NAVOI STATE UNIVERSITY

SSE13412 URBAN & INDUSTRIAL ECOLOGY — COURSE SYLLABUS

Faculty of Natural Sciences & Medicine | Department of Biology | Program: 60520200 Ecology & Environmental Protection

COURSE PASSPORT & ACADEMIC METADATA

Course Title: Urban and Industrial Ecology

Course Code: SSE13412

Course Type: Mandatory

Field of Study: 500000 Natural Sciences

Field: 520000 Environment

Program: 60520200 Ecology & Environmental Protection

Academic Year: 2026–2027

Semesters: 3 & 4

Form of Education: Full-time

Language: Uzbek

Total Workload Allocation: 150 Hours Contact (Lectures, Practical, Lab) + Independent Study |

Assessment: Examination

Aligned UN SDGs: SDG 9 (Industry & Innovation), SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption)



1. Course Description & Urban Ecosystems Focus

Urban & Industrial Ecology examines urban ecosystem dynamics, industrial zoning, urban sprawl, industrial waste management, Maximum Permissible Concentrations (PDK/PVD/PDS), acoustic/electromagnetic pollution, fitoremediation, and zero-waste technologies.

In alignment with SDG 9, 11, and 12, the course equips environmental engineering and ecology students with practical skills in urban eco-monitoring, industrial eco-auditing, GIS mapping, and sustainable urban design.

2. Course Aims & Engineering Competencies

Course Aim: To cultivate expertise in urban ecological design, industrial waste recycling, environmental quality monitoring, pollution abatement engineering, and sustainable city planning.

- Urbo-Ecological Competency: Understand urbanization dynamics, urban heat island effects, industrial zone functional planning, and natural-technogenic balances.
- Industrial Risk & Audit Skills: Evaluate industrial emissions, toxic waste hazard classes (1-5), wastewater treatment, and Maximum Permissible Emission (PVD) projects.
- Bio-Indication & Laboratory Diagnostics: Execute lichenoindication, leaf dust sorption tests, soil phytotoxicity bio-assays, and noise level measurements.
- SDG Competencies: Implement Zero Waste concepts, green infrastructure, smart city solutions, and industrial ecology frameworks (SDG 9, SDG 11).

3. Prerequisites

Prerequisites: Introduction to Specialty (IXT1104), General Ecology, General Chemistry, Higher Mathematics.

4. Course Structure & Workload Allocation

Semester / Activity	Curriculum & Technical Focus	Workload Allocation
Semester 3: Urbanization & Industrial Zoning	Lectures, Practical & Lab Diagnostics	Contact Hours
Semester 4: Waste Recycling & Eco-Design	Lectures, Practical & Lab Diagnostics	Contact Hours
Independent Research & Projects	Zero Waste, Smart Cities & Industrial Audits	Self-Directed Hours
Total Workload (Full Module)	2-Semester Comprehensive Module	150 Hours Contact + Self-Study

5. Detailed Course Curriculum Outline

5.1 Lecture Syllabus Outline

• **L1: Introduction to Urban & Industrial Ecology:** Scope, history, interdisciplinary ties, artificial ecosystems, and human health in industrial cities.

• **L2: Industrial Classifications & Environmental Impacts:** Processing, metallurgy, chemical, machine building, food, and construction industries.

• **L3: Urbanization Dynamics & Ecological Consequences:** Demographic growth, megacities, urban sprawl, ground/soil/climate shifts, and health risks.

• **L4: Ecological Functional Zoning of Industrial Areas:** Industrial zones, transportation corridors, underground infrastructure, and sanitary buffers.

• **L5: Architectural Eco-Geometry & Energy Efficiency:** Resource-saving construction, thermal convection, lighting, and eco-geometry in factories.

• **L6: Environmental Remediation in Industrial Zones:** Gas scrubbing, industrial wastewater treatment, solid waste utilization, and municipal waste culture.

• **L7: Industrial Energy Systems & Thermal Pollution:** Thermal power plants, atmospheric emissions, fuel balance, nuclear energy risks.

• **L8: Atmospheric Air Quality in Industrial Cities:** Smog, acid rain, air circulation, urban acoustics/noise, and land monitoring.

• **L9: Soil & Water Quality in Industrial Zones:** Heavy metal contamination, soil salinization, biological activity, and industrial effluent standards.

• **L10: Environmental Culture & Awareness in Cities:** Role of media, national traditions, environmental education, and civic eco-projects.

• **L11: Industrial Waste Recycling & Agricultural Reuse (Sem 4):** Secondary raw materials, hazardous waste burial/neutralization, eco-certified products, GIS mapping.

• **L12: Green Infrastructure & Urban Forestry:** Phytocides, noise attenuation by trees, windbreaks, sanitary protection green belts.

• **L13: Natural-Technogen Components of Cities:** Energy sector impacts, atmospheric emission dynamics, particulate matter sorption.

• **L14: Environmental Standards & Norms (PDK, PVD, PDS):** Regulatory compliance, Maximum Permissible Discharges, UNEP cooperation, and environmental pasports.

• **L15: Sustainable Development & Green City Futures:** Preserving biosphere integrity, resource renewal capacity, zero-waste transition, and UN SDGs.

5.2 Practical & Seminar Discussion Outline

- Sem 3: History of industrial cities and post-industrial revolution urbanization stages.
- Sem 3: Quantitative urban metrics: Agglomeration index, urban density, and growth rate formulas.
- Sem 3: Urban Sprawl challenges: Resource depletion and land degradation analysis.
- Sem 3: Ecological mapping of industrial zones (promzona), soil and groundwater contamination.
- Sem 3: Natural-technogenic balance calculations in urbo-ecosystems.
- Sem 3: Industrial ecotoxicology: Assessing noise, vibration, and occupational health risks.
- Sem 3: Environmental Impact Assessment (EIA/ZVO) principles for industrial enterprises.
- Sem 3: Hazard classification of industrial waste (Classes 1-5) and toxicological profiling.
- Sem 3: Regulatory compliance: Working with PDK, PVD, and PDS standard tables.
- Sem 3: Green modernization of factories: Dust filters, closed-loop water systems, fitoremediation.
- Sem 4: Spatial layout and structural formation models of industrial districts.

- Sem 4: Landscaping factory perimeters with gas/dust-resistant plant species.
- Sem 4: Urban acoustic pollution: Measuring decibel levels using sound level meters.
- Sem 4: Eco-urbanism & Master Plans (Genplan): Evaluating urban planning against SanPiN standards.
- Sem 4: Industrial waste recycling: Pyrolysis, composting, and secondary raw material loops.
- Sem 4: Resource consumption in industry: Water, energy, and mineral depletion analysis.
- Sem 4: Zero Waste concepts, Smart Cities, Eco-Cities, and international eco-organizations (UNEP, IUCN).

5.3 Laboratory & Field Diagnostics Outline

- Sem 3: Lichenoindication of urban air quality; Tree leaf dust sorption capacity measurement.
- Sem 3: Chlorophyll extraction for plant gas resistance analysis; Urbo-soil phytotoxicity bio-assays.
- Sem 3: Fluctuating asymmetry calculation in leaves under urban pollution stress.
- Sem 3: Industrial wastewater pH, salinity, suspended solids, and heavy metal titration.
- Sem 3: Urban acoustic measurement: Measuring traffic noise in decibels (dB).
- Sem 4: Electromagnetic field radiation measurement in computer labs and high-voltage zones.
- Sem 4: Atmospheric CO and NOx gas analysis using portable gas analyzers.
- Sem 4: Calculating Air Pollution Index (IZV) based on hydrometeorological statistics.
- Sem 4: Analyzing factory Maximum Permissible Emission (PVD) draft passports.
- Sem 4: Municipal Solid Waste (MSW) morphological composition modeling and recycling plans.

5.4 Independent Study & Analytical Projects

- Megacities and agglomerations: Global and local ecological footprints.
- Urban Heat Island (UHI) effect: Causes, consequences, and mitigation strategies.
- Aerosol air pollution: PM2.5 and PM10 micro-particle sources and human health risks.
- Heavy metal contamination and fertility loss in urban soils (Urbozyoms).
- Ecotoxicological analysis of chemical and petrochemical enterprises (Navoi, Almalyk, Bekabad case studies).
- Designing Sanitary Protection Zones (SMZ) around industrial facilities.
- Municipal solid waste management: Sorting, recycling, and landfill safety.
- Phytoremediation and bioremediation technologies for heavy metals and oil spills.
- Electronic waste (E-waste): 21st-century environmental hazards and recycling technologies.
- 'Yashil Makon' national tree-planting project in Uzbekistan: Ecological microclimate benefits.
- Smart City and Eco-City concepts: Global best practices and implementation in Uzbekistan.
- Green architecture: Vertical greening, rooftop gardens, and ecological urban karkas.
- GIS and remote sensing applications in urban environmental monitoring.

6. Recommended Literature & Information Sources

- Xushvaqtova X., Yormatova D. Urban and Industrial Ecology (Textbook). Tashkent, 2021.
- Egamberdiyeva L.Sh., Egamberdiyev K.F. Urban and Industrial Ecology. Tashkent, 2021.

- Rayeva O.X. Ecology (Study Guide). Jizzakh, 2021.
- Ayres R.U., Ayres L.W. A Handbook of Industrial Ecology. Edward Elgar Publishing, 2002.
- Yormatova D. Industrial Ecology. Tashkent, 2007.