all ages

**SDG4:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

**Statement:** The holistic understanding of the course will bring global impact on quality education.

**SDG9:** Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

**Statement:** Understanding the safety precautions required for mitigating the nuclear hazards, waste management and nuclear disarmament.

**SDG16:** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels