

## NUCLEAR TECHNOLOGY AND RADIATION SAFETY PROGRAM 2024-2025 COURSE CONTENTS

### SEMESTER I

#### **GKM-General Chemistry**

**(2+0), ECTS:3**

Matter, Elements, Compounds, Mixtures, Measurements and Mole Concept, Finding Chemical Formulas, Redox Reactions, Calculations Based on Chemical Reactions, Atom: Atom models, Proton, Neutron, Electron, Electromagnetic Radiation, Bohr Atomic Theory, Periodic Table, Quantum Numbers, Atom Radius, Ionization Energy, Electron Affinity, Electronegativity, Structure of Atomic Nucleus, Chemical Bonds: Ionic and Covalent Bonds, Exceptions to the Octet Rule, chemical bonding theories, Acid-Base Concept, Solutions, Buffer solutions, Food calorie calculation.

#### **MAT 101-Basic Mathematics (BSEC)**

**(2+0), ECTS:3**

Numbers, Exponents, Radical Numbers, Absolute Value, Factoring, Proportion, Proportion, Equations, 1st Degree Equations with 1 Unknown, 1st Order Equations with 2 Unknowns, Inequalities, Functions, Sets

#### **NTR 103-Radiation Physics I**

**(3+0), ECTS:4**

Matter, Atom and Structure of Atomic Nucleus, Some Properties of Nuclei, Fission, Fission, Nuclear Reactions, Mass, Energy and Bonding Energy, Radioactivity Laws, Radioactive Decays, Half-Life, Natural Radioactivity units, Uranium, Thorium, Radium, Radon and Harmful Effects, Radiation Types, Ionization, Radiation units, Interaction of radiation with matter, Photoelectricity, Event Compton Effect, Pair Formation, Interaction of particle radiation with matter, Radiation dosimetry

#### **NTR 109-Basic Biomechanics**

**(3+0), ECTS:4**

Introduction, Measurement, Estimation, Units and Dimensions. Motion in One Dimension, Kinematics: Displacement, Velocity and Velocity, Acceleration, Free Fall. Scalar and Vectors, Motion in 2 and 3 Dimensions: Position, Velocity, Acceleration, Oblique Throw, Circular Motion and Relative Motion, Dynamics: Newton's Laws, Applications of Newton's Laws, Applications of Newton's Laws: Gravity, Friction, Viscosity Forces, Forces in Circular Motion, Work, Kinetic Energy, Work-Energy Principle, Work, Kinetic Energy, Work-Energy Principle, Conservative and Conservative Forces, Potential Energy, Conservation of Energy, Linear Momentum and Conservation, Elastic and Inelastic Collisions, Center of Mass, Vibrations and Waves: Simple Harmonic Motion and Simple Pendulum, Rotational Motion,

Torque, Torque, Rotational Kinetic Energy, Angular Momentum and Conservation, Rotation Dynamics, Work and Energy in Angular Motion.

### **NTR 107-Basic Information Technologies (0+2), ECTS:2**

Basic computer knowledge, Windows XP, Microsoft Word, Microsoft Excel, Microsoft Powerpoint, Internet usage.

### **İLK 101- First Aid (BSEÇ) (2+0), ECTS:3**

Basic applications of first aid, first and second assessment, basic life support in adults, basic life support in children and infants, respiratory tract, first aid in obstruction, external and internal bleeding, wound and wound types, first aid in regional injuries, head and spine fractures, upper first aid in extremity fractures, dislocations and sprains, first aid in hip and lower extremity fractures, dislocations and sprains, first aid in diseases requiring emergency care, first aid in poisoning, heat stroke, burns and frostbite, foreign body escape.

### **RKUL 101-University Culture-I (ÜSEÇ) (0+2), ECTS:1**

Each semester includes seminars, conferences, panels, workshops and talks to be held for 14 weeks within the framework of a program consisting of suggestions from the academic units, student council and student clubs at the university.

### **İNGU 101 -English I (3+0), ECTS: 3**

tokens; Prepositions: Place, Time, Movement; Singular and Plural Nouns: Countable and Uncountable Nouns; Tenses: Present tense, Past tense structures; Modals: Will, Should, Should not, Must, Must not, Can; Comparative structures; Pronouns: Personal pronouns, Possessive pronouns; Adjectives; Affirmative sentences, Negative sentences and Interrogative sentences; Conjunctions: And, But, Because.

### **TURK 101 -Turkish Language I (2+0), ECTS:3**

Language and its features; The relationship of language, which is a social institution, with nation, culture and thought; Classification of world languages and the place and importance of Turkish among these languages; Spoken language, written language and historical development periods of Turkish written language; The current situation of Turkish and its spreading areas, sounds and sound events in

Turkish; Syllable knowledge, vowels and consonants in Turkish words; Spelling rules and punctuation marks.

### **ATA 101 Ataturk's Principles and History of Revolution I**

**(2+0), ECTS:3**

The backwardness of the Ottoman society and state order and the reform movements; The disintegration of the Ottoman state and the beginning of the national struggle; Mustafa Kemal Pasha's organization of the national struggle in Anatolia; opening of the first T.B.M.M.; Military and political developments between 1920-1922; revolutions and counter-reactions; establishment of the constitutional system; domestic and foreign policy in the republican period; The basic features of the Turkish revolution and the currents of thought that affected it; innovations in law, education, economy and social life; Atatürk's principles and general characteristics of these principles; Evaluation of Kemalism from an ideological perspective.

## **II. SEMESTER**

### **NTR 110-Mathematics in Nuclear Technology (BSEC)**

**(2+0), ECTS:2**

Polynomials, Matrix, Determinants, Functions, Limit and Continuity, Derivative and Applications, Integral and Applications, Differential Equations.

### **NTR 100-Radiation Physics II**

**(3+0), ECTS:4**

Atomic Spectra. X-Rays and spectra of multi-electron atoms, Obtaining X-Rays, Scattering and Absorption Mechanisms, Properties of X-Rays, Interaction with Matter, Parameters of X-Ray Devices, Uses of Radiation and Radioactivity, Sterilization by Radiation, Age Determination by Nuclear Methods, C-14 Method, Determination of the Age of the Earth, X-ray fluorescence spectroscopy (XRF), Neutron activation analysis (NAA), Mass spectrometry, Use of radiation in medicine, X-ray Imaging Techniques, Computed Tomography (CT), Magnetic Resonance Imaging, Nuclear Medicine Imaging Techniques, Positron Emission Tomography (PET) , Ultrasonic Imaging Techniques, Radiotherapy Applications, Harmful Effects of Radiation, Radiation Safety, ALARA.

### **NTR 112-Basic Electricity (BSEC)**

**(3+0), ECTS:4**

Electric Charge, Electric Field, Gauss's Law, Electric Potential, Capacitance, Dielectrics, Storage of Electric Energy, Electric Current and Resistance, Direct Current Circuits, Magnetism, Magnetic Field Sources, Electromagnetic Induction and Faraday's Law, Electromagnetic Induction Inductance and Electromagnetic Oscillations, Maxwell's Equations, Electromagnetic Waves, Light.

**RTR116- Programming and Simulation in Nuclear Technology (BSEC)****(1+2), ECTS:4**

Programs used in nuclear technologies, Detector Design and Simulations, Radiation Shielding Simulations, virtual reality studies in the Nuclear Energy Sector.

**RPSI 209 Positive Psychology and Communication Skills (ÜSEÇ)****(2+0), ECTS:3**

Definition of positive psychology, basic concepts, theoretical foundations and applications, examining brain behavioral systems of emotional experience and behavior, knowing oneself and others, psychosocial life skills and problem-solving skills, motivation and planning, anger, aggression, violence, anger, aggression, violence, relationship management, sound decision making, perseverance and compromise.

**RTR 114-Biological Effects of Radiation****(3+0), ECTS:5**

Structure and Organelles of Cell, Structure of DNA and Replication, Effects of Radiation at Cellular Level, Effects of Radiation at Molecular Level, Concept of Dose, Concept of Radiation Dose, Doses of Radiation Workers and Society, Biological Half-Life, Effective Half-Life Calculations, Radiation Hypersensitivity Cells and Event Chain, Radiation Sensitivity of Tissues and Organs, Early Effects of Radiation, Late Effects of Radiation, Epidemiological Studies, Radiation Accidents and Biological Effects Depending on the Degree of Dose; Changes in Blood Values, Vomiting, Nausea, Mortality, Genetic Risks, Chromosome Abnormalities, Radiation Damages and Repair Events.

**RKUL 102- University Culture-II (ÜSEÇ)****(0+2), ECTS:1**

Each semester includes seminars, conferences, panels, workshops and talks to be held for 14 weeks within the framework of a program consisting of suggestions from the academic units, student council and student clubs at the university.

**INGU 102- English II (3+0), ECTS:3**

Tenses: Present tense, Present tense, Past tense, Future tense structures; Modes: Might, Could, Can, Must, May; Adverbs: Place, Direction, Purpose, Adverbs of State; Adjectives: Order of adjectives, Comparison, Superlative structures; Passive Structure: Present, Extended, Past, Future passive structure; Conditional Phrases; Adjective Phrases; Transfer Sentences; Verb Structures: TO, -ING; Noun Phrases; Adverb Phrases; Comparative Structures.

**TURK 102- Turkish Language II****(2+0), ECTS:3**

To gain the ability to use the mother tongue correctly; Punctuation marks and spelling rules, composition rules, writing types are discussed with examples in the course, where it is essential to generate ideas and write their thoughts in order to improve the abilities of the students who came to the university by gaining this skill. In addition, various novels, poetry books and theater works are read and studied. A reading theater is made in the classroom and applied emphasis and intonation lessons are given with various diction techniques.

**ATA 102- Ataturk's Principles and History of Revolution II****(2+0), ECTS:3**

Recession of Ottoman Social and State Order and Reform Movements; The Disintegration of the Ottoman State and the Beginning of the National Struggle; Mustafa Kemal Pasha's Organization of the National Struggle in Anatolia; Opening of the First T.B.M.M.; Military and Political Developments Between 1920-1922; Revolutions and Counter-Reactions; Establishment of the Constitutional System; Domestic and Foreign Politics in the Republican Era; The Basic Features of the Turkish Revolution and the Thought Movements Affected by it; Innovations in Law, Education, Economy and Social Life; Atatürk's Principles and General Characteristics of These Principles; Evaluation of Kemalism in Ideological Perspective.

**III. SEMESTER****NTR201 RADIATION MEASUREMENT METHODS****(2+0) ECTS:3**

Radiation, Radiation Sources and Units, Radiation Measurement Principles, General Properties of Radiation Detectors, Ionization Detectors, Proportional Counters, Geiger – Müller Detectors, Scintillation Detectors, Semiconductor Detectors, Neutron Detectors, Radiation Spectrometer in Scintillators

**NTR215 BASIC ELECTRONICS****(2+0) ECTS:3**

Direct Current, Alternating Current, Series circuits, Parallel circuits, Series-parallel circuits, Resistors, Capacitors, Coils, Diodes, Transistors, Number Systems, Basic Gates.

**NTR207 NUCLEAR ENERGY TECHNOLOGIES****(2+0) ECTS:2**

Energy, Types of Energy, Uses of Nuclear Energy, Basic concepts for nuclear energy, the concept of radioactivity isotope, Basic Principles of Nuclear Energy (The Rationale and Vision of the Peaceful Use of Nuclear Energy, Benefits, Transparency, Sustainability), Nuclear Safety Basic Safety Standards in Radiation Protection, Reactor Theory and Operation, Permits and documents for Nuclear Facilities, Nuclear Facilities in the World, Nuclear Facilities in Turkey), Nuclear Power Facilities Installation and Planning, Industrial Control of Nuclear Energy, Decommissioning of Nuclear Facilities, Radioactive Materials and Waste Management in Nuclear Facilities, Fission and Fusion reactions.

**MYO022 VOCATIONAL ENGLISH (SECMYO)****(2+0) ECTS:3**

Introduction to professional English, with professional examples Present Simple Tense, Present Continuous Tense, Future Simple Tense, Past Tense, Modal Verbs, Professional dialogue examples

**NTR209 RADIATION SAFETY APPLICATIONS I****(2+8) ECTS:12**

Learning about the History of Radiation, Radioactivity and Analytical Measurement, Radiation Related Concepts, Natural and Artificial Radiation Sources, Radiation Types and Properties (observation of alpha, beta radiation), X-Ray Properties and Obtaining, X-Ray Tube and working principle, X-Ray Physics, Nuclear Fuel and Materials, Obtaining and cycling of fuels, Basic Safety Standards and Protection System in Nuclear Technology, Radiation Protection Principles and Shielding Principles, Radiation Protection Methods, Identification of Radiated Areas and Radiation Areas (Controlled areas, Surveillance areas), Deterministic and Stochastic Effects, Evaluation of the application area, opinions and suggestions

**NTR211 RADIATION SHIELDING PRINCIPLES****(2+0) ECTS:3**

Basic definitions, concepts and units, Interaction of heavily charged particles with matter, Interaction of Photons with Matter, Effect Sections, Interaction of Neutrons with Matter, Radiation detection methods, Radiation Dosimetry, Dose calculations, Radiation protection criteria and standards, Basic principles of shielding, Simple Shielding Calculation methods , Empirical Methods, Protection from external radiation.

**NTR213 PHYSICS OF ACCELERATOR****(2+0) ECTS:3**

Particle Sources, Thermionic Guns and RF Guns, Accelerator Units, Excitation of Electrostatic and RF Fields, RF Cavity Technology, Klystrons, Waveguides, Beamlines, Energy for Beams, Current, Emittance, Position Measurements, Beam Diagnostic Tools, Position and Energy Monitors , Vacuum Technologies in Accelerators, Power and Cooling Technologies for Accelerators, Bundle Stop Techniques, Medical Accelerators, Industrial applications of Accelerator.

**IV. SEMESTER****NTR 202- Radiological Emergency Planning Principles****(3+0), ECTS:4**

Nuclear and Radiological Hazard Situation National Implementation Regulation, Hazard State Detection, Duties and Responsibilities of the Related Ministry, Institutions and Affiliates, and Governorates, Preliminary Information to be Given to the Public Regarding a Possible Nuclear and Radiological Accident or Hazard Situation, A Nuclear and Radiological Accident or Hazard Situation Information to be announced to the public during the TENMAK Disaster and Emergency Management Center Directive, Establishment of the Disaster and Emergency Management Center, Duties and Responsibilities, Working Principles of the Disaster and Emergency Management Center, Execution of Services, Records and Documents, National Radiation Emergency Plan (URAP) ), National Level Institutions and Organizations and Service Groups to Take Charge in Radiation Emergency, Planning Principles; National Disaster Response Organization, Radiation Emergency Plans, Emergency Response Process, International Organizations and Agreements, National Guidelines

**NTR 204- Radiation Safety Applications II****(2+8), ECTS:12**

Reactor and its types, Research Reactors, Biological Effects of Radiation, Biological Effects of Radiation (DNA and Chromosome Damages), Radiobiology (Chromosome damages, detection of chromosome affected by radiation), Radiation Metrology (Learning the concept of dose and its effects), Risk, Hazard and Accidents, Radiation Protection in Interventional Radiology, Radiation Protection in Radiotherapy, Nuclear Electronics Manufacturing (Chips and Nuclear Batteries), Radioactive Waste Management (Disposal of Low Level Wastes), Radioactive Waste Management (Disposal of Intermediate Waste), Radioactive Waste Management (Disposal of High Level Wastes), Radiation Protection Equipment

**NTR 206- Health Physics (BSEC)****(2+0), ECTS:4**

Definition and basic concepts of health physics, Radioactivity, Radiation dosimetry, Problems with radiation dosimetry, Natural and artificial radiations and radioactive fallout, Biological effects of radiation, Radioisotopes important for human health and environment, Problem solving, Radiation protection, Accumulation of radioactive material wastes, harmless Conditioning and transportation methods, Planning of radiation working places, radiation accidents and legal situation related to radiation, Use of radiation and radionuclides in medicine, biology and industry

**NTR 200- National and International Nuclear Legislation and Waste Management (BSEC) (2+0), ECTS:4**

Introduction, Nuclear Safety and Nuclear Regulatory System, Construction Control Regulation of Nuclear Power Plants, Authorization of Nuclear Structure Inspection Institutions, Nuclear Substance Counter and Control Regulation, Regulation on the Physical Preservation of Nuclear Plants and Nuclear Materials, Physical Protection Measures Against Defiance During Use, Storage and Storage of Nuclear Material, Physical Protection Measures Against Sabotage Towards Nuclear Material and Nuclear Facilities, International Nuclear Regulations and the Prevention of Nuclear Weapons, Nuclear Waste and Activity, Low Level Radioactive Waste, Storage and Disposal, Intermediate Level Radioactive Waste, Storage and Disposal, High Level Radioactive Waste, Storage and Disposal, Liquid and Gaseous Nuclear Waste, Nuclear Waste Transportation Regulation, License, Permit, Control, Records.

**NTR 216- Industrial Control and Motors****(2+0), ECTS:3**

Relay, Contactor, Thyristor, Triac, Thyristor and Triac Trigger Elements, Semiconductor Elements, Semiconductor Sensors and Transducers, Thermal Sensor and Transducers, Mechanical Sensors and Transducers, Digital-Analog Converters, Analog-Digital Converters, Motors, Rotor Movement with Voltage Variable Motors, Changing Rotor Movement with Digital Pulse

**NTR 218- Reactor Theory and Management****(2+0), ECTS:3**

Energy sources and Nuclear energy, Fusion and Fission Energies, Radioactivity, Nuclear Reactor Physics, Chain Reaction and Multiplication Coefficient, Neutron loss and Critical conditions, Critical size calculation, Classification and technical characteristics of power reactors, Basic elements of power

reactors, Reactor kinetics: volume- flow-time relationships, mass balance, deposition, reaction rate, Reactor hydraulics: advective and convective diffusion, dispersion, flux, residence time concepts, distribution of residence time in ideal and non-ideal flow reactors, interface area, motions and velocities of liquid and solid phases, Operational characteristics of reactors, Nuclear fuel cycles, Nuclear reactor accident analysis, Nuclear energy in economic and environmental terms