Academic Programs Booklet

College of Science

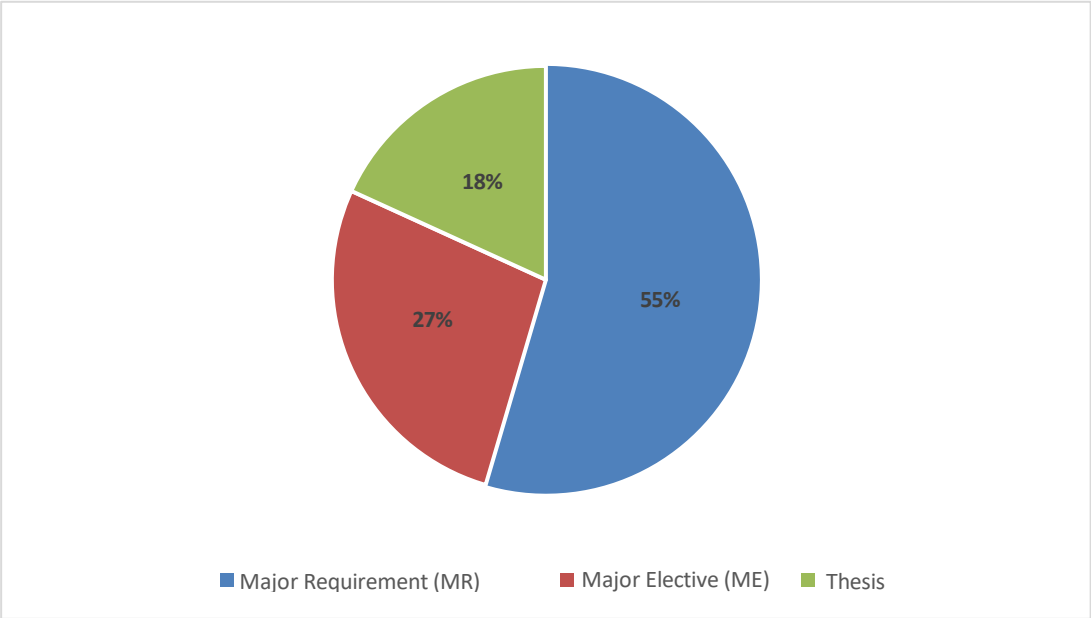
2017

Prepared By: VP For Academic Programs and Graduate Studies Office

College of Science

Master in Environment and Sustainable Development (2017)

Program Components



Course Type	CRD
Major Requirement (MR)	**18**
Major Elective (ME)[1]	**9**
Thesis	**6**
Total Credit (CRD)	**33**

Teaching Language: English

[1] Student must select **three** courses from Major Electives (ME) List.

Detailed Study Plan

Year 1- Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre Requisite	Major GPA
		LEC	PRAC	CRD			
ESD 501	Environmental Science	3	0	3	MR	---------	Yes
ESD 503	Environmental Economics	3	0	3	MR	---------	Yes
ESD 547	Research Methods	3	0	3	MR	---------	Yes

Year 1- Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre Requisite	Major GPA
		LEC	PRAC	CRD			
ESD 502	Environmental Law	3	0	3	MR	---------	Yes
ESD 504	Resource Management and Technology	3	0	3	MR	---------	Yes
ESD 511	Energy and the Environment	3	0	3	MR	---------	Yes

Year 2- Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre Requisite	Major GPA
		LEC	PRAC	CRD			
ESD 5XX	Elective Course	3	0	3	ME	---------	Yes
ESD 5XX	Elective Course	3	0	3	ME	---------	Yes
ESD 5XX	Elective Course	3	0	3	ME	---------	Yes

Year 2- Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre Requisite	Major GPA
		LEC	PRAC	CRD			
ESD 548	Thesis	6	0	6	MR	---------	Yes

Major Elective Courses List

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ESD 505	Environment and Society	3	0	3	ME	None	Yes
ESD 506	Environmental Education	3	0	3	ME	None	Yes
ESD 507	Environmental Pollution	3	0	3	ME	None	Yes
ESD 508	Environmental Conservation	3	0	3	ME	None	Yes
ESD 509	Environmental Hazards	3	0	3	ME	None	Yes
ESD 510	Environmental Stresses on Man	3	0	3	ME	None	Yes
ESD 514	Desert Ecology and Desertification	3	0	3	ME	None	Yes
ESD 515	Climate Changes and Air Pollution	3	0	3	ME	None	Yes
ESD 516	Geographical Information System (Gis)	2	3	3	ME	None	Yes
ESD 519	Biological Biodiversity	3	0	3	ME	None	Yes
ESD 521	Solid Waste Management I	3	0	3	ME	None	Yes
ESD 522	Land Use and Management	3	0	3	ME	None	Yes
ESD 523	Environmental Problems in the Gulf Region	3	0	3	ME	None	Yes
ESD 524	Environmental Laws in the Gulf States	3	0	3	ME	None	Yes
ESD 526	Environmental Impact Assessment	2	3	3	ME	None	Yes
ESD 527	Environmental Data Analysis	2	3	3	ME	None	Yes
ESD 528	Sustainable Development of Living Marine Resources	3	0	3	ME	None	Yes
ESD 529	Ecosystems of the Arabian Gulf	3	0	3	ME	None	Yes
ESD 531	Environmental Microbiology	2	3	3	ME	None	Yes
ESD 534	Marine Pollution	2	3	3	ME	None	Yes
	SD 538 Environmental Chemistry	2	3	3	ME	None	Yes
ESD 541	Oil Pollution	3	0	3	ME	None	Yes
ESD 542	Environmental Radiology	3	0	3	ME	None	Yes
ESD 544	Environmental Engineering	3	0	3	ME	None	Yes
ESD 545	Environmental Analysis Techniques	2	3	3	ME	None	Yes
ESD 546	Special Topics in Environmental Science	3	0	3	ME	None	Yes
ESD 547	Research Methods	3	0	3	ME	None	Yes

Course Description

Course Code: ESD 501 **Course Title**: Environmental Science
Environment and Ecology; relationship between man and the environment. Industrialization and urbanization and its effect on the environmental quality. Earth and biogeochemical cycles. Life and environmental ecosystems, nutrient cycling, ecosystem and population balance. Natural and renewable resources: minerals, biota, trash, energy, soil, water, fossil, fuel, nuclear and alternative energy. Human population. Water and wastewater management. The atmospheric environment; climate and climatic changes. Soil and land use. Air, Soil and water pollution and environmental hazards. Pollution prevention, environmental preservation and protection.

Course Code: ESD 502 **Course Title**: Environmental Law
Environmental laws, techniques: prevention, implementation, enforcement and remedial measures. International Laws, conventions and agreements. Regional conventions and agreements. National laws, by-laws, legislation and standards on: air, water, soil, noise, light, radiation, oil, hazardous material, waste, dumping, marine, terrestrial, hunting, fishing, exploitation, liability, compensation, environmental protection, pollution prevention and control. Bahrain s regulations compared with regional and international laws.

Course Code: ESD 503 **Course Title**: Environmental Economics
Understand how economic methods can be applied to environmental issues facing society; Understand difficulties arising in using economic analysis in environmental policy design; Solve and manipulate a variety of diagrammatic and algebraic models in environmental economics and critically evaluate these models; Be familiar with a number of real world environmental policy problems and understand how economic analysis has been applied in their solution.

Course Code: ESD 504 **Course Title**: Resource Management and Technology
Water management, wastewater management, ground water management. Pest control, problems and method. Trash, collection storage, transportation, disposal and recycling. Mineral, biological, and energy resources in terms of exploitation, conservation and control. Renewable energy resources.

Course Code: ESD 505 **Course Title**: Environment and Society
Interaction between human societies and natural environmental systems; causes and nature of human impacts on the environment; implication of key environmental issues on human societies; environmental protection in contemporary societies; emergence of environmental movements.

Course Code: ESD 506 **Course Title**: Environmental Education
Concepts of environment and environmental education. Objectives of environmental education. Ecosystems and mans relation to ecosystems. Historical, philosophical and psychological basics of environmental education. Environmental problems: water, air, food, etc. Religious teachings, attitudes and values of environmental education: promoting environmental values, attitudes and ethics.

Course Code: ESD 507 **Course Title**: Environmental Pollution
Air pollution: effect and Meteorological aspects of air pollution. Biomedical and health aspect of air pollution. Water pollution: industry and water pollution; effect of water pollution. Waste and waste disposal, control and abatement of pollution from solid wastes. Noise pollution: sources, types, effects, control. Food pollution. Social, legal and economic aspects- of environmental pollution case studies

Course Code: ESD 508 **Course Title**: Environmental Conservation
Urban development. Land use planning. Agriculture and food production. Conservation of forests, woodlands and grasslands. Conservation of wildlife. Conservation of water resources. Air pollution and conservation. Wastes recycling for conservation. Recreational activities and conservation. National institutions and efforts for conservation. International effort on conservation.

Course Code: ESD 509 **Course Title**: Environmental Hazards

Earth structure and material, earth system and cycles and geological processes. Earthquakes, volcanoes, (meteorology) hurricanes, tsunamis, tidal currents, red tides, landslides, floods, sea level rise and other hazards of ocean and weather (meteorology). Pollution and accidental hazards and disease outbreaks

Course Code: ESD 510 **Course Title**: Environmental Stresses on Man

Environmental Stressors: Stress and the environment, non-auditory effects of noise on behavior and health. Thermal stress: Physiological, comfort, performance and social effects of hot and cold environment. Air pollution and human behavior. Ambient stress and the designed environment. The building environment is a source of psychological stress; impact of buildings and cities on satisfaction and behavior. Environmental factors affecting impatient stress in acute care hospitals. School environments and stress. The office environment as source of stress. Neighborhood physical environment and stress. Environment stress and public policy: much about environmental stressor research: policy implication.

Course Code: ESD 511 **Course Title**: Energy and The Environment

Introduction: definition, use, environmental consideration, sources of conventional energy. Air pollution and energy use. Sources of renewable energy: solar, wind, biomass, hydroelectricity, geothermal and temperature difference energy. Environmental consideration of renewable energy sources.

Course Code: ESD 514 **Course Title**: Desert Ecology and Desertification

Desert geomorphology, desert surface, weathering forms. Deserts, past and present, origin of desert depressions and oasis. Water and soil in desert, Remnants of fluvial processes. Wadis and flash floods. Shoreline characteristics and potentials in the desert environment. Factors affecting climatic changes in the desert environment. Ecological concepts and dynamics of desert ecosystems. Plant and animal sociological relations and methods of assessment. Relationships and dynamics affecting the management of desert ecosystems. Human impact of abundance, distribution and ethology of wildlife in desert ecosystems. Structural and physiological adaptations of plants and animals to desert environment, Definition of desertification and land degradation. Causes of desertification and degradation. Extent of desertification. Methods of control and avoiding desertification.

Course Code: ESD 515 **Course Title**: Climate Changes and Air Pollution

'The earth's atmosphere, air circulation and weather patterns. Air pollution, sources of air pollution. Effects of air pollution and synergistic effects of air pollutants. Meteorological aspects of air pollutants. Local, regional and international aspects of air pollution. Air pollution and global climate. Air quality and standards. Methods of measurements of air quality and air pollution control.

Course Code: ESD 516 **Course Title**: Geographical Information System (GIS)

Introduction: basic concepts. The theory of Cartography and the representation of data and statistics into maps. Techniques of mapping: topographic, geological, vegetation, etc. Aerial photographs and image processing. Multivariate analysis of geographical data and GIS. Computerized systems for capturing, analyzing and displaying spatial and related attribute information on man-made and natural environment. Application of GIS in all related environmental sciences. Interpretation of GIS data. The use of GIS in improving environmental quality.

Course Code: ESD 519 **Course Title**: Biological Biodiversity

Biodiversity, categories of biodiversity. Characteristic patterns of biodiversity. Threats to biodiversity. Human perception of land and sea. The conservation of biodiversity, legal framework of biodiversity conservation. UN convention on biological diversity. Other related conventions and declarations.

Course Code: ESD 521 **Course Title**: Solid Waste Management I

Types of solid waste. Sources of solid waste. Collection, storage disposal and treatment. Solid waste is a pollutant and environmental stressor. Solid waste on land, solid waste in aquatic environment. Effect of litter and plastics on the environment with particular emphasis on sea environment. Open sea, shores, coastal area, sea-grass beds and coral reefs. Factors affecting the transportation and distribution of solid waste in the oceans and coastal areas. Effect of tourism. Management of solid waste. Role of education and public awareness. Related international agreements and conventions.

Course Code: ESD 522 **Course Title**: Land Use and Management

Methods of preparing environmentally sound land use plans; factors affecting land use patterns; Land use zoning; land use conflicts and control; land use environmental impacts; use of GIS and remote sensing techniques in land use management; land use regulations.

Course Code: ESD 523 **Course Title**: Environmental Problems in The Gulf Region

Water Scarcity, consumption. Deterioration of water quality. Groundwater depletion. Recharge of reservoirs. Increasing water salinity. Pollution. Land use: urbanization. Desertification. Agriculture: palm treas. Population: Distribution patterns along the coasts. Problems related to mangrove forests. Problems related to biodiversity, fisheries and wild life: fishing and over fishing, over grazing, hunting, problems related to energy: development, consumption. Wastes: collection, disposal, treatment, reuse, recycling. Marine environment: pollution; industrial waste, municipal waste, solid waste, oil pollution: production, transportation. Dumping and filling, dredging. Sea level rise. Desalination. Air pollution, oil production, oil refineries, fuel consumption. Dust and particulates.

Course Code: ESD 524 **Course Title:** Environmental Laws in The Gulf States

Regulations, laws and decrees related to environmental issues in Bahrain and other Gulf States. Comparisons between these laws. Discussion of gaps, implementation difficulties, shortcomings and enforcement problems. Possible development modifications and amendments for better implementation. Coordination in this subject among the Gulf states. Related international conventions.

Course Code: ESD 525 **Course Title**: Coastal Zone Management

Concept and definitions of coastal parameters. Principal features of integrated coastal zone management (ICZM), guidelines of the development of ICZM, formulation of the plan through stages. Global environment agreements. Role of scientific bodies and role of regulatory bodies.

Course Code: ESD 526 **Course Title**: Environmental Impact Assessment

Environmental impacts of human actions, administrative procedure. Scope of the environmental impact assessment (EIA), methods of EIA; identification, prediction, communication, determining inspection procedures. General approaches to assessing impacts. Uncertainty in EIA. EIA and risk assessment. EIA in plan making. Monitoring, auditing of impacts and evaluation of assessment, Training required for EIA.

Course Code: ESD 527 **Course Title**: Environmental Data Analysis

Visualizing and Summarizing Data; Descriptive statistics; Probability theory; Random Variables and Distribution; Hypothesis Testing; One way and two-way ANOVA; Environmental Sampling; Linear and multiple Regression Analysis; Maximum Likelihood Estimation; Discrete Dependent Variables; Nonparametric Tests; Time Series Analysis,

Course Code: ESD 528 **Course Title**: Sustainable Development of The Living Marine Resources

Development and sustainable development. Living marine resources and their environment. Fishing along the coastal fringe, coastal and shelf-sea resources, management of coastal and shelf-sea fisheries. Resources and environment of enclosed and semi-enclosed seas. The optional harvesting of living marine overfishing. Factors affecting fish stock and other marine living resources. The role of research and technology and monitoring. International framework for sustainable development and living marine resource use.

Course Code: ESD 529 **Course Title**: Ecosystems of The Arabian Gulf

The concept of semi-enclosed seas in contrast with open seas and oceans. Distinctive geological and geomorphological features of the Gulf. Chemical and physical properties and characteristics of the Arabian Gulf. Circulation patterns in the Gulf, Salinity and temperature distribution and seasonality. Marine habitats of the Arabian Gulf: mud flats, salt marshes, mangroves, coral reefs, sandy, rocky and pebbled beaches. Factors affecting the Gulf environment will be introduced briefly. Effects of temperature, salinity, water motion and other variables on the distribution of marine life of the Gulf. Surface, pelagic, benthic modification of ecosystems by man.

Course Code: ESD 531 **Course Title**: Environmental Microbiology

Functional aspects of microorganisms in nature, diversity of microbial habitat, transformation in geochemical cycles, microbial toxins in the environment. An introduction to bacteria and their interaction with the environment. Bacteria as indicator of sanitary conditions. Microbiology and cycles of carbon, nitrogen, phosphorous, sulfur and iron in water. Microbiology and water and wastewater treatment: activated sludge, anaerobic digestion, composting, other liquid and solid waste treatment processes. Bacteria in genetic engineering for industrial microbiology.

Course Code: ESD 534 **Course Title**: Marine Pollution

Review of major pollutants in the marine environment. Sewage. Industrial wastes. Organic pollutants. Inorganic pollutants. Chlorinated and polychlorinated hydrocarbons. Heavy metals and other toxic trace elements. Detergents. Radioactive wastes. Thermal pollution. Dredging, filling, mineral exploitation and sediment pollution. Oil pollution. Solid waste and non- biodegradable solid material. Mode of entry of pollutants, pathways of pollutants. Fate of pollutants in the marine environment. Effect of pollutants on organisms. Eutrophication. Effects of pollution on man's health. Aesthetic effects. Pollution prevention. Pollution monitoring. Biological indicators of pollutions. Other pollution indicators. Socioeconomical aspect of marine pollution. Public awareness. Positive and negative aspects of publicity. Local, regional and international agreements, conventions and regulations dealing with marine pollution.

Course Code: ESD 538 **Course Title**: Environmental Chemistry

Aquatic chemistry, nature and composition of natural waters. Redox equilibrium and complexation in natural and waste waters. Microbial catalysis of aquatic chemical reactions. Liquid-solid-gas interactions in aquatic chemistry. Environmental chemistry of soil. Chemical composition of atmosphere and atmospheric pollutants. Atmospheric photochemical reactions. Ozone and its effect on the environment. Environmental biochemistry and chemical toxicology of chlorinated and polychlorinated organic compounds, soaps and detergents. Chemistry of water and wastewater treatment.

Course Code: ESD 541 **Course Title**: Oil Pollution

History of oil production, transportation and oil accidents. Composition of oil and related hydrocarbons. Sources, causes and prevention of oil pollution. Treatment methods and control. Extent of oil pollution in selected regional seas and coastal areas. Extent of global oil pollution. Factor affecting movement of spilled oil slicks. Processes and fate of spilled oils. Effects of oil on marine ecosystems, water and beaches, as well as on human health. Conventions on oil pollution and related matters contingency plans.

Course Code: ESD 542 **Course Title**: Environmental Radiology

Radiation, radiation sources. Nuclear reactors, particle accelerators, environmental hazards from radiation, biological effects, radiation standards and assessment of radiation effects. Radiation protection, radiation detection methods. Global problems and issues related to radioactive pollutants: storage, use, disposal and safety. Risk against benefits of radiation.

Course Code: ESD 544 **Course Title**: Environmental Engineering

Concept of Ecology; population, community, biome, biosphere, diversity, reproduction, competition and succession. Concept of productivity, food chain and food web. Technology for management of air, water, noise and radioactive pollution, technology for management and treatment of water, wastewater and solid waste.

Course Code: ESD 545 **Course Title**: Environmental Analysis Techniques

Environmental variable and analysis, principle of instrumental analysis. Fluorimetry, spectrophotometry, potentiometry, Atomic absorption spectrophotometry, stripping voltammetry, chromatography (GC, HPLC), X-ray fluorescence, X-ray diffraction, electron microscopy. Inductive coupled plasma (ICP). Ion selective electrodes. Hyphenated analytical methods (CP-MSD, GC-MSD, HPLC- MSD).

Course Code: ESD 546 **Course Title**: Special Topics in Environmental Science

The study of a particular topic of contemporary interest in environment and sustainable development. Topics are to be selected with the consent of the program administrative committee.

Course Codee: ESD 547 **Course Title:** Research Methods

Principles and basics of research, the structures of research, research ethics, searching and reviewing the literature, Research methods, collecting and analyzing data, qualitative data analysis, and writing the proposal and writing up the research.

Course Code: ESD 54 **Course Title:** Thesis

In partial fulfilment of the Master program in Environment and sustainable development, the student must conduct research work, write up and successfully defend thesis in a field of e interest in ESD. The research project is carried out under the supervision of a faculty member. The program committee must approve the topic of the thesis. (Prerequisite: Passing 12 Credits with at least 2.67 GPA).