CURRICULUM REVISION FOR LEVEL- 4M

PRINCIPAL SUBJECT: ZOOLOGY

(Effective from the Academic Year 2019/2020)

The last major curriculum revision for Zoology was done in 2014under the Quality Innovation Grant of the Higher Education for Twenty First Century Project of the Ministry of Higher Education (HETC/QIG/W2/JFN Biological Sciences). Revising the curriculum was one of the major activities of the grant.

The curriculum revision was started in March 2013 with the guidance of subject experts. The whole set of revised curricula for the level 1G, 2G, 3G, 3M, 4M and 4X were submitted to the Faculty Board of Science and approved at the 144th meeting held on 31st January 2014 (SFB/144/06(c)) and at the 160th meeting held on 13.06.2017 (SFB/160/06). Consequently, the Senate recommended and approved the curricula of the same on its 389th meeting (S/389/10/d) and 426th meeting held on 24.06.2014 and 18.09.2017 respectively.

Another revision was initiated after the changes in the degree structure of the BSc and BSc Honours degree programmes since the academic year 2016/2017. The approval for the revised curricula for the Levels 1G and 2G was obtained in the Faculty Board of Science (SFB/168/5e) on 27th November 2018 and in the CEC (Curriculum Evaluation Committee) of the University meeting held on 26th December 2018 and at the 429th Senate meeting held on 20.02.2018.

The approval for the revised curriculum of the Levels 3G and 3M was obtained in the Faculty Curriculum Evaluation Committee on 3rd January 2020, at the Faculty Board of Science (175th meeting, held on 11.02.2020) and at University Curriculum Evaluation Committee (26th meeting, held on 14/07/2020, CEC/26/3.6) and at the Senate meeting (445th meeting).

The 4M syllabus has been submitted to the 9th CDRMC (Curriculum Development Revision and Monitoring Committee) of the Faculty of Science, meeting held on 22.01.2021 for its recommendations. Then the revised syllabus was submitted to the 182nd Faculty Board which was held on 19.05.2021 and it was approved with minor amendments. The amended version of the 4M syllabus was placed at the 28th CEC (Curriculum and Evaluation Committee) of the University held on 13.07.2021 and got approved. The approved draft is submitted for the approval of the Senate.

The staff of the Department of Zoology namely Prof. S. N. Surendran, Prof. Mrs. R. Gnaneswaran, Ms. R. Nithyagowry, Dr. T. Eswaramohan, Dr. Mrs. A. Sivaruban, Mr. W. VenkateshLuckshman, Dr. K. Gajapathy, Mrs. P. Sivakumar, Dr. Mrs.T. W. Shanthakumar and Mrs. G. Parththuran were involved in the revision of this 4M new curriculum.

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Curriculum for

Bachelor of Science Honours in Zoology

Level 4M

Effective from the Academic Year2019/2020

4M courses (Effective from the Academic Year 2019/2020)

Course code	Course title	Credit value	No. of Hours			
			Theory	Mentoring	Practical (P) and /field (F)	Independent learning
*ZOL401M3	Advanced Parasitology and Vector Control	03	27		54	69
*ZOL402M3	Advanced Molecular Animal Physiology	03	27		54	69
*ZOL403M3	Marine Biology	03	27		54	69
*ZOL404M3	Aquaculture	03	27		54	69
*ZOL405M2	Insect Taxonomy	02	20		36	44
*ZOL406M2	Herpetology	02	21		27	52
*ZOL407M2	Seminar Presentation and Essay	02	30		-	70
*ZOL408M6	Research Project	06	-	60	-	540
ZOL409M2	Insect Ecology	02	20		36	44
ZOL410 M2	Molecular Ecology	02	20		36	44
ZOL411M2	Insect Structure and Function	02	20		36	44
ZOL412M2	Ornithology	02	20		36	44
ZOL413M2	Ichthyology	02	20		36	44
ZOL414M2	Advanced Evolutionary Biology and Zoo Geography	02	20		36	44
ZOL415M2	Forensic Zoology	02	20		36	44
ZOL416M2	Integrated Coastal Management	02	21		27	52

* The courses are compulsory for all Zoology (4M) students

Course Code:	**ZOL401M3**		
Course Title:	Advanced Parasitology and Vector Control		
Credit Value:	**03**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	27	54	69

Objectives:

- Provide basic knowledge and concepts with reference to terminology, classification and identification of major parasites and vectors of human diseases.
- Discuss epidemiology, host-parasite interaction, diagnostic techniques, and control strategies of major parasitic and vector-borne diseases.

Intended Learning Outcomes:

- Categorize the adaptations of the major animal parasites and vectors and their survival strategies
- Analyze the survival and evolutionary significance of these adaptations
- Assess the parasitic and vector-borne disease epidemiology
- Analyze pathogen – vector interactions of major vector-borne diseases in Sri Lanka
- Recommend suitable control strategy to the existing parasitic and vector-borne diseases in Sri Lanka

Course Contents:

- Epidemiology: Facts and analysis.
- Parasite-Host interactions: parasitic adaptations, defense mechanisms of host and parasite.
- Diagnostic techniques for parasitic diseases: basic laboratory, immunological and molecular biological techniques.
- Disease control: chemotherapy, vaccine developments. vector control – vector replacement and vector suppression approaches, challenges and case studies (chemical, biological, environmental management and novel approaches.
- Integrated vector control applications: Insecticide resistance and resistance mechanisms.

Teaching and Learning Methods:

- Theory: Lectures, tutorial discussion, group presentation, library and take home assignments. problem-based learning, digital content creation.
- Practical: Hands on training, field based studies, laboratory based experiments, take-home assignments, oral presentation - individual / group assignments.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP): In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks = (6MT+4MP)/10

References:
• LaMann, G.V. (2010). Veterinary Parasitology. Nova Biomedical Press. New York. • Mullen, G.R. and Durden, I.A., ed. (2009). Medical and Veterinary Entomology, 2nd Edition. Academic Press, Amsterdam. • Gajapathy, K. (2015). Beginners Guide to Sandfly Taxonomy. Lambert Academy Press, Germany.

Course Code:	**ZOL402M3**		
Course Title:	Advanced Molecular Animal Physiology		
Credit Value:	**03**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	27	54	69
Objectives:			
• Provide knowledge on the physiological functions and the molecular mechanisms. • Evaluate the common physiological disorders in animals.			
Intended Learning Outcomes:			
• Explain essential system physiology in selected animals • Analyze molecular mechanisms and pathways of physiological functions • Apply knowledge of functional mechanisms and their regulation to explain the pathophysiology underlying common diseases			
Course Contents:			
• Functions of the spinal cord, cerebral lobes, and other brain areas; sensory process; gas exchange across the respiratory surfaces; blood flow and pressure regulation; digestive system; kidney and osmoregulatory organs; homeostasis; signaling molecules and cellular receptors. • Basic cellular and molecular processes such as intracellular trafficking of proteins and lipids; ion transport; signal transduction; regulation of gene expression; cell growth control; cytoskeletal dynamics and cell migration. • Common physiological diseases of the digestive system, cancer, osteoporosis, wound healing, pulmonary and cardiovascular diseases, spinal cord regeneration, and cellular mechanisms of aging, with emphasis on genetic diseases such as cystic fibrosis, polycystic kidney disease; lysosomal storage diseases; • Physiology of common diseases in human having a genetic basis such as hypertension,			

diabetes mellitus, obesity, cancer and Alzheimer's disease.

Teaching and Learning Methods:

- Theory: Lectures, tutorial discussion, group presentation, library and take home assignments, problem-based learning.
- Practical: Hands on training, laboratory based studies, oral presentation - individual / group assignments, digital content creation, blogging.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks = (6MT+4MP)/10

References:

- Richard, H., Gordon A. and Wyse, M.A. (2017). Animal physiology, 4th Edition. Sinauer Associates Inc., Sunderland USA.
- Moedecai, P. Blausein, J.P.Y., Kao, D.R.M. (2012). Cellular Physiology and neurophysiology. 2nd Revised Edition. Elsevier- Health Sciences Division: St Louis, USA.
- Valerie, C. S., and Tina, S. (2014). Essentials of Anatomy and Physiology. FA Davis Company 7th Edition. Pensylvania USA.
- Barret, K.M., Barman, S.M., Boitan S. and Brooks, H.L. (2016). Ganong's Review of Medical Physiology. 25th Edition, Mc Graw Hill Education, New York.
- Sambrook, J. and Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual. 3rd Edition, Cold Spring Harbor Laboratory Press, New York.

Course Code:	**ZOL403M3**		
Course Title:	Marine Biology		
Credit Value:	**03**		
Hourly Breakdown	**Theory**	**Practical+ Field visits**	**Independent Learning**
	27	54	69

Objectives:

- Impart knowledge on fundamental concepts in marine biology and human impacts on marine environment.
- Provide hands on training on different sampling techniques used in marine environment.

Intended Learning Outcomes:

- Identify and classify the zones in natural marine oceanic environments

- Execute techniques to characterize properties of water in various zones
- Analyze the qualitative adaptations of marine organisms
- Apply different bio-sampling methods in the marine environment
- Describe Sri Lanka ocean surface current patterns with monsoonal patterns

Course Contents:

- Types of marine ecosystem: sea and ocean, coastal lagoon and estuary, mangrove, sand dunes, salt marshes, rocky shore, sandy shore, muddy shore, coral reefs, sea grass bed.
- Distribution of organisms with respect to living zones and their behaviour and adaptations, Zooplankton: holoplankton, ooze, meroplankton, veliger, trochophore, bipinnaria, echinopluteus, nauplius, cypris, zoea, megalopa, icthyoplanton, bioluminescence, diel migration: nocturnal, twilight, reverse, seasonal vertical migrations, patchiness.
- Diversity and Life histories of marine plankton, nekton, neuston, benthos, invertebrates, vertebrates.
- Biological sampling, biotic and abiotic factors of marine environment.
- Marine productivity, primary production, factors, regulating marine production, food chain, food web and energetic events.trophodynamics in trophic levels in open ocean, continental shelves, upwelling zones,phytodetritus, mineral cycles of N, S, C.
- Marine animals:marine mammals, reptiles, birds, nektonic- crustaceans, cephalopods, mesoand bathy pelagic fish,benthos: littoral, sub littoral, bathyal, abyssal, hadal: plants and animals, infauna, epifauna, vents, shallow vents and seep, vent fauna.
- Oceanography: temperature vertical, horizontal.thermoclines, isohaline, brackish, hypersaline, upwelling, downwelling, hydrostatic pressure, light: compensation, critical depths.ocean circulation: gyres and rings.continental divergence and convergence, shelf break fronts.river plume fronts, island mass and Langmuir frontal zones.
- Sri Lanka ocean surface currents: monsoonal, inter monsoonal and seasonal.
- Human impacts on marine environment: resource mining, waste discharges.

Teaching and Learning Methods:

- Theory: Lecture, tutorial discussions, library and take home assignments, field based studies and reports, group assignments, student presentation.
- Practical and field sessions: Hands on training in field and laboratory, group assignments, student presentations and discussions.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Barnes, R. S. K. and Hughes, N. R. (1998). An Introduction to Marine Ecology. 3rd Edition. Blackwell Publishing, Blackwell Science Ltd, U.K.
- De Bruin, G.H.P., Russell, B.C. and Bogusch, A. (1994). The Marine Fishery Resources of Sri

Lanka. Food and Agriculture Organization of the United Nations, Rome.
- Gray, S. J. and Michael, E. (2009). Ecology of Marine Sediments from Science to Management. 2nd edition. Oxford University Press.
- Lalli, C.M., Parsons. T.R. (1997). Biological Oceanography – An Introduction. 2nd edition. Elsevier Butterworth– Heinemann.
- Munro, I.S.R. (1955). Marine and fresh water fishes of Ceylon. Canberra, Dept. of External Affairs.
- National Research Council (NRC) (2003). Ocean Noise and Marine Mammals. Washington, DC: National Academy Press.
- Silva, E.I.,Katubothe, J., Amerasinghe, O., Manthirithilake, H. and Ariyaratna, R. (2013). LAGOONS OF SRI LANKA: From the origin to the Present. IWMI.
- Tait, R.V. and Dipper, F.A. (1998). Elements of Marine Ecology. Butterworth Neinmann. 4thedition.

Course Code:	**ZOL404M3**		
Course Title:	Aquaculture		
Credit Value:	**03**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent study**
	27	54	69

Objectives:

- Impart knowledge on aquatic animal protein harvest strategies, and hybridizing marketable aquatic organisms for commercial prospectus.
- Describe technically formatted culture techniques for low cost breeding and harvest of food fish culture and ornamental fish culture.

Intended Learning Outcomes:

- Interpret the basic needs and enhancement of cultivable aquatic organisms
- Differentiate animal protein harvestable culture organisms
- Construct culture of cultivable organisms based on their favourable features
- Design production systems with best protein harvest
- Distinguish techniques involved in ornamental fish culture
- Develop methods for the formulation of feed for fish culture

Course Contents:

- Principles of Aquaculture methods and practices.

- Cultivable aqua food types – fin fish, shell fish, sea cucumber, oyster, mussels, krill, clam, abalone, scallop, associated sea weeds, algae, and ranching species in conservation – turtles, crocodiles, corals, sharks and others.
- Culture types – water – marine, fresh, brackish, waste water, open water reservoir, lagoon, estuary, coastal + inland sea areas, species – sex, grow, breed, life stages,stocking density and feed, waste management. culture system– PAS (Partitional), RAS (recirculate), Aqua ponics, mono, poly, integrated with farm animals, with aquatic organisms IMAS (Integrated multi trophic aquaculture system) , IFAS(Integrated fisheries and aquaculture system), IAAS (Integrated agriculture aquaculture system), cage and pen, raft.
- Nutrition, therapeutants, additives, probiotics, vitamins and others.
- Breeding and propagation-natural, artificial – induced by hormone, physical factors, hybridization, genetic improvements, cross breeding, gynogenesis, androgenesis, cloning, molecular genome techniques – interspecific nuclear transfer,linkage mapping – microsatellite, AFLP (Amplified Fragment Length Polymorphism), spawning, and hatchery, nursery techniques, marker assisted selection.
- Shellfish, Mollusc, Echinoderm biology – basic characteristics, classification and systemics, identification, life cycles and breeding, life stages and development.
- Sri Lankan ornamental fish industry, Important ornamental fish species.
- Design and construction of an aquarium. Culture techniques: Maintenance of Aquarium.

Teaching and Learning Methods:

- Theory: Lectures, tutorials, library and take home assignments, student presentation, discussions.
- Practical: Hands on training in Field-based *insitu* assessments and reports. Laboratory-based samples analyses and records. Group assignments and discussions.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Gjedrem, T. (2005). Selection and Breeding programmes in Aquaculture. Springer, Netherlands.
- Pillay, T.V.R. and Kutty, M.N. (2005). AQUACULTURE - Principles and Practice, 2nd edition, Blackwell Publishing.
- Tidwell, J.H. ed. (2012). AQUACULTURE PRODUCTION SYSTEMS. World Aquaculture Society. Wiley Blackwell. A John Wiley & Sons, Ltd. Publishing.
- Lim, C., Webster, C.D. ed. (2001). Nutrition and Fish Health. Food products press, New York.

- Tomasso, J.R., ed. (2002). Aquaculture and Environment in United States. U.S. Aquaculture Society, A chapter of the World aquaculture Society, U.S.A.
- Moksness, E., KjØrsvik E. and Olsen, Y. (2004). Culture of cold-Water Marine Fish. Blackwell publishing.
- Dholakia, A. D. (2010). Ornamental Fish Culture and Aquarium Management, Daya Publishing House.
- Udeni, E. (2014). Ornamental Fish.Kandy offset printers, Kandy.

Course Code:	**ZOL405M2**		
Course Title:	Insect Taxonomy		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	20	36	44

Objectives:

- Impart knowledge on the insect taxonomy using various taxonomic methods.
- Discuss the evolutionary significance of morphological characters.

Intended Learning Outcomes:

- Identify insects and their life stages using taxonomic keys.
- Describe insect structure in relation to evolution.
- Analyze the morphology based, numerical and molecular taxonomic results.
- Apply skills in collection and curation of insects.
- Prepare insect specimens properly for research purposes.

Course Contents:

- Distinguishing characteristic features of all 30 insect orders and important insect families (life stages).
- Insect taxonomic keys construction and use of keys.
- Species Investigation-Use of morphometric, morphological features, numerical and molecular systematics in species identification.
- Field collection, appropriate laboratory processing and slide mounting of insects body parts.

Teaching and Learning Methods:

- Theory: Lectures, group presentation, library and take home assignments, computational assignments, problem-based learning using OER.
- Practical: Hands on training, field and laboratory based studies, oral presentation - individual / group assignments.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Borror, D. J., Charles, A.T. and Norman, F.J. (2005). An introduction to the study of insects. No. Ed. 7. Saunders college publishing.
- Chapman, R.F., Stephen J.S. and Angela, E.D. (2013). The Insects: Structure and Function 5th Edi. Cambridge Press, UK.
- Richards, O.W. and Davies, R.G. (1997). Imms' General Textbook of Entomology, Volume I: Structure, Physiology and Development. Vol II- Classification. London, Chapman and Hall.
- Godfrey, M.H., Johnston, A.W.B. and Young, J.P.W., eds. (2013). Molecular techniques in taxonomy. Vol. 57. Springer Science & Business Media.

Course Code:	**ZOL406M2**		
Course Title:	Herpetology		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	21	27	52

Objectives:

- Provide essential knowledge on the identification characteristic features of amphibians and non-avian reptiles.
- Explain the structural, functional and biological adaptations for the survival of amphibians and non-avian reptiles and their conservation strategies.

Intended Learning Outcomes:

- Describe the diversity, distribution and evolution of amphibians and non-avian reptiles
- Distinguish the structural, functional and biological adaptations of herpetofauna
- Describe monitoring and estimation strategies of herpetofauna

- Develop conservation plans to alleviate their threats

Course Contents:

- Biogeography, origin and early evolutionary history, systematics, diversity and endemicity of herpetofauna in Sri Lanka.
- Reproduction and life histories of herpetofauna.
- Foraging and feeding strategies, interaction with predators, communication, and adaptive radiation.
- Challenges and current threats against herpetofauna.
- Field techniques for monitoring amphibian and reptilian populations.
- Case studies in relation to conservation actions on herpetofauna.

Teaching and Learning Methods:

- Theory: Lectures, group presentation, library and take home assignments, computational assignments, problem-based learning, discussion.
- Field visits: Hands on training, learning in the field and laboratory based studies, oral presentation - individual / group.

Assessment Strategy:

- In-Course Assessments (MIA) Field based and theory based (30%)
- Theory (MT): End of Course Examination (70%)

  Overall Marks = (7MT+3MIA)/10

References:

- Vitt, L.J. and Caldwell, J.P. (2014). Herpetology : An Introductory Biology of Amphibians and Reptiles. 4th Edition. Academic press of Elsevier, USA.
- Lilly White, H.B. (2014). How Snakes Work: Structure, Function and Behavior of the World's Snakes 1st Edition. Oxford University Press, New York.
- Heatwole, H. and Rowley J.J.L., eds. (2018). Status of conservation decline status of amphibians. Australia, New Zealand and Pacific Islands. CSIRO Publishing.

Course Code:	**ZOL407M2**		
Course Title:	Seminar Presentation and Essay		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	30	-	70

Objectives:

- Provide essential knowledge on scientific, oral and written communication and training to

acquire competency on speaking and writing ability.

Intended Learning Outcomes:

- Search scientific literature
- Select recent topics relevant to Zoology
- Compose scientific essays
- Construct an oral presentation
- Demonstrate effective presentation skill
- Discuss scientific issues

Course Description:

- Perform literature surveys using scientific journals, periodicals and online resources on the selected titles.
- Construct scientific essays, write abstract on the essay.
- Prepare digital content to perform effective oral presentation of the essay.
- Learn the reference citation

Teaching and Learning Methods:

- Literature survey, library and take home assignments, discussions and oral presentation

Assessment Strategy:

- Oral presentation (30%) End of Course Examination (70%)

References:

- Schmidt, R.K. Smyth, M.M and Kowalski, V.K. (2014). Teaching the Scientific Literature Review: Collaborative Lessons for Guided Inquiry, 2nd Edition.Libraries unlimited and Imprint of ABC-CLIO, LLC Santa Barbara, California.
- Zandars, E. and Macleod, L. (2018). Presentation skills for Scientists – A Practical Guide. Cambridge University Press, UK.
- Tripathi, B.R.C. (1991). Speaking at Scientific Meetings: Oral Presentation techniques. International Livestock centre for Africa.

Course Code:	**ZOL408M6**
Course Title:	Research Project
Credit Value:	06

Hourly Breakdown:	Mentoring	Independent Learning (Field and / Lab)
	60	540

Objectives:

- Impart concepts and training to undertake a research study with respect to develop a research proposal, setting up experiments, data collection and analysis, and presentation of findings.

Intended Learning Outcomes:

- Articulate a clear research question or problem and formulate hypothesis
- Conduct a literature survey, using print and electronic media
- Prepare a project proposal giving objectives, research design/ methodology
- Analyze the data related to the methodology
- Demonstrate and apply problem solving skills
- Construct the project report and present the findings

Course Description:

- A guided research project is an integral component of the degree programme. Student must identify a research topic/problem in consultation with supervisor(s) at the beginning of the level 4M. The duration of the project is 2 semesters in parallel to the 4M academic year. On completion of the research work a report, in a specified format, must be submitted within the stipulated period for evaluation.
- The student is required to deliver three presentations, (a) pre-project presentation, based on preparatory work and research plan (b) progress presentation and (c) end of the project presentation, based on the outcome of research and prepare a comprehensive report (containing Title page, Abstract, Introduction and Literature Review, Objectives, Materials & Methods (experimental design and statistical analysis), Results, Discussion and References) along with the similarity report.

Teaching and Learning Methods:

- Library and laboratory work, field work, software and internet resource application, consultation with supervisor, presentation (oral and poster)

Assessment Strategy:

- In-Course Assessments (30%)
  Pre-project presentation (10%) Mid-project Presentation (20%)
- End of Course Examination (70%)
  Final Presentation- oral and poster (10%) Project report (60%)

References:
• Myers, J.L and Well, A.D. (2003). Research design and statistical analysis. Lawrence Erlbaum Associates. • Cargil, M. and Connor, P.O. (2009). Writing scientific research articles – strategy and steps. Aquaculture International **18,** 705–706 (2010). https://doi.org/10.1007/s10499-009-9261-7

Course Code:	**ZOL409M2**		
Course Title:	Insect Ecology		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	20	36	44
Objectives:			
• Provide knowledge on the role of insects in the ecosystems they inhabit and to study how the insects interact with the ecosystems.			
Intended Learning Outcomes:			
• Recall fundamental ecological concepts in relation to insects • Demonstrate the experimental approaches for studying insect ecology • Recognize the general role of insects in the ecosystem • Construct the ecological framework for management of insect abundance			
Course Contents:			
• Fundamental principles of insect population dynamics, diversity and distribution. • Functional role of insects in populations, communities, and ecosystems, including intra and inter specific interactions, and trophic dynamics. Insect trophic relationships. • Ecology and adaptations of insects to specific environments: terrestrial (forest, desert, 'chena cultivation' and grass land) insects, aquatic (freshwater, estuary, marine) insects and arboreal and aerial insects. • Co-evolution of insects: pollination ecology, physiological ecology, behavioural ecology, chemical ecology, population ecology. • Application of concept of insect ecology: the significance of insects as model systems in development of ecological and evolutionary principles. • Demonstrate techniques used in insect ecology through field research and laboratory rearing.			
Teaching and Learning Methods:			

- **Theory**: Lectures, tutorial discussion, group presentation. Library and take home assignments. Computational assignments. Problem-based learning, discussion.
- **Practical**: Hands on training, field and laboratory based studies, oral presentation - individual / group assignments.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

Overall Marks = (6MT+4MP)/10

References:

- Speight, M.R., Hunter, M.D., and Watt, A.D. (2008). *Ecology of Insects: Concepts and Applications*. Wiley-Blackwell.
- Henderson,P. A. and Southwood, T.R.E. (1978). *Ecological Methods* 4thWiley-Blackwell. (2016).
- Southwood, T.R.E. 1978. Ecological methods with particular reference to the study of insect populations .
- Robert, G.F. and Peter, H.A. (2018). *Insect Biodiversity : Science and Society*Vol I and II, Wiley Blakwell.
- Sinu, P.A. and Shivanna, K.R. (2016). Mutualistic interactions between flowering plants and animals. Manipal University press, India. 317 Pp.

Course Code:	**ZOL410M2**		
Course Title:	Molecular Ecology		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	20	36	44

Objectives:

- Impart knowledge on how molecular methods are used to investigate ecological processes in natural populations.

Intended Learning Outcomes:

- Identify contemporary molecular ecological methods
- Describe molecular approaches to address ecological problems
- Explore and synthesize ecological research questions
- Apply tools to generate molecular ecological data
- Analyze and interpret molecular ecological data
- Assess ecological problems using molecular tools

Course Contents:

- eDNA concept and applications, molecular markers and methods to investigate genetic variations.
- Molecular tools in population genetics: genetic diversity, effective population size, bottlenecks, inbreeding, population, subdivision, gene flow, factors affecting genetic structure.
- Molecular tools in adaptive genetic variation: gene expression, invasion, species identity.
- Molecular tools in species conservation: genetic diversity, inbreeding, conservation strategies.

Teaching and Learning Methods:

- **Theory**: Lectures. in-class exercises, tutorial discussion, group presentation. library and take home assignments. computational assignments. problem-based learning, discussion.
- **Practical**: Hands on training, field and laboratory based studies, oral presentation - individual / group assignments.

Assessment Strategy:

- Theory (MT): In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP): In-Course Assessments (30%) End of Course Examination (70%)

Overall Marks = (6MT+4MP)/10

References:

- Freeland, J. R., Petersen, S. D. and Kirk, H. (2011). Molecular Ecology (2nd ed'n.). John Wiley & Sons.
- Matthew, M. (2011). Population Genetics. Wiley-Blackwell

Course Code:	**ZOL411M2**		
Course Title:	Insect Structure and Function		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	20	36	44

Objectives:

- Illustration of the structures and functions involved in organ systems in insects and explain the basic principles of the mechanics of physiological systems in insects.

Intended Learning Outcomes:

- Describe the structure of organ systems in insects.
- Relate the structure and function within the physiological systems.
- Apply physiological techniques in sub-field in entomology

Course Contents:

- Anatomy of organ systems of insects-Integumental (structure of Integument), Digestive (gut structure and function, peritrophic membrane), Ciruculatory (structure of heart, hemolymph &hemocytes), Respiratory (structure and modifications of tracheal system), Nervous (neuro anatomy), Excretory (structure of malphigian tubules & hindgut), Reproductive and Endocrine systems (structure of reproductive organs and endocrine systems).
- Physiology of moulting, sclerotization, melanization ,growth ,metamorphic development and hormonal influence on moulting and metamorphosis, digestion and metabolism (digestive enzymes, hormonal influence, counter current circulation, physiology of digestive enzymes), neurophysiology (nerve cells, responses to stimuli, physiology and biochemistry at synapses), circulation and immunity (function of heart and aorta, hemocytes and hemolymph), physiology of gas exchange, nitrogenous excretion (water and salt balance, osmoregulation), hormone and reproductive physiology (endocrine physiology and hormonal regulation of reproductive organs, signaling pathways).

Teaching and Learning Methods:

Lectures: Tutorial discussion, group presentation, library and take home assignments, computational assignments, problem-based learning, discussion.

Practical: Hands on training, laboratory based studies , oral presentation - individual / group assignments

Assessment Strategy:

- Theory (MT): In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP): In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Chapman, R.F., Stephen J. S. Angela E.D. (2013). The Insects: Structure and Function 5th edition.
- Richards, O.W. and Davies, R.G. (1994). IMM's General Text book of Entomology, 10th edition. Vol.1. Structure, Physiology and development.

Course Code:	**ZOL412M2**		
Course Title:	Ornithology		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical +Field visits**	**Independent Learning**

	20	36	44

Objectives:

- Provide knowledge on the diversity, evolution, biology, and the behaviour, of birds with special reference to Sri Lanka.
- Develop technical skills to study and analyse bird migration and navigational ecology.

Intended Learning Outcomes:

- Recall the diversity and evolutionary biology of birds
- Recognize bird species by sight and sound
- Interpret migration and navigation of birds using traditional and modern technology
- Apply standard bird survey techniques and statistics to monitor different habitats
- Interpret ecological and behavioural aspects of birds with special reference to feeding ecology
- Distinguish structural and functional variations in bird species
- Evaluate bird-related research articles on current technology and research methodology
- Develop digital library of bird sounds and investigate bird sounds using standard software

Course Contents:

- Origin of bird phylogeny and avian diversity.
- Ornithological methods: bird survey techniques, bird counting, recording of bird vocalizations, capturing and banding wild birds and current methods of studying bird migration.
- External morphology of birds: structure and coloration of feathers and plumages, bill, tail, wings, feet); Avian anatomy (skeletal system and muscular system); bird physiology (Respiratory, Digestive, Circulatory, nervous and urinogenital system; Senses).
- Avian flight: Origin of flight, basic mechanics of bird flight, takeoff and landing, coordinated formation flight.
- Migration: geographic patterns of migration, types of migrations, migration routes, obstacles on familiar routes and myths about migration.
- Navigation: physiological bases and control of migration, behavioural adaptations for migration, orientation mechanisms and navigation hypotheses.
- Ecology of birds with special reference to feeding ecology.
- Breeding biology of birds (sexual selection, nest-building, egg-laying, incubation, parental care and development of young.
- Avian vocal behaviour, functions of bird songs, and Bird sound analysis using standard software.
- Literature survey on bird-related current technology and research methodology.

Teaching and Learning Methods:

Lectures. Tutorial discussion, group presentation, library and take home assignments, computational assignments, problem-based learning, discussion.

Practical: Hands on training, field and laboratory-based studies, oral presentation - individual / group assignments.

Assessment Strategy:
• Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%) • Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%) Overall Marks =(6MT+4MP)/10
References:
• Harrison, J. A. (1999). *Field Guide to the Birds of Sri Lanka*. Oxford University Press, • Kotagama, S. andRatnavira, G. (2012). *An illustrated guide to the birds of Sri Lanka.* Field Ornithology Group of Sri Lanka, Colombo. • Lovette, J. and Fitzpatrick, J.W., eds. (2016). *Handbook of Bird Biology*. 3rd Edition. Cornell Lab of Ornithology. • Lederer, R. (2016). Beaks, Bones and Bird Songs: How the Struggle for Survival Has Shaped Birds and Their Behavior. Timber Press, Portland Oregon. • Welty, J. C. The Life of Birds. W. B. (1964). Saunders company, The United States of America.

Course Code:	**ZOL413M2**		
Course Title:	Ichthyology		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical + Field visits**	**Independent study**
	20	**36**	**44**

Objectives:
• Describe the morphological features and diversity of fish,interpreting and differentiating the anatomy and diversity of fishes. • Analyze the adaptation of fishes with respect to their habit and habitat.
Intended Learning Outcomes:
• Identify commercially important fish species. • Explain the anatomy and biology of fishes. • Compare the anatomical and morphological diversity among fishes. • Discuss the adaptations in fishes.
Course Contents:

- Introduction to characteristics of extant fishes
- Fish classification and systematics: identification of fishes based on meristic and morphometric characters of fishes
- Morphology, anatomy, biology, ecology, life history of fishes
- Adaptive radiation of fish based on structure and behaviour of fish

Teaching and Learning Methods:

- **Theory** :Lectures, tutorials, library and take home assignments, student presentation, discussions
- **Practical**: Field Laboratory-based samples analysis and records. digital content creation. group assignments and discussions

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Larger, K.F., Bardach, J.E. and Miller, R.R. Ichthyology. John Wiley and sons. (1962).
- Munro, I.S.R., (1955). Marine and fresh water fishes of Ceylon.
- George, H.P. and Russell, B.C. (1994). FAO species identification field guide for fishery purposes. The Marine fishery resources **of** Sri Lanka. FAO. Rome, Italy.

Course Code	**ZOL414M2**		
Course Title:	Advanced Evolutionary Biology and Zoo Geography		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Practical+ Field visits**	**Independent Learning**
	20	36	44

Objectives:

- Impart knowledge on the principles of zoogeography, outline the concepts in evolutionary biology.
- Explain the evolutionary process, its types and respective mechanisms.

Intended Learning Outcomes:

- Construct ideas about the process of evolution.
- Interpret the theories in detail and discriminate them.
- Distinguish bio molecules as tools for taxonomy.
- Investigate different techniques and models to evaluate the evolution of different groups of organisms.
- Analyze the zoogeography and evolution of different animals.

Course Contents:

- Different hypothesis for evolution of animals, mechanism of most accepted and plausible evolutionary theories, processes other than natural selection.
- Developing phylogenetic trees using morphological and molecular data-parsimony, maximum likelihood, neighbourjoining and Bayesian approaches.
- Zoogeography: The examples for animal evolution and distribution.

Teaching and Learning Methods:

- **Theory**: Lecture presentation, tutorial discussion, take-home assignments, group presentations, problem-based learning, journal paper critique.
- **Practical**: Field based studies, laboratory based experiments, take-home assignments.

Assessment Strategy:

- Theory (MT) : In-Course Assessments (30%) End of Course Examination (70%)
- Practical (MP) : In-Course Assessments (30%) End of Course Examination (70%)

  Overall Marks =(6MT+4MP)/10

References:

- Jones , S. (2000). Darwin's Ghost. the origin of species updated. Steve Jones. Ballantine Publishing Group. New York.
- Gajapathy, K., Ramanan, A., Goodacre, S.L., Ramasamy, R., and Surendran, S.N. (2016). Use of Bioinformatics in Revealing the Identity of Nature's Products with Minimum Genetic Variation: The Sibling Species. In (edited by Sumiko Anno): Gene environment Interaction Analysis; methods in Bio Informatics and Computational Biology. Pan Stanford press. Singapore.
- Darlington PJ Jr. (1957). "Zoogeography." The Geographical Distributions of Animals. John Willy and Sons., Ney York.

Course Code:	ZOL415M2		
Course Title:	Forensic Zoology		
Credit Value:	02		
Hourly Breakdown:	Theory	Practical and Field	Independent Learning
	20	36	44

Objectives:

- Provide basic knowledge and concepts with reference to terminology and recognition of major arthropod desirability.
- Discuss animal-carcass interaction, epidemiology and diagnostic techniques.
- Impart knowledge on the different biological tools used in forensic sciences.

Intended Learning Outcomes:

- Identify forensic sciences
- Describe the role of animal biological samples in forensic analysis
- Discuss the succession of arthropods in forensic investigation
- Recognize the role of molecular biology tools in forensic science
- Explain the DNA profiling
- Recognize the role of accreditation in molecular biology application in Forensic sciences

Course Contents:

- Introduction: to forensic sciences, DNA profiling: Principles and methods, examples.
- Biological samples/ organisms: Organisms in forensic science. Insects and other arthropods: types and lifestyles: succession in crime scene: determination of postmortem interval (PMI) : case histories biological evidences and serology, distribution and spattering of blood and other useful biological samples.
- Sample isolation: isolation of DNA from forensic samples.
- Tools and techniques: DNA analysis technique. forensic DNA databases. population data analysis, forensic genetics, challenges. case studies (local and international).
- Accreditation and quality control, applications such as criminal investigations and paternity analysis, implications in law enforcements, future trends.

Teaching and Learning Methods:

Theory: Presentation, tutorial discussion, take-home assignments, group presentations, problem-based learning, journal paper critique.
Practical: Field based studies, laboratory based experiments, take-home assignments.

Assessment Strategy:
• Theory (MT): In-Course Assessments (30%) End of Course Examination (70%) • Practical (MP): In-Course Assessments (30%) End of Course Examination (70%) Overall Marks =(6MT+4MP)/10
References:
• Buckleton, J. S., Bright, J. A., and Taylor, D., eds. (2016). Forensic DNA evidence interpretation. CRC press. • Li, R. (2015). Forensic biology. CRC Press. • Marquez-Grant, N. and Roberts, J., eds. (2012). Forensic Ecology handbook: from crime scene to court. • Byrd, J. H. and Castner, J. L., eds. (2010). Forensic entomology: the utility of arthropods in legal investigations Taylor and Francis Group, LLC.

Course Code:	**ZOL416M2**		
Course Title:	Integrated Coastal Management		
Credit Value:	**02**		
Hourly Breakdown:	**Theory**	**Field visits**	**Independent Learning**
	21	27	52
Objectives:			
• Provide knowledge on the purpose of Integrated Coastal Management (ICM) to ensure sustainable utilization of coastal resources.			
Intended Learning Outcomes:			
• Identify the ecosystem services in coastal habitats • Describe issues and hazards in coastal zone • Describe ICM and explain the importance of integration in relation to managing coastal resources • Plan conservation measures to protect coastal ecosystem with integrated stakeholder participation. • Identify key challenges and potential barriers to achieving ICM with action plans for coastal zone management in Sri Lanka.			

Course Contents:

- Coastal environment: Coastal ecosystems and habitats as near shore terrestrial, intertidal, benthic and pelagic.
- Issues/threats: Problems faced by the Coastal habitats : natural and manmade as Coastal pollution, degradation of mangroves and coral reefs, coastal erosion, sand mining, coastal fisheries, coastal aquaculture. tourism and hotel industry, urbanization.
- Integrated Coastal management (ICM): Integration and coordination of various coastal and marine management efforts.
- ICM process and –stages of ICM process cycle. Global initiatives in brief.
- Initiatives in Sri Lanka, Coastal Conservation Department (CCD), Coastal Conservation Act, Integrated coastal management plan, Coastal pollution management, Fisheries management and Conservation measures.
- Importance of public participation in ICM – realizing the benefits for management. - integrated stakeholder participation.
- Key challenges and potential barriers to achieving ICM Role of governess in the success of ICM.

Teaching and Learning Methods:

- Theory: Presentation, tutorial discussion, library assignments.group discussion.
- Field sessions: Impact Assessment, questionnaire based data collection.

Assessment Strategy:

- In-Course Assessments (MIA):
  Theory based In-Course Assessments (10%),
  Field session based In-Course Assessments (20%)
- Theory (MT): End of Course Examination (70%)
  Overall Marks =(7MT+3MIA)/10

References:

- Frank. A. (2018). Integrated coastal management, Springer Vieweg.
- Lauretta, B., Yumiko K., Ken K., Carmen R., Mark S., and Don M.A. (2001). Pilot Analysis of Global Ecosystems: Coastal Ecosystems, Washington D.C.
- Post R.C. and Lundin C.G., eds. (1996). Guidelines for Integrated Coastal Zone Management. Environmentally Sustainable Development Studies and Monographs Series No. 9. The World Bank, Washington DC.
- Ramanathan, A.L., Bhattacharya, P.,Dittmar, T., Balakrishna Prasad, M. and Neupane, B.D. (2010). Management and Sustainable Development of Coastal zone Environment springer,

List of Resource Persons Contributed to the Preparation of these Syllabus

Course code	Course title	Credit value	Resource Persons
*ZOL401M3	Advanced Parasitology and Vector Control	03	Prof.S.N.Surendran, Dr.K.Gajapathy
*ZOL402M3	Advanced Molecular Animal Physiology	03	Dr.T.Eswaramohan
*ZOL403M3	Marine Biology	03	Mr.W.VenkateshLuckshman, Dr.T.W. Shanthakumar
*ZOL404M3	Aquaculture	03	Mr.W.Venkatesh Luckshman Ms.P. Sivakumar
*ZOL405M2	Insect Taxonomy	02	Prof. R Gnaneswaran Dr.K.Gajapathy
*ZOL406M2	Herpetology	02	Dr.A.Sivaruban
*ZOL407M2	Seminar Presentation and Essay	02	Dr.A.Sivaruban
*ZOL408M6	Research Project	06	Prof S.N.Surendran
ZOL409M2	Insect Ecology	02	Prof R.Gnaneswaran
ZOL410 M2	Molecular Ecology	02	Prof S.N.Surendran
ZOL411M2	Insect Structure and Function	02	Prof S.N.Surendran, Ms.Nithiyagowry R
ZOL412M2	Ornithology	02	Dr.A.Sivaruban Ms.G. Parththuran
ZOL413M2	Ichthyology	02	Ms.P.Sivakumar
ZOL414M2	Advanced Evolutionary Biology and Zoo Geography	02	Dr.K.Gajapathy
ZOL415M2	Forensic Zoology	02	Prof S.N.Surendran, Prof R.Gnaneswaran, Dr.K.Gajapathy
ZOL416M2	Integrated Coastal Management	02	Prof R.Gnaneswaran Ms. Nithiyagowry R. Dr.T.Eswaramohan