NUCLEAR POWER ENGINEERING

Progress of atomic energy in the European Union and in the World.
Basis of atomic technology: Principles of nuclear fissions, chain and controlled reactions and collision cross-sections. Critical mass and energetic classification of neutron radiation as well as reactions with matter. Nuclear radiation. Detectors of nuclear radiation.
Nuclear fuel: Fission and fertile materials. Kinds and properties of nuclear fuel. Obtaining of nuclear fuel, nuclear fuel processing, nuclear fuel purge, nuclear fuel enrichment.
Heat – transfer medium: Kinds and properties of heat – transfer media as well as tasks of heat – transfer media. Light water, heavy water, He, CO_2 , organic compounds, liquid metals Na, K, eutectic mixtures Na-K, Bi, Pb.
Moderator: Kinds and tasks of moderators and particular properties of moderators.
Partition of nuclear reactors, taking into consideration, construction and structure details. Influence of neutron radiation upon structure and properties of reactor materials: Radiation failure of structure of metal materials. Neutron absorption by fuel and constructional materials. Mechanical properties: strength, plastic strain, crack toughness, radiation creep resistance, fatigue at constant temperature as well as thermo-mechanical fatigue. Ballooning of a fuel clad. Formation of γ radiation hardness .
Nuclear corrosion of constructional materials of nuclear reactor: Factors determining of corrosion processes. Interstitial corrosion of austenitic steel and nickel base alloys as well as zirconium alloys. Influence of impurities of water upon corrosion processes. Neutralization of these impurities. Corrosion of constructional materials in liquid–alkali metals. Corrosion of heat resistant alloys in gas- cooled reactor.
Basic kinds of nuclear reactors. Construction and work scheme and primary parameters of chosen nuclear reactors: Pressurized Water Reactor, Boiling Water Reactor, Canadian Deuterium Uranium Reactor, Advanced Gas-Cooled Reactor Liquid Metal Fast Breeder Reactor, high temperature reactor for example Thorium High Temperature Reactor.
Constructional materials – basis of choice: heat resistant steels upon reactors vessels PWR and BWR, martensitic – ferritic steels for vessels and pipes in THTR, heat resistant nickel base alloys as well as Ni-Fe base alloys. Cr-Ni, Cr-N-Mo austenitic steels- properties, applications.
Fuel elements: Materials used for construction fuel rods and their properties as well as basic tasks.
Reactor control system: Basic tasks of reactor control system. Materials used in control rods and their features.
Emergency core cooling system: Tasks of emergency core cooling system, properties and wear of constructional materials.
Prompt reactivity of reactor, burning absorbents. Poisoning of a reactor by means of fragments and fission products.
Perspectives of utilization of fusion energy.

Literature :
Samuel Glasstone and Aleksander Sesonske: Nuclear Reactor Engineering: Reactor Systems Engineering, Fourth Edition vol. 2, Pub. in Great Britain by Chapman&Hall 1994
Elmer E Lewis: Fundamentals of Nuclear Reactor Physics, Elsevier Inc. 2008
Weston M Stacey: Nuclear Reactor Physics, Pub. Wiley 2001
Gwyneth Cravens: Power to Save World the Thruth about Nuclear Energy , pub, Alfred A. Knopf 2007
J. Adamczyk, K. Szkaradek Materiały metalowe dla energetyki jądrowej, pub. Politechnika Śląska, Gliwice, 1992

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