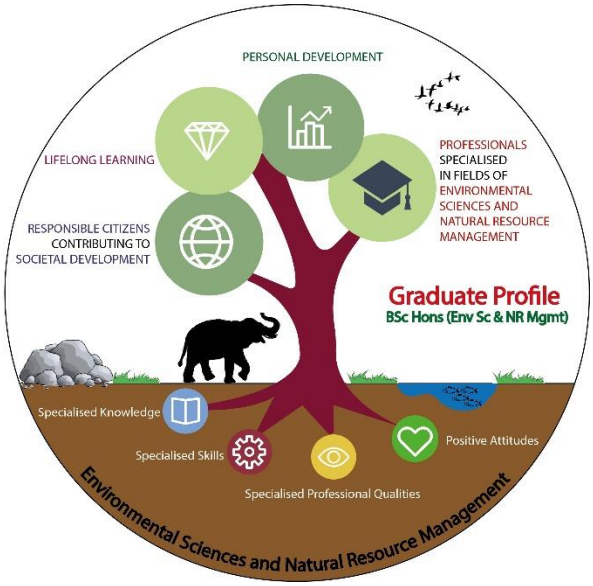
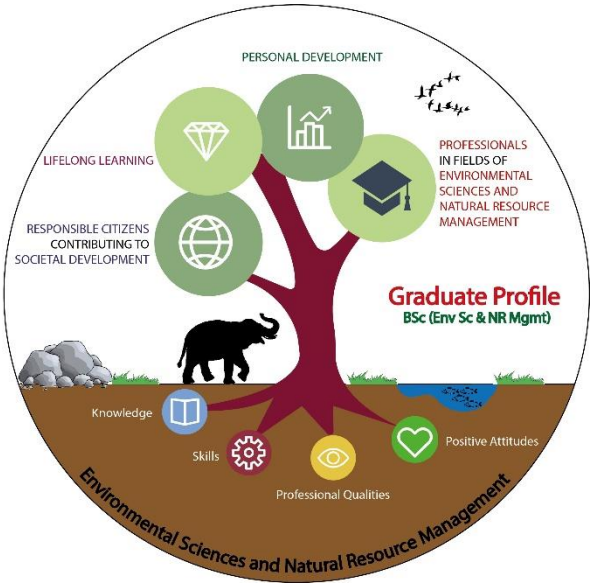
DEPARTMENT OF NATURAL RESOURCES

DEGREE PROGRAMS

Bachelor of Science Honours in Environmental Sciences and Natural Resource Management [BScHons (Env Sc & NR Mgmt)]
Bachelor of Science in Environmental Sciences and Natural Resource Management [BSc (Env Sc & NR Mgmt)]

ANTICIPATED GRADUATE PROFILE





COURSE NOTATION

A course code contains an abbreviation to the name of the degree program, year of study, semester of study, number of credits assigned for the subject and the course number, respectively.

Example: The course code of ESNRM 12201 denotes the following;

Degree Program	Year	Semester	No. of Credits	Course Number
Environmental **S**ciences and **N**atural **R**esource **M**anagement	**1**	**2**	**2**	**01**

Degree Programs are designed to cater to the current needs in the following fields,

01. Environmental Management,
02. Earth Resources Management,
03. Biodiversity Conservation and Management.

SUMMARY OF THE COURSES

Table 1: Courses offered in Semester I of the Year I			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 11301	Introduction to the Environment and Natural Resources	3	Compulsory
ESNRM 11202	Biology I: Cellular and Organismic Biology	2	Compulsory
ESNRM 11203	Biology II: Evolution and the Diversity of Life	2	Compulsory
ESNRM 11104	Biology - Practical	1	Compulsory
ESNRM 11205	General Chemistry	2	Compulsory
ESNRM 11106	Inorganic Chemistry for Natural Resource Studies - Practical	1	Compulsory
ESNRM 11207	Computer Literacy for Natural Resource Studies (Theory and Practical)	2	Compulsory
ESNRM 11208	Mathematics for Natural Resource Studies	2	Compulsory
NRM-EGP-1101	General English I	2	Compulsory (Non-GPA)
	Total Number of Credits	17	

Table 2: Courses offered in Semester II of the Year I			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 12201	Earth Materials and Processes	2	Compulsory
ESNRM 12202	Fundamentals of Hydrology	2	Compulsory
ESNRM 12203	Concepts of Ecology	2	Compulsory
ESNRM 12204	Physical Chemistry for Natural Resources Studies	2	Compulsory
ESNRM 12205	Fundamentals of Analytical Chemistry	2	Compulsory
ESNRM 12206	Organic Chemistry for Natural Resource Studies (Theory and Practical)	2	Compulsory
ESNRM 12107	Computer Literacy for Natural Resource Studies - Practical	1	Compulsory
ESNRM 12208	Fundamentals of Statistics (Theory and Practical)	2	Compulsory
NRM-EGP-1201	General English II	2	Compulsory (Non-GPA)
	Total Number of Credits	17	

Table 3: Courses offered in Semester I of the Year II			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 21201	Limnology (Theory and Practical)	2	Compulsory
ESNRM 21202	Microbiology for Natural Resource Studies (Theory and Practical)	2	Compulsory
ESNRM 21203	Genetics, Biotechnology and Biosafety (Theory and Practical)	2	Compulsory
ESNRM 21204	Mineralogy and Petrology	2	Compulsory
ESNRM 21205	Biodiversity (Theory and Practical)	2	Compulsory
ESNRM 21206	Physics for Natural Resource Studies	2	Compulsory
ESNRM 21207	Statistics for Experimental Analysis (Theory and Practical)	2	Compulsory
ESNRM 21208	Natural Product Chemistry (Theory and Practical)	2	Compulsory
NRM-EAP-2101	Academic English I	2	Compulsory (Non-GPA)
	Total Number of Credits	18	

Table 4: Courses offered in Semester II of the Year II			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 22201	Fundamentals of Soil Science	2	Compulsory
ESNRM 22202	Introduction to Economics	2	Compulsory
ESNRM 22103	Geomorphology and Geology of Sri Lanka	1	Compulsory
ESNRM 22104	Erath Science - Practical	1	Compulsory
ESNRM 22205	Statistical Methodology (Theory and Practical)	2	Compulsory
ESNRM 22206	Analytical Techniques for Environmental Sciences and Natural Resources (Theory and Practical)	2	Compulsory
ESNRM 22207	Field Techniques in Ecology and Biodiversity (Theory and Practical)	2	Compulsory
ESNRM 22208	Forestry	2	Compulsory
ESNRM 22109	Forestry - Practical	1	Compulsory
NRM-EAP-2201	Academic English II	2	Compulsory (Non-GPA)
	Total Number of Credits	17	

Table 5: Courses offered in Semester I of the Year III			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 31201	Remote Sensing and Geographic Information Systems	2	Compulsory
ESNRM 31102	Remote Sensing and Geographic Information Systems - Practical	1	Compulsory
ESNRM 31203	Environmental and Natural Resource Economics	2	Compulsory
ESNRM 31204	Environmental Toxicology	2	Compulsory
ESNRM 31205	Industrial Chemistry and Technology	2	Compulsory
ESNRM 31206	Industrial Minerals	2	Compulsory
ESNRM 31107	Hydrology and Soil Science - Practical	1	Compulsory
ESNRM 31208	Biogeography	2	Compulsory
ESNRM 31209	Waste Management	2	Compulsory
NRM-EBP-3101	Business English	2	Compulsory (Non-GPA)
	Total Number of Credits for BSc Hons (Env Sc & NR Mgmt) Degree	18	
Students, those who wish to exit at the end of the 3rd year (after completing a three year general degree programme), should complete the compulsory/optional course units of ESNRM 41201(in this semester as ESNRM 31210), ESNRM 41202 (in this semester as ESNRM 31213; optional), ESNRM 41204 (in this semester as ESNRM 31211), ESNRM 41205 (in this semester as ESNRM 31214; optional) and ESNRM 41208 (in this semester as ESNRM 31212) within the semester I.			
ESNRM 31210	Research Methodology and Scientific Communication	2	Compulsory
ESNRM 31211	Literature Review and Research Proposal Development for BSc Dissertation	2	Compulsory
ESNRM 31212	Managing People in Organizations	2	Compulsory
ESNRM 31213	Environmental Legislation and Regulation	2	Optional
ESNRM 31214	Statistical Application in Natural Resource Studies (Theory and Practical)	2	Optional
	Total Number of Credits for BSc (Env Sc & NR Mgmt) Degree	24	

Table 6: Courses offered in Semester II of the Year III only for BSc (Env Sc & NR Mgmt) Degree			
Students should select optional course units covering 06 credits from the 07-course units available (from ESNRM 32201 – ESNRM 32207)			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 32201	Resource Efficient and Cleaner Production	2	Optional
ESNRM 32202	Aquatic Resource Management (Theory and Practical)	2	Optional
ESNRM 32203	Coastal and Marine Resource Management (Theory and Practical)	2	Optional
ESNRM 32204	Tools for Environmental Management	2	Optional
ESNRM 32205	Study and Management of Natural Hazards	2	Optional
ESNRM 32206	Biodiversity Conservation and Management (Theory and Practical)	2	Optional
ESNRM 32207	Soil Degradation and Management	2	Optional
ESNRM 32409	B.Sc. Dissertation in Environmental Sciences and Natural Resource Management	4	Compulsory
	Total Number of Credits	10	

Table 7: Courses offered in Semester II of the Year III only for BSc Hons (Env Sc & NR Mgmt) Degree			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 32201	Resource Efficient and Cleaner Production	2	Compulsory
ESNRM 32202	Aquatic Resource Management (Theory and Practical)	2	Compulsory
ESNRM 32203	Coastal and Marine Resource Management (Theory and Practical)	2	Compulsory
ESNRM 32204	Tools for Environmental Management	2	Compulsory
ESNRM 32205	Study and Management of Natural Hazards	2	Compulsory
ESNRM 32206	Biodiversity Conservation and Management (Theory and Practical)	2	Compulsory
ESNRM 32207	Soil Degradation and Management	2	Compulsory
ESNRM 32108	Community Outreach Program (Mini Project)	1	Compulsory
Students are given an option to select course units equivalent to at least two credit points from the following optional course units. Students are encouraged to select subjects from one of the following subject combinations if they are interested in pursuing a career or higher education in any of the following focal areas.			
Subject Combination		Main Subjects	
SC1	Environmental Management	Climatology, Environment and Society, Protected Area Management, Ecotourism, Applied Hydrology, Machine Learning for Natural Resource Studies	
SC2	Earth Resources Management	Mineral Exploration and Management, Oil Exploration, Gemmology, Groundwater Exploration and Management, Climatology, Applied Hydrology, Basic Methods of Surveying Sciences, Machine Learning for Natural Resource Studies	
SC3	Biodiversity Conservation and Management	Lichenology, Biogeography and Conservation Planning, Protected Area Management, Ecotourism, Forestry and Rural Development, Basic Methods of Surveying Sciences, Bioinformatics, Machine Learning for Natural Resource Studies	
ESNRM 32210	Lichenology (Theory and Practical)	2	Optional
ESNRM 32211	Biogeography and Conservation Planning (Theory and Practical)	2	Optional
ESNRM 32212	Environment and Society	2	Optional
ESNRM 32213	Mineral Exploration and Management	2	Optional
ESNRM 32214	Bioinformatics	2	Optional
	Total Number of Credits	17	

Table 8: Courses offered in Semester I of the Year IV			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 41201	Research Methodology and Scientific Communication	2	Compulsory
ESNRM 41202	Environmental Legislation and Regualation	2	Compulsory
ESNRM 41203	Energy Resource Management (Theory and Practical)	2	Compulsory
ESNRM 41204	Literature Review and Research Proposal Development for BSc Dissertation	2	Compulsory
ESNRM 41205	Statistical Application in Natural Resource Studies (Theory and Practical)	2	Compulsory
ESNRM 41206	Environmental Geochemistry	2	Compulsory
ESNRM 41207	Field Techniques in Earth Science (Theory and Practical)	2	Compulsory
ESNRM 41208	Managing People in Organizations (Theory and Practical)	2	Compulsory
ESNRM 41209	Environmental Governance	2	Compulsory
Students are given an option to select at least two-course units equivalent to 4 credit points from the following optional course units.			
ESNRM 41210	Applied Hydrology (Theory and Practical)	2	Optional
ESNRM 41211	Gemmology (Theory and Practical)	2	Optional
ESNRM 41212	Groundwater Exploration and Management (Theory and Practical)	2	Optional
ESNRM 41213	Protected Area Management (Theory and Practical)	2	Optional
ESNRM 41214	Ecotourism (Theory and Practical)	2	Optional
ESNRM 41215	Oil Exploration	2	Optional
ESNRM 41216	Forestry for Rural Development (Theory and Practical)	2	Optional
ESNRM 41217	Basic Methods of Surveying Sciences (Theory and Practical)	2	Optional
ESNRM 41218	Climatology	2	Optional
ESNRM 41219	Machine Learning for Natural Resource Studies (Theory and Practical)	2	Optional
	Total Number of Credits	22	

Table 9: Courses offered in Semester II of the Year IV			
Course code	**Course title**	**No of Credits**	**Compulsory or Optional**
ESNRM 42801	BSc Dissertation in Environmental Sciences and Natural Resource Management	8	Compulsory

SUMMARY OF CREDITS OFFERED:

For BSc (Env Sc & NR Mgmt) Degree Programme						
	Year I		Year II		Year III	
	Semester I	Semester II	Semester I	Semester II	Semester I	Semester II
Credited and Compulsory courses	8	8	8	9	12	4
Credited and Optional courses	0	0	0	0	2	7
Credited, Compulsory and Non-GPA Courses	1	1	1	1	1	0
Total credits	34		35		34	
Total credits for the degree programme	103					

For BSc Hons (Env Sc & NR Mgmt) Degree Programme								
	Year I		Year II		Year III		Year IV	
	Semester I	Semester II	Semester I	Semester II	Semester I	Semester II	Semester I	Semester II
Credited and Compulsory courses	8	8	8	9	9	8	9	1
Credited and Optional courses	0	0	0	0	0	5	10	0
Credited, Compulsory and Non-GPA Courses	1	1	1	1	1	0	0	0
Total credits	34		35		35		30	
Total credits for the degree programme	134							

DETAILED SYLLABUS

Year I Semester I

ESNRM 11301	Introduction to the Environment and Natural Resources

The Earth system and its spheres, Definitions of environmental sciences and natural resources; Characteristics and classification of natural resources; Introduction to major natural resources (Lithospheric resources – land, soil, and mineral resources; Hydrospheric resources – water, inland aquatic, and coastal and marine resources; Atmospheric resources; Biospheric resources - wild and cultivated biological resources, forest resources); Energy resources, History of environmentalism, Environment, development, technology and society (human wellbeing, environmental health, environmental remediation and the concept of Sustainable Development).

ESNRM 11202	Biology I: Cellular and Organismic Biology

Introduction to Biology, Chemicals of life (simple and macromolecules and their significance), Organization of life (the cells, tissues, and organs of plants and animals), Metabolism, Protein synthesis, Enzymes, Respiration, Nerve transmission, Homeostasis, Excretion and Osmoregulation, Reproduction, Photosynthesis, Plant growth and development.

ESNRM 11203	Biology II: Evolution and the Diversity of Life

Introduction to the origin and evolution of life, The scenario of evolution within the geological time scale, Biosystematics (taxonomy, classification and nomenclature), The diversity of life (lower organisms, fungi, plants and animals).

ESNRM 11204	Biology - Practical
Development of observation, Illustration and microscopy skills in Biology, Understanding the cell, Understanding animal and plant Tissues, The diversity in lower Kingdoms of Life, The Diversity of Fungi, The Diversity of Plants, The Diversity of Animals.	

ESNRM 11205	General Chemistry
Review of classical atomic theory (Atoms and molecules, Orbital, Electron configurations of elements, Aufbau principle, Hund's rule, Pauli exclusion principle), De Broglie relationship, Heisenberg's uncertainty principle, Wave-particle duality, Schrödinger equation, Atomic spectra, Sub-atomic particles, Chemical bonds (Covalent bonds, Ionic bond and ionic lattices, Partial covalent character of ionic bonds, Fajan's rule, Intra and intermolecular forces), Lewis theory, Valence bond theory, Molecular orbital theory, Shapes of molecules from VSEPR theory, Hybridization. Size and energy factors in Chemistry, Born-Haber cycle, Oxidation-reduction reactions, Balancing chemical equations and Half-reactions, Concepts of acid-base, Nernst equation and applications of electrode potential data.	

ESNRM 11106	Inorganic Chemistry for Natural Resource Studies - Practical
Qualitative analysis of anions and cations, Quantitative inorganic analysis; Volumetric titrations, Apparatus and measurements, Introduction to measurements and error analysis.	

ESNRM 11207	Computer Literacy for Natural Resource Studies (Theory and Practical)
Overview of computer Hardware: Motherboard, CPU, Computer Memory, I/O devices; Software: System software and Application Software; Introduction to Data management: Fundamental concepts of database systems, Database management tools; Best practices used for computer security: Computer viruses and anti-virus SW, Information security, Cybersecurity, Introduction to programming.	

ESNRM 11208	Mathematics for Natural Resource Studies
Number system, Introduction to sets, Intervals, Inequalities, Coordinate system, Functions (Properties, Linear Functions, Quadratic function, Polynomials, Graph of functions), Linear and quadratic equations and their solutions, Introduction to the trigonometric functions and identities, Differentiation, Integration, Matrix algebra (Introduction, Addition and subtraction, Multiplication, Inverse of a matrix), Complex numbers (Introduction, Real and imaginary numbers, Algebra of complex numbers), Vectors (Introduction to vectors and scalars, Position vectors, Algebra of vectors), Mathematical applications in Natural Resource Studies.	

Year I Semester II

ESNRM 12201	Earth Materials and Processes
The Universe, The solar system, Origin, Structure and composition of the earth, Endogenetic, exogenetic, and extra-terrestrial processes, Theory of plate tectonics, Earth's internal processes (volcanism, earthquakes and tsunamis, deformation and metamorphism), Introduction to minerals and rocks, Physical properties of minerals, Rock cycle, Introduction to Historical Geology, Geological time scale, Determining absolute and relative age/time of geological materials/events.	

ESNRM 12202	Fundamentals of Hydrology
Hydrological cycle, Introduction to basic principles of hydrology including mathematical, physical and chemical concepts, Commonly used analytical techniques in understanding the different components of the hydrological cycle, Hydrological parameters (precipitation, evapotranspiration, run-off, infiltration, permeability etc.), Sources of streamflow, Uniform and steady-state flow, Hydrographs and hydrologic routing, Basin study and water balance, Social hydrology, Concepts of rainwater harvesting.	

ESNRM 12203	Concepts of Ecology
Introduction to Ecology, Concept, structure and functions of ecosystems, Autotrophy, heterotrophy and energy dynamics, Autecology, Population ecology, Community ecology, Introduction to behavioural ecology, Ecological applications, Human ecology, Conservation ecology and habitat restoration, Introduction to global change ecology.	

ESNRM 12204	Physical Chemistry for Natural Resources Studies
Properties of gases: The perfect gas, Gas laws, Kinetic model of gases, Real gases and their behaviour, Van der Waals equation of state; Thermodynamics: First law, Expansion work, The internal energy, Enthalpy, Thermochemistry, Adiabatic changes, Entropy, Second and Third laws of thermodynamics, Statistical entropy, Gibbs free energy, Chemical potential and mass action law, Thermodynamics of electrochemical cells; Chemical kinetics: Rate laws, Rate constant, Order of a reaction, Integrated rate laws of zeroth, first and second-order reactions, Arrhenius equation, Steady state approximation.	

ESNRM 12205	Fundamentals of Analytical Chemistry
Introduction to chemical analyses, Sampling methods, Types of errors, Error analysis, Statistical treatment of analytical data, Introduction to classical methods; Titrimetric analysis (Acid-base, Complexometric, Gravimetric etc.), Electromagnetic spectrum, Introduction to spectroscopic methods (UV-visible, AAS, Emission spectroscopy), Solvent extraction, Principles of separation techniques (solvent-solvent, solvent-solid, solid-solid, Calibration methods (External and internal standard methods, and standard addition).	

ESNRM 12106	Organic Chemistry for Natural Resource Studies (Theory and Practical)
Structure and Bonding of organic molecules: Review of atomic structure of Carbon, Atomic and molecular orbitals, Sigma and pi-bonds, Hybridization, Review of Lewis bonding theory, Ionic bonds, Covalent bonds, Lewis structures of organic molecules, Formal charge, Resonance and hyperconjugation; Functional groups in organic compounds: IUPAC nomenclature of organic compounds-alkane, Alkene alkyne, Alkylhalides, Alcohols, Carboxylic acids, Amines; Intermolecular interactions: Electronegativity, Dipole moments, Polarity of organic molecules, Dipole-dipole interactions, Hydrogen bonding, Van der Waals interactions, Intermolecular interactions and properties of organic compounds, Solubility, Melting points and boiling points of organic compounds; Acid-base properties of organic compounds: Review of acid-base theory, Lowry-Bronsted theory and Lewis theory, Acid-base trends in organic compounds, Inductive effect, Resonance effect; Isomerism: Structural and stereoisomerism, Geometrical isomerism cis/trans vs E/Z nomenclature, Conformational isomers, Conformational analysis of open chained compounds and cyclic compounds, Optical isomerism, Chirality and stereocenters, Enantiomers and diastereomers, R and S nomenclature, Fisher projections, Racemic and meso comp, Atropisomerism, Separation of racemic compounds, Biological importance of isomers. Practical component Laboratory Safety, Physical nature of organic compounds, Acid-base properties and solubility behaviour, Beilstein Test, Preparation of Lassaigne's fusion extract, Functional group analysis, Unsaturated organic compounds, Alkyl and aryl halides, Alcohols (primary, secondary tertiary), Aldehyde and ketones, Phenols, Carboxylic acid and their derivatives, (amides, esters, ammonium salts) Amines, Carbohydrate analysis.	

ESNRM 12107	Computer Literacy for Natural Resource Studies - Practical
Managing a database: Excel, Access/ MySQL, Graphics for Science Communication, Preparation of Web-Based portfolio; Introduction to programming: Python, C.	

ESNRM 12208	Fundamentals of Statistics (Theory and Practical)
Introduction to statistics: Types of data and presentations, Data collection methods, Population and sample, Sampling techniques; Descriptive statistics: Data presentation and Summary measures, Measure of central tendency, Measure of variability and dispersion; Elementary Probability: Elements of probability, Different approaches of probability, Elementary properties of Probability, Calculating the probabilities of simple and complex events, Conditional probability and Bayes' theorem; Random variables and Probability Distributions: Properties of Probability distributions; Special Probability Distributions: Discrete; Bernoulli, Binomial, and Poison; Continuous, Uniform, Normal, and Exponential. Introduction to statistical software: Data management and familiarize with the common statistical functionalities; Entering, Summarizing, Presenting and Describing the data.	

Year II Semester I	
ESNRM 21201	Limnology (Theory and Practical)

Introduction to limnology, Structure of aquatic ecosystems, Physical, chemical and biological characteristics of water and aquatic environment, Classification of lentic ecosystems using thermal properties, Trophic relationships in lotic and lentic systems, Nutrient dynamics, Oligotrophy, Eutropy and dystrophy in inland ecosystems, Ecological concepts in stream ecology, Animal adaptations to aquatic environment and bioindicators, Human influence on aquatic systems and their consequences, Eutrophication management and pollution control, Limnology field and laboratory.

ESNRM 21202	Microbiology for Natural Resource Studies (Theory and Practical)
Introduction to microbiology, Microbial habitats: virus, bacteria and fungi (classification characteristics, identification, nutrition and metabolism); Microbial techniques, Structure of microbial communities, Microbial interaction with plants, animals, and humans; Role of micro-organisms in ecosystems and industry, Epidemiology of human and zoonotic diseases, Microbial toxins in the environment, Advances in Microbiology, Microbiology laboratory.	

ESNRM 21203	Genetics, Biotechnology and Biosafety (Theory and Practical)
Introduction to genetics, DNA and RNA, Gene technology, Introduction to plant tissue culture and genetic engineering, Principles and applications of plant tissue culture and genetic engineering, Biofuels, Bio-safety, Biopiracy and Bioprospecting, Advance techniques in Biotechnology, Biotechnology laboratory.	

ESNRM 21204	Mineralogy and Petrology
Symmetry, Bravais lattices, Crystal forms, Habits and twinning, Point group symmetry, Classification into crystal systems and classes, Introduction to common rock-forming minerals, Physical and optical properties of minerals, Classification, Composition and physicochemical properties of economic minerals, Optical properties of minerals, Basic petrology (Igneous, sedimentary and metamorphic rocks).	

ESNRM 21205	Biodiversity (Theory and Practical)
Introduction to biodiversity, Levels of biodiversity, Alpha, Beta and Gamma diversity, Values of biodiversity, Measuring biodiversity, Introduction to biodiversity assessment, Ecosystem processes and services, Biodiversity of Sri Lanka, Introduction to biodiversity conservation, Field excursion to explore the biodiversity of a unique protected area.	

ESNRM 21206	Physics for Natural Resource Studies
Newton's laws of motion, Fluid dynamics, Streamlines, Pascal's Principle, Bernoulli's equation, Concept of temperature and heat, Thermal expansion, Specific heat and latent heat, Vapour pressure, Relative humidity, Elementary geometrical optics (Reflection, Refraction, Mirrors, Lenses etc.), Introduction to physical optics (Interference, Diffraction and Polarization of light), Static electricity, Electric charge, Introduction to Gauss's law, Electric potential, Electric field, Current and resistance, Capacitance, Magnetism, Basics of EM theory (Electromagnetic induction, Radiation and ionisation), Noise and wave phenomena (Longitudinal and transverse waves, Propagation of waves).	

ESNRM 21207	Statistics for Experimental Analysis (Theory and Practical)
Estimation: Point and interval estimation for measures of centre (mean) and measures of dispersion (variance); Hypothesis testing: Concepts of hypothesis testing, single sample tests, two-sample tests (dependent and independent); Introduction to the design of experiments: simple and comparative experiments, factors and treatments, randomization, replication, blocking, balanced and unbalanced designs, fixed effects and random effects; Introduction to analysis of variance (ANOVA): Assumptions and basis of F –test, One-way ANOVA and two-way ANOVA, Multiple comparison analysis testing in ANOVA; Special experimental designs: Complete randomized design (CRD), Randomized complete block designs (RCBD), Latin square and Graeco-Latin square design. Mean comparisons methods, Two factor factorial with CRD and RCBD, Analysis the real-world data by using statistical software and interpret the results.	

ESNRM 21208	Natural Product Chemistry (Theory and Practical)
Primary and secondary metabolism, Enzymes and coenzymes, Construction mechanisms in biological systems such as alkylation, Wagner-Meerwein rearrangement, Aldol and Claisen condensations, Schiff base formation, Mannich reaction, Transamination, reductions and oxidations in biosynthesis; Fatty acids and polyketides from	

acetate pathway: Saturated/Unsaturated fatty acids, Prostaglandins, Aromatic polyketides (Cyclization to give simple phenols and Anthraquinones), alkylation and coupling reactions of polyketides, Macrolides and polyether, Cyclization through Diels-Alder reaction to give statins; Aromatic amino acids and phenylpropanoids from shikimate pathway: Aromatic amino acids and simple benzoic acids, Lignans and lignin, Phenylpropanes, Benzoic acids from C6C3 compounds, Coumarins; Terpenoids and steroids from mevalonate pathway: Monoterpenes, Sesquiterpenoids, Diterpenoids, Sesterterpenoids, Triterpenoids, Carotenoids, Steroids, Steroid skeleton, numbering, conformations, main types of steroids and their biological functions, steroids; Biosynthesis of Alkaloids from amino acids: Chemical structure, Biosynthesis of alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine, tryptophan, anthranilic acid, and histidine; Mixed biogenesis: Flavonoids and stilbenes, Meroterpenoid; Carbohydrates: Conformations of carbohydrates and conformational effects; An Introduction to Natural Products Extraction, Identification, and Structure elucidation process.

Year II Semester II

ESNRM 22201	Fundamentals of Soil Science
Soil formation and development, Soil composition, Description of soil profile, Soil classification, Soils of Sri Lanka, Soil properties (physical properties and functions: colour, texture, structure, consistency, porosity, bulk density, soil water movement, soil moisture and soil moisture characteristic curves, soil temperature and soil compaction; Chemical properties and functions: composition, colloidal nature, ion exchange, base saturation, organic matter, soil reaction, redox potential; Biological properties and functions), Soil fertility.	

ESNRM 22202	Introduction to Economics
Introduction to economics (resource scarcity, choices, opportunity cost, factors of production), Microeconomics; Theory of consumer behaviour, Theory of production and cost, Market structures (perfect competition, monopoly and imperfect competition), Macroeconomics; Circular flow of income and aggregate demand, National income accounting, Consumption, Investment and inflation, Unemployment, Introduction to cost-benefit analysis.	

ESNRM 22103	Geomorphology and Geology of Sri Lanka
Earth landforms, Landform evolution, Processes forming landscape, Geomorphology of Sri Lanka, Geological and tectonic evolution of Sri Lanka. Field excursion to selected sites in order to identify geological processes acting on the earth surface, field occurrence of minerals and rocks, and to discuss geomorphology and geology of Sri Lanka.	

ESNRM 22104	Erath Science - Practical
Topographic maps and cross-sections, Identification of common crystal forms and habits, Determining point group symmetry, Classification into crystal classes and systems, Physical identification of common rock forming minerals, Identification of economic minerals on the basis of physicochemical properties, Study of mineralogy and texture of common igneous, sedimentary and metamorphic rocks, Identification of structures in hand specimens, Optical identification of minerals under the microscope.	

ESNRM 22205	Statistical Methodology (Theory and Practical)
Simple linear regressions and multiple linear regressions, parameter estimation (OLS) and its properties, tests for regression coefficients, tests for significance of the fitted model (ANOVA), model adequacy checking and remedial measure, Models with qualitative independent variables (Dummy variables), and model selection procedures; Nonparametric statistical methods: Scale of measurements; Single sample tests: Sign and Wilcoxon signed rank test; Two sample tests: Wilcoxon matched paired signed rank test, Wilcoxon rank sum test; The Kruskal–Wallis one-way analysis of variance by ranks, and Friedman two-way analysis of variance by ranks; Rank correlations (Spearman's and Kendall Tau); Analysis of count data: Chi-squared test of goodness of fit. Introduction to time series analysis and Forecasting: Component of Time Series Data, Smoothing Methods, Forecasting methods; Analysis of the real-world data by using statistical software and interpret the results.	

ESNRM 22206	Analytical Techniques for Environmental Sciences and Natural Resource (Theory and Practical)
Instrumental methods in advanced environmental analysis (Atomic Absorption Spectrophotometer-AAS,	

microwave digester, Gas-Ghromotograph-Mass Spectrophotometer-GC-MS, High-Performance Liquid Chromatography-HPLC, Fourier Transform Infrared-FTIR gas analyser); Global environmental problems; air pollution; water and soil pollution; sampling of air, water and soil for chemical analysis; Measurement of air, water and soil parameters; preservation, monitoring techniques; Trace metal toxicity on soil and water; Extraction of toxic heavy metals from water and soil; Practical lessons- water, soil analysis.

ESNRM 22207	Field Techniques in Ecology and Biodiversity (Theory and Practical)
Introduction to biodiversity related field techniques and evidence-based conservation, Biodiversity assessment and monitoring, Systematic recording of field data, Plant Identification and Preparation of Herbarium Specimens, Sampling techniques for flora, Species identification characters for fauna, Inventorying of fauna (Total species listing, Time-restricted searches, Encounter rates, Species discovery curves, MacKinnon lists), Species-area curves, Monitoring of animal populations, Relative and absolute abundance, Population census techniques (Total counts, Territory mapping), Population estimation techniques (Sampling and survey designs, Plot sampling, Indices of abundance, Transect and point counts, Distance sampling, Mark and recapture technique, Removal technique, Indirect sampling methods); Animal behaviour study techniques; Advanced field techniques and software in biodiversity studies; Field excursion to gain hands-on practical experience of biodiversity related field techniques.	

ESNRM 22208	Forestry
Forest types in Sri Lanka and their characteristics, Introduction to forestry, Principles and practices of silviculture, Plant reproduction and regeneration, Nursery establishment and management, Plantation establishment and management, Forest degradation, Forest Plantation Management, Biomass and carbon sequestration, Principles in wood science and timber technology, Forest mensuration, Field excursion, Forestry Field and Laboratory.	
ESNRM 22109	Forestry - Practical
This practical includes measurements of bark thickness, diameter, height and volume of trees, stand basal area, slope and altitude; Determination of stand volume using single tree volume tables.	

Year III Semester I

ESNRM 31201	Remote Sensing and Geographic Information Systems
Overview and concepts of remote sensing technology, Fundamental characteristics of electromagnetic radiation and their interaction, Remote sensing platforms, Satellite system and sensors, Overview of RS applications, Introduction to GIS, Definition, History and concepts of GIS, Functional elements of GIS, Required hardware and software for GIS, Scope, Application areas and benefits of GIS, Data structures (raster and vector data), Data quality and spatial data modelling, Input of geospatial data, Sources of data and input devices, Introduction to GPS, and principles of GPS measurements.	

ESNRM 31102	Remote Sensing and Geographic Information Systems - Practical
Manipulation and analysis of satellite images, Image interpretation, pre-processing, processing, and classification, Image data handling in computer systems, Data input, linking non-spatial and spatial databases, Data manipulation and pre-processing in GIS, Spatial analysis for Natural Resources Studies, and Map generation.	

ESNRM 31203	Environmental and Natural Resource Economics
Rationale of natural resource economics and environmental economics, Sustainable development, Markets and social welfare, Market failure; Property rights, Externalities, Public good and missing preferences, Resource utility value, Economic principles of managing renewable and non-renewable resources, Potential market economic solutions to mitigate environmental degradation, Project cycle and criteria for project analysis, Introduction to environmental valuation techniques, Role of economics in Environmental Impact Assessment (EIA), Introduction to ecological economics, Introduction to ecosystem market place, Economics of ecosystems and biodiversity.	

ESNRM 31204	Environmental Toxicology

Historical roots of toxicology, Toxicology branches, Classification of toxic substances, Sources and pathways of contaminants, Environmental partitioning of toxic substances (octanol-water partitioning (K_{ow}), solid-water distribution coefficient (K_{id})), Sorption-adsorption isotherm, Environmental processes of toxicants (human and plant uptake, persistence, fate), Toxicokinetics and toxicodynamics, Effects of toxic agents on living organisms. Toxicological features and effects of toxic substances, Factors affecting the toxicity (routes, sites, duration and frequency of exposure, Determination of toxicity, Dose-response relationship, Toxicity measurement (LD_{50}, LC_{50}), Quantification of toxic substance loading to the environment (Quantitative health risk assessment (QHRA), Environmental risk assessment (ERA), Strategies to avoid contaminant exposure to living organisms – exposure management.

ESNRM 31205	Industrial Chemistry and Technology
Introduction to the importance of chemical processes used in industry and to the aspects of research and development in the industry, Concepts of cleaner production, Industrial organic chemistry, Plantation crop industries, Coconut, Tea, Rubber, Sugar Cane, and Soap industry, Edible margarine industry, Detergents, Oils as fats, Petroleum products, Organic dye stuffs, Chemistry of essential oils.	

ESNRM 31206	Industrial Minerals
Classification of economic minerals, Economic minerals of Sri Lanka, Mineral based industries: Glass, Graphite (Graphene), Silica, Clay, Ceramics, Mineral sands (ilmenite, rutile, zircon, monazite, garnet), Cement, Fertilizers (Apatite, Dolomite); Metallurgy, Steel and cast iron, Gems and Gem industry. Field excursion to selected industrial mineral sites and economic mineral deposits in order to identify field occurrence of mineral resources and their exploitation, utilization and environmental impact and management.	

ESNRM 31207	Hydrology and Soil Science - Practical
Laboratory based practical in hydrology and soil science (physical, chemical and biological), Quantification of soil degradation (field and model-based). Field excursion to obtain hands on experiences on hydrology and soil science related applications in the field.	

ESNRM 31208	Biogeography
Introduction to biogeography, Key concepts and processes in biogeography (Evolution, Vicariance, Speciation, Radiation, Dispersal, Colonisation, Endemism, Cosmopolitanism, Extinction, Refugia, Range/Distribution, Areas and centres of endemism, Provincialism, Regionalisation), History of biogeography, Main approaches in biogeography (historical and ecological biogeography, vicariance and dispersal biogeography), Global patterns of species diversity, Global patterns of ecosystem diversity, Biomes of the World, Biogeographic regionalisation (Intuitive to numerical methods; global to local scales), Global biogeography, Biogeography of Sri Lanka, Biogeography and Conservation.	

ESNRM 31209	Waste Management
Introduction to waste: classification, quantification and characterization, biochemical transformations, Hierarchy of waste management and respective techniques for solid, liquid, air, hazardous waste; Solid waste management: Construction of disposal yards, Treatment of solid waste (primary treatment, solid-composting, pyrolysis, incineration, anaerobic digestion, bioreactors, Sludge handling and disposal, management techniques for e-waste and hazardous waste); Introduction to wastewater: constituents and characteristics, Wastewater treatment (physical, chemical and biological treatment methods, constructed wetlands); Emission control and management of gaseous waste; Field visit to a central waste treatment plants at industrial zones to explore different wastewater treatment systems.	

Students, those who wish to exit at the end of the 3rd year (after completing a three year general degree programme), should complete the compulsory/optional course units of ESNRM 41201(in this semester as ESNRM 31210), ESNRM 41202 (in this semester as ESNRM 31213; optional), ESNRM 41204 (in this semester as ESNRM 31211), ESNRM 41205 (in this semester as ESNRM 31214; optional) and ESNRM 41208 (in this semester as ESNRM 31212) within the semester I.

Year III Semester II

Students, those who wish to exit at the end of the 3rd year (after completing a three year general degree programme), should select optional course units covering six credits from the seven course units available (from ESNRM 32201 – ESNRM 32207), and compulsory course unit of ESNRM 32409.

Students, those who wish to exit at the end of the 4th year (after completing a four year honours degree programme), should select optional course units covering two credits from the five course units available from ESNRM 32210 – ESNRM 32214, and compulsory course units of ESNRM 32201 – ESNRM 32108.

** A given course unit will be offered only if a minimum of five students have applied for it (Alternative provisions allowed upon the approval of the subject coordinator).

ESNRM 32201	Resource Efficient and Cleaner Production
Metrics of resource consumption (ecological footprint, water footprint (ISO 14046) and carbon footprint(ISO 14064)), Principles of Cleaner Production (CP), Introduction to CP auditing, Introduction to ergonomics, Introduction to Green Productivity (GP) Management system elements according to ISO 14001, Occupational health and safety management, ISO 45001, Quality management, ISO 9000 standards, Environment performance measurements, Green reporting, Resource efficiency indicators, Benchmarking, circular economy, Life cycle thinking, Biomimetics, Eco design, Environmental auditing and compliance, Environmental accounting, Chemical management, Field visit to industrial sites to gain hands-on experience on tools of environmental management and their applicability.	

ESNRM 32202	Aquatic Resource Management (Theory and Practical)
Part I: Fisheries and Aquaculture; Resource availability and production statistics related to Sri Lanka, Fish biology; Age and growth of fish, Food and feeding, Reproduction, Fish yield prediction; Inland fisheries and introduction to Aquaculture, Shrimp culture, Ornamental fish culture; Environmental problems related to aquaculture; Laboratory practical on Fish Biology. *Part II: Water Resource Management;* Water resource, scarcity and global distribution, issues, Water footprint, Approaches to reduce water footprint and water conservation, Water pollution; Agricultural impacts on water, Irrigation water quality; Effects of urbanization and industrialization on water quality; Water pollutants; Groundwater and groundwater aquifers in Sri Lanka, Groundwater pollution and management; Water resource management; Field excursion to explore Aquaculture practices.	

ESNRM 32203	Coastal and Marine Resource Management (Theory and Practical)
History of ocean exploration; Introduction to Oceanography: Ocean floor characteristics, Ocean water chemistry, Waves, Tides, Currents and Ocean circulation; Resources from the ocean: Living and nonliving resources, Zones of the ocean, Marine and coastal communities and their adaptations, Marine primary production and fish production; Marine fishery: Problems related to marine fishery management, Ecological impacts of fishing and fishery management options; Human impacts on the marine environment: pollution, climate change, species introduction, overexploitation of marine resources, Management of Marine and coastal environment; Field excursion to explore marine and coastal environment, coastal environmental issues and their management.	

ESNRM 32204	Tools for Environmental Management
Environmental Impact Assessment (EIA); EIA in project cycle, Legislative and administrative documents in the EIA process, Project screening, Scoping, Impact assessment methods, EIA/IEE Reports, Development of a TOR, Review processes, Preparation of an EIA report, Reviewing and evaluation), Cumulative environmental management, Strategic Environmental Assessments (SEA), Contemporary economic tools in environmental management (Carbon crediting), Risk management, Case studies; Field excursion to sites of large scale development projects to observe project compatibility with sustainable environmental management practices.	

ESNRM 32205	Study and Management of Natural Hazards
Introduction to risk, hazard, Vulnerability and disaster, Types of natural hazards (Geological, Hydrological, Meteorological and Biological), Environmental health and disaster management, Diseases and occupational health hazards, Conducting hazard assessments, Applications of GIS and RS in management of natural hazards, Management of natural disasters, Case studies; Optional field excursion.	

ESNRM 32206	Biodiversity Conservation and Management (Theory and Practical)

Introduction to biodiversity conservation, Historical development of forest and wildlife conservation in Sri Lanka, Causes for and mechanisms of loss of biodiversity, *In-situ* and *Ex-situ* conservation, Global, regional and national biodiversity conservation initiatives and regulatory mechanisms, Principles and approaches of Conservation Biology. Field excursion to study biodiversity conservation in practice.

ESNRM 32207	Soil Degradation and Management

Types and nature of soil degradation, Soil and water conservation measures, Management of soils in relation to potentials and limitations for agricultural, engineering and other uses, Economics of land degradation, Quantification of soil degradation (field and model based), Socio-economic determinants of soil degradation, Concepts of watershed management, Case studies, Field excursion to soil degraded lands, in order to identify major causes and migratory measures for them.

ESNRM 32108	Community Outreach Program (Mini Project)

Capacity development on using information, tools and skills to plan a community outreach activity, and conducting a mini project that will produce a quantifiable output. The mini project could be a community based project or a placement at a recognized governmental or non-governmental organization.

ESNRM 32409	BSc Dissertation in Environmental Sciences and Natural Resource Management

Student research projects should commence in the first semester of the final year. Students are expected to plan their project, review relevant literature, develop methodologies and establish links with relevant organizations during the first semester.

Field/ industrial/ laboratory studies on a research problem relevant to natural resources should be conducted during the second semester leading to a research dissertation. The Dissertation should compulsorily consist of the following components;

1. Introduction, justification, and objectives
2. Literature review
3. Materials and methods
4. Results/Observations
5. Discussion
6. Conclusion and recommendations
7. Bibliography

Both theoretical and practical components of the dissertation should be completed within a given schedule. The topic of the project will be selected through the consensus of the internal and external supervisors and the respective student.

The research project will be evaluated, based on the efficiency of student's field/ industrial/ laboratory work, written dissertation and presentations (oral and poster).

Students are given a total of four credits for the dissertation based on the research project carried out throughout the third year (ESNRM 32410).

It is compulsory for those students who complete the three year BSc (Env Sc & NR Mgmt) Degree Programme to obtain a total of 93 credits.

Obtaining the pass mark of 40% (D+) for the English Programme is a requirement for the award of the BSc Degree in Environmental Sciences and Natural Resource Management.

Students should select optional course units covering four credits from the 10 course units available from ESNRM 41210 – ESNRM 41219.

ESNRM 32210	Lichenology (Theory and Practical)

Classification and identification of lichens, Lichen symbiosis, Sexual and vegetative reproduction of lichens, Lichen photobionts, Ecology and evolution of lichens, Lichen-animal interactions, Field and herbarium techniques in lichenology, Lichen chemistry, Lichens as an air pollution indicator, Ecological and economic benefits of lichens, Lichenology laboratory.

ESNRM 32211	Biogeography and Conservation Planning (Theory and Practical)
Island biogeography, Conservation biogeography, Landscape Ecology, Climate changes and biogeography, Diversity vs. endemism (species and phylogenetic) in conservation planning, Introduction to systematic conservation planning, Global, regional and Sri Lankan practices in setting spatial conservation priorities, Introduction to conservation planning software, A field visit to study biogeographic gradients and spatial conservation planning in practice.	

ESNRM 32212	Environment and Society
Structure of the society, Social stratification, Rural communities, Indigenous knowledge (IK); IK vs. Scientific knowledge, IK in agriculture and water resources management, Land tenure, Gender and environment, Data collection methods for research on rural society (Rapid rural appraisals, participatory rural appraisals), Community development, Social responsibility and ethics towards environmental sustainability; A field excursion to obtain indigenous knowledge practices and apply data collection method for research on rural society.	

ESNRM 32213	Mineral Exploration and Management
Ores and ore deposits, Tectonics and mineralization, Geological, geophysical and geochemical methods in mineral exploration, Reserve evaluation, Drilling, Borehole logging, Mining, Mineral mining and environmental problems in Sri Lanka, Mineral resource management.	

ESNRM 32214	Bioinformatics
Introduction to bioinformatics, Bioinformatics algorithms Basic concepts in Molecular Biology, Nucleic acids and Proteins, Bioinformatics Databases, Sequence alignment, Similarity searching, DNA sequence analysis and protein sequence analysis, protein structure prediction, Genome bioinformatics, Applications of bioinformatics. Computational approaches to biological science concepts of bioinformatics the computational skills for problems solving in biology, Establish, and maintain research information in biology, Solutions to bioinformatics, software packages, usages, and development.	

Year IV Semester I

ESNRM 41201	Research Methodology and Scientific Communication
What is Science and what is research? Why do we do research? Characteristics of Research, Methods of inquiry, The scientific method and research methodology, Research the process, Qualitative and quantitative research. Choosing a research problem, Literature search and review, Objective formulation and research proposal preparation, Data analysis and interpretation, Writing and presentation of research results, References, Dissemination of knowledge and scientific communication, Research management, Personality and career development, Social and interpersonal skills.	

ESNRM 41202	Environmental Legislation and Regulation
Introduction to the legal system of Sri Lanka, Constitution of Sri Lanka, Introduction to environmental law (National environmental act, laws pertaining to the conservation of fauna, flora, forest and wetlands, coastal zone management, protected area management, wildlife trade, pollution control and other related acts), Public nuisance and environmental protection, Relevant case studies.	

ESNRM 41203	Energy Resource Management (Theory and Practical)
Forms of energy, Energy transformation, Energy sources, Categories of energy, Historical and latest trends in global and Sri Lankan energy production and demand, Global fuel stocks, Energy crisis, Energy Management, Energy units, prices and tariffs, Electricity price in Sri Lanka, Energy charge (kWh) and demand charge (kVA), Energy efficiency vs effectiveness, Energy efficiencies in the energy supply chain, Electricity demand management, Energy efficiency in domestic and industrial sectors, Energy benchmarking, Energy auditing and standards, Energy Exploration and production (Biofuels, Biogas, Hydroelectricity, Wind energy, Solar, Coal, Natural gas), Energy storage, Energy within Environmental Constraints, Emissions from fuel combustion and their effects on the environment, Options for reducing emissions and energy-related environmental pollution, Green rating tools and techniques in energy management (Green building concepts).	

ESNRM 41204	Literature Review and Research Proposal Development for BSc Dissertation

Student research projects should commence in the first semester of the final year. Through this course, students are expected to discuss with their supervisors, plan their projects, review relevant literature, develop methodologies and establish links with relevant organizations, Project proposals will be evaluated at the end of this course.

ESNRM 41205	Statistical Application in Natural Resource Studies (Theory and Practical)
Special sampling methods related to natural resources studies, Introduction to Multivariate Statistics; Multi-normal distribution, Principal Component Analysis (PCA), Factor Analysis and MANOVA, Introduction to Logistic Regression, Repeated measure data analysis, Analysis of real world data using statistical software and interpretation of results.	

ESNRM 41206	Environmental Geochemistry
Fundamentals of Geochemistry, Element mobility and their distribution in the Earth systems, Aqueous solutions in Geology, Geochemical cycle, Water chemistry, Water quality standards, Causes and concepts of pollution of water, Groundwater and base flow contamination, Inorganic chemicals and organic compounds in water, Application of geochemical principles to study of natural systems, Application of isotopes, Traceelements related health problems, Laboratory sessions: Laboratory analysis, data handling, data analysis, reporting, and information utilization.	

ESNRM 41207	Field Techniques in Earth Science (Theory and Practical)
Study and interpretation of maps and cross-sections, Use of geological instruments in the field, Identification of geological structures in the field, Methods of field geology, Mapping of rock sequences, Preparation of geological maps and reports.	

ESNRM 41208	Managing People in Organizations (Theory and Practical)
Organizations and management, Understanding human behaviour at work, Developing communication skills, Conflict management and resolution, Stress management techniques, Leadership, Managing teams, Managing change, discipline, and adaptability.	

ESNRM 41209	Environmental Governance
Defining “Governance”, Components and principles of governance, Issues leading to governance mechanisms; local, global and transboundary, Organizations and institutions in global environmental governance, Evolution of Multi-Lateral Environmental Agreements (MEA’s; CBD, RAMSAR, CITES, CMS, UNFCC, UNCLOS), Local institutional setup and policy framework, National and local level environmental governance (with case studies); Field visit to observe and experience a selected MEA being put into practice at the local context.	

Students should select optional course units covering four credits from the 10 course units available from ESNRM 41210 – ESNRM 41219.

** A given course unit will be offered only if a minimum of five students have applied for it (Alternative provisions allowed upon the approval of the subject coordinator).

ESNRM 41210	Applied Hydrology (Theory and Practical)
Use of Meteorological data, Evaporation and transpiration, Infiltration and percolation, groundwater, Surface runoff, Urban hydrology, Rainwater harvesting techniques, Catchment characteristics and catchment management, Water quality and groundwater contamination, Hydrological forecasting and modelling, Applications of hydrology.	

ESNRM 41211	Gemmology (Theory and Practical)
Classification of gemstones, Formation and geological setting of gemstones, Major gem occurrences of the world, Crystallography and mineralogy of gemstones, Physical and optical properties of gemstones, Synthetic gemstones, Fashioning of gemstones, Value addition of gemstones, Gemmological instruments, Geology of gem deposits of Sri Lanka, Environmental management of gem mining.	

ESNRM 41212	Groundwater Exploration and Management (Theory and Practical)

Groundwater occurrences and aquifers, Geological and geophysical methods in groundwater exploration, Drilling, Borehole logging, Pumping tests, Chemical quality of groundwater measurements and remedies, Groundwater pollution, Artificial recharge of groundwater, Groundwater safety, Groundwater modelling.

ESNRM 41213	Protected Area Management
Introduction to Protected Area (PA) management, PA categories (Global and National), Threats to PAs, PA management approaches (Habitat management, Species management), Research needs for evidence-based PA management, Planning and management of PAs (Ecosystem approach, Participatory approach, Incident management, Adaptive management, Tourism and visitor management, Community-based management), Indigenous people and PAs, Integrated Community Development Plans (ICDP). Field excursion to study PA management in practice.	

ESNRM 41214	Ecotourism (Theory and Practical)
Concept and evolution of Ecotourism (guidelines, planning, policies), Structure and market of Ecotourism industry, Interpretation techniques, Assessment of visitor impacts and carrying capacity, Visitor services and management approaches, Ecotourism marketing, Ecotourism for sustainable development, Assessment of Ecotourism potential, Case Studies and field excursion.	

ESNRM 41215	Oil Exploration
Nature of oil and gas, Overview of petroleum industry and petroleum engineering, Formation of oil and gas, Petroleum systems, Structure and stratigraphy, Exploration methods, Heat flow analysis, Basic volumetric calculation, Basic concepts related to formations evaluation, Completion and production, Surface facilities, Petroleum law and economics, Health, safety and environmental policy.	

ESNRM 41216	Forestry for Rural Development (Theory and Practical)
Introduction and defining agroforestry systems, State-managed to community-based forestry practices, Forestry for sustainable development of rural livelihood, Preparation of forest inventories and management plans; Field excursion.	

ESNRM 41217	Basic Methods of Surveying Sciences (Theory and Practical)
Definitions, principles, divisions of surveying; Applications of Surveying; Introduction to Modes of spatial data collection; Units of Measurements: distance, area and volume; Distance and Direction (angle); Introduction to Coordinate Systems; Working with maps: scale, legend, symbols and measurements on maps; Introduction to Conventional surveying techniques: chain, plane table and compass surveying; Introduction to Theodolite, Leveling and Heights/contours, EDMs and GNSS (GPS); Surveying Applications in Natural Resources Studies. Practical Component Familiarization with conventional surveying techniques; Chain, Plane Table, and Compass Surveying; Familiarization with Theodolite; Familiarization with Levelling and Height measurements; Familiarization with Total station/EDM; Familiarization with GNSS(GPS) Mapping Task with Handheld GPS; Fieldwork Documents: Project report on the mapping task and group presentation on the mapping task and an individual oral viva session covering all field practical aspects.	

ESNRM 42218	Climatology
The Earth and Its Atmosphere; Warming the Earth and the Atmosphere; Water in Atmosphere; Condensation, Stability and Precipitation; Air Pressure and Winds: Small Scale, Local Scale, and Global Scale; Thunderstorms, Tornadoes and Cyclones; Climate Changes: Past and Future; Air Pollution; Weather Charts, Forecasting, and Analysis; Meteorological Instruments and observations.	

ESNRM 41219	Machine Learning for Natural Resource Studies (Theory and Practical)
Supervised Algorithms: K-mean, Agglomerative algorithm; Unsupervised Algorithms: Decision Tree, Support Vector Machine, Neural Network, Introduction to Deep Neural Network. Practical component Implementation of machine learning algorithms using python and tools such as “Weka tool”.	

RULES AND REGULATIONS

Year IV Semester II

ESNRM 42801	B.Sc. Dissertation in Environmental Sciences and Natural Resource Management

Student research projects should commence at the first semester of the final year. Students are expected to plan their project, review relevant literature, develop methodologies and establish links with relevant organizations during the first semester of the fourth year.

Field/ industrial/ laboratory studies on a research problem relevant to natural resources should be conducted during the second semester leading to a research dissertation. The Dissertation should compulsorily consist of the following componants;

1. Introduction, justification, and objectives
2. Literature review
3. Materials and methods
4. Results/Observations
5. Discussion
6. Conclusion and recommendations
7. List of references

Both theoretical and practical componants of the dissertation should be completed within a given schedule.

The topic of the project will be selected through the consensus of the internal and external supervisors and the respective student.

The research project will be evaluated, based on the efficiency of student's field/ industrial/ laboratory work, written dissertation and presentations (oral and poster).

It is compulsory for those students who complete the four year BSc Hons (Env Sc & NR Mgmt) Degree Programme to obtain a total of 134 credits.

Obtaining the pass mark of 40% (D+) for the English Program is a compulsory requirement for the award of the BSc Degree in Environmental Sciences and Natural Resource Management.

1. Students should earn a total of 103 and 134 credits to be eligible for the award of the Bachelor of Science degree in Environmental Sciences and Natural Resource Management and the Bachelor of Science Honours degree in Environmental Sciences and Natural Resource Management, respectively.

2. Students should obtain a minimum grade of D+ for each component in the credited, compulsory and non-GPA courses General English I, General English II, Academic English I, Academic English II and Business English) to be eligible for the award of BScHons (Env Sc & NR Mgmt) and BSc(Env Sc & NR Mgmt) degrees.

3. Students are also required to actively contribute to the educational, community outreach, aesthetic and cultural programs/activities/ field excursions organized by the Faculty, Department, and Student Society of Natural Resource Studies (SNRS).