Course Content – Department of Zoology and Environment Sciences

ZL 1008	Variety of Animal Life	ZL 3091	Human Molecular Genetics
EN 1008	Introduction to Environmental Sciences	EN 3013/ 3061	Natural Hazards and Disaster Risk Management
ZL 1009	Evolution and Biogeography	EN 3018/ 3066	Public Policy and Social Movement
ZL 1010	Animal Behaviour	EN 3019	Climate Change
EN 2008	Fundamentals of Environmental Management	EN 3020	Seminar
ZL 2009	Principles of Ecology	EN 3060	Environment Resource Management
ZL 2010	Animal Form and Function	EN 3063	Environmental Economics and Sustainable Development
ZL 2011	Biosystematics	EN 3064	Environment and Industry
ZL 3006	Molecular Biological and Immunological Applications	EN 3065	Landscape Ecology
ZL 3010	Fish Biology and Fisheries	ZL 4048	Seminar
ZL 3018	Animal and Human Parasites	ZL 4049	Guided Reading and Essay
ZL 3059	Molecular Biology	ZL 4052	Research Project
ZL 3066	Immunology	ZL 4060	Developmental Biology
ZL 3069	Fundamentals of Conservation Biology and Wildlife Management	ZL 4061	Aquaculture
ZL 3070	Ecotoxicology	ZL 4062	Entomology
ZL 3071	Animal Kingdom I	ZL 4063	Ornithology
ZL 3072	Comparative Anatomy and Physiology I	ZL 4064	Parasitology
ZL 3073	Animal Kingdom II	ZL 4065	Wildlife Management
ZL 3074	Comparative Anatomy and Physiology II	ZL 4066	Project Development
ZL 3080	Bioethics	ZL 4070	Molecular Immunology
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ZL 3082	Foundations in Molecular Ecology	ZL 4082	Epigenetics
ZL 3083	Molecular Taxonomy	ZL 4083	Bioinformatics and Functional Genomics
ZL 3084	Practical Molecular Biology I	ZL 4084	Molecular and Immunotoxicology
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ZL 3086	Population Genetics and Genomics	ZL 4087	Molecular Medicine
ZL 3087	Conservation Genetics	ZL 4088	Practical Immunology II
ZL 3088	Applications and Management of Genetic Resources	EN 4021	Tools of Environment Management
ZL 3089	Immune System in Diseases	EN 4022	Environmental Education, Journalism and NGOs
ZL 3090	Practical Immunology I	EN 4023	Environmental Policies

EN 4024	Environmental Issues
EN 4025	Nuclear Technology and Environment
EN 4026	Instrumentation for Environment Management
EN 3901	Introduction to Business and Environment
EN 3902	Business and Biodiversity
EN 3903	Sustainable Development and Business
EN 3904	Adapting Business for Climate Change
EN 3905	Sustainable Tourism
EN 3906	Environmental Communication
EN 3907	Group Project
EN 3908	Case Studies
ZL 4091	Project Development
ZL 4902	Seminar
EN 4909	Industrial Training
EN 4910	Industry Research Project

Course Code and Title: ZL 1008: Variety of Animal Life

Credit Value: 3C (30L, 30P)

Rationale: This course provides an introduction to the diversity of animal life on earth, which is a fundamental requirement of the discipline of Zoology. The variety of animal life will be examined through an ecological and evolutionary approach, using the major animal groups living today.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- identify any member belonging to the major animal phyla
- recognize the variety of body forms of animals belonging to different classes of the major phyla.
- explain major adaptations seen in animals for different modes of life, using selected examples from invertebrates and vertebrates.

Course Contents:

Lecture Component: Basic and unique characteristics and adaptive radiation of animal protoctists, diploblastic and acoelomate triploblastic forms, pseudocoelomates, protostomes and deuterostomes.

Practical Component: Microscopy, biological drawing, field collection, preservation and identification techniques, Study of animal variety using representative specimens from major phyla.

Methods of Evaluation: End of semester theory examination, class assignments & practical assessments.

Recommended Reading: Invertebrate Zoology (Rupert & Barnes), The Life of Vertebrates (Young).

Course Code and Title: EN 1008: Introduction to Environmental Sciences

Credit Value: 3C (30L, 30P)

Rationale: Students following this course will get exposed to a variety of topics related to nature and environment. The students will learn about the anthropogenic contribution towards the destruction of the natural balance of the earth system and what measures could be taken in efforts to reverse such environmental damage.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- integrate the theoretical concepts with the practical experience in the laboratory/field to evaluate the contribution of various environmental factors in shaping life processes.
- discuss various environmental issues, causes, and remedies.
- test environment-related hypotheses through laboratory and field exercises.
- analyse consequences of environmental degradation.

Course Content:

Lecture Component: Earth system- main components and processes, climate and life. Human impact on the environment: population growth and environment, development and environment (Agriculture, Industry, Energy use, health, and the concept of sustainable development). Key global environmental issues (Air and water pollution, climate change and global warming, ozone depletion, loss of biodiversity). Introduction to environment conservation and management.

Practical Component: The 3-hour laboratory will meet once a week. The laboratory sessions will cover both field and laboratory exercises, including an independent assignment at the end of the semester.

Methods of Evaluation:
The following percentages will be used to calculate your final grade:
Theory examination: 67%
Practical - Continuous assessment based on weekly performance, independent study or end of semester practical examination: 33%

Recommended Reading: Reading material will be provided by the lecturer.

Course Code and Title: ZL 1009: Evolution and Biogeography

Credit Value: 2C (15L, 30P)

Rationale: This course intends to provide the basics of two major fields of study in Biology namely, Evolution and Biogeography, both of which are important for the study of all biological phenomena and the patterns of distribution of plants and animals over the planet through time and space. This course is taught to all entrants to the Biological Sciences stream due to its importance as a fundamental course.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain the major theories of Evolution in biological systems.
- apply theoretical knowledge to explain evolutionary change.
- relate the history of life on earth and its geological history.
- recognize the present biogeographical regions of the world, the patterns of distribution and special characteristics of their mammalian fauna and the processes that cause these patterns.

Course Content:

Lecture Component: Brief outline of the history of evolutionary theories, Darwin's Principle of Natural Selection and its application to examples, Neo Darwinism, genetic fitness and how to measure it, concept of the gene pool, units of selection, factors for evolutionary change in a population, introduction to population genetics, genetic drift, genetic bottlenecks and founder effects with examples, modes of selection: the geological time scale and animal life through geological history. Mass extinctions and their impacts on life on earth; Theories of Continental Drift and Plate Tectonics; Basic concepts of animal distribution and distribution maps. Wallace's biogeographical regions and their characteristic mammalian fauna.

Practical Component: Field visit to a chosen site by division of the entire class into groups and assigned a taxonomic group for study in the field. This is followed by the preparation of a group poster and group presentation, evaluated as an examination.

Methods of Evaluation:

End of semester theory paper – 50%
The marks for the practical component are sub-divided as attendance at field visit, preparation for poster, poster (uploaded to course site at LMS) and presentation – 50%

Recommended Reading: To be given by the teacher as selected websites for Evolution and Biogeography textbooks in the library updated over time. Selected reading material will be uploaded to the LMS.

Course Code and Title: ZL 1010: Animal Behaviour

Credit Value: 2C (15 L, 30P)

Rationale: The course will provide the students with an in-depth knowledge in animal behavior. The course will familiarize students with both recent and historical aspects of animal behaviour experiments. An interdisciplinary approach through theory and practical sessions will provide the students with the skills, concepts and experience to study animal behavior in a scientific manner. Students will gain necessary skills to apply this knowledge in animal welfare and understand human behavior.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- define behavior and explain history of ethology
- explain different categories of behaviors and their functions
- discuss the development and control of behavior in animals giving emphasis on animal communication
- measure behavior using continuous and time sampling methods
- apply techniques of minimizing error in behavior studies
- relate animal and human behavior

Course Content:

Lecture Component: History of ethology: Definition of behaviour and behaviour patterns: Categories of behaviour: Measuring behaviour, continuous sampling and time sampling: Analysis of Ethograms: Minimizing errors in behavior assessments: Development of behavior: Control of Behavior: Animal communication: Significance of study of animal behavior in animal welfare: Aspects of human behaviour

Practical Component: Will include in–class measuring behaviour exercises using live animals and videos: Simulations to understand and minimize of errors that occur in behavioural studies: Behavioural research conducted at the department. An integral part of the practical component will be a field workshop conducted at the Pinnawala Elephant Orphanage or Zoological Gardens.

Methods of Evaluation: End of semester theory examination (70%) and practical examination (20%): Continuous assessments (10%)

Recommended Reading: Manning A. and Dawkins M.S. (2012) An Introduction to Animal Behaviour, Cambridge University Press; Paul Martin and Patrick Bateson (2007) Measuring Behaviour: An Introductory Guide, Cambridge University Press.

Course Code and Title: EN 2008: Fundamentals of Environmental Management

Credit Value: 3C (30L, 30P)

Rationale: This course will provide the students an insight to Environmental Management which is a mandatory component of development. The course will strengthen the knowledge of students on the fundamentals of environmental management and management tools, along with the associated policy aspects.

Pre-requisites: EN 1008

Intended Learning Outcomes: At the end of this course the students will be able to;

- link the existing management practices and tools with the fundamental environment management principles introduced by the Rio Earth Summit and Agenda 21.
- analyze the practical experience during field visits for obtaining a better understanding on the theoretical aspects of Environmental Management including international standards such as ISO 14001.

Course Content:

Lecture Component: Fundamentals of environmental management (e.g. Polluter pays principle, precautionary principle), Concept of sustainability: Introduction to Environmental management systems (EMS); Environmental Standards and regulations; Monitoring; Adaptive environment management; Integrated environment management; Environmental risk and impact assessment and management; Community participatory approaches and role of stakeholders in environment management; Pollution management, Natural resource management, Introduction to ecosystem management; Challenges of environment management.

Practical Component: Weekly 3-hr laboratory to go along with the theory contents.

Methods of Evaluation:

The following percentages will be used to calculate your final grade:
Theory examination: 67%
Practical - Continuous assessment on weekly performance: 33%

Recommended reading: Reading material will be provided by the lecturer.

Course Code and Title: ZL 2009: Principles of Ecology

Credit Value: 3C (30L, 30P)

Rationale:
This course aims at examining key ecological concepts with reference to populations, communities and ecosystems. The basic concepts that govern the distribution and abundance of species will be examined with reference to interactions and environmental factors. At the level of populations, the focus will be on population dynamics, population processes, growth and regulation and at the community level the focus will be on the structure and functioning of communities. Students will gain knowledge and skills to identify various ways humans impact the ecosystems and made aware of strategies to minimize them.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the ways in which organisms interact with their physical environment and with each other
- describe the dynamic nature of populations using basic population processes, age structure, sex composition and productivity
- describe community dynamics and ecosystem characters
- identify tools in measuring environmental parameters in ecological surveys
- recommend techniques to determine population distribution and abundance
- conduct a preliminary ecological survey to describe the status of an ecosystem
- appraise the human impact on ecosystems

Course Content:

Lecture Component: Introduction to Ecology: Populations and Metapopulations: Population Dynamics: Population growth and regulation: Population interactions: Community structure and function: Ecosystem characters: Ecosystem patterns, processes and development: Energy in ecosystems: Biogeochemical cycles: Ecosystem types: Human impact on ecosystems.

Practical Component: Study of biotic and abiotic factors using ecological tools, techniques associated with population census and estimates, study of ecosystem characters and processes. A short-term research project will be conducted by small teams on a selected ecological topic and the findings will be disseminated as poster presentations. A field workshop will be conducted in a wetland ecosystem or forest ecosystem to study population and community dynamics and ecosystem characters.

Methods of Evaluation:
End of semester theory examination (70%) and practical examination (20%) and continuous assessments (10%)

Recommended Reading: Odum, E. and Barrett, G. W. (2010) Fundamentals of Ecology, Brooks Cole; Chapman. J. L. and Reiss, M. J. (1992) Ecology: Principles and Applications, Cambridge University Press; Krebs. C. J. (2013) Ecology: The experimental analysis of distribution and abundance, Pearson.

Course Code and Title: ZL 2010: Animal Form and Function

Credit Value: 3C (30L, 30P)

Rationale: Animals live under different environmental conditions and therefore they need to solve their challenge of living within the constraints of the available environment. By comparing different animals and examining how each animal has solved its challenge of living we would be able to gain insight into the general principles that underlie the form and function of animals. Hence this course explore the form and function of animals in an ecological and evolutionary backdrop.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- review the basic strategies used by living organisms to solve fundamental life processes such as gaseous exchange, nutrition, excretion, defense, transport, movement, coordination and reproduction.
- discuss evolutionary and environmental forces that underlies these strategies.
- describe the basic form and functions of the main organ systems present in living organisms.
- design, conduct experiments and analyze data to demonstrate the functions of organ systems.
- conduct standard clinical diagnostic tests of major organ systems and interpret results.

Course Content:
This course deals with the basic function (physiology) of animals. The topics include comparative study of digestion and metabolism; sensory integration, neuronal and endocrine regulation of the body, circulation and defense; respiration; excretion; and reproduction. This course explore how an animal function and the mechanisms present in animals to regulate and coordinate its functional components to exist as a smooth-functioning organism.

Methods of Evaluation: In class practical assignments and end of semester theory and practical examinations.

Recommended Reading: Guyton, A.C., & Hall, J.E, (1996) Textbook of Medical Physiology. Prism Books (Pvt.) Ltd. India; Ganong W.F. (1983) *Review of Medical Physiology* Lange Medical Publications, California; Schmidt-Nielsen, K. (1983) *Animal Physiology: adaptation and environment* Cambridge University Press, London; Wilson, K.J. (1990) *Anatomy and Physiology in Health and Illness* Churchill Livingstone, London.

Course Code and Title: ZL 2011: Biosystematics

Credit Value: 1C (15L)

Rationale: Biosystematics determines the taxonomic status of organisms from experimental evidence and assists biologists to better understand diversity, differentiation and divergence. Learning biosystematics provides generates fundamental knowledge to study taxonomy, biodiversity, ecology and environment, evolution and biogeography, agriculture and forestry and biotechnology.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- understand the value of learning "Biosystematics" and identify the difference between biosystematics and taxonomic classification.
- identify the types of data used in biosystematics and describe taxonomic characters important in biosystematics and classification.
- understand taxonomic relationships and differences between phenetic and cladistic taxonomic relationships.
- describe relationships of taxa in monophyletic, paraphyletic and polyphyletic groups.
- construct phylogenetic relationships among taxa using molecular characters.

Course Content: Definitions of biosystematics, taxonomy and classification. History and importance of biosystematics. Trends in biosystematics: chemotaxonomy, cytotaxonomy and molecular taxonomy. Species concepts. Data types and taxonomic characters used in biosystematics. Molecular characters and phylogenetic trees. Phenetic and cladistic taxonomic relationships. Phylogram and cladogram construction. Monophyletic, paraphyletic and polyphyletic relationships. International codes of Nomenclature.

Methods of Evaluation: End of semester theory examination.

Recommended Reading: Principles of Systematic Zoology (Mayr & Ashlock); Reading material will be provided by the lecturer.

Course Code and Title: ZL 3010: Fish Biology and Fisheries

Credit Value: 3C (30L, 30P)

Rationale: Sri Lanka, being an island nation, relies on the ocean for its supply of fish as the main source of proteins for people. Therefore, the effective and sustainable management of its coastal and off shore fin fish resources is of great importance. This course provides the basic knowledge on diversity and taxonomy of fin fish, selected aspects of the biology and adaptations of fishes, their exploitation by man and principles of fisheries management.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- identify and classify the main orders and families of bony fishes of economic importance.
- discuss the morphological and functional adaptations of bony fishes for their success in the aquatic environment, with reference to swimming, respiration, feeding, sensory perception, neutral buoyancy and reproduction.
- describe the basic aspects of fisheries management, main fishing gear, their uses and limitations.

Course content:

Lecture Component: Evolution and classification of fishes. Functional morphology of locomotion, feeding, gas exchange, sensory perception and reproduction. Fishery resources of the world; Capture and culture fisheries. Principles of fish population dynamics. Fishing gear and their design. Principles of Fisheries Management. Marine and inland fisheries of Sri Lanka.

Practical Component: Classification of fishes, morphological diversity of fishes with special reference to swimming, feeding, gas exchange and reproduction. Identification of important edible marine fish; Analysis of a commercially landed fish catch based on sampling (field visit to a fish landing site); Study of different types of fishing methods and gear.

Methods of Evaluation: End of semester theory and practical examination.

Recommended Reading: Ichthyology(Miller, Bardach and Passino), Biology of fishes (Bond);,Explorations in the life of fishes (Marshall), Introduction to fishery science (Royce), Manual of methods of fish stock assessment (Gulland), Modern fishing gear of the world (FAO).

Course Code and Title: ZL 3018: Animal and Human Parasites

Credit Value: 3C (30L, 30P)

Rationale: This course is designed to provide students with an in-depth knowledge of parasites interacting with their hosts taking several examples from different groups of parasites. The course is delivered to dissect these interactions with the knowledge in basic biology and life cycles of parasites, parasitic infections, including epidemiology, clinical features, laboratory diagnosis, treatment and prevention. Integrated laboratory component provides students with identification and diagnostic skills in Parasitology which would be useful in their future research and day to day life.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the basic definitions in animal associations
- identify the major taxonomic groups of parasites occurring in vertebrates
- describe the adaptations that characterize each parasite group.
- analyze the economic burden of parasitic infections
- identify specimens of parasites with their unique features
- analyze infectious biological samples with appropriate safety precautions for parasitic stages.

Course Content:

This course is designed to examine the impact of parasites on human and animal populations.

Lecture Component: Animal associations and parasitism, physiological behavioral and morphological adaptations to parasitic lifestyle, study of biology, pathology, geographical distribution, transmission, diagnosis and control of selected parasites from different phyla with a special emphasis on parasites relevant to Sri Lanka and current research in parasitology.

Practical Component: Examining fixed and live specimens of selected parasites, conducting a parasitological survey, and a field visit.

Method/s of Evaluation: Assignments. End of semester theory examination. Practical component will be continuously assessed.

Recommended Reading: Relevant reading material will be provided by the lecturer.

Course Code and Title: ZL 3059: Molecular Biology

Credit Value: 2C (30 L)

Rationale:
Molecular Biology as a subject is fast developing and advancing globally. Its applications are also been utilized in various other scientific disciplines including almost all of natural and medical sciences. Advances in molecular biology have also benefited many countries for their national development. Therefore it is extremely important that university undergraduates get a clear theoretical basis of molecular biology and specially its novel and modern applications. This course offers students a comprehensive knowledge on basic theories of molecular biology in general and its widely used applications.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- analyse the complexity of defining a gene in the post genomic
- describe the central dogma of molecular biology
- discuss molecular biological mechanisms
- identify the use of basic knowledge of molecular biology in drug designing
- identify basic theories behind molecular biological applications

Course Content:
The topics covered are: Structure of the gene, Mechanisms of generating genetic variability, Role of the gene within the cell, Regulation of gene expression, Replication, Transcription, Translation, Post translational modification, Gene cloning, Sequencing and transfection, Construction of genomic and c DNA libraries, Recombinant DNA technology and its applications, PCR technology and its uses, Mitochondrial genomics

Methods of Evaluation:
End of semester theory examination

Recommended Reading:
1.Molecular Biology of the gene, James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Pearson Education
2.Recombinant DNA, A short Course, James J Watson, John Tooze and David T Kurtz, Scientific American Books, W H Freeman and Company
3.Principles of gene manipulation, An introduction to genetic engineering, R W Old and S B Primrose, Blackwell Scientific Publication.

Course code and Title: ZL 3066: Immunology

Credit Value: 3C (30L, 30P)

Rationale: The aim of this course is to introduce students to theory of the components, fundamental principles and mechanisms of the human immune system and to core practical immunology methods.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- comprehend the principles underpinning immune mechanisms that protect the body from infection.
- recognize occasions and mechanism underlying malfunctioning of the immune system.
- understand strategies of vaccination.
- perform core laboratory techniques in Immunology.

Course Content:
Lecture Component: Components (cells, tissues & organs) of the immune system, Mechanisms of innate and adaptive immunity; Antigen recognition by B and T cells; Structure and functions of antibodies; Properties of antigens; Failures of the Immune system – Immunodeficiency, Hypersensitivity and Autoimmunity; Immune tolerance; Vaccination.
Practical Component: Cells, tissues and organs of the rat immune system; Phagocytosis functional assay; Serum separation and partial purification of immunoglobulins; Antigen – antibody interactions i.e. ouchterlony double diffusion, ELISA, SDS- PAGE, Laboratory visit to observe use of immuno – diagnostics.

Methods of Evaluation: Assignments and end of semester theory and practical examinations.

Recommended Reading: *Kuby Immunology* by Goldsby, Kindt and Osborne; *Practical Immunology* by Hudosn & Hay.

Course Code and Title: ZL 3069: Fundamentals of Conservation Biology and Wildlife Management

Credit Value: 3C (30L, 30P)

Rationale:
The course brings together key concepts in conservation biology and wildlife management to train students in applying them to formulate conservation strategies and effective wildlife management. Furthermore, this course gives special emphasis on the human-wildlife conflict and providing scientific solutions. Theory would be backed with extensive hands-on experience in the field to enable students to experience the real-life applications.

Pre-requisites: ZL 2009 - Principles of Ecology

Intended Learning Outcomes: At the end of this course the students will be able to;

- discuss the concepts of conservation biology and apply the concepts to manage wildlife resources
- describe the protected area (PA) network of Sri Lanka and problems associated with PAs
- apply ecological knowledge to manage wildlife populations and habitats
- recommend suitable tools to inventorize and monitor wildlife populations
- evaluate the importance of management of human dimension in wildlife conservation to minimize human-wildlife conflicts

Course Content:
The topics covered are: Historical perspectives: Biodiversity and its values: Extinction: Concepts of Conservation Biology: Island Biogeography Theory: Species-area relationships: Critical reserve area: Criteria involved in establishment of PAs: Protected area categories: PA network of Sri Lanka: Integrated management of PAs: National and international conventions/ protocols on wildlife conservation: Application of ecological principles to manage wildlife populations: Symptom and cause management: Tools in wildlife management: Current wildlife management practices in Sri Lanka: Overview on wildlife study techniques: Field craft
An integral part of the practical course will be two mandatory field workshops conducted in a dry zone PA and wet zone PA in Sri Lanka. Also, basic cartography, map reading and a short term independent study on an assigned wildlife management topic will be important components. Students will apply the knowledge gained during the course to support a selected community around a protected area which will reduce resource dependencies.

Methods of Evaluation:
End of semester theory examination (60%) and practical examination (20%): Continuous assessments (20%)

Recommended reading: Bolen E. G. and Robinson W. L. (2003) Wildlife Ecology and Management, Prentice Hall; Primack R. G. (2002) Essentials of Conservation Biology, Sinaeur Associates; Gopal R (1992) Fundamentals of Wildlife Management, Natraj Publishers; Rodgers W. A. (1991) Techniques for Wildlife Census in India - A Field Manual, Wildlife Institute of India (WII).

Course Code and Title: ZL 3070: Ecotoxicology

Credit Value: 4C (45L, 30P)

Rationale: Accelerated industrial development in Sri Lanka and elsewhere has led to the deterioration of terrestrial and aquatic ecosystems hindering their potential to provide commercial goods and ecosystem services. More importantly, the harmful effluents released into aquatic systems often induce toxic impacts that threaten the wellbeing of biota as well as impose health risks to human beings. Ecosystem health could only be restored through the implementation of proper mitigation measures and continuous monitoring of environmental contaminants. Successful implementation of such programmes would require persons to possess sound knowledge and skills related to the field of ecotoxicology.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- know the fundamental concepts and terms related to ecotoxicology.
- have a basic knowledge of the fate of chemicals in the environment.
- have a basic knowledge of how contaminants are taken up and excreted by organisms.
- describe lethal and sublethal endpoints of toxicity.
- have a basic training in techniques used to monitor contaminants in the environment and impacts of contaminants on biota.

Methods of evaluation: End of semester examination, practical assignments and assessment.

Recommended Reading: Walker, C.H., Sibly, R.M., Peakall, D.B., Hopkin, Steve P. (1996). Principles of Ecotoxicology. Published by CRC Press 1996-04-11. ISBN 10: 0748402217.

Course Code and Title: ZL 3071: Animal Kingdom I

Credit Value: 3C (30L, 30P)

Rationale: Explores the constraints placed on the basic organization and design of single celled organisms, extant metazoan invertebrates and protochordates by evolution and physical laws.

Pre-requisites: ZL 1008 – Variety of Animal Life

Intended Learning Outcomes: At the end of this course the students will be able to;

- understand the origin, evolution and phylogeny of major and minor invertebrate phyla and protochordates.
- identify the main characters of the major and minor invertebrate phyla and protochordates.

Course Content:
Lecture Component: Origins and evolution of major and minor invertebrate phyla and protochordates. Structural organization of selected examples from major and minor invertebrate phyla and protochordates. Phylogenetic overview of invertebrates and transition to Chordates.

Practical Component: Morphological adaptations of invertebrates and protochordates. Invertebrate behavior patterns. Senses and communication. Use of taxonomic keys for identification.

Methods of Evaluation: End of the semester theory, practical examination and assignmments.

Recommended Reading: Invertebrate Structure and Function (Barrington), Invertebrate Zoology (Rupert and Barnes).

Course Code and Title: ZL 3072: Comparative Anatomy and Physiology I

Credit Value: 3C (30L, 30P)

Rationale: This course takes a comparative approach to examine the diversity of selected anatomical and physiological processes (digestion, circulation, excretion, respiration) employed by different animal species and how these adaptations are related to the physical environment.

Pre-requisites: ZL 2010 – Animal Form and Function

Intended Learning Outcomes: At the end of this course the students will be able to;

- identify the anatomical characters of the major invertebrate and vertebrate phyla.
- relate the anatomical characters with the physiological processes.
- compare the differences in anatomy and physiology between the different animal phyla.

Course Content:
Lecture Component: Basic modes of nutrition; Digestive systems of invertebrates and vertebrates; Mechanism of digestion and its regulation; Mechanisms of absorption of digestive products. Circulatory system of invertebrates and vertebrates; Composition and functions of blood; Blood pigments; Hemoglobin-oxygen dissociation curves. Excretory systems of invertebrates and vertebrates; Nitrogenous excretory products of animals and their advantages and disadvantages. Respiratory structures and systems of invertebrates and vertebrates; Mechanisms of ventilation and gaseous exchange and their regulation.

Practical Component: Comparative anatomy of digestive, circulatory, respiratory and excretory systems. Analysis of blood and excretory products.

Methods of Evaluation: End of the semester theory and practical examinations.

Recommended Reading: Comparative Anatomy of the Vertebrates (Kent), Comparative Animal Physiology (Withers), Animal Physiology: Adaptation and Environment (Schmidt-Nielsen), Textbook of Medical Physiology (Guyton).

Course Code and Title: ZL 3073: Animal Kingdom II

Credit Value: 3C (30L, 30P)

Rationale:
This course will provide a wide knowledge in vertebrate fauna emphasizing on selected aspects of diversity, life history, ecology, behaviour, adaptations, evolution, and phylogeny. This course lays a strong basis for the courses that would follow in the advanced levels where it gives students a holistic picture of vertebrates.

Pre-requisites: ZL 1008 Variety of Animal Life

Intended Learning Outcomes: At the end of this course the students will be able to;

- comment on the diversity and unique characters of vertebrates with reference to taxonomic classes and families
- describe life history, ecology, behaviour and adaptations of the vertebrate animals for different modes of life
- explain the origin and evolution of chordates with respect to diversification and lifestyles
- discuss phylogenetic relationships of vertebrates

Course Content:
The topics include: Origin and major evolutionary trends: Chordate body plan and factors underlying the evolutionary changes: Diversification of vertebrates and different modes of life: Major classes of chordates and their unique characters: Diversity and adaptations: Overview on phylogeny of vertebrates.
The practical component will focus on morphological, physiological and behavioural adaptations of vertebrates, evolutionary trends seen among vertebrates, use of taxonomic keys for identification of vertebrate fauna of Sri Lanka and preservation techniques of vertebrates.

Methods of Evaluation: End of the semester theory examination (70%), practical examination (20%) and assignments (10%).

Recommended Reading: Pough F. H. , Jani C. M. and Heiser J. B. (2010) Vertebrate Life, Benjamin Cummings; Redinsky, L. B. (1987) The Evolution of Vertebrate Design, University of Chicago Press; Young J. Z. (1962) The Life of Vertebrates, Oxford University Press; Young J. Z. (1957) The Life of Mammals, Oxford University Press.

Course Code and Title: ZL 3074: Comparative Anatomy and Physiology II

Credit Value: 3C (30L, 30P)

Rationale: This course takes a comparative approach to examine the diversity of selected anatomical and physiological processes (nervous, endocrine, skeletal, muscular, reproductive) employed by different animal species and how these adaptations are related to the physical environment.

Pre-requisites: ZL 2010 – Animal Form and Function

Intended Learning Outcomes: At the end of this course the students will be able to;

- identify the anatomical characters of the major invertebrate and vertebrate phyla.
- relate the anatomical characters with the physiological processes.
- compare the differences in anatomy and physiology between the different animal phyla.

Course Content:
Lecture Component: Homeostasis. Integumentary systems, their structure and functions. Nervous systems and sense organs of invertebrates and vertebrates; human brain and its main functions. Invertebrate and vertebrate endocrine tissues and their hormones; Chemical nature of hormones; Functions of hormones; Endocrine, paracrine and autocrine control mechanisms; Invertebrate and vertebrate pheromones. Skeletal and muscular systems of invertebrates and vertebrates. Reproductive systems and life histories of invertebrates and vertebrates; Menstrual cycle and menopause; Physiology of pregnancy and lactation.

Practical Component: Functioning of nerves and muscles. Comparative anatomy of the skull and skeletal systems of vertebrates and invertebrate nervous systems.

Methods of Evaluation: End of the semester theory and practical examinations.

Recommended Reading: Comparative Anatomy of the Vertebrates (Kent), Comparative Animal Physiology (Withers), Animal Physiology: Adaptation and Environment (Schmidt-Nielsen), Textbook of Medical Physiology (Guyton).

Course Code and Title: ZL 3080: Bioethics

Credit Value: 1C (15L)

Rationale: Rapid advances in the fields of molecular biology & biotechnology in biology, medicine & agriculture have resulted in moral & ethical issues that needs to be addressed. These issues must be analyzed and debated in order to make rational decisions. The discipline of bioethics enables students to deal with real world problems that relate to the use of living organisms, through critical thinking, analysis of issues, writing and discussion.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain basic problems, methods, and core concepts in the field of bioethics
- recognize ethical dilemmas facing health care professionals and patients
- apply legal and public policies and procedures related to bioethics in genetic and clinical research
- engage in the critical analysis of selected bioethical issues related to biology, medicine & agriculture and articulate their theoretical and practical dimension

Course Content: Bioethics & the ethics of science and technology, Fundamental ethical principles, theories of ethics, autonomy, informed consent and informed choice, prenatal diagnosis of genetic diseases; Ethical issues arising due to genetic engineering, genetically modified food, genetic privacy, eugenics, human gene therapy, euthanasia, organ donation, research on human & animal subjects; assisted reproduction, cloning, Environmental ethics; Neuroethics.

Methods of Evaluation: End of semester theory examination & class assignments

Recommended Reading: Relevant reading material & sources of reference will be provided.

Course Code and Title: ZL 3081: Cellular and Molecular Physiology

Credit Value: 3C (45L)

Rationale:

The course is designed to provide students with an understanding of the molecular transactions within a cell at cellular, molecular, biophysical, and physiological levels. Students gain an in-depth knowledge in cell membrane biology and it's pivotal role in major cellular processes such as membrane transport, generate electrical currents, or perform mechanical displacement. The interactions among proteins in determining the physiological behaviors of cells and tissues are also stressed. Cellular communication is discussed with an emphasis on it's role in virulence and human diseases.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- discuss the complexity of cell membranes and their functions in key cellular events
- discuss the functions of membrane proteins in regulating cellular functions
- describe the mechanisms of inter and intra-cellular communication and their involvement in human diseases
- relate physiological functions of organisms with underlying cellular mechanisms
- analyze the molecular mechanisms of selected human diseases and therapeutic interventions

Course Content:

The aim of this course is to introduce the structure and function of cells that is necessary for students to understand cellular interactions at a molecular level. The topics covered include: basic structure, function and diversity of prokaryotic and eukaryotic cells; cell membrane; role of the membrane lipids; role of the membrane proteins in maintaining membrane potentials, cellular transport, cell signaling, cell-cell and cell-extracellular matrix interactions; cytoskeleton and its role in vesicular trafficking, endocytosis, exocytosis and motility; cell cycle and its regulation; cell communication; cell behaviour; cell death.

Methods of Evaluation: Assignments and end of the semester theory examination.

Recommended Reading: Molecular Biology of the Cell (Alberts, B. Johnson, A. Lewis, J. Raff, M. Roberts, K. and Walter, P.), 2002 Molecular Cell Biology (Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell J., W. H Freeman), 2012

Course Code and Title: ZL 3082: Foundations in Molecular Ecology

Credit Value: 2C (30L)

Rationale: The use of genetic markers and technology in the studies of ecology and evolution has led to the formation of a new and rapidly developing field in biological sciences commonly known as the Molecular Ecology. While genetic techniques are central to the Molecular Ecology, it emphasizes fundamental principles and predictions from ecological and evolutionary theory.

Rationale: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- introduce the concepts of ecology and evolution in the light of genetics and genomics.
- introduce the concept of molecular markers and explore the applications of molecular markers in wide range of disciplines.
- learn methods used in building genetic and population models to study basic ecology in both wild and captive populations.

Course Contents:
This course covers ecological and evolutionary questions from the genes to the ecosystem level in the light of genetic diversity, gene flow and population history and environmental genomics. It will also explore current issues in areas of applied importance such as GM organisms, adaptation to a changing climate, antibiotic resistance and extinction of species. Students will explore examples from wild and domesticated animals and from humans across diverse environments. The field classes include field sampling in remote wilderness, museum sampling and computer analysis of real datasets.

Methods of Evaluation: In class assignments, class presentations and end of semester theory examination.

Recommended Reading: Trevor Beebee and Graham Rowe 2008. Introduction to Molecular Ecology; Freeland et al. 2011. Molecular Ecology; Molecular Ecology Journal http://onlinelibrary.wiley.com/ journal/10.1111/(ISSN)1365-294X (John Wiley and Sons).

Course Code and Title: ZL 3083: Molecular Taxonomy

Credit Value: 1C (15L)

Rationale: Taxonomy underpins all biological research, with implications for many basic scientific and applied fields. Insights into the stability or change of animal and plant guilds require species identification on a broad scale and biodiversity questions have become a major public issue. But this comes at a time when taxonomy is facing a crisis, because ever fewer specialists are available. Here, we explore the possibility of using DNA-based taxonomy or molecular taxonomy to overcome these problems.

Pre-requisites: ZL 2011 – Biosystematics

Intended Learning Outcomes: At the end of this course the students will be able to;

- know basic principles and procedures in taxonomy, nomenclature and classification.
- analyse morphological and molecular character matrices and evaluate the resulting phylogenetic trees using a variety of methods.
- build and design cladograms and use computer programmes to analyse taxonomic data.

Course Contents:

Lecture Component: A brief introduction to morphological taxonomy. Introduction to molecular taxonomy. Types, collection and sampling properties of data used in molecular taxonomy. Molecular methods used in taxonomy – hybridization, DNA sequencing, restriction mapping, chromosome banding, amino acid sequencing, immunological methods. Methods in molecular phylogenetic analysis – distance matrix methods, UPGMA method, discrete data methods, parsimony methods, maximum likelihood; Phylogenetic analysis tools.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Reading materials will be provided by the lecturer.

Course code and Title: ZL 3085: Advanced Applications in Immunology and Molecular Biology

Credit Value: 2C (30L)

Rationale: The aim of this course is to create an in depth understanding of the principles and methodologies involved in current immunological and molecular biological techniques related to Zoology.

Pre-requisites: ZL 3058 - Immunology and ZL 3059 - Molecular Biology

Intended Learning Outcomes: At the end of this course the students will be able to;

- understand principles underpinning immunological and molecular biological methods used in both research and disease diagnostics.
- apply laboratory techniques in immunology and molecular biology to solve research questions.
- apply diagnostic laboratory techniques to diagnose diseases using immunological and molecular biological techniques.
- interpret experimental data on research in Immunology & Molecular Biology.

Course Content:
The topics covered include advanced applications in immunology such as production of polyclonal and monoclonal antibodies; immunoassays (principles and methods of antigen-antibody reaction) *i.e.* precipitation reactions, agglutination reactions, RIA, ELISA, SDS- PAGE & Immunoblotting, immunoprecipitation, immunofluorescence, flowcytometry, immuno electron microscopy.

The advanced applications in molecular biology covered in the course include DNA extraction methods from animal tissues, hybridization and probing techniques, gene cloning and PCR, RT-PCR and gene expression studies, genotyping studies in human diseases, molecular mechanisms in immunogenetics and immunopathogenesis in the treatment of immunological disorders (gene therapy).

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Handbook of Experimental Immunology (Edited by D.M.Weir); Practical Immunology (Hudson & Hay)

Course Code and Title: ZL 3086: Population Genetics and Genomics

Credit Value: 2C (30 L)

Rationale: Population genetics provide insight into ecological and evolutionary processes by investigating how and why the frequencies of alleles and genotypes change over time within and between populations. It has extensive applications in the fields of conservation genetics, phylogeography, molecular epidemiology and forensic molecular biology.

Pre-requisites: ZL 1009 – Evolution and Biogeography

Course Content:
Lecture Component: The aim of this course is to introduce the key concepts of population genetics and genomics and its applications. The topics covered include: Methods of detection of genetic variation in natural populations. Estimation of genetic variability parameters. Hardy Weinberg equilibrium and its application. Evolutionary forces and their effect on populations. Neutral theory and coalescence. Measures of inbreeding, population fragmentation and genetically viable populations, models for population structures, summary statistics. Applications of population genetics in conservation, medical and vector genetics and also in human genetics. Molecular methods of data collecting. Analysis of molecular markers. Locus specific effects and genome wide effects. Evolution of genome size and composition, organismic complexity and the c-value paradox, base composition of genomic DNA. Polymorphism and its mechanisms. Human population genetics. Natural selection and related concepts. Population genetics and conservation.

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain the difference between microevolution and macroevolution.
- measure genetic variation within populations.
- analyse how genetic structure of populations is influenced by mutation, migration, genetic drift and natural selection.
- measure genetic differentiation among populations.
- apply the knowledge of inbreeding in conservation and medical genetics.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Principles of Population Genetics (Daniel L. Hartl and Andrew G. Clark) 2006; Genetics of Populations (Philip W. Hedrick) 2009; Introduction to Conservation Genetics (Richard Frankham, Jonathan Ballou and David Briscoe) 2010.

Course Code and Title: ZL 3087: Conservation Genetics

Credit Value: 2C (30L)

Rationale: Conservation genetics is a discipline that uses molecular genetic tools to assess factors affecting extinction risk of populations and mitigate extinctions through preserving species as dynamic entities able to respond current and future (environmental) conditions. It is an overlap of genetics, conservation biology and evolutionary theory.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- introduce the concepts of conservation biology in the light of genetic theory.
- study how populations go extinct and to assess the risk of extinction in wild populations.
- study the applications of key concepts in molecular ecology and population genetics such as effective population size, isolation, fragmentation and Evolutionary Significant Units (ESUs) in minimizing extinctions.

Course Contents:
The course covers the broad topics of conservation biology such as the levels of biodiversity, species concepts, conservation units and extinction. It also covers measures and contributors of genetic diversity, inbreeding depression, effective population size, heterozygosity and polymorphisms. The more advance topics of the course deals with the mutations in the genome, hybridization, gene flow and genetic drift, Evolutionary Significant Units (ESU), corridors and avoiding fragmentation and conservation genetics for Sri Lanka.

Methods of Evaluation: Class presentations and end of semester theory examination.

Recommended Reading: Richard Frankham, Jonathan Ballou and David Briscoe 2010. Introduction to Conservation Genetics; Joanna Freeland, Heather Kirk and Stephen Petersen 2011. Molecular Ecology.

Course Code and Title: ZL 3088: Applications and Management of Genetic Resources

Credit Value: 1C (15L)

Rationale: This course examines the need for preservation of genetic material, the infrastructure available for preservation and the tools available to use genetic material in biological studies, achieving wellbeing in society and the sustainable use of environment.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- study the diverse sources of genetic material available for research and industry.
- introduce different tools available to utilize genetic material.
- provide a snapshot of applications available in wide array of fields from theoretical biology, biotechnology to biomedical sciences.

Course Contents:
The course cover topics such as sampling and preservation techniques for genetic resources, museums, ancient DNA, genotyping, DNA barcoding, *in situ* versus *ex situ* conservation, domestication, gene banks and 'Doomsday Collections', management of very large collections of genetic material, the transfer and use of genetic material, and customs and legal regulations in Sri Lanka. It also covers the use of genetic resources in agriculture and biomedical sciences.

Field classes cover, the use of global genetic resources such as NCBI GenBank and Ensemble, and a hand-on study of the National Museum's research collection.

Methods of Evaluation: Student-led journal club, in-class discussions and end of term theory paper.

Recommended Reading: 10 science journal articles covering main topics of the course are given for class discussions. Online genetic databases: (e.g.NCBI Genbank: https://www.ncbi.nlm.nih.gov/genbank/, Ensemble Genome Browser: https://asia.ensembl.org/index.html)

Course Code and Title: ZL 3089: Immune System in Diseases

Credit Value: 2C (30L)

Rationale: The aim of this course is to highlight the functioning of the immune system in infection and disease as well as to outline the immune disorders that arise due to dysfunction of the immune system.

Pre-requisites: ZL 3058 - Immunology

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain how the immune system responds to infection, vaccination, cancer
- discuss how human disease can result from aberrations in immune responses

Course Content:
Topics covered will include: *Immunity to infectious diseases*- immunity to viruses, bacteria & fungi, protozoa & helminths; *Disorders of the immune system*- Autoimmune diseases; Examples of hypersensitivity - Immediate (type I) hypersensitivity, Antibody-mediated (type II) hypersensitivity, Immune complex-mediated (type III) hypersensitivity and Cell-mediated (type IV) hypersensitivity ;Immunodeficiency- primary & secondary immunodeficiency; immunodeficient diseases and syndromes, AIDS; Tumor immunology.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Immunology by Roit, Brostoff & Male; *Immunobiology, the immune system in health and disease* by Janeway, Travers, Walport, and Shlomchik.

Course code and Title: ZL 3090: Practical Immunology I

Credit Value: 4C (120P)

Rationale: This practical course aims to provide hands on experience to the students in immunological procedures performed in research and diagnostic laboratories using molecular and cellular approaches.

Pre-requisites: Application of basic principles acquired from ZL 3058 - Immunology, ZL 3085 - Advanced Applications in Immunology and Molecular Biology, ZL 3089 - Immune System in Diseases.

Intended Learning Outcomes: At the end of this course the students will be able to;

- perform core laboratory techniques in Immunology.
- understand principles of ethics in animal research.

Course Content: The topics covered are cells, tissues and organs of the rat immune system; Phagocytosis functional assay; Serum separation and partial purification of immunoglobulins; Antigen – antibody interactions i.e. ouchterlony double diffusion, ELISA, SDS- PAGE, Laboratory visit to observe use of immuno – diagnostics; Visit a state of the art animal house facility where they are exposed to handling animals for immunological experiments, observe immunization routes and learn about ethics in animal research; Hands on experience in carrying out immunological assays *i.e*. indirect ELISA, Sandwich ELISA, SDS-PAGE etc.

Methods of Evaluation: End of semester practical examination (including viva) and evaluation of laboratory record books.

Recommended Reading: Practical Immunology by Hudson & Hay.

Course Code and Title: ZL 3091: Human Molecular Genetics

Credit Value: 2C (30L)

Rationale: This course would introduce the role of human genome in health and diseases and would serve as an introductory course for those who wish to pursue in areas of biomedical research and clinical genetics.

Pre-requisites: BT 1011 – Genetics and Cell Biology

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the organization of the human genome.
- explain the molecular mechanisms that contribute to genetic variation and gene mutations.
- explain the chromosomal and molecular basis for simple and complex genetic diseases.
- use family pedigrees and linkage analysis to predict the genetic basis for a disease and the risk of inheritance.
- compare how DNA sequence can alter normal gene function.
- predict how mutations in oncogenes and tumor suppressors contribute to cancer risk.
- discuss how model organisms are used for research in human genetics.
- critically analyze experimental findings and scientific literature in the field of human genetics.

Course Contents:

A broad range of topics will be covered including analysis of structure and function of chromosomes, genes and genomes, fundamentals of molecular genetics, cytogenetics, molecular basis of human genetic disease, analysis of human monogenic and polygenic diseases, neurogenetics, immunogenetics, cancer genetics, developmental genetics, comparative genomics, animal models and transgenesis, mouse and other models of human diseases, therapy of genetic disease, gene therapy, stem cell therapy in human genetic diseases and current research in human molecular genetics.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Human Molecular Genetics (4 ed.) by Andrew Read and Tom Strachan, Garland Science 1999 ; available online at http://www.ncbi.nlm.nih.gov/books; Genetics in Medicine (8 ed.) by Robert L. Nussbaum, Thompson & Thompson.

Course Code and Title: EN 3013/ 3061: Natural Hazards and Disaster Risk Management

Credit Value: 3C (30L, 30P)

Rationale:
No place on the earth is safe from natural hazards. Yet vulnerability and exposure transform hazards into disasters. In the recent past various human activities and climate change have contributed to the overall increase in such events. Managing natural hazards is becoming increasingly complex due to a combination of factors, including population growth and unsustainable development. Many natural disasters can and do have severe negative socio-political, environmental and economic impacts. This course will present the students with opportunities to gain theoretical and practical (field and laboratory) knowledge in disaster management and reducing risks.

Pre requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- demonstrate knowledge in fundamentals of hazards, disasters and associated natural/social phenomena.
- understand the socio-economic, health and environmental impacts of disasters.
- demonstrate knowledge in disaster management theories and the cycle and existing global frameworks.

Course Content:
Lecture Component: Definitions and analysis of natural hazards and disasters, how natural hazards become disasters and even catastrophes. The unique geophysical, atmospheric and human variables of an event. The causes and impacts of natural hazards and disasters. Patterns of occurrence, prediction, and our adaption to geophysical and atmospheric threats. Specific hazards including earthquakes, volcanoes, tornadoes, hurricanes, tsunamis, tidal surges, coastal erosion, floods, landslides and wildfires. The theory of, and properties inherent to, plate tectonics, its contribution to earthquake occurrence, magnitude and threats. Techniques used to predict frequency of natural hazards, magnitude, threat and post-event impact. Elements of human responsibility in both precipitating and mitigating some natural hazards and disasters. Principles of Disaster Management and Management Frameworks. Assessment of Disaster Vulnerability of a location and vulnerable groups. Preparedness and Mitigation measures for various Disasters. Impacts on Environment, Health and Sanitation, Social and economic structure. Information systems and decision making tools. Voluntary Agencies and Community participation at various stages of disaster.

Practical Component: Will focus on the use of reference materials such as atlases, public and private studies, the Internet, and library resources to investigate natural hazards and disasters. Variables used in natural hazards and risk assessment, understanding risk and risk management. The use of geographic tools such as maps, graphs, tables, and models to analyze natural hazards and disasters for Disaster Risk Management. Risk Assessment and management.

Methods of Evaluation: End of semester theory and practical examinations and assignments.

Recommended Reading: Necessary reading material will be made available in the library.

Course Code and Title: EN 3018/3066: Public Policy and Social Movement

Credit Value: 2C (30L)

Rationale: This course introduces the concepts of environment related public policy and how social movements and collective protest have influenced policies including theoretical approaches and empirical methods.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- develop critical thinking and analytical ability about public policy and social movement.
- have knowledge in contemporary trends in social movements.

Course Content:

The aim of this course is to provide information on the interaction of Public Policy and society in environmental issues. Topics covered include - Role of social movement in shaping public policy. Economics, development and social change. Environment, social and policy conflicts. Environment based social and political movements of the world and in Sri Lanka. Selected case studies from developed and developing countries on environment and social movements. Students will discuss through role play and data gathering major environmental issues in relation to the above.

Methods of Evaluation: Continuous assessment for practical, written submissions, and end of semester exams for theory.

Recommended Reading: Necessary reading material will be made available in the library during the course

Course Code and Title: EN 3019: Climate Change

Credit Value: 3C (30L, 30P)

Rationale: Students following this course will get exposed to an overall coverage of climate change as a major global environmental issue, with a special focus on human influence and how to deal with the recent anthropogenic climatic change.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- integrate the theoretical concepts with the practical experience in the laboratory/field to evaluate the overall impact of climate change and our contribution to it.
- discuss different adaptation and mitigation aspects of climate change.
- analyze the linkage between global carbon cycle considering both spatial and temporal dynamics of it in relation to climate change.

Course content:

Lecture Component: Earth's climate system, anthropogenic influence, terrestrial and oceanic carbon cycling, land-atmosphere exchange and soil carbon sequestration, major international and national policies and measures, climate change and sustainability- impacts, mitigation, and adaptation aspects (Including cleaner production, energy auditing, carbon footprint analysis, etc.).

Practical Component: The 3-hour laboratory will meet once a week. Practical sessions will include field visits and assignments, including a group assignment on carbon footprint analysis at the end of the semester.

Methods of Evaluation:
The following percentages will be used to calculate your final grade:
Theory examination: 67%
Laboratory - Continuous assessment of laboratory/field assignments: 33%

Recommended reading: Reading material will be provided by the lecturer

Course Code and Title: EN 3020: Seminar

Credit Value: 1C

Rationale: Environmental Seminar will provide the students with information and sharing experience in a range of environment-related subject areas.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- review scientific papers and make in-class presentations.
- lead discussions on scientific literature by scientists/researchers in different environmental areas.

Course Content: Reviewing and leading discussions on selected research papers by eminent research/scientists in specific environmental areas, weekly seminar presentations- Each seminar will be led by an EN- or Zoology (special) student or an invited speaker on a selected environmental topic.

Methods of Evaluation: The students will be evaluated based on their presentations and leading discussions and effective contribution during Question-and-answer (Q&A) sessions.

Recommended Reading: Reading material will be provided by the lecturer or selected by students.

Course Code and Title: EN 3060: Environment Resource Management

Credit Value: 4C (45L, 30P)

Rationale: From a human standpoint, a resource is anything obtained from the environment to meet human needs and wants. These resources would continue to be useful to humans only if they are consumed on a rational basis, and managed effectively with some technological ingenuity. Currently most natural resources are heavily depleted and degraded due to improper anthropogenic practices. Thus, implementing sustainable management practices for available natural resources is timely and urgent.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- have basic knowledge on the different natural resources.
- assess their availability and status of exploitation.
- describe issues and challenges related to their management.

Course Content: Wildlife, fisheries, wetlands and forest – their nature, availability and mechanisms of management. Planning for the environment, interpretation, visitor management. Fish stocks and management of fish resources, the fishery, its predicament and current global and local trends. Forest resources as timber, non-timber forest products, distribution and current demands. Silviculture, demands, Conservation practices, Wetlands – definition, functions and attributes, types, benefits and wise use concept in wetlands and wetland conservation. Minerals of Sri Lanka, their exploitation and issues – soil, gems, plumbago, phosphate, mineral sand etc; Energy – types (hydrothermal, oil, coal and natural gas) their generation, use, demand & conservation, Biofuels. Alternate sources of energy generation, their potential and availability. Energy Policy of Sri Lanka. Water – surface, ground and deep water; fresh and saline waters, Water balance and demand, Consumption for industry, agriculture and domestic use etc. Water Policy of Sri Lanka and water management. Hydraulic civilization and its marvels. Air as a resource, pollution and prevention.

Methods of Evaluation: End of term examination and assignments and assessment.

Recommended Reading: Rao M. N. and H. V. N. Rao (2003) - Air pollution McGraw-Hill; UNEP (2005) One planet – many people: Atlas of our changing environment, UNEP, Nairobi, Kenya; Yaron B, R. Calve, and Prost (1996) Soil Pollution: Process and Dynamics Springer.

Course Code and Title: EN 3063: Environmental Economics and Sustainable Development

Credit Value: 3C (45 L)

Rationale: The aims of this course are to a) study the principles of environmental economics and its applications and b) study the principles of sustainable development and its application as an alternate development model.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- comprehend the basics of environmental economics and analyze the impact of environmental problems utilizing their knowledge on the same.
- discuss and evaluate how sustainable development (and associated goals) could be a better and alternative model in a country's development.

Course Contents:

Environmental Economics: the scope of environmental economics, natural resource economics, the fundamental balance, terminologies, emissions, ambient quality, and damages, short-run and long-run choices. Cost-benefit analysis, biological valuation, environmental economic analysis-impact, cost-effectiveness and cost-benefit, risk, with the use of case studies. **Sustainable Development:** The aim of this part of the course is to study the principles of sustainable development and its application as an alternate development model. The topics covered will include definitions and evolution of development since the early 40's; definition of Sustainable Development. Ecological basis and the science of sustainable development, "Haritha Lanka" – the programme of Sustainable Development for Sri Lanka-its components and implementation. Transitional management.

Methods of Evaluation: End of semester examination and assignments.

Recommended Reading: Selected collection of material from internet, UNEP and from the WSSD 2002. Brundlant Commission Report – Our Common Future

Course Code and Title: EN 3016/3064: Environment and Industry

Credit Value: 3C (30L, 30P)

Rationale: Industrialization, while important for the development and economic growth can also be detrimental to the environment. Amongst other things industrial process can cause pollution to air, water and soil, impact on wildlife and create many health and socio economic issues.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- demonstrate knowledge on the impacts of industries on the environment, wildlife and human health.
- describe different mitigatory measures to manage industry related environmental problems.

Course Content:
Lecture Component: This course aims to provide information on the industries of Sri Lanka, their development and establishment and related environmental issues. Topics covered include - Common industrial pollutants of land, air and water; Agricultural pollutants such as biocides, fertilizers, toxic chemicals, dyes and fixatives. Methods of prevention of industrial pollution. Water and wastewater treatment. Solid waste management and actions to reduce solid waste with special reference to solid waste in Sri Lanka; landfills. Mitigation actions involving Standardization –ISO, EMS, Cleaner Production Mechanisms and its application in industry. Branding and Greening philosophy and practice using case studies. Management approaches.
Practical Component: Will focus on the aspects discussed in the theory class and include field visits to selected industries.

Methods of Evaluation: End of semester theory and practical examinations and assignments.

Recommended Reading: Necessary reading materials will be made available in the library.

Course Code and Title: EN 3065: Landscape Ecology

Credit Value: 4C (45L, 30P)

Rationale: Landscape ecology is an interdisciplinary science dealing with interrelations between the human society and its living environment. Through deforestation and urbanization humans are constantly creating new and modified landscapes, with consequential impacts on natural patterns and processes. Often such anthropogenic changes in natural landscapes also lead to detrimental impacts on species. Characterizing landscape patterns and processes, and understanding their temporal changes would allow us to manage landscapes in a sustainable and aesthetically beneficial manner.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- know how to detect and characterize landscape patterns.
- know what changes take place in natural landscapes through time.
- describe implications of landscape changes on populations, communities and ecosystems.
- manage landscapes so as to facilitate these natural process and to have positive impacts on biota.

Course Content: Landscape ecology is an area of ecology that has grown tremendously during the past two decades and emphasizes spatial patterning--its causes, development, and importance for ecological processes. Landscape ecology often focuses on ecological dynamics over large regions. Topics covered include introduction to landscape ecology, importance of scale and landscape concept. Agents of landscape patterns- physical template, biotic processes, and disturbance regimes. Characterizing landscape structure- models of landscape structures, landscape metrics: conceptual foundation, and patch metrics. Landscape dynamics- landscape modeling, disturbances and perturbations, succession models, range of variability concepts and landscape dynamics. Implication of Landscape structure- populations and communities, landscape genetics and ecosystem processes. Landscape ecology in practice- protected area designs, connectivity, planning and urban sprawl. The practical component will focus on the aspects discussed in the theory class and includes field visits to selected sites.

Methods of Evaluation: End of semester examination & practical assignments.

Recommended reading: Landscape ecology in theory and practice (Turner, M. G., R. H. Gardner, and R. V. O'Neill), Learning landscape ecology (Gergel, S. E. and M. G. Turner).

Course Code and Title: ZL 4060: Developmental Biology

Credit Value: 2C (30L)

Rationale:

The study of developmental biology has undergone a major revolution during in the last several decades due to rapid advances made in cell biology and molecular genetics. It provides a promising approach to develop advance therapeutic interventions for many developmental and degenerative disorders and reproductive inadequacies.

Pre-requisites: None

Intended learning outcomes: At the end of this course the students will be able to;

- describe the process of development
- explain development as a process of differential gene expression
- discuss how genes regulate the process of development
- analyse the errors in development
- analyse how therapeutic interventions are devised from the knowledge in developmental biology

Course Contents: Developmental biology is an attempt to explain the genetic and cellular processes that underlies the transformation of the fertilized egg to a complex multicellular organism. The course aims to introduce the fundamental principles of animal development including following; cell cycle and cell division, cell differentiation through differential gene expression, genes and development, fertilization, cleavage, blastulation, gastrulation, organogenesis, sex determination, post embryonic development: metamorphosis, growth, regeneration, and ageing, evolution of developmental patterns, teratology, cloning and use of embryonic stem cells, invitro fertilization and genomic imprinting.

Methods of Evaluation: Assignments end of the semester theory examination

Recommended Reading:

Gilbert S.F. (2006) *Developmental Biology, Eighth Edition* Sinauer Publishers (Massachusetts).

Course Code and Title: ZL 4061: Aquaculture

Credit Value: 3C (30L, 30P)

Rationale: Aquaculture is the fastest growing food production sector today. It makes a significant contribution to fin fish and shell fish production globally. In Sri Lanka, the culture of tilapia and carps is gaining popularity in sustaining inland fisheries in numerous tanks in the dry zone, providing a source of protein for people in these areas. Shrimp culture has great potential as an export oriented industry as well as to supply the local market. This course provides fundamental knowledge on basic principles and practices of aquaculture and some important aspects of sustainable aquaculture.

Pre-requisites: ZL 3010 - Fish Biology and Fisheries

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the variety of practices and methods used in the culture of tilapia, Chinese carps, Indian carps, shrimps and bivalves.
- explain management aspects of successful shrimp culture.
- discuss applications of biotechnology in aquaculture.
- discuss environmental impacts of aquaculture and sustainable culture practices.

Course content:
Lecture Component: Culture methods of selected fresh and brackish water finfish, shrimps and prawns, crabs and crayfishes, mollusks and seaweeds: Principles of farm management, integrated aquaculture: Feed formulation and nutrition of finfish and shellfish: Reproduction and genetic selection; the role of biotechnology in aquaculture: Important diseases of finfish and shellfish and their control: Environmental impacts of aquaculture and their mitigation: Planning, regulation and socio-economics of aquaculture.
Practical Component: The practical component will include field visits to aquaculture facilities as well as laboratory exercises.

Methods of Evaluation: End of semester theory and practical examinations and assignments.

Recommended Reading: Sustainable Aquaculture (Bardach), Aquaculture principles and practices (Pillay).

Course Code and Title: ZL 4062: Entomology

Credit Value: 3 C (30L, 30P)

Rationale: This course aims to provide a general knowledge and skills to study insects and provide an appreciation of the value and importance of insects to man and environment. This is of particular interest as insects are among the most diverse of animals and of great economic importance.

Pre-requisites: ZL 3071 – Animal Kingdom I

Intended Learning Outcomes: At the end of this course the students will be able to;

- have a basic knowledge on the morphological features of insects and how to use them in insect identification.
- understand the phylogeny of insects with relation to other arthropods and within the class.
- know the structure and physiology of the major systems of insects.
- understand the fundamental concepts of insect ecology and it's effect on insect diversity and distribution.

Course Content:

Lecture Component: Insect taxonomy. Position of insects in phylum Arthropoda; Relationships with other arthropods. Classification of insects; Important characters of orders, sub-orders and families of economic importance. Role of molecular biology in entomology. Insect morphology and physiology. Insect ecology. Insect communication; Insects and phytochemicals. Introduction to diversity of Sri Lankan insects including major pest groups. Impacts of climate change on distribution of insects.

Practical Component: Identification of insects using morphological characters. Insect morphometrics. Slide preparation to study insect anatomy. Variations in insect morphological characters – antennae, legs, wings, mouthparts. Insect collecting techniques.

Methods of Evaluation: End of semester theory, practical examinations and assignments.

Recommended Reading: An Introduction to the study of Insects (Donald J. Borror); The Insects: structure and function (R.F. Chapman); The Principles of insect physiology (Wigglesworth); A general textbook of entomology: including the anatomy, physiology, development and classification of insects (A.D. Imms). Suggested web based materials.

Course Code and Title: ZL 4063: Ornithology

Credit Value: 3C (30 L, 30P)

Rationale:
This course is designed to make students appreciate the origin, evolution, biology and unique role of birds in nature. The course covers a wide array of topics to achieve the above objective while giving an overview of ornithology within a framework of evolutionary, ecological, behavioral and economical aspects. This course focuses on the scientific basis of bird conservation and management and will provide hands-on experience in conventional and modern tools in the management of bird populations with concurrent theoretical knowledge.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the major families of birds, their salient features and adaptive radiation which allows them to be successful in various guilds and habitats
- describe basic anatomy, physiology and behaviour of birds
- discuss the role of birds in nature and the importance of birds to humans
- discuss the origin and evolution of birds in relation to their unique features
- apply classical and modern tools in bird studies
- interpret the available protocols, policies and other strategies on conservation of birds
- evaluate aviary and cage bird management techniques.

Course Content:
The topics covered are: History and current status of the study of birds: Use of birds in current research: Origin of birds: Fossil history: Evolution of birds: Avian characteristics: Taxonomy and modern classification of birds: Major orders of birds: Bird families of Sri Lanka: Structure and function: Bird flight: Migration, navigation and orientation: Ecology and behaviour of birds: Bird conservation and management: Threatened birds: Endemic Birds: Important Bird Areas: Conventions related to conservation of birds: Economic importance of birds.
The practical component will include field and laboratory based exercises such as the study of aviary and cage bird management in the National Zoological Garden as well as obtaining hands-on experience in classical and modern tools in the management of bird populations which will be conducted in selected PAs. As an integral part of the practical course, students will be participating in a National Bird Ringing Programme conducted by the Field Ornithology Group of Sri Lanka (FOGSL).

Methods of Evaluation:
End of semester theory examination (70%) and practical examinations (20%): Continuous assessments (10%)

Recommended Reading: Proctor N. S. and Lynch P. J. (1998) Manual of Ornithology: Avian structure and function, Yale University Press; Bibby C. J, Burgess N. D. and Hill D. A. (1992) Bird Census Techniques, Academic Press

Course Code and Title: ZL 4064: Parasitology

Credit Value: 3C (30L, 30P)

Rationale: This course aims to provide advanced, comprehensive knowledge on human & animal parasites and the diseases caused by them.

Pre-requisites: ZL 3011 - Animal and Human Parasites; ZL 3066 - Immunology

Intended Learning Outcomes: At the end of this course the students will be able to;

- specify various physiological aspects of parasites and the applied aspects that may contribute to parasite control.
- explain major biochemical processes that take place in parasitic protozoa and helminthes.
- recognize the basis of vaccination based on parasite immunology.
- identify major components of integrated national control programmes for parasitic diseases.
- explain the central role of molecular biology to elucidate parasite biochemistry, and the application of DNA and RNA technologies to manipulate the parasite genomes.
- discern emerging and remerging parasitic diseases.
- practice examination of vertebrates for parasitic infestations, identify the parasite species using keys based on prepared whole mounts, take parasite egg counts, etc.
- practice coprological identification of parasite ova and cysts using concentration methods.
- maintain murine malaria parasites in a rodent model.

Course Content:

Lecture Component: Biology of parasites in host systems, diagnosis and control of important animal and human parasites while focusing on physiological, biochemical, immunological, molecular biological and genetic aspects of parasitic infections. Emerging trends in parasitic diseases will be emphasized.

Practical Component: Parasitic surveys of vertebrate hosts; faecal analysis including concentration methods, of domestic, zoo and wild animals; techniques associated with the use of rodent malaria models.

Methods of Evaluation: Assignments and end of semester theory and practical examination.

Recommended Reading: Foundation of Parasitology by G D Schmidt & L S Roberts; Modern Parasitology edited by F E G Cox; Immunology by Roit, Brostoff and Male.

Course Code and Title: ZL 4065: Wildlife Management

Credit Value: 3C (30L, 30P)

Rationale: Improper landuse practices leading to habitat destruction, degradation and fragmentation are causing large scale irreversible losses of species worldwide. Additionally, human-wildlife conflicts are also taking a heavy toll on wild species. There is a crucial need to counteract these trends. Proper management of a species and their habitats must be based upon the sound knowledge of a species' biology and ecology, and its responses to human interventions. This course intends to impart knowledge on different approaches to conserving wildlife both within and outside protected areas focusing on methods to manage threats and enhance survival. Furthermore, it would be important to know how wildlife conservation and management relates to the economy and environment. All of these aspects would be particularly relevant for Sri Lanka which supports is a biodiversity hotspot.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- know ways to assess the status of wildlife populations and their habitats
- know the different approaches to wildlife management
- describe the legislation related to wildlife conservation and management
- know how to apply knowledge on species' ecology and responses to management to solve issues related to problem animals
- design appropriate management actions to restore species and their habitats

Course Content:
The aim of this course is to impart knowledge and training on scientific principles, tools and approaches used in managing wildlife and their habitats. The broad areas of focus will be Designing and Managing Protected Areas, Tools in wildlife Management and park planning and interpretation. Topics dealt with include designing protected areas, Protected Area Network of Sri Lanka, its limitations and protected area gap analysis; Development of management plans, legislative frame work, species and ecosystem approach, habitat management, managing small populations, adaptive and participatory management; Monitoring and surveying techniques, radio-tracking and geo-referencing, and species inventorying and assessment; Visitor management, park interpretation and personnel management. Special areas of interest will include conservation genetics, conservation education and managing problem animals and invasive species. The practical component will include both laboratory and field sessions.

Methods of Evaluation: End of semester examination, practical assignments and assessment.

Recommended Reading: The Wildlife Techniques Manual by Nova J. Silvy.

Course Code and Title: ZL 4066: Project Development

Credit Value- 1C (15L)

Rationale:
This course is intended to provide an overview of the major steps required to develop a project and its successful implementation. It will introduce the basic concepts of project development including the initial requirements to develop and implement a project successfully.

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain the different types of projects and their main components
- apply project development tools, techniques and skills to develop projects
- analyze the project life cycle and measure its outcomes and other contributions

Course Content:
Why projects are needed, different types of projects and their goals; introduction to the main steps of project development; underlying assumptions for different types of projects, stakeholder analyses; SWOT analysis; LOG frame theory and application; measuring project progress and outcomes, evaluation of project benefits

Methods of Evaluation:
End of semester theory paper 70%, In-class- assignments 30%

Recommended Reading:
To be provided by the teacher as relevant to the projects used as examples in the course.

Course code and Title: ZL 4070: Molecular Immunology

Credit Value: 1C (15L)

Rationale: This course will focus on the molecular basis of the immune system.

Pre-requisites: ZL 3058 - Immunology

Intended Learning Outcomes: At the end of this course the students will be able to;

- Predict how the immune system will respond to disease, cancer or pathogens.
- Understand disease states and their immunological cause.

Course Content: The topics covered include Human leucocyte antigens (HLA); Cytokines; Pathogen recognition receptors (PRRs); Cell adhesion molecules (CAMS); NF-kB pathway; Caspase pathways; Jak-Stat Pathway.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: *Kuby Immunology* by Goldsby, Kindt and Osborne

Course Code and Title: ZL 4081: Molecular Phylogeography and Evolution

Credit Value: 2C (30L)

Pre-requisites: ZL 1009 – Evolution and Biogeography; ZL 3083 – Molecular Taxonomy; ZL 3086 – Population Genetics

Rationale: Currently molecular research is combined with many other fields to provide better understanding of the underlying processes. The association of molecular studies with biogeography and evolution is studied in this course.

Intended Learning Outcomes: At the end of this course the students will be able to;

- provide an understanding of the association of phylogeography and evolution with other disciplines such as population genetics, phylogenetic biology and biogeography.
- explain why phylogeographic networks are often the most appropriate choice to depict close evolutionary relationships whereas phylogenetic trees are often the most appropriate choice to depict relatively distant evolutionary relationships.
- build and interpret phylogenetic networks and phylogenetic trees to infer the evolutionary history of populations and species.

Course Contents:

Lecture Component: The effects of the various molecular mechanisms on the structure of genes, proteins and genomes. The methodology involved in dealing with molecular data from an evolutionary perspective and molecular hypothesis testing. Information and analytical tools will be provided from genome projects involving bacteria, plants and animals that have been developed and perfected in the last decade. Further an introduction to phylogeography and phylogeographic concepts, patterns and processes, molecular phylogeography, phylogeographic methods and current studies and new software and statistical tools for phylogeographers will be introduced. Phylogenetic tree and Phylogenetic/ Haplotype network construction and interpretation.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Reading materials will be provided.

Course Code and Title: ZL 4082: Epigenetics

Credit Value: 2C (30 L)

Rationale: Epigenetics has been a hot topic for research over the past decade. It is a fascinating science which gives an answer to most questions unanswered by genetic data. Aberrant epigenetic control is shown to contribute towards many complex diseases and regarded a key element in developing effective therapeutic interventions.

Pre-requisites: ZL 3092 - Human Molecular Genetics

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the structure and function of chromosome and its role in epigenetics.
- explain the processes of epigenetic signal transmission between generations.
- explain the role of DNA methylation and RNA in epigenetic processes.
- relate the concept of epigenetics to relevant biological phenomena such as behaviour, diseases and evolution.
- analyze directions in published epigenetic research

Course Content:

The following topics along with the current research in epigenetics will be discussed in class for the understanding and appreciation of this emerging field of science. Chromatin, nucleosome assembly, gene regulation through chromatin modification, histone modifications, DNA methylation, genomic imprinting, X inactivation, mechanisms of gene silencing (RNA interference), epigenetic inheritance, epigenetics in human diseases, ageing, epigenetics and the brain and behavior, current developments in epigenetics research.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Epigenetics. Allis, Jenuwein, Reinberg and Caparros. Cold Spring Harbour Laboratory Press. ISBN-13: 978-0879697242 | Edition: 1
Literature on up-to-date research will be provided.

Course Code and Title: ZL 4083: Bioinfomatics and Functional Genomics

Credit Value: 2C (30L)

Rationale: Bioinformatics is a necessity in the world today on how to collect, store, manage, analyze and integrate the vast amounts of biological information.

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe the techniques used to collect sequence and expression data.
- identify appropriate biological databases for specific analyses.
- manipulate on-line resources appropriately.
- manage bioinformatics tools.
- apply appropriate statistical methods to determine sequence similarity.

Course Contents:
Topics covered include basic genetic mechanisms, genome-wide sequence data and comparative genomics; genome annotation, genome browsers; information retrieval from biological databases, assessing pairwise sequence similarity, creation and analysis of protein multiple Sequence alignments, sequence assembly and finishing methods, gene prediction; gene and genome variations; transcriptomics (microarrays and transcriptome sequencing); proteomics. protein structure predication and analysis, Completed genomes and the tree of life, genomics of virusus, bacteria and archaea, eukaryotic chromosome, fungi, eukaryotic genome, human genome genomic research methods (association studies, linkage studies, haplotype analysis).

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading:

Bioinformatics and Functional Genomics (Jonathan Pevsner) 2009

Course Code and Title: ZL 4084: Molecular and Immunotoxicology

Credit Value: 1C (15L)

Rationale: This course is designed to introduce students to the basic concepts and processes involved in molecular biological and immunological aspects of toxicology

Pre-requisites: ZL 3058 Immunology & ZL 3059 Molecular Biology

Intended Learning Outcomes: At the end of this course the students will be able to;

- understand basic concepts and processes of molecular and immunotoxicology

Course Content: The topics covered include Metabolism of xenobiotics, Biomarkers of toxicity, reactive oxygen species and damage to biomolecules, DNA damage and repair, mechanisms of cell death, chemicals that induce carcinogenesis and their mechanisms, genetic polymorphisms in responses to toxic agents. Molecular mechanisms associated with immune toxicology include Effects of xenobiotics (heavy metals, pesticides, ionizing radiation) on the immune system and potential consequences in terms of enhanced infectious, neoplastic, allergic, and autoimmune diseases; Immune toxicology of drugs including of nanodrugs; Ecological/wildlife immuno toxicology

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Reading materials will be provided

Course Code and Title: ZL 4085: Practical Molecular Biology II

Credit Value: 4C (120P)

Rationale:

Laboratory and field classes are extremely important for students to gain confidence in applying the theoretical knowledge in practical situations. This course is designed with a extensive and a rich mixture of practical sessions to make students interested in application of molecular biological skills in different situations. The practical sessions are mostly designed as mini group projects to provide students with transferable skills of collaborative group work, interpersonal skills, leadership, time management and presentation skills along with the thorough practical skills in molecular biology.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- describe underlying mechanisms of practical methods
- apply techniques in solving research or industrial problems
- design experimental procedures to solve research problems
- compare and Modify methods to optimize for given situations
- prepare written and oral presentations to defend their results

Course Content: Practical sessions in the following subjects are offered in this course; ZL - 4081 (Molecular Evolution Phylogeography) and ZL - 4083 (Bioinfomatics and Functional Genomics), ZL - 4084 (Molecular and Immunotoxicology). This course may include a work placement programme.

Method/s of Evaluation: Assignments and continuous assessments

Recommended Reading: Reading materials will be provided.

Course Code and Title: ZL 4087: Molecular Medicine

Credit Value: 2C (30L)

Rationale: Molecular Medicine is a relatively new scientific discipline, which entails the elucidation of molecular aspects of disease; *i.e.* study of molecular structures and mechanisms of diseases, identification of fundamental molecular and genetic errors of disease and the development of molecular diagnostics and interventions for these diseases: This course aims to provide an introductory expose to molecular medicine.

Pre-requisites: ZL 3059 Molecular Biology & ZL 3058 Immunology

Intended Learning Outcomes:

Course Content: This course integrates genetics, genomics, and molecular biology approaches to elucidate the pathogenesis of major human diseases, and unravelling of novel disease mechanism for improving management of human diseases. Insight into disease at the molecular level; Infectious Diseases, Inherited Genetic Diseases, Immune System and Blood Cells, Cancer; Molecular Diagnostics and Therapeutics; Genomics to personalized health care.

Methods of Evaluation: Assignments and end of semester theory examination.

Recommended Reading: Introduction to Molecular Medicine by Dennis W Ross

Course Code and Title: ZL 4088 - Practical Immunology II

Credit Value: 4C (120P)

Rationale: This practical course aims to provide hands on experience to the students in immunological/ immunotoxicological procedures performed in research and diagnostic laboratories using molecular and cellular approaches

Pre-requisites: Application of basic principles acquired from ZL 4060 Molecular Immunology, and ZL 4084 (Molecular and Immunotoxicology)

Intended Learning Outcomes: At the end of the course students will be able to:

- perform advanced laboratory techniques in Immunology and Immunotoxicology
- carry out mini-project based on immunological techniques

Course Content: Include hands on experience in planning and carrying out a mini project – planning and following an immunization protocol to produce polyclonal antibodies to a specific antigen; optimization and establishment of indirect ELISA using extracted antigen and polyclonal antibodies; SDS PAGE & Immunoblotting; methods used in Immunotoxicology; other pertinent advanced immunological methods.

Methods of Evaluation: End of semester practical examination (including viva) and evaluation of laboratory record books/ project report

Recommended Reading:
Practical Immunology by Hudson & Hay

Course Code and Title: EN 4021: Tools of Environment Management

Credit value: 3C (30L, 30P)

Rationale: In the context of increasing environmental degradation and related socio-political and other issues, environmental policy and other environmental management tools are of prime importance to achieve sustainable development, human welfare and environmental conservation. This course will provide basic understanding of various environmental tools.

Prerequisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- demonstrate knowledge on the impacts due to environmental issues.
- identify the primary tools used for environmental management and define their appropriate application.

Course Content:
Lecture Component: These methods shall be dealt with under the following broad areas: Policy, Legislative and Administrative tools: These will be done to highlight the application of the new philosophies of adaptive management and ecosystems approach beyond Natural Resources. Planning Tools: With the new vision of "Planning for the environment with people in place" the following subject areas will be discussed: Visioning; Participatory approach; Structuring and Environmental Profiling; SWOT analysis; Integrated approach and Regional Planning; Systems Investment Planning. Assessment Tools: From the numerous available the following will be emphasized; Cumulative Effects Assessment; Ecological Footprint Assessment; Strategic Environment Assessment; Environment Impact Assessment; Social Impact Assessment; Initial Environment Evaluation/Assessment; Environment Risk Assessment; Environment Management systems and certification. Auditing and Monitoring Tools: Introduction to Green auditing; Monitoring and use of indicators.
Practical Component: Will include laboratory/in-class and field components.

Methods of Evaluation: End of semester theory and practical examinations and assignments.

Recommended Reading: UNEP Technical Workbook on Environment Management Tools for decision Analysis – 14; Environment Management Tools and their application – a review with reference to case studies. – Dr. Annik Magerholm Fet; Environment Management Tools for SME – a hand book Richard Starkey.

Course Code and Title: EN 4022: Environmental Education, Journalism & NGOs

Credit Value: 3 C (30 L, 30 P)

Rationale: The media plays a pivotal role in disseminating environmental information to the masses. Frequently such information is distorted and reported in a manner that results in disharmony, misinterpretation and public unrest. Thus, there is a dire need to train environmental reporters and educationists to impart knowledge on critical environmental issues in a simplified but scientifically accurate, credible and ethical manner. This course intends to provide knowledge on the principles of journalism and to introduce environmental education. As NGOs play a crucial role in conservation and raising awareness on issues related to the environment, the course will also touch upon this aspect.

Pre-requisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- list key ethical guidelines in environmental journalism
- know the structure of a newspaper article and key persons involved in its publishing
- discuss environmental reporting challenges
- define data types relating to the environment
- prepare a report on a locally relevant environmental issue

Course content: The aim of this course is to introduce the student to the communications and media aspects of the environment. The topics include; Emergence of environmental education, Principles of education, Belgrade Charter, The Tiblisi Conference outcomes. Nature of EE-integrated, interdisciplinary holistic, issue based or single subject. Curriculum and instruction material, teaching strategies, field approach, Philosophy of 'hands-on, minds-on'. Distinguish publicity, propaganda and promotion. News and views science in journalism. Journalism and environment principles of communication, the media, understanding print, electronic and traditional communication systems. Modes of communication. Responsible reporting. Code of ethics in journalism. Good writing, speaking and presenting. NGO's, PVO's,CBO's, PO's, and INGO's, roles and operational strategies of NGO's. NGO—GO interaction and roles – partnership in research, extension, field testing etc. Administration and Management in NGO's. Students will have to actively engage in EE,and Journalism activities as assignments

Methods of Evaluation: End of semester examination and practical assignments

Recommended Reading: Keya Acharya, Frederick Noronha (2010). The Green Pen: Environmental Journalism in India and South Asia. SAGE Publications India, 312 pp.

Course Code and Title: EN 4023: Environmental Policies, Legislation and Administration

Credit Value: 2C (30L)

Rationale: To provide a comprehensive knowledge of the available policies relevant to environmental issues and principle legislations to protect and conserve the environment.

Pre-requisites: None

Intended Learning Outcome: At the end of this course the students will be able to;

- comprehend the policy cycle and stages and the decision making processes involving the national and sub national level environmental policies and legislation.
- evaluate the institutional framework for policy formulation and implementation and identify the loopholes and limitations.

Course Content: Definition of Policy and Policy formulation; Vision and Mission statements; National Environmental Policy; Analysis of available policies in areas such as wildlife, forest, water, industry, agriculture and land use. Their impacts and effect on sustainable development with special reference to financial policy implications on environment. The major legislations in the country and their implications on ensuring a "managed" environment in the country. The constitution of Sri Lanka, 13th amendment, Local Government Act, The National Environmental Act and other related Acts. Environmental auditing, Administration of the environment, at National, Provincial and Local level.

Methods of Evaluation: End of semester examination and assignments.

Recommended Reading: Reading material will be provided by the lecturer.

Course code and Title: EN 4025: Nuclear technology & Environment

Credit value: 3 credits (30 L, 30P)

Rationale: This course will introduce the student to the technical basis for nuclear related environmental issues

Prerequisites: None

Learning Outcomes: At the end of this course the students will be able to;

- utilize nuclear techniques in studying environmental properties
- comprehend and discuss the importance of nuclear techniques in evaluating environmental issues (e.g. marine pollution)
- discuss how the nuclear operations have affected the environment

Course contents:

Introduction to the technical basis for nuclear related environmental issues; Nuclear fuel cycle and environment, comparison with fossil fuel, fuel cycle and waste generation, Geological disposal concept: Yucca mountain, Sweden/Finland, Environmental impact and recycling, Nuclear weapons: environmental effects, Nuclear Winter, Nuclear Techniques for Environment Protection: Air, Earth and Oceans NAA, XRF ,PIXE, isotope hydrology, Monitoring, assessment and protection of air quality, reduction of industrial emissions at the source, reduction of threat to water resources, improvement of land productivity(soil erosion studies using Cs-137) and protection of disease(SIT, CR Formulations), Food Irradiation- alternative to chemicals damaging the environment and use of less energy, Nuclear Laws in relation to safeguarding the environment. Nuclear disasters; The future of nuclear energy. Practical will include laboratory & field components

Methods of evaluation: End of semester theory and practical examinations and assignments

Suggested Reading: Necessary reading material will be made available in the library.

Course Code and Title: EN 4026: Instrumentation for Environment Management

Credit Value: 3C (15L, 60P)

Rationale: A knowledge on various instruments that are used to detect environmental parameters is essential for students and this course is designed to offer an in depth awareness on how water, air, soil and other relevant parameters could be examined.

Prerequisites: None

Intended Learning Outcomes: At the end of this course the students will be able to;

- demonstrate knowledge in different instruments used to detect environmental parameters
- explain how these instruments could be used in the field and in the laboratories
- identify different pros and cons of each equipment

Course Contents: This course emphasizes the use of instruments (equipments) and related technological instrumentation for environment management and introduces the student to the variety of such instrumentation available at present. The following topics will be dealt with: GIS and remote sensing techniques; radio telemetry; geo—locators & transmitters; Equipment used for the analysis of physico-chemical parameters of water, air & soil; survey tools and surveying; maps & map reading; compasses; measurement of weather parameters; computer software (including Magic R) and their uses; vegetation survey instruments; photography. Practical will include laboratory & field components

Methods of Evaluation: End of semester theory examination, practical examinations and assignments.

Recommended Reading: Necessary reading material will be made available in the library.

Course Code and Title: EN 3904: Adapting Business for Climate Change

Credit Value: 3 Credits (30L, 30P)

Rationale: Students following this course will get exposed to an overall coverage of climate change as a major global environmental issue, with a special focus on human influence and how to deal with the recent anthropogenic climatic change.

Pre-requisites: None.

Intended Learning Outcomes: At the end of this course the students will be able to;

- evaluate the contribution of greenhouse gases in changing the earth's climate and environment.
- recognize the potential differential role to be played by business entities in mitigating greenhouse gas emissions and adapting to climate change.
- evaluate the effectiveness of the different options available for continued management of businesses under the climate change related risks/threats.

Course Content:

Lecture Component: The first part of the lectures are common to both EN 3904 and IN 3019- earth's climate system, anthropogenic influence, terrestrial and oceanic carbon cycling, land-atmosphere exchange and soil carbon sequestration, major international and national policies and measures, climate change and sustainability- impacts, mitigation, and adaptation aspects (Including cleaner production, energy auditing, carbon footprint analysis, etc.) ; in addition, EN 3904 has the following content: Climate change and sustainable businesses: impacts and business-related mitigation- and adaptation aspects (including sustainable resource use: minimizing carbon footprint through reduced energy, water, material use, and cleaner production, built environment, and business-specific policy- and other measures (e.g. insurance schemes, enhanced resilience, business continuity management (BCM) plans and an adaptation plans, etc.).

Practical Component: The 3-hour laboratory will meet once a week. Practical sessions will include field visits and assignments, including a group assignment on carbon footprint analysis of a selected business entity at the end of the semester.

Methods of Evaluation:

The following percentages will be used to calculate your final grade:
Theory examination: 67%
Practical: Continuous assessment of laboratory/field assignments: 33%

Recommended Reading: Reading material will be provided by the lecturer.

Course Code and Title: ZL 4901: Project Development

Credit Value- 2C (15, 30P)

Rationale:

This course is intended to provide an overview of the major steps required to develop a project and its successful implementation. It will introduce the basic concepts and skills for initiating and developing a project as well as the theory and skills required to manage and monitor them effectively in order to obtain benefits for the intended stakeholders. Special attention will be given to the types of projects that are of relevance to businesses that have a direct relationship with the environment.

Intended Learning Outcomes: At the end of this course the students will be able to;

- explain the main components of a project and its development process
- apply project development tools, techniques and skills in the project life cycle including monitoring and evaluation
- understand areas of uncertainty in a project and measures that are applied to mitigate their effects on project outcomes

Course Content

Why projects are needed, different types of projects and their goals; introduction to the main steps of project development; underlying assumptions for different types of projects, stakeholder analyses, critical resources for project implementation and management; SWOT analysis and other types of project analysis tools; LOG frame application, measuring project progress and outcomes, evaluation of project benefits; areas of uncertainty and methods to manage them; analysis of project impact evaluation using Sri Lanka examples.

Practicals: The practicals will be based on real life project topics in Sri Lanka where the students will analyse existing projects as well as develop project proposals on the theme of environmental issues of importance to business.

Methods of evaluation

End of semester theory paper 70%, Practical assignments 30%

Recommended Reading:

Reading material will be provided by the teacher based on the types of projects used as examples.

Course Code and Title: ZL 4902: Seminar

Credit Value- 1C (30P)

Rationale:

This course is intended to enhance knowledge and develop the analytical, quantitative, logical thinking, communication and presentation skills of students.

Learning outcomes: At the end of this course the students will be able to;

- search for and gather information pertaining to current topics in selected areas using multiple media sources
- analyse the information in relation to its relevance to modern businesses and environment
- communicate the information effectively through an oral presentation and written document

Course content:

This course is devoted to gathering information, reading, analysis and discussion of a current topic of relevance to business and environment. Each student will be assigned a specific topic with which they are expected to become proficient and to be able to discuss through a report and presentation.

Methods of Evaluation:

Oral presentation- 60%, Written report - 40%

Recommended Reading:

It will vary depending on the topic assigned to a student.

Course Code and Title: EN 4908: Industrial Training

Credit Value- 12 C (360 P)

Rationale:

The major objective of industrial training is to prepare students for future employment in their chosen area related to Business and Environment. It will improve the ability of a student to practice what they have learnt as theoretical knowledge and to develop skills and attitudes required for the world of work. In addition students will have the opportunity to meet and work with potential employers, real life organisations and to assess the options available to them in selecting employers and to make informed choices about career pathways and disciplines.

Intended Learning Outcomes: At the end of this course the students will be able to;

- apply theoretical knowledge to solve practical problems in the workplace
- experience the structure and functions of an organization including the discipline required to achieve organizational and individual career goals
- develop skills and attitudes that are essential for successful employment including interpersonal and communication skills
- interact with other groups that are related and non-related to the students own area of expertise

Methods of Evaluation:

Preparations by the student suit the industrial training placement- 10%, Monitoring of progress of work- daily log book and assessed by visits to the placement, organization by supervising academic- 35%, Employers survey results on the performance of student-20%, Technical report- 15%, Seminar on the industrial placement-20%,

Recommended Reading:

To be provided by the supervisor in consultation with the employer as relevant to the subject area.