The following Table shows the summary of courses offered at 300 and 400 levels for the Special Degree programme in Environmental Science:

Course Number	**Course Title**	**No. of Credits**	**Lecture hrs**	**Lab hrs**	**Prerequisites**	**Compulsory**
ES 301	Concepts in Environmental Science ***(new)***	3	45			√
ES 302	Biological Indicators in Environmental Management (same as **ZL 306**)	2	15	30		
ES 303	Water and Soil Pollution ***(new)***	3	30	30		√
ES 304	Environmental Law and EIA ***(new)***	2	30			√
ES 305	Remote Sensing and GIS (same as **GL 316**)	2	15	30		√
ES 306	Ecosystems of Sri Lanka: Their Ecology and Conservation (same as **BT 310**)	2	15	30		
ES 307	Wetlands and their Exploitation ***(new)***	2	15	30		
ES 308	Marine Resources and Marine Pollution ***(new)***	2	15	30		
ES 309	Analytical Chemistry (same as **CH 341**)	3	45		CH 231	√
ES 310	Hydrology (same as **GL 309**)	2	30			
ES 311	Mining and the Environment ***(new)***	2	30			
ES 312	Biodiversity, Conservation and Management (same as **BT 309**)	2	15	30		
ES 313	Energy, Weather and Environment	3	30	30		√
ES 314	Geological Environment and Earth Resources ***(new)***	2	30			
ES 315	Advanced Microbiology (same as **BT 302**)	2	15	30		
ES 316	Mathematics for Environmental Modeling	3	45			
	Total credits of the third year courses	**37**				

Syllabi of the 300 level courses:

Course No. **:** ES 301 **Course Title** **:** Concepts in Environmental Science **Credits** **:** 03 **Prerequisites** **:** None
Compulsory/Optional: Compulsory
Aims and/or Objectives and/or Intended Learning Outcomes: This course aims to introduce students to the interdisciplinary nature of Environmental Science.
Course Syllabus / Course Description **Human Civilization:** Development of human civilizations, man's special place on earth, conflicts with nature, environmental effects of developments in science and technology on human civilization; Addressing environmental problems; Scientific method; Inductive and deductive reasoning, prediction, experimental controls, theories and principles, scientific design and uncertainty; An assessment of risks; Government and environment policy. **Environment and society:** Interaction between human society and the environment; Environmental literacy; Tradeoffs of industrialization and unanticipated natural disasters; Well managed environment and continued economic prosperity with quality of life; Technological, political and social options and strategies for managing the society and the environment; Food resources and world food problem; Agriculture and its impact on the environment and man; Crop disasters.
Recommended Texts: 1. Environment and Society: Human Perspectives on Environmental Issues, C.L Harpet, Prentice Hall, 2007. 2. Redesigning Animal Agriculture. The Challenge of the 21st Century, D L Swain, E Charmley, J W Steel, S G Coffey, 2007.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 302 (same as ZL 306) **Course Title** **:** Biological Indicators in Environmental Assessments **Credits** **:** 03 **Prerequisites** **:**None
Compulsory/Optional: Optional
Aims and/or Objectives and/or Intended Learning Outcomes: This course aims to provide an adequate knowledge on the role of biological indicators in environmental monitoring and in environmental health.
Course Syllabus / Course Description Changes and challenges of environment of emerging Asia, Indicator organisms:

background, principles and examples; The use of Biota, sediments and water in environmental monitoring; Indicators of land and water quality and sustainable management; A systematic approach using indicator organisms to measuring and reporting environmental problems such as acidification, air pollution and climatic changes; Framework for the development of environmental health indicators; Biological indicators of environmental health; Rapid urban environmental assessment and case studies of urban development in the developing world; developing a national set of environmental indicators.

Recommended Texts:

1. Limnology - Lake and River Ecosystems, R.G. Wetzel. Harcourt Brace College Publishers, San Dieg, 2002.
2. Pollution of Lakes and Rivers, A Paleolomnological Perspective, J. Smol, Oxford University Press, 2004.
3. Data Analysis in Community and Landscape Ecology, ed. R.H.G. Jongman, C.J.F. ter Braak & O.F.R. Tongeren, Cambridge University Press, 1999.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 303
Course Title : Water and Soil Pollution
Credits : 03
Prerequisites : None

Compulsory/Optional: Compulsory

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a background on water and soil pollution; their evaluation and control of pollution.

Course Syllabus / Course Description

Aquatic environment and water resource; Properties of freshwater and seawater; Lotic and lentic waters; Man-made lakes and other aquatic facilities; Water pollutants; Types and sources of pollutants; Eutrophication and algal toxins; Biological oxygen demand and chemical oxygen demand and opacity; Run-off from agricultural land and roads; Sediment pollution; Seepage from mine tailings and landfill operations; Water quality parameters and standards; Chemical and ecological water pollution control; Techniques of containment and dispersal; Water-borne diseases.

Chemistry of soil, The classification of common pollutants in soils, soil functions, soil and sediment, soil pollutant load and soil quality parameters; Soil pollution.

Groundwater geochemistry: Fundamentals; Aquifer geochemical system; Rain water and groundwater; Solute transport; Contaminant interactions and reactive transport; Vadose zone processes; Water/rock interactions; Solution, redox and gas exchange processes; Classification of groundwater quality; Contamination of groundwater by inorganic and organic compounds and by microorganisms; Groundwater monitoring and remediation;

Practical applications- landfills, metals contamination, acid mine waste, organic compound contamination; Water quality standards; Development of conceptual geochemical models; Numerical modeling.

Recommended Texts:

1 Geochemistry, Groundwater and Pollution. C.A.J. Appelo D. A.A. Balkema Rotterdam-Brookfield, 2006.
2. Environmental Chemistry, S.E. Manahan, 8th edition. CRC Press, 2007.
3. Groundwater and Surface Water Pollution D.H.F. Liu and BG Liptark, Lewis Publishes, 2000.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 304
Course Title : Environmental law and Environmental Impact Assessment
Credits : 02
Prerequisites : None

Compulsory/Optional: Compulsory

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a basic knowledge on legal aspects and environmental impact assessment.

Course Syllabus / Course Description

Environmental acts and their enforcement. Legal aspects of environmental standards, case studies**.** Resource development and Environmental Impact Assessment (EIA) in Sri Lanka; Resources needed for EIA; Important principles in managing an EIA; The EIA process and Case studies**.**

Recommended Texts:

1. Handbook on Environmental Impact Assessment: Impact and Limitations . J. Pette, Cambridge press, 1999.
2. Environmental Protection, Law and Policy, Second edition by J.Holder and M.Lee,Cambridge press, 2005.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 305 (same as GL316)
Course Title : Remote sensing and GIS

Credits : 02
Prerequisites : None

Compulsory/Optional: Compulsory

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to introduce GIS as a tool in environmental monitoring

Course Syllabus / Course Description

Fundamental characteristics of electromagnetic radiation and the interaction of radiation with matter; Concepts of spectral resolution and detection; Remote sensing platforms; Active and passive sensing systems; Visual-digital interpretation; Applications of remote sensing in geology; Resource Exploration; Land use and land pattern analysis; Environmental and natural hazards; Introduction to GIS: Overview, history and concepts of GIS, scope and application areas, purpose and benefits of GIS, functional elements of GIS; Mapping concept – Map elements, map scales and representation map projection, geometric rectification, data structure – Raster and vector data structure, data acquisition, digitization; Laboratory work with GIS programs (e.g.,Arcview and arc-Info).

Recommended Texts:

1. Remote Sensing Geology, 2nd Ed, Gupta, R.P, Springer, 2002
2. Principles of Geographical Information Systems, P.A. Burrough and R.A.McDonnell, Oxford University Press, 1998.
3. Techniques for Image Processing and Classification in Remote Sensing, R. A. Schowengerdi Academic Press, 1983.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 306 (same as BT 310)
Course Title : Ecosystems of Sri Lanka: Their Ecology and Conservation
Credits : 02
Prerequisites : None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a background knowledge on ecosystems of Sri Lanka and their ecology and conservation

Course Syllabus / Course Description

To provide a background on toxicological aspects of environmental chemicals and on mitigation of environmental toxins.
Geography, climate, geology, soils and floristic zones of Sri Lanka. Natural vegetation types of the island in relation to their distribution, extent, climate, vegetation structure, floristic richness, family and species dominance, population size distributions, endemic species, underutilized species. Factors responsible for degradation of natural ecosystems. Conservation and restoration of natural ecosystems. The ecosystems considered are i) marine, ii) maritime (mangroves, sea shore, and salt marshes) and inland aquatic

ecosystems, forest types (rain forests -lowland & montane, dry zone forests and scrub vegetation), grasslands (wet and dry pathanas, thalawas, savannahs and damanas).

Recommended Texts:

1. Ashton, P. M. S. et al. (1997). A field guide to the common trees and shrubs of Sri Lanka. The Wildlife Heritage Trust, Sri Lanka, 432pp.
2. Whitmore, T. C. (1990). An introduction to tropical rain forests. Oxford University Press, Oxford, 226pp.
3. Mabberley, D. J. (1992). Tropical Rain Forest Ecology. Blackie and Son Ltd., 300pp.
4. Anon (2000) Natural Resources of Sri Lanka. The National Science Foundation, Sri Lanka, 306pp.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 307
Course Title **:** Wetlands and Their Exploitation
Credits **:** 02
Prerequisites **:** None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:

This course aims to introduce fauna and flora of wetlands and their environmental problems.

Course Syllabus / Course Description

Wetland types; Wetlands and wildlife; Fauna and flora of wetlands; Threats to wetlands; environmental problems associated with wetland exploitation; Salinisation and desalinization of wetlands**;** Ancient and recent irrigation systems of Sri Lanka; Water based tourism and its environmental effects; Wetland reclamation; Wetland and fisheries; Capture and culture fisheries; Effects of fisheries on the environment.

Recommended Texts:

1. Biology, N.A. Campbell, J.B. Reece and L.G. Mitchel, Cambrdge Press 2004.
2. The Biology of Lakes and Ponds, C. Bronmakr and B. Mamquist, Lewis Publishes 2002
3. The Biology of Streams and Rivers, P.S. Gilter and L.A. Hansso, Lewis Publishers, 2002.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 308
Course Title **:** Marine Resources and Marine Pollution

Credits : 02
Prerequisites : None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to introduce to marine environment and its resources.

Course Syllabus / Course Description

Marine resources; Marine habitats and biodiversity (fauna and flora): coastal zone, open water and deep sea; coral and other reefs, Mangroves and salt marshes. Fishing and whaling; Over exploitation of marine resources; Marine and coastal pollution; Marine transportation and its effects on the sea; Desalination; Salt and chemical production.

Recommended Texts:

1. An Introduction to the Biology of Marine Life, J. Sunrich, 1999.
2. The Living Ocean: Understanding and Protecting Marine Diversity, B. Thorne – Miller, 2006.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 309 (same as CH 341)
Course Title : Analytical Chemistry
Credits : 03
Prerequisites : CH 231

Compulsory/Optional: Compulsory

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide comprehensive knowledge on quantitative/ instrumental chemical analysis to solve environmental related problems.

Course Syllabus / Course Description

Advanced Calculations: Review of statistics in chemical analysis: Test of significance, paired t-test, F-test, etc.; Statistics of linear chemical relationships; Performance characteristics of analytical methods; Inter laboratory testing; Sensor characteristics; Advanced calculations as applied to chemical analysis: derivation and error calculations associated with acid-base, redox and complexometric titrations; Iteration methods; metal-complex equilibria; Solubility equilibria and Gran plots.

Analytical Aspects of Spectrophotometry: Atomic absorption and emission methods, molecular uv and visible absorption spectroscopy. Electroanalytical Chemistry: Potentiometric applications; voltammetry including polarographic methods, pulsed techniques, steady-state and flow injection amperometric methods, bulk electrolysis methods, microelectrodes in chemical analysis, electrochemical sensors,

Separation Methods: Solvent extraction, partition coefficient, distribution ratio, multiple extractions, extraction of metals, introduction to chromatographic techniques and

classifications, gas chromatography, van-Deemter equation, ion-exchange chromatography, thin layer and paper chromatography, introduction to liqiuid-liquid chromatography.

Recommended Texts:

1. Analytical Chemistry, D.A. Skoog, West and Holler, Saunders College Publishing 1998
2. Laboratory Techniques in Electroanalytical Chemistry, P. Kissinger and W.R. Heineman, Marcel Dekker, 1984.
3. Electrochemical Methods, A.J. Bard and L. Faulkner, Marcel Dekker, 1980.
4. Analytical Chemistry, G.A. Christian, John Wiley & Sons, 2000.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 310 (same as GL 309)
Course Title : Hydrology
Credits : 02
Prerequisites : None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a informative background on hydrology, techniques in hydrology and hydrological cycle.

Course Syllabus / Course Description

Introduction to basic principles of hydrology including mathematical, physical and chemical concepts; Discussion on practical applicability of common-used analytical techniques in understanding the different components of the hydrological cycle – climate, precipitation, evapotranspiration, runoff and infiltration. Hydrological Cycle: sources of stream flow, uniform and steady state flow; Hydrographs and hydrologic routing: basin study and water balance, probability and statistical techniques; Computer applications in hydrology.

Recommended Texts:

1. Handbook of Applied Hydrology – A Compendium of Water Resource Technology, Ven T. Chouw, McGraw-Hill, 1964.
2. Hydrology for Engineers, 3rd Ed. R.K Linsle, M.A. Kohle and J.L. Paulthus, Mc Graw-Hill,1982.

Assessment	Percentage Mark

Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 311
Course Title **:** Mining and the Environment
Credits **:** 02
Prerequisites **:** None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a comprehensive knowledge on mineral resources, mining and environmental consequences of mining.

Course Syllabus / Course Description

Methods of exploration and mining geology, including mapping, geophysics, remote sensing, exploration geochemistry, inclusion studies and diamond drilling. Technical and economic aspects of exploration programme design and reserves evaluation procedures. Open cast mining, underground mining, mining in the soft ground, underwater and deep sea**;** Use of minerals, mineral distribution and formation, mining, processing and extraction. Environmental implications, Mineral conservation and recycling; Mining and its environmental problems in Sri Lanka (gems, dolomite, sand, clays, silica)**.**

Recommended Texts:

1. Geophysics and Geochemistry in the Search for Metallic Ores, Proceedings of Exploration 77, International Symposium held in Ottawa, Canada, Economic Geology Report No. 31, Hood, Peter J. (Editor), Geological Survey of Canada, 1977.
2. An Introduction to Geophysical Exploration (2^{nd} Ed.) P. Keare, and M. Brooks Blackwell Scientific Publications, 1991.
3. Applied Geophysics (2^{nd} Ed), W.M. Telford, L.P. Geldart, R.E. Sherif, Cambridge University Press, 1990.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 312 (same as BT 309)
Course Title **:** Biodiversity Conservation & Management
Credits **:** 02
Prerequisites **:** None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to cover the important aspects on biodiversity, biodiversity conservation and ecotourism.

Course Syllabus / Course Description

Biodiversity : Introduction, global biodiversity estimates, measuring biodiversity, loss of biodiversity, threats to biodiversity; Biodiversity conservation and sustainable development, setting conservation principles, species management, habitat management, conservation education & ecotourism; Indigenous knowledge and biodiversity, international conventions on biodiversity, Field visits.

Recommended Texts:

1. Global Biodiversity: Status of the Earth's Living Resources, B. Groombrige, Chapman and Hall, 1992.
2. Global Biodiversity Assessment, R.T .Watson, V.H Heywood, UNEP, 1995.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 313
Course Title : Energy, Climate and Environment
Credits : 03
Prerequisites : None

Compulsory/Optional: Compulsory

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to cover the aspects on world's energy crisis, alternate energy sources and climatic change.

Course Syllabus / Course Description

Renewable and non-renewable energy sources; The nature of electricity; The World's energy problem; Generation of electricity/Basic mechanics; Potential/ Kinetic energy: frictional energy losses; Exponential growth and energy usage; Feedback Loops/ Hydrological Cycle; Fossil fuel production/ Consumption; Nuclear structure and energy; How a reactor works; Nuclear waste management; Urbanization and environment. Energy conservation I: Lightning and Insulation; Energy conservation II: Transportation and fuel savings; an overview of alternative energy**;** Atmosphere: Composition and structure; Earth –sun geometry; Energy and energy transfer; Nuclear radiation; Energy balance; Temperature; Atmospheric moisture; Atmospheric stability; Clouds and precipitation; Forces and winds; Wind systems; Weather systems; Severe storms; Climate change.

Recommended Texts:

1. Energy and Problems of a Technical Society, J.J. Kraushaar and R.A. Ristine, 2002.
2. J.M. Moran, and M.D. Morgan, Meteorology, 2002.
3. The Physics of Atmosphere, 2nd Ed. J.T. Haughton, Cambridge University Press, 2001.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. **:** ES 314
Course Title **:** Geological Environment and Earth Resources
Credits **:** 02
Prerequisites **:** None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide a detailed knowledge on earth's resources, resource extractions and geological hazards.

Course Syllabus / Course Description

Evolution of the earth, minerals and rocks, formation of rocks, rock cycles, weathering and soil formation, processes of landform development, interior of the earth, earth's internal processes, geological time scale, earth's resources.
Environmental effects of resource extraction, conserving geological resources, introduction to geological hazards (landslides and mass wasting, earthquakes and tsunamis, volcanoes, erosion)**.**

Recommended Texts:

1. Environmental Geology, B.W. Murck, John Wiley & Sons, 1996.
2. Geohazards - Natural and Ma-made, G.J.H. McCall, Chapman and Hall, 1992.
3. Goals, Opportunities and Priorities for the USGS Earthquake Hazard Reduction Program. A. Robert, USGS Circular 1079, 1992.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 315 (same as BT 302)
Course Title **:** Advanced Microbiology
Credits : 02
Prerequisites **:** None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide basic knowledge on theoretical and practical aspects of microbiology.

Course Syllabus / Course Description

Population counts; Growth cycle of microorganisms; Applied microbiology; Microorganisms in their natural habitats and major activities; microbiology of air (types,

diseases transmitted); soil (types, estimation, distribution, role in nutrient cycling); water: (Types, water pollution, coliform bacteria. sanitary water analysis, water borne diseases, water purification); and Food: (food microflora, food spoilage, food preservation and food borne diseases); Laboratory exercises based on above topics.

Recommended Texts:

1. T.D. Brock, M.T. Madigan, J.M.Martinko and J. Parker, Biology of microorganisms (8^{th} edition), Prentice Hall, USA.
2. M.T. Madigan, J.M. Martinko, J. Parker, Prentice Hall, USA, 986 pp.
3. Nitrogen fixation in tropical cropping systems K.E . Giller, and K.F Wilson, CAB. International, UK, 1991.
4. R.G. McLaren, and K.C. Cameron, Soil Science: Sustainable Production and Environmental Protection, Oxford University Press, UK,1996.
5. The Nature and Properties of Soils (10^{th} edition), N.C Brady, Macmillan Publishing Company, UK, 1990.

Assessment	Percentage Mark
Continuous assessment	40%
End semester examination	60%

Course No. : ES 316
Course Title : Mathematics for Environmental Modeling
Credits : 03
Prerequisites : None

Compulsory/Optional: Optional

Aims and/or Objectives and/or Intended Learning Outcomes:
This course aims to provide and strengthen mathematical background of students in environmental sciences

Course Syllabus / Course Description

Linear Algebra: Introduction to matrices, the algebra of matrices, the transposed matrix, the inverse matrix, solving simultaneous linear equations by Gaussian elimination, finding the inverse of a matrix, determinants, eigenvalues and eigenvectors, numerical methods. Ordinary differential Equations: Introduction to differential equations, first order differential equations. (Variables separable differential equations, population models, epidemic models), linear differential equations, systems of first order differential equations.Recurrence equations: Introduction recurrence equations, first order recurrence equations, linear constant coefficient recurrence equations.
Mathematical modeling: Mathematical modeling through ordinary differential equations, Mathematical modeling through difference equations, mathematical modeling through mathematical programming.

Recommended Texts:

1. A First Course in Differential Equations, D.G. Zill, 1998.
2. Linear Algebra, K. Hoffman and R. Kunze, 1999.
3. Mathematical Modelling, J.N. Kapur, 1998.