

MM 480E Nuclear Power Plants				DEPARTMENT of MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project / Field Study	Homework	Other	Total	Credit	ECTS Credit
8	42	0	-		20	13	75	3	3.0
Language	English								
Compulsory / Elective	Elective								
Prerequisites	None								
Course Contents	Introduction to nuclear power plants. Basic knowledge about the generation of heat from nuclear fuels. Nuclear thermal power cycles. Nuclear reactors. The other units of nuclear power plants.								
Course Objectives	The course is designed to give fourth year mechanical engineering students the fundamental physics of nuclear structure, reactions, neutrons and their interactions, reactor heat generation, nuclear power systems. Students are instructed in the simple analysis and comparison of boiling-reactor, pressurized-water reactor and gas-cooled reactor power plants, fast breeder reactors and power plants.								
Learning Outcomes and Competences	Learning of atomic, nuclear structure and reactions, neutrons and their interactions. Understanding of reactor heat generation and nuclear power systems. Learning the working principles of boiling-reactor, pressurized-water reactor and gas-cooled reactor power plants, fast breeder reactors and power plants.								
Textbook and /or Reference	J. R. Lamarsh and A.J. Barata, “Introduction to Nuclear Engineering”, Third Edition, Prentice Hall, New Jersey 2001.								
Assessment Criteria						If any, mark as (x)		Percentage (%)	
	Midterm Exams					X		50	
	Quizzes					X		5	
	Homeworks					X		5	
	Projects								
	Term Paper								
	Laboratory Work								
	Other								
Final Exam					X		40		
Instructors									
Week	Subject								
1	ATOMIC AND NUCLEAR STRUCTURE AND REACTIONS: Atomic structure, the structure of heavy atoms, the chemical reaction, energy from nuclear fission and fusion reactions.								
2	ATOMIC AND NUCLEAR STRUCTURE AND REACTIONS: Conversion and breeding, energy from fission and fuel burnup, radioactivity, decay rates and half-lives, radioactive chains.								
3	NEUTRONS AND THEIR INTERACTIONS: Neutron energies, fission and thermal neutrons, neutron flux and reaction rates. The 1/V region, the resonance region and the fast-neutron region.								
4	REACTOR HEAT GENERATION: Neutron conservation, heat generation rate in fuel, the fission energy in reactors, heat generated by a single fuel element, the total heat generated in core								
5	HEAT CONDUCTION IN REACTOR ELEMENTS: Heat flow out of solid-plate-type fuel elements, cylindrical fuel elements and spherically shaped fuel, thermal shields. Absorption of core radiation.								
6	NUCLEAR POWER SYSTEMS: The fusion reactor, neutron energy and moderation, fission power plants, gas-cooled-reactor power plants, fluid-fueled reactors, direct conversion of nuclear energy.								
7	BOILING REACTORS: Boiling reactor mass and heat balance, driving pressure in a boiling channel, average density in a boiling channel, chimney effect. MIDTERM EXAMINATION I								
8	BOILING-REACTOR POWER PLANTS: Radioactivity of the steam system, the direct cycle power plant, experimental boiling-water reactor, the dual-cycle power plant, Dresden I nuclear power plant.								
9	PRESSURIZED-WATER REACTORS: Materials for water reactors, steam generators, reactor-system pressurizers, chemical-shim control, pressurized heavy-water reactors.								
10	PRESSURIZED-WATER REACTOR POWER PLANTS: The shippingport atomic power station, the point beach reactor power plant, Pickering heavy-water reactor power plant, fluidized-bed concept.								
11	GAS-COOLED REACTORS: Thermodynamic cycles; the direct open cycle, indirect open cycle and the direct closed cycle, gas-coolant radioactivity, comparison of gas coolants.								
12	GAS-COOLED REACTOR POWER PLANTS: Analysis of the gas-steam system; the simple cycle, analysis of the gas steam system: The dual-pressure cycle, the Hinkley point a station								
13	FAST-BREEDER REACTORS: Nuclear reactions in fast-breeder reactors, conversion and breeding, the conversion (breeding) ratio, doubling time. MIDTERM EXAMINATION II								
14	FAST BREEDER REACTORS AND POWER PLANTS: Reactor plant arrangements, the Enrico Fermi nuclear power plant, the Sefor plant.								