

COURSE DESCRIPTION

BACHELOR OF ENVIRONMENTAL SCIENCE (B.ENV.SC.)

LEVEL 100

ENS 130: ENVIRONMENTAL PHYSICS

Properties of matter; force and motion; thermodynamics; gas laws; waves, sound and environment; basic radiation laws; electromagnetic spectrum; radioactivity and the environment; energy and the environment; radioactivity; methods and units of measurements; laboratory sessions.

ENS 131: ENVIRONMENTAL CHEMISTRY

The periodic table; chemical energetics; organic processes and effect on the environment; oxides of carbon, sulphur, phosphorus and nitrogen in the environment; halogen compounds; chlorofluorocarbons; chemical processes: oxidation and hydrolysis; standard analytical techniques: heating, filtration, centrifugation, volumetric analysis, weighing, pH measurements; conductance measurements and spectrophotometry; laboratory sessions.

ENS 132: ENVIRONMENTAL BIOLOGY

Bio techniques: biosystematics; chemicals of life: carbohydrates, liquids and proteins; cell biology; morphogenesis and development anatomy; self-perpetuation adaptation: embryogenesis; plant and animal parasites; life cycles of major insects and acarine groups; plant/animal responses; laboratory sessions.

ENS 134: TECHNOLOGY, ENVIRONMENT AND DEVELOPMENT

Development continuum and environment; technologies and environmental resource use; Industrialization and Urbanization; sustainable development; perspectives of development; agricultural technologies and environment; globalisation and environment; challenges on technology implementation; modern versus indigenous technology in agriculture and industry.

ENS 135: INTRODUCTION TO EARTH SCIENCES

The earth's crust and its physical and chemical characteristics; erosion: water and wind; mass movement and environmental impacts: landslides, mudflows and soil creep; volcanicity and earthquakes: causes, prediction and impacts; atmosphere and oceans as an integrated system of fluids in motion; geomorphological processes; physical properties of rocks; weathering; laboratory sessions.

ENS 136: PRINCIPLE OF ENVIRONMENTAL SCIENCE

Concept of environment; perspective of environmental sciences; development of environmental science; globally, regionally and nationally. Kenya approach to environmental science; recent advances and research in environmental science; role of environmental science in sustainable development.

ENS 137: MATHEMATICS FOR ENVIRONMENTAL SCIENCE

Introduction to applied mathematics for environmental science; derivatives and differentiation; integration; ordinary differential equations; ordinary differential equation systems; numerical solution of ordinary differential equations; second order ordinary differential equations; linear algebra; non-linear equations; and partial differential equations.

ENS 138: PRINCIPLES OF ENVIRONMENTAL ECONOMICS

Introduction to economics; societal organization and gains through trade; supply and demand; elasticities of supply and demand; welfare economics: consumer and producer surplus; government policy: price controls and taxes; perfect competition, externalities and public goods.

LEVEL 200

ENS 230: ENVIRONMENTAL ECOLOGY

Principles of ecology; ecosystems; ecological succession; communities; population dynamics; isolation; behavioural ecology; measurements of ecological factors; human influences on ecosystems; one week field course on man-made and natural ecosystems.

ENS 233: SOIL HABITATS

Introduction to soil Science, soil forming processes; soil components; minerals and organic matter; soil aggregates; chemical reactions on soil colloidal surfaces; soil aeration; drying and wetting of soil; soil physical properties; Emphasis on soil as a habitat: soil as a disturbed environment; Viruses and bacteria in the soil; Soil contamination with heavy metals; remediation of contaminated soils; application of molecular biology in development of microbes to degrade hazardous pollutants in the soils.

ENS 234: ENVIRONMENTAL GENETICS

Nature of genetic materials in organisms, and its functions; Impacts of environment on the genetic material of living organisms. Process of mitosis and meiosis. Mendelian theory of genetics and non-mendelian inheritance. Heredity; variation in chromosome structure; mutation; types of variations in natural populations, modes of speciation and species diversity; Role of genetics in the development and improvement of plants and animals. Case studies on Natural vegetation, wild animals and agricultural development.

ENS 237: HUMAN POPULATION AND ENVIRONMENT

Population dynamics; types of population dynamics and their influence on population change; population structure and composition; measures of population dynamics – levels, trends and patterns; demographic transition – facts and theories; role of the demographic transition in world development; perspectives of population change on the environment; population policy; efforts to monitor and evaluate population control/change.

ENS 240: FUNDAMENTALS OF ENERGY SCIENCE

Basic of energy science: energy units and conversion; first and second law of thermodynamics; energy efficiency; energy and power; different forms of energy; mechanical energy, potential energy, kinetic energy, rotational energy; thermal; internal energy, chemical energy, stoichiometry: mass balance in chemical reactions; enthalpy; the energy dimension of chemical reactions.

ENS 241: BIODIVERSITY CONSERVATION

Definition of biodiversity and species; mega biodiversity and conservation areas of east Africa; causes of species extinctions; endangered, threatened and vulnerable species; exotic species and extinctions; biodiversity conservation: habitat protection, insitu and ex-situ, legislation and recovery plans; cases.

ENS 242: CLIMATE CHANGE AND GLOBAL WARMING

Causes of climate change and global warming; greenhouse gases; detection of climate change and global warming, impacts of climate on the environment, Agriculture, water, human health: climate change responses and adaptations, climate change polices and interventions.

ENS 243: ENVIRONMENTAL MICROBIOLOGY

Characteristics of micro-organisms; micro-organism communities and their interrelationships; biodegradation; role of micro-organisms in ecological balance; micro-organisms and pollution; microbes and environmental health: biocides, bactericides, fungicides; microbes as a resource; genetically engineered microbes and environment

ENS 245: ENVIRONMENTAL HYDROLOGY

Fundamentals of environmental hydrology; human activities and the hydrologic cycle; basic hydrological data: discharge, rainfall, evaporation; water balance; groundwater: occurrence, dynamics and degradation; hydrological hazards: causes, impacts, responses and mitigation.

ENS 246: FOREST RESOURCESMANAGEMENT

Forest types and functions; forest products; tropical rain forest composition; life forms and tree population; principles of forest management; forest regeneration; recruitment and recovery; tree growth rates; indigenous and exotic plantation; socio-economic, cultural and ecological values; forest fauna; policy and legal framework.

LEVEL 300

ESU 300: ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT

Principles of Environmental Impact Assessment (EIA); types of EIA; EIA components, procedures and techniques; outputs and implementation; EIA as a path to sustainable development; EIA and project cycles; institutional, policy and legal aspects; Environmental Audit: principles, procedures and applications; case studies.

ESU 301: ENVIRONMENTAL LAW AND POLICY

Understanding policy and law as concepts; Ethics in environmental policy and management; Principles of environmental policy and law; International Environmental Convention, Protocols and Treaties; Environmental Management and Coordination Act: Challenges and opportunities in environmental policy and law enforcement (EMCA 1999); Case studies.

ESU 302: STATISTICS

Importance of statistics; scales of measurements; statistical concepts; sampling procedures and organization of data; measures of central tendency and dispersion and relative position, formal distribution and measure of relationships; measure of significance of differences between two means in a research study (t-test); measurement of standard error incurred during a research study.

ESU 304: RESEARCH METHODS

Environmental research problem; research design and study scope; the research process: definition of the problem, formulation of objectives and hypotheses, literature review, methodology, sampling procedures and instruments, data collection and analysis, results presentation and interpretation, conclusions and recommendation; report and abstract writing; publication preparation; role of modelling in research; seminar preparation and presentation techniques.

ESU 305: ENVIRONMENTAL ECONOMICS

Theory of environmental economics: resource use and allocation, opportunities and constraints in economic development; environment as a public good; externalities; efficiency versus social consideration; political economy of resource use and environmental management; public and private conflicts in resource use; economic and cost-benefit analysis of utilization of environmental resources; valuation techniques for market and non-market environmental goods and services; integration of environment in economic management and development.

ENS 334: PRACTICUM

The aim of the field practicum is to enhance awareness of physical and human environment. The field practicum will enable students to be attached to institutions as part of the workforce. Students will learn to utilize skills and techniques necessary to understand and solve environmental problems. The practicum will normally last for duration of three months and be supervised **THREE** times. The practicum will be graded according to the University Regulations.

ENS 331: REMOTE SENSING FOR ENVIRONMENTAL MONITORING

Concepts and foundations; energy interaction in the atmosphere and with earth features; data acquisition; photographic and electronic data types; platforms and sensors; data processing; film spectral sensitivity and processing - black and white colour films; colour concepts; fundamentals of aerial photography, imagery interpretations and mapping; earth resource satellite and sensors (Landsat, SPOT, NOAA, Radarsat, and others); applications in environmental monitoring and management.

ENS 344: MUNICIPAL SOLID WASTE MANAGEMENT

Sources, categorization and composition of municipal solid waste; waste: separation, storage and transportation; management systems: waste minimization, reuse and recycling; biological and thermal treatment; disposal options: combustion, composting, incineration and landfill; strategies for sustainable waste management; integrated waste management; eco-park concept. Legal, political and economic aspects; policy regulation; EMCA.

ENS 343: WATER POLLUTION

Characteristics of water bodies; Physico-chemical properties; Biological characteristics; Water pollutants: point and non-point sources; inorganic and organic wastes and their measurements; water quality issues in lakes rivers, reservoirs and groundwater; impacts of water pollution on human, terrestrial land and aquatic organisms; water quality assessment techniques and standards; sedimentation and siltation and their impacts on water sources; water pollution control; legal and technological.

ELECTIVES

ENS 342: ENVIRONMENTAL HEALTH AND EPIDEMIOLOGY

Infectious and parasitic diseases: endemics and pandemics, environmental diseases, malaria sleeping sickness cholera, typhoid, etc. and their epidemiology, epidemiological factors: population, housing, sanitation and migration: epidemiological methods: screening, surveillance; quarantine and immunization; strategies for enhancing environmental health

ENS 347: ENERGY RESOURCES AND MANAGEMENT

Energy: renewable, non-renewable; sources; types: conventional and alternative sources; energy balance: structure and elements of energy balance; overview of Kenya and world energy scenarios, energy economics, energy planning and audits, sustainable energy policy, energy and climate change, environmental problems of energy and energy resource use.

SMR 305: WILDLIFE ECOLOGY AND MANAGEMENT

Wildlife as a natural resource; wildlife habitats; carrying capacity; threat to species; characteristics of wildlife populations; annual cycles and stability; population stress factors; responses to stress and recovery; territoriality, migrations and nomadism; methods of studying wildlife: wildlife management; establishing protected areas; zoning as a management strategy;

wildlife farming; use of ecosystem models in wildlife management; trends in wildlife research; policy and legal framework; case studies.

LEVEL 400

ENS 430: RESEARCH PROJECT - 2 Units (*Pre-requisite ESU 304*)

All students in the Department will undertake a research project. The choice of topic will be made in consultation with assigned supervisors in the Department during the first semester. Students will be required to develop and present research proposals, make oral presentations in a Departmental seminar. In the second semester, students will analyse data, write and submit final project reports for assessment and grading.

ENS 431: SOIL AND WATER CONSERVATION

Types of soil erosion; factors of soil erosion; impacts of soil erosion; modelling soil loss; sediment production, transport and deposition; physical and biological methods of soil conservation; appropriate soil management; conservation of cropland and grazing land; gully control; road and river bank protection; extension methods in soil and water conservation; legislation and policy; case studies; 1 week field study.

ENS 432: ENVIRONMENTAL MODELING

Principles and concepts; types of environmental models; model formulation, model development, model solution, application and validation; model spatial components; taxonomy of environmental models; applications of models to environmental systems: hydrological, atmospheric, ecological, soil, socio-economic; population modeling; case studies.

ENS 433: ENVIRONMENTS AND BIOTECHNOLOGY

Global aims and objectives of Biotechnology; Interdisciplinary nature and application of environmental biotechnology; Genetic materials in plants, animals and humans and their significance; Viral and bacterial nucleic acids; Grafts and transplants of organs; Grafting and transplanting techniques, biotechnological methods for the improvement and development of agriculture; Tissue and Aqua culture techniques & methods; genetic engineering; genetic code and coding; Clone and cloning; Gene therapy; Synthetic genes and environment; Genetically modified organisms and their products; Super gene(s); Prions; Role of biotechnology in waste management. Policy issues in Biotechnology.

ENS 436: INDUSTRIAL ECOLOGY AND CLEANER PRODUCTION

Concepts of pollution prevention: Principles of life analysis (LCA) industrial ecosystem; environmental resource audits, water, energy and waste audits, environmental management systems, eco-labelling, cleaner production, industrial ecology; energy efficiency, cleaner production; environmental sustainability and vision 2030; case studies; one week field course.

ENS 437: LAND DEGRADATION AND DESERTIFICATION

Concepts and issues of land degradation; desertification: global, regional and national dimensions; anthropogenic and physical causes of land degradation and desertification; effects of

land degradation and desertification processes; desertification control and management; governmental and non-governmental initiatives; the UN Plan of Action to control desertification; case studies.

ENS 454: MINING AND SUSTAINABLE DEVELOPMENT

Impact of mining on the environment; health and safety; measures to reduce impact of mining activities on the environment; protection of surface and ground water; controlling acid mine drainage; use of mining wastes; rehabilitation of mined areas: planning and rehabilitation; uses for rehabilitated areas; monitoring programmes; policy and legal framework.

ENS 455: RENEWABLE ENERGY TECHNOLOGIES

Biomass: potential of biomass energy; biomass energy conversion technologies, environmental impacts and economics of biomass energy systems, wind energy: the potential of wind energy, development of installed wind power, environmental and economic aspects of wind energy, solar energy systems: hydroelectricity development and potential; environmental and social-economic aspects, energy planning and audits, sustainable energy policy.

ENS 456: AQUATIC ECOLOGY

Water: occurrence, types, properties of the water column, quality and monitoring; fresh and saline water ecology: productivity, food chains, energy transfer; limiting factors; flora and fauna: classification, habitats, distribution and adaptation; role of water in development: agriculture, fisheries, power generation and water supply; impacts of land use on water quality; role of development authorities in utilization of water resources.

ELECTIVES

ENS 435: URBAN ECOLOGY AND POLLUTION

The urban environment as an ecosystem: components, energy and material flows, settlements and population dynamics; comparative analysis of urban and natural ecosystems; environmental and health problems associated with built environment; noise pollution; supersonic transport; air pollutants; pollution assessment, monitoring and control, pollution protocols; ecologically sound cities.

ENS 440: ENVIRONMENTAL RISK AND HAZARD MANAGEMENT

Concepts and principles; anthropogenic and natural hazards; risk and hazard assessment; hazard identification; estimation of risks; risk management; ethical analysis; risk perception and responses; risk benefit analysis; hazard preparedness and management; monitoring and early warning systems; case studies.

ENS 449: COASTAL MARINE RESOURCES MANAGEMENT

The marine environment: Physical and chemical properties of water; Marine organisms: reproduction, dispersal and migration; Organisms of the open ocean: Plankton and Nekton; Organisms of the sea bed; Intertidal Ecology: Estuaries and Marshes, Mangrove ecosystems; Sea

grass, and Coral reefs; Diversity of marine invertebrates; Deep sea biology; Human impact on marine; field trips to the coast. ; Utilization and management of coastal and marine resources; marine parks and reserves; impact of development on marine environment; policy, legislation and International conventions.

ENS 457: ARID AND SEMI ARID LANDS (ASALs) DEVELOPMENT

Physical environment of the dry lands; adaptations of plants and animals; dry land resources; issues of development; government policy on ASALs; dry land farming; irrigation; agroforestry; pastoralism and ranching; tourism and wildlife; soil and water conservation; strategies to cope with drought; sustainable development projects of ASALs; one week practical field studies on selected Kenyan ASALs.