SEMESTER S4

NUCLEAR SAFETY

Course Code	PESFT417	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. To bring out the importance of nuclear engineering and its safety.
2. To impart the safety design principles of nuclear reactors.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Binding energy – fission process – radio activity – alpha, beta and gamma rays radioactive decay – decay schemes – effects of radiation – neutron interaction – cross section – reaction rate – neutron moderation – multiplication – scattering – collision – fast fission – resonance escape – thermal utilization – criticality. Characteristics of the fission reaction, neutron moderation, practical fission fuels-Reactor power, fuel burn up, and fuel consumption, Neutron chain-reacting systems-Homogeneous and heterogeneous cores, reflectors Reactor kinetics and dynamics, reactivity feedback Core composition changes during reactor operation, nuclear system lifetime.	9
2	Control requirements in design considerations – means of control – control and shut down rods – their operation and operational problems – control rod worth – control instrumentation and monitoring – online central data processing system. Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants- pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in	9

	power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India and important plants across the globe.	
3	Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – quality assurance in plant components – operational safety – safety regulation process – public awareness and emergency preparedness. Accident Case studies- Three Mile island accident and Chernobyl accident.	**9**
4	Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits – barriers for control of radioactivity release – control of radiation exposure to plant personnel – health physics surveillance – nuclear safety in medical treatment - waste management and disposal practices –environmental releases.	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

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Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basic principles of nuclear reactions which can be used for Power Generation and Medical purposes	**K2**
CO2	Detail about various nuclear power plants and control systems	**K2**
CO3	Understand safety design principles and regulations in Nuclear Power plants	**K2**
CO4	Analyse the accidents in nuclear power plants as case study	**K4**
CO5	Understand the exposure control and waste management in nuclear power and medical purpose operations	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											3
CO4	3											
CO5	3					3	2					

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Nuclear Safety Principles and Applications	Paul F. Coley	Whittles Publishing	2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Nuclear Safety	Gianni Petrangeli	Elsevier – Butterworth Heinemann	2nd Edition 2006

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1-4	https://onlinecourses.swayam2.ac.in/cec24_ma13/unit?unit=6&lesson=9 https://onlinecourses.swayam2.ac.in/cec24_ma13/unit?unit=6&lesson=21

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