

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree
Zoology

BSc FIRST YEAR, FIRST SEMESTER

Core Course

Module No. – Zool – 1101

Module Name – Organization and Variety of life

(A) Cells and Organization

- The Cells
- Tissues and Organs

(B) Variety of Life

- Domains
- Five Kingdoms
- Animal Kingdom
- Phyla

REFERENCES

- Hickman, C.P., Roberts, L.S., Larson, A.L., 1995. *Integrated Principles of Zoology*. 9th Edition. W.W.C. Brown, England, Mosby Year Book. USA.
- Johnson, G.B., 2006. *Essentials of the living world*. McGraw-Hill Companies, Inc., New York.
- Raven, P.H., Johnson, G.B., 2002. *Biology*. 6th Edition, McGraw-Hill Companies, Inc., New York.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree
Zoology

BSc FIRST YEAR, SECOND SEMESTER

Core Course

Module No. – Zool – 1102

Module Name – Life Processes and Homeostasis

(A) Life Processes

- Nutrition
- Cellular Respiration
- Transport

(B) Homeostasis

- Water Balance
- Osmoregulation
- Thermal regulation

REFERENCES

Gottfried, S.S., 1993. *Biology today*. Mosby-Year Book, Inc., London.

Hickman, C.P., Roberts, L.S., Larson, A., 1995. *Integrated Principles of Zoology*. 9th Edition. W.W.C Brown, England, Mosby year Book. U.S.A.

Johnson, G.B., 2006. *Essentials of the living world*. McGraw-Hill Companies, Inc., New York.

Lewis, R., 1992. *Life*. Wm.C. Brown Publishers. USA.

Raven, P.H., Johnson, G.B., 2002. *Biology*. 6th Edition. McGraw-Hill Companies, Inc., New York.

PAYA UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree

BSc SECOND YEAR, FIRST SEMESTER

Core Course

Module No. – Zool-2101

Module Name –Protista and Lower Invertebrates

Phylum –Ciliophora

- General Characteristics
 - Classification down to class level with examples
- Type- e.g. *Paramecium caudatum*

Phylum–Porifera

- General Characteristics
 - Classification down to class level with examples
- Type- e.g. *Scypha*

Phylum– Cnidaria

- General Characteristics
 - Classification down to class level with examples
- Type- e.g. *Hydra*

REFERENCES

Barnes, R.D., 1963. *Invertebrate Zoology*. London. W.B. Saunders Company.

Hickman, C.P., Roberts, L.S., Larson. A., 2001. *Integrated Principles of Zoology*. 11th Edition. Mc Graw. Hill Publishing Company Ltd.

Jordan, E.L., Verma, P.S., 1976. *Invertebrate Zoology*. Ram Nagar New Dehli-110055.S. Chand and Company Ltd.

Jordan, E.L., Verma, P.S., 1985. *Invertebrate Zoology*. Ram Nagar New Dehli-110055.S. Chand and Company Ltd.

Raven, P.H., Johnson, G.B., 2002. *Biology* 6th Edition. Mc Graw. Hill Companies.

Mader, S.S., Windelspech, M., 2013. *Biology* 11th Edition. Mc Graw. Hill Companies.

Storer, T.I, Usinger, R.L., Stebbins, R.C., Nybakken, J.W., 1975. *General Zoology*. 5th Edition. New Dehli. Tata Mc Graw. Hill Publishing Company Ltd.

Storer, T.I, Usinger, R.L., Stebbins, R.C., Nybakken, J.W., 1979. *General Zoology*. 6th Edition. Mc Graw. Hill Publishing Company Ltd.

PAYA UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree

BSc SECOND YEAR, FIRST SEMESTER

Core Course Module No. – Zool – 2102

Module Name –Mollusca

INTRODUCTION

- Key features of Mollusca

Class – Pelecypoda

- General characteristics
- Classification down to subclass

Class – Gastropoda

- General characteristics
- Classification down to subclass

Class – Monoplacophora

- General morphology and Anatomy of Monoplacophora

Class – Polyplacophora

- General characteristics
- Classification

Class–Aplacophora

- General characteristics
- Classification

Class– Scaphopoda

- General characteristics
- Classification

Class–Cephalopoda

- General characteristics Human interaction with molluscs
- Molluscs in culture
- Used by human
- Seashell and List of edible molluscs
- Bioindicators
- Phylogeny
- Economic Importance of Molluscs

REFERENCES

Bruno, S., 1980. *Simon & Schuster's Guide to shells*. Published by Simon & Schuster Inc. New York, London, Toronto, Sydney, Tokyo, Singapore.

Keen, M. A., 1971. *Sea Shells of Tropical West America*. Second Edition. Stanford University Press, Stanford, California.

Winder, J.M., 2011. *Oyster Shells from Archeaeological Sites*. A brief illustration guide to basic processing.

Internet. Make Money Online: <http://ow.ly/KNICZ>, WIKIMEDIA Project, Powered by Media WIKI

PAYA UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree

BSc SECOND YEAR, FIRST SEMESTER

Core Course

Module No. –Zool – 2103

Module Name – Arthropoda

Phylum– Arthropoda

- General Characteristics
 - Classification down to class level with examples
- Type– e.g. *Scorpion*

Class – Crustacea

- General Characteristics
 - Type– e.g. *Macrobrachium rosenbergii*

Class – Insecta

- General Characteristics
 - Type– e.g. *Periplaneta americana*

Class – Diplopoda

- General Characteristics
- Type– e.g. *Julus*

Class –Chilopoda

- General Characteristics
- Type– e.g. *Scolopendra*

REFERENCES

- Barnes, R.D., 1966. *Invertebrate Zoology*. W.B Saunders Company. Philadelphia / London.
- Cloudsley –Thompson, J.L., 1958. Spiders, Scorpions, Centipedes and Mites. The Ecology and Natural History of Woodlice, 'Myriapods' and Arachnids, Pergamon Press, London.
- Hiroshi Motoh, 1980. Field Guide for the edible Crustacea of the Philippines. Southeast Asian Fisheries Development Center (SEAFDC). Aquaculture Department, Hoilo, Philippines.
- Hickman, Jr. C.P., Roberts, L.S., Larson, A., 1993. *Integrated Principles of Zoology*, Ninth Edition, Mosby– Year Book, Inc. St. Louis.
- Jordan, E.L., Verma, P.S., 1976. *Invertebrate Zoology*, S.Chand and Company. LTD. Ram agar, New Delhi.
- Johston, D., Keenan, C.P., 1994. Mud crab culture in the Minh Hai Province, South Vietna (internet) (cited 1994). Available from <http://www.Doc.ctu.edu.vu/sardi/Aacrab CW/ Publication/323 CRA.html>.
- Microsoft Encarta, 2007, 1993–2006 Microsoft Corporation.
- Nichol. J., 1989. *Bites and Stings*. The World of Venomous Animals, Facts on File, Inc. 460 Park Avenue South, New York, USA.

- New, M.B.,2002. Farming fresh water prawns. A manual for the culture of the giant river prawn (*Macrobrachium rosenbergii*).F.A.O Fisheries Technical Paper,food and Agriculture Organization of the United Nations.
- Raven,P.H., Johnson, G.B., 2002. *Biology*, 6th edition, McGraw-Hill Companies,Inc. New York.
- Saw Htoo Baw, 1978. The anatomy of *Scylla serrata*.M.Sc Thesis.Department of Zoology, Art and Science University of Rangoon.
- Storer,T.I,Usinger,R.L.,Stebbins,R.C., Kybakken,J.W., 1979.*General Zoology*, Six Edition, McGraw-Hill Book Company, New York.
- Shokita, S.K., Kakazu, A., Tomori and Toma, T.1991.Aquaculture in Tropical Areas, Midori Shobo Co., Ltd. Toshima, Tokyo, Japan.<http://en.wikipedia.org/wiki/centipede> 26/1/12

PAYA UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree

BSc SECOND YEAR, FIRST SEMESTER

Elective Course

Module No. – Zool – 2104

Module Name – Acoelomata and Coelomata

The Acoelomic animals

- General Characteristics of Phylum Platyhelminthes
 - Classification down to class level with examples
- Type- e.g. *Schistosoma*

The pseudocoelomic animals

Phylum Nematoda

- General Characteristics of Phylum Nematoda
 - Classification down to class level with examples
- Type- e.g. *Ascaris lumbricoides*

The coelomic animals

Phylum Annelida

- General Characteristics of Phylum Annelida
 - Classification down to class level with examples
- Type- e.g. *Hirudinaria granulose*

REFERENCES

- Hickman, C.P., Roberts, L.S., Larson, A., 1995. *Integrated Principles Zoology*. 14th Edition. W.W.C Brown, England, Mosby year Book. U.S.A.
- Jordan, E.L., Verma. P.S., 1976. *Invertebrate Zoology*. S. Chand and Co., Ltd., Ram Nagar, New Delhi.
- Jordan, E.L., Verma, P.S., 2003. *Invertebrate Zoology*. S. Chand, Co., Ltd. Ram Nagar, New Delhi.
- Raven, P.H., Johnson, G.B., 2002. *Biology*. 6th Edition. McGraw-Hill Book Company, New York.
- Storer, I.T., Usinger R. L., Stebbins, R.C., Nybakken, J.W., 1979. *General Zoology*. (6th edition). Mc. Graw-Hill Book Co., New York.

PAYA UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc Degree

BSc SECOND YEAR, FIRST SEMESTER

Elective Course

Module No. – Zool – 2106

Module Name – Echinodermata

Phylum Annelida

- General Characteristics
- Classification down to order level with examples
- Type- e.g. *Asterias*

REFERENCES

- Banister, K.,A. and Campbell.1985. *The Encyclopedia of Aquatic life*. New York: Facts on file.
- Grzimek, B., 1972. *Grzimek's Animal Life Encyclopedia: volume 3: Mollusks and Echinoderms*.
Van Nostrand Reinhold.
- Hyman, L.H., 1955. *The Invertebrate, Echinodermata* Vol. IV, Mc Graw Hill Book Co., New York.
- Jordan, E.L. and Verma, P.S., 1965. *Invertebrate Zoology*. S.C Hand and Co. Delhi, New Delhi,
Bombay, Calcutta.
- Raven, P. N and Johnson, G., 1999. *Biology, fifth Ed*. Boston: WCB/McGraw-Hill.
- Storer, T.I, Usinger, R.L., Stebbins R.C. and Nybakken, J.W., 1979. *General Zoology*. 6th Edition.
Mc Graw Hill Book Company
- Vasantika, K.,1997. *Life of Invertebrates*. Vikas Publishing House.
- <http://www.google.com.mm/search?q=echinodermata&client>
- <http://www.starfish.ch<reef<echinoderms.html>
- <http://en.wikipedia.org/wiki/Echinoderm>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

Second Year, Second Semester

Core Course

Module No. Zool 2111

Module Name: Ichthyology

- Introduction to taxonomy of fishes
- General characters and classification of fishes
- Classification of fishes
- Class Placodermi
- Class Chondrichthyes
- Class Osteichthyes
- Classification of fishes (Chart)
- Meristic characters and morphometric measurements
- Skeleton
- Integumentary system
- Digestive system
- Respiratory system
- Circulatory system
- Nervous system
- Excretory system
- Reproductive system
- Induced breeding of carps
- Conservation

REFERENCES

Cleveland P., Hickman, JR., Larry S. Roberts and Allan Larson, 2001. *Integrated Principles of Zoology*, 11th Edition, Companies, Inc., 1221 Avenue of the Americas, New York, North America.

Helfman, G.S, Collette, B.B, Facey, D.E. and Bowen, B.W (2009). *The Diversity of Fishes Biology, Evolution, and Ecology*.

Paul, M. and Chanda, M., (2015). *Induced Breeding of Carps*.

Piska, R.Sand Naik, S.K., (2007). *Fish Biology and Ecology*.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

Second Year, Second Semester

Core Course

Module No. Zool 2112

Module Name: Herpetology

AMPHIBIAN

- The importance of amphibians
- Role of frogs as biological pest control agent
- Classification of amphibians with silent features and examples

General features of the class

- Classification of Amphibia
Fejervaryalinnocharis(Gravenhorst, 1829)
- Description, geographic range, life history, population, conservation actions
Holobatrachustigerinus(Daudin, 1803)
- Description, geographic range, life history, population, conservation actions
Polypedatesleucomystax(Gravenhorst, 1829)
- Description, geographic range, life history, population, conservation actions
Duttaphrynusmelanostictus (Schneider, 1799)
- Description, geographic range, life history, population, conservation actions
*Tylototritonverrucosus*Anderson, 1871
- Description, geographic range, life history, population, conservation actions
*Ichthyophisakohtaoensis*Linnaeus, 1758
- Description, geographic range, life history, population, conservation actions

REPTILE

- Characteristics of Class Reptilia
- Morphology and physiology
- Relations with humans
Ptyas mucosa (Linnaeus, 1758)
- Description, Habitat, Ecology, Behaviour, Reproduction
*Python bivittatus*Kahl, 1820
- Description, Habitat, Ecology, Behaviour, Reproduction
*Naja kaouthia*Lesson, 1831
- Description, Habitat, Ecology, Behaviour, Reproduction
Daboia russelli(Shaw and Nodder, 1797)
- Description, Habitat, Ecology, Behaviour, Reproduction
Calotes versicolor(Daudin, 1802)
- Description, Habitat, Ecology, Behaviour, Reproduction

Order: Testudines (Chelonia)

Cheloniamydas(Linnaeus, 1758)

- Description, geographic range, life history, conservation

Batagusbaska(Gray, 1830)

- Description, geographic range, life history, conservation

Czeocheloneplatynota(Blyth, 1863)

- Description, geographic range, life history, conservation

*Crocodylusporosus*Schneider, 1801

- Description, geographic range, life history, conservation

REFERENCES

Asian Turtle Trade Working Group (2000). *Geocheloneplatynota*. 2006. *IUCN Red List of Threatened Species*. IUCN 2006. www.iucnredlist.org. Retrieved on 11 May 2006.

Boulenger, G. A. (1890). The fauna of British India, including Ceylon and Burma: Reptilia and Batrachia. Taylor & Francis.

Erdelen, W. 1984. The genus *Calotes* (Sauria: Agamidae) in Sri Lanka: distribution patterns. *J. Biogeogr.* 11: 515–525

Fritz Uwe, Peter Havaš (2007). "Checklist of Chelonians of the World". *Vertebrate Zoology* 57(2): 279. ISSN 18640–5755. Archived from the original on 2010–12–17. Retrieved 29 May 2012.

Gilbert, SF, Corfe, I (2013). "Turtle origins: picking up speed". Dev Cell. 25 (4): 326–328.

Grigg, G., Kirshner, D. (2015). *Biology and Evolution of Crocodylians*. CSIRO Publishing.

Nussbaum, *et al.* (1995). "A taxonomic review of *Tylototriton verrucosus*". Until 1995, most if not all authorities considered *Tylototriton*.

Romer, A.S. & T.S. Parsons. 1977. *The Vertebrate Body*. 5th ed. Saunders, Philadelphia.

Seminoff, J.A. (2004). "*Cheloniamydas*". *IUCN Red List of Threatened Species*. Version 2012.2. International Union for Conservation of Nature.

<http://www.preservearticles.com/201104085135/classification-of-amphibians-with-silent-features-and-examples.html>

https://en.wikipedia.org/wiki/Hoplobatrachus_tigerinus

www.caudata.org/cc/species/Tylototriton/T_verrucosus.shtml

https://en.wikipedia.org/wiki/Himalayan_newt

<https://en.wikipedia.org/wiki/Caecilian>

<https://www.reference.com> › Pets & Animals › Reptiles › Snakes

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

Second Year, Second Semester

Core Course

Module No. – Zool – 2113

Module Name –Ornithology I

INTRODUCTION

- Characteristics
- Evolution

FLIGHT OR AERIAL ADAPTATION OF BIRDS

A. Morphological Volant Adaptations

- Bird Flight
- Flapping flight

B. Anatomical Volant Adaptations

ECONOMIC IMPORTANT OF BIRDS

- Uses of Birds
- Harms from Birds

CLASSIFICATION DOWN TO ORDER LEVELS

Class Aves

Birds

- structure of a bird

Type example – Domestic fowl

Systematic position of *Gallus domesticus*

- External features
- Body covering
- Feathers

Flight feathers and Molting

- Remiges
- Primaries
- Secondary
- Tertials
- Rectrices
- Molting

Skeletal System

- Skeleton

Muscular System

- Internal organs of birds

Digestive System

- The alimentary canal

The Circulatory System

- A highly complex heart
- Arteries
- Veins

Respiratory System

The Nervous System

The Sense organs and senses

- The eye
- The ear
- Vision
- Hearing
- Touch, taste and smell

The most important glands

The nature and functions of hypophysis

- Endocrine glands

Excretory System

Reproductive System

Structure of other birds

Adaptive features

Heterogeneous shapes

Different types of the beaks or bills

Types and uses of bird's feet

How fertilized egg is formed

Chick Development

Extra embryonic Membranes

REFERENCES

Bradley, O. C., 1960. *The structure of the fowl* 4th Edition. Oliver and Boyd Ltd. London.

Britannica. Illustrated Science Library– Birds 2008–2008 Editorial Sol 90.

Cornell Laboratory of Ornithology *handbook of birth biology*. 2004. Princeton University Press. ISBN 0-938027-62-X. (hardcover)

Del Hoyo, Josep, et al. *Handbook of Birds of the World Vol 1*. 1992. Barcelona: Lynx Edicions, ISBN 84-87334-10-5.

Dingle, JG (1990) *Module 3: Metabolism: Nutrient Procurement and Processing, Study Book: Poultry Husbandary 1*, DEC,USQ, Toowoomba, Australia.

Neisham, MC, Austic, RE and Card, LE (1979) *Potry Production*, 12th Edition, Lea and Febiger, Philadelphia, USA.

Raven, P, H, G. B. Thonson., 2002. *Biology* 6th Edition. McGraw Education, A division of the McGraw Hill Companies.

Storer, T. I., Usinger, R.L., Stebbins, R.C., Nybakken, I.W., 1979. *General Zoology* 6th Edition. McGraw– Hill Book Company. New York.

<https://e.wikipedia.org/wiki/Birds-flight>

<https://www.boundless.com/physiology/textbooks/boundless-anatomy-and-physiology-textbook/skeletal-system-parts-of-the-skeleton-7/the-upper-limb-86/ulna-and-radius-the-forearm-4787-7741/>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

Second Year, Second Semester

Elective Course

Module No. Zool 2114

Module Name: Mammalogy I

- Introduction
 - General characteristics
 - Class- Mammalia
- Integument, support and movement
- Food and feeding
 - Insectivorous
 - Carnivorous
 - Herbivorous
- The nervous and endocrine systems and biological Rhythms
 - Nervous system
 - Endocrine system
 - Biological rhythms

REFERENCES

Feldhamer, G.A., Dickamer, L.C., Vessey, S.H., and Merritt, J.F., (1999). *Mammalogy: Adaptation, Diversity and Ecology*. McGraw-

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

BSc SECOND YEAR, SECOND SEMESTER

Elective Course

Module No. – Zool – 2115

Module Name –Protochordates and Cyclostomes

INTRODUCTION

PROTOCHORDATES

- Protochordata
- General characteristics of Protochordates
- Hemichordata
- General characteristics of Hemichordata

CHORDATES

- Class Myxinoidea and Class Petromyzontida
- General characteristics of Urochordata
- Class I- LARVACEA
- Class II- Ascidiacea
- Cephalochordata
- General characteristics
- Difference between Protochordates and higher Chordates
- Protochordates
- Higher Chordates

GENERAL CHARACTERISTICS OF PHYLUM CHORDATA

- Four chordate hallmarks
- Notochord
- Dorsal tubular nerve cord
- Pharyngeal pouches and gill slits
- Postanal tail

PHYLUM CHORDATA

- Subphylum (A) Urochordata
- (B) Cephalochordata
- (C) Vertebrata
- Subphylum Cephalochordata

Type Example I – *Branchiostoma* (Amphioxus)

- Systematic position
- Form and Locomotion
- Nervous system and sense organs
- Musculature and Notochord
- Coelom

- Digestive System and Nutrition
- Hemal System and Internal Transport
- Excretion
- Reproduction and Development
- Diversity of cephalochordata
- Physical characteristics
- Tunicata (Urochordata)
- Ascidiacea

Type example – *Ascidia* (Sea-squirt)

- Systematic position
- Solitary body form
- Colonial body form
- Body Regions
- Tunic, Body wall and Musculature
- Pharynx and Atrium
- Digestive system and nutrition
- Internal transport and gas exchange
- Excretion
- Nervous system
- Reproduction and Development
- Tadpole larva and Metamorphosis
- Budding
- Distribution
- Habitat
- Behavior
- Feeding ecology and diet
- Reproductive biology
- Conservation status
- Significance to humans

INTRODUCTION

CYCLOSTOMATA

CLASS CYCLOSTOMATA

GENERAL CHARACTERISTICS OF *PTEROMYZON* (LAMPREY)

- Classification

Type example – *Pteromyzon* (Lamprey)

- Systematic position
- Shape and size
- Colour
- Division of body
- Locomotion
- Nutrition

- Respiratory System
- Body wall
- Circulatory system
- Excretory System
- Reproductive System

REFERENCES

Hickman, C.P., 1970. *Integrated Principles of Zoology*. 4th edition. C.V Mosby Company, Toppan Company, Ltd.

Hickman, C. P., Robert, Jr. L. S., Larson, A., 1995. *Integrated Principles of Zoology*, 9th edition. C.V Mosby Year Book, Inc. U.S.A.

Jordan, E. L., Verma, P.S., 1989. *Chordate Zoology and Elements of Animal Physiology*, 9th edition. S. CHAND & COMPANY Ltd. New Delhi.

Storer, T. I., Usinger, R. L., 1979. *General Zoology*, 6th edition. McGraw Hill Book Company. New York.

en.wikipedia.org/wiki/Sea lamprey

[http://www.google.com/imgres?q=lamprey anatomy](http://www.google.com/imgres?q=lamprey+anatomy)

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

BSc SECOND YEAR, SECOND SEMESTER

Elective Course

Module No. –Zool – 2116

Module Name –Comparative Anatomy

INTEGUMENT

GENERAL FEATURES OF THE INTEGUMENT

Integument of fishes

Integument of Tetrapods

Birds

- Basic structure

Mammals

Respiratory organs

THE CIRCULATORY SYSTEM

- Single and Double circulation
- Overview of Aortic arch evolution
- General body veins
- Pulmonary system

Hearts

- Chelonian / Squamate Hearts

DIGESTIVE SYSTEM

- Components of the digestive system
- Tooth Anatomy
- Specialized Teeth in Mammals

THE UROGENITAL SYSTEM

- Urinary System

REPRODUCTIVE SYSTEM

THE NERVOUS SYSTEM

- Central Nervous System

REFERENCES

Kenneth, V.K., 2008. *Vertebrates Comparative Anatomy, Function, Evolution.*
Fifth Edition. McGraw-Hill Companies.

Kent, G.C., 1987. *Comparative Anatomy of the Vertebrates.* 7th Edition. Wm. C.
Brown Communications, Inc. Printed in the United State of America.

Kingsley, J.S., 1912. *Comparative Anatomy of Vertebrates.* 3rd Edition, P. Blakiston
Son and Coltt, Philadelphia.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for Second Year Zoology

Second Year, Second Semester

Elective Course

Module No. Zool 2002

Module Name: Vertebrate Zoology

- Phylum Chordata
- Characteristics of phylum Chordata
- Four chordate hallmarks
 - Notochord
 - Dorsal tubular nerve cord
 - Pharyngeal pouches and gill slits
 - Postanal tail
- Classification of Phylum Chordata
- Protochordates
 - Protochordata
- Type example – Protochordata *Amphioxus*
 - External features
- Class Cyclostomata
 - Characteristics
- Type example – Cyclostomata *Petromyzon*
 - External features
- Class Chondrichthyes
 - Characteristics
- Type example – Elasmobranchii *Scoliodon*
 - External features
- Class Osteichthyes
 - Characteristics
- Type example – Osteichthyes *Sperataseenghala*
 - External features
- Class Amphibia *Amphibians*
 - Characteristics
- Type example – Anura *Hoplobatrachustigerinus*
 - External features
- Class Reptilia – Reptiles
 - Characteristics
- Type example – Squamata *Lacerta viridis*
 - External features

- Class Aves – Birds
 - External features
- Type example – Galliformes *Gallus domesticus*
 - External features
- Class Mammalia – Mammals
 - Characteristics
- Type examples – Artiodactyla *Sus scrofa*
 - External features

REFERENCES

- Bradley, O. C., 1960. *The structure of the fowl* 4th Edition. Oliver and Boyd Ltd. London.
- Britannica. Illustrated Science Library– Birds 2008–2008 Editorial Sol 90.
- Cornell Laboratory of Ornithology *handbook of bird biology*. 2004. Princeton University Press. ISBN 0-938027-62-X. (hardcover)
- Del Hoyo, Josep, et al. *Handbook of Birds of the World Vol 1*. 1992. Barcelona: Lynx Edicions, ISBN 84-87334-10-5.
- Dingle, JG (1990) *Module 3: Metabolism: Nutrient Procurement and Processing, Study Book: Poultry Husbandary 1*, DEC,USQ, Toowoomba, Australia.
- Neisham, MC, Austic, RE and Card, LE (1979) *Poultry Production*, 12th Edition, Lea and Febiger, Philadelphia, USA.
- Raven, P, H, G. B. Thonson., 2002. *Biology* 6th Edition. McGraw Education, A division of the McGraw Hill Companies.
- Storer, T. I., Usinger, R.L., Stebbins, R.C., Nybakken, I.W., 1979. *General Zoology* 6th Edition. McGraw– Hill Book Company. New York.
- https://en.wikipedia.org/wiki/Birds_flight
- <https://www.boundless.com/physiology/textbooks/boundless-anatomy-and-physiology-textbook/skeletal-system-parts-of-the-skeleton-7/the-upper-limb-86/ulna-and-radius-the-forearm-4787-7741/>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool- 3101/ Zool-3201

Module Name – Taxonomy and Nomenclature

THE SYSTEMATIC BACKGROUND

- Systematics
- Classification and nomenclature
- The taxonomic hierarchy

Table 1. The categories of the taxonomic hierarchy

- Names and Codes
- The purpose of names
- Codes of nomenclature
- Modification of the codes

SCIENTIFIC NAMES

- Alphabet and language
- Names of taxa above the rank of genus
- Names of genera
- Names of taxa intermediate in rank between genus and species

Table 2. Standardized Endings for the Names of Taxa

- Names of species
- Names of taxa below the rank of species
- Names groups
- Names, rank and position

OPERATIVE PRINCIPLES OF NOMENCLATURE

- The aims of the codes
- Publication

Table 3. The Nomenclatural Filter (For explanation see text)

- Typification
- What is a type?
- How the type method works
- Kinds of types
- Priority
- Limitations of priority
- Starting-point dates
- Limitations of priority with respect to rank
- Names excluded from consideration for the purposes of priority when the name by which a taxon should properly be known is being decided
- Homonyms

- Superfluous names
- Tautonyms
- Widely and persistently misapplied names
- Conservation and Rejection of Names
- Orthographic Variants

I. ZOOLOGICAL NOMENCLATURE

Article 1 to 3

II. NUMBER OF WORDS IN ZOOLOGICAL NAMES

Article 4 to 6

III. CRITERIA OF PUBLICATION

Article 7 to 9

IV. CRITERIA OF AVAILABILITY

Article 10 to 20

V. DATE OF PUBLICATION

Article 21 to 22

VI. VALIDITY OF NAMES

Article 23 to 24

VIII. FORMATION AND EMENDATION OF NAMES

Article 25 to 29

- Glossary

REFERENCES

Heywood, V. H. (1973). *Biological Nomenclature*. 2nd Edition. The Camelot Press Ltd, Southampton.

Stoll, N.R., Dollfus, R. Ph., Forest, J., Riley, N.D., Sabrosky, C.W., Wright, C.W. and Melville, R. V. (1961). *International code of Zoological nomenclature*. International trust for zoological nomenclature.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool- 3102/ Zool –3202

Module Name – Ecology

ECOLOGY AND ECOSYSTEMS

- Ecology and Biosystems
- Ecosystem concept
- Energy Flow in Ecosystems
- Solar Radiation and Global Energy Balance
- Primary Production and Productivity
- Food Chains
- Bioenergetics
- Ecological Efficiencies
- Biomagnification of Pollutants

BIOGEOCHEMICAL CYCLES

- Sedimentary and Gaseous Nutrient Cycles
- Carbon Cycle
- Increased Greenhouse Effect
- Nitrogen Cycle
- Sulphur Cycle
- Phosphorus Cycle
- Water Cycle
- Population Ecology
- Regulation of Population Density
- Niche concept and Importance of Abiotic factors for Regulation of Populations
- Importance of Interspecific factors for Regulation of Populations
- Competition
 - (1) Displacement of a species from another species
 - (2) Fundamental and realized niche is not identical
 - (3) Niche diversification
 - (4) Character displacement
- Predation
- Keystone species
- Invasive species
- Symbiosis
- Importance of Intraspecific factors for the Regulation of Populations
- Species Diversity
 - High/low productivity

- The age of the biotic community
- Transition Zones and Edge Effects
- Ecological Succession
- Autogenous Succession
- K and R – Strategists
- Allogeneic Succession
- Climax Ecosystems
- Succession in “Space”
- The Biosphere as an Ecosystem
- Ecosystem Complexity and Stability
- Marine Ecosystems
- Open Seas
- Primary Production and Hydrography
- Marine Shallow Water Areas
- Lake Ecosystems
- Temperature Stratification in Lakes
- Seasonal Variations in Lakes
- Forest Ecosystems
- Food Chains in Forests
- Humans and Nutrient Balance

REFERENCES

- Clapham, W.B.** 1983. Natural ecosystems. Macmillan Publishing Co., Inc., New York.
- Ingersoll, A.P.** 1983. The atmosphere. Scientific American, 249, 114–130.
- Kormondy, E.J.** 1969. Concepts of ecology. Prentice–Hall, Inc., Englewood Cliffs, New Jersey, 209 pp.
- Odum, E.P.** 1971. Fundamentals of ecology. Saunders Co., Philadelphia.
- Revelle, R.** 1982. Carbon dioxide and world climate. Scientific American, 247, 33–41.
- Riisgård, H. U.,** 2017. General Ecology Outline of Contemporary Ecology for University Students, 1st Ed. bookboon.com.
- Warren, C.F.** 1971. Bioenergetics and growth. – In: Biology and water pollution control, pp. 135–167. Saunders Co., Philadelphia.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool- 3103/ Zool – 3203

Module Name – Zoogeography

- ZOOGEOGRAPHY
 - History of zoogeography
 - Disjunct distributions
 - Distribution by dispersal
 - Distribution by vicariance
 - Continental-drift theory
 - Temporary land bridges
- ANIMAL DISTRIBUTION
 - Kinds of animal distribution
 - Factors affecting distribution
 - Barriers
 - Modes of dispersal
- ZOOGEOGRAPHIC REALMS
 - Palaearctic region
 - Ethiopian region
 - Oriental region
 - Australian region
 - Neotropical region
 - Nearctic region
 - Central American- Mexican transition area
 - Wallace's Line, Weber's Line, and Wallacea
 - Summary of faunal transition
- INSULAR FAUNA
 - Continental Islands
 - Oceanic Islands
 - Galapagos Islands
 - Ancient Islands

REFERENCES

- Cleveland P. Hickman, Jr., Larry S. Roberts, Susan, L. Keen, Allen Layson. Helen I' Anson and David J. Elsenhour., 2008. *Integrated principle of zoology*. 14th edition, The McGraw-Hill Companies, Inc, New York.
- Darlington ,P.J., 1996. *The Geographical distribution of animals*. 4th Edition, John Wiley & Son, Inc. New York.

Sambasiviah .I.,KamalakaraRao . A. P., Chellappa . A. S., 1990. *Text book of Animal Physiology and Ecology*. 2nd edition, S. Chand & Company Ltd., Ram Nagar, New Delhi.

Wallace. A. F., 1876. *The Geographical Distribution of Animals*: Volume I and II. HARPER & BROTHER Publisher, Franklin square, New York.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool-3104/ Zool – 3204

Module Name – Descriptive Statistics

- Experimental design
 - Replication and randomization
 - Randomized design
 - Random sampling
 - Stratified random sampling
 - Number of strata
 - Systematic random sampling
 - 1. The paired sample design
 - 2. The randomized block design
 - 3. Latin square design
 - 4. Split plot design
- What is Statistics?
 - General definition
 - Population and sample
- Quantitative and qualitative populations
 - Levels of Measurement
 - What are variables?
 - Types of variables
- Qualitative and quantitative variables
- Discrete and continuous variables
- Accuracy and significant figures
- Frequency distributions
- The shape of a distribution
 - Histogram
 - Bell-shaped
 - Bimodal
 - Skewed right
 - Skewed left
 - Uniform
 - Random
 - Symmetrical or non-skewed distributions
- Introduction to normal distributions
 - Summary of the properties of the theoretical normal distribution
 - Determining normality

- Confidence intervals and sample size
- Confidence intervals
- Hypothesis testing
 - The traditional method
 - P-value method for hypothesis testing
- Parametric and nonparametric statistics
 - Introduction
 - Advantages and disadvantages of nonparametric methods
 - t test for a mean
 - Testing the difference between two means: small dependent samples
 - Testing the difference between two means: small independent samples
 - Analysis of variance
 - One – way analysis of variance
 - Chi square with a Priori Hypothesis
 - Chi square without a Priori Hypothesis
 - Mann–Whitney U test
 - The Kruskal–Wallis test

REFERENCES

Berensanet. el., 2013. *Basic Business Statistics 3, Concepts and Applications*. Pearson Australian Group Pty Ltd.

Bluman Allen G., 2007. *Elementary Statistics A Step by step Approach* (Second edition), The McGraw–Hill Higher Education.

Mc Donald John, H., 2009. *Handbook of Biological Statistics* (Second edition), Sparky House Publishing

Spiegel Murray, H., 1961. *Theory and Problem of Statistics*, McGraw–Hill Book Company.

Zar Jerrold, H., 1984. *Biostatistical Analysis* (Second edition), Prantice–Hall International Editions.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool. 3105/ Zool. 3205

Module Name – Palaeontology

- INTRODUCTION**
 - The nature of fossils
 - Fossilization
 - Use of fossils
 - Fossils can form in several ways
 - Fossils provide a record of evolution
- THE ANIMAL KINGDOM**
 - Invertebrate fossils
 - Protozoans
 - Parazoans
 - Spicules and fibres
 - Coelentrates
 - Growth of coral
 - Molluscs
 - Worms
 - Arthropods 1
 - Arthropleura
 - Insect features
 - Arthropods 2
 - Trilobite body plan
 - Living fossils
 - Arthropod 3
 - Spider fossils
 - Spider in amber
 - Arthropod 4
 - Tentaculates
 - Brachiopods and bivalves
 - Echinoderms and Branchiotremes
- Vertebrates fossils**
 - Jawless fishes
 - Spiny fishes
 - Jaws evolving
 - Sharks and their skin
 - Bony fishes

- Evolving tails and heads
- Amphibians
- Reptiles
- Turtles and tortoises
- Neck benders
- Mammal-like reptiles
- Cynognathus skull
- Inner jaws
- Birds
- Flightless birds
- Water birds
- Land birds
- Mammals
- Pouched mammals
- Placental pioneers
- Primates

REFERENCES

- Easton, W.H., 1960. *Invertebrate Paleontology*. Harper & Row, Publishers, New York and London.
- Lambert, D., 1985. *The field guide to prehistoric life*. Facts on file, Inc. New York and London.
- Moore, R., Lalicker, C. G., Fischer, A. G., 1952. *Invertebrate fossils*. McGraw-Hill Book Company Inc. T
- Nowicki, S., 2008. *Biology*. MacDougal Lithouell., a division of Houghton Mifflin Company.
- Shrock, R. R., 1953. *Principles of Invertebrate Paleontology*. McGraw-Hill Book Company Inc.
- Shrock, R. R., Twenhofel, W. H., 1953. *Principles of Invertebrate Paleontology*. Second edition. McGraw-Hill Book Company Inc. New York Toronto London.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, FIRST SEMESTER

Module No. – Zool.3106/ Zool. 3206

Module Name – Animal Behaviour

INTRODUCTION

THE BEHAVIOUR OF INDIVIDUAL ANIMALS

- Feeding Behaviour
- Predators
- Prey Deference
- Animal Architects
- Behavioral Rhythms

MIGRATION

Bird Migration

- Types of bird migration
- Causes of migration
- Advantages of migration

Fish Migration

- Methods of migratory movements
- Advantages of migration

NAVIGATION AND HOMING

ANIMAL RELATIONSHIPS

Communication in Animals

- Courtship and mating behaviour of animals
- Roles of courtship

Communication in Social Groups

- Aggression
- Parental care
- Breeding System

THE ORIGINS OF BEHAVIOUR

- Learning
- Inheritance and behaviour
- Evolution of behaviour

SOCIO BIOLOGY

- Social organizations
- Social organization of arthropods
- Social organization of vertebrates

CULTURE IN ANIMALS

REFERENCES

- Gundervia, H and Singh, H.G., 2016. *A Text Book of Animal Behaviour*, Second Edition. S. Chand & Company PVT. Ltd. Varanasi, India.
- Raven, P.H and Johnson, G.B., 2002. *Biology*. 6th Edition. McGraw– Hill Higher Education, a Division of the McGraw– Hill Companies.
- Sarkar, A., 2003. *Fundamentals of Animal Behaviour*, Discovery Publishing House. New Delhi, India.
- Slater, P.J.B., 1987. *The Encyclopedia of Animal Behaviour*. Equinox (Oxford) Ltd. New York.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Core course Module No. – Zool –3211/3111

Module Name – Elementary Physiology

ANIMAL PHYSIOLOGY

- Food, Proteins, Carbohydrates, Fats, Compound lipids, Mineral salts, Water, Vitamins
- Biological role of vitamins
- Animal Nutrition and the Digestive System
- Respiration
- Exchange of O₂ and CO₂ in the blood
- The Excretory System
- The Circulatory System
- Osmoregulation
- Immunology
- The Nervous System
- Receptors and Effectors
- Special Sense Organs
- Hormones and the Endocrine System

REFERENCES

Fried, G., & George J., Hademenos, 2009. Biology. 3rd Edition. Schaum's Outline Series, New York, Chicago San Francisco, Lisbon, London.

Sambasiviah, Kamalakara Rao & Augustine Chellappa. 1990. Animal Physiology and Ecology. S. Chand & company Ltd. Ram Nagar, New Delhi.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Core course Module No. – Zool –3212/3112

Module Name – Parasitology

PARASITOLOGY

- PROTOZOA
- Pathologic characteristics of Protozoa
 - *Naegleria fowleri*
 - *Acanthamoeba* species
 - *Toxoplasma gondii*
 - *Cryptosporidium*
 - *Pneumocystis carinii*
- TREMATODES
- *Schistosoma japonicum*
- TAPEWORM
- *Echinococcus granulosus*
- NEMATODE
- *Trichuris trichiura*
- *Filaria*
- Parasites of Arthropods
 - Mites (Parasites: *Chorioptes bovis*, *Ornithonyssus bacoti*, *Pneumonyssoides caninum* Trombiculid Mites)
 - Tick (Parasite: *Haemaphysalis* spp.)
 - Fleas (Parasite: *Ctenocephalides felis felis*)
 - Lice (Parasite: Avian Lice)
 - Flies (Parasite: *Hypodermalineatum*, *Dermatobia hominis*)
- Parasites of fishes
 - Helminths and Protozoans (Parasite: *Ichthyophthirius multifiliis*, *Cryptocaryon irritans*, *Trichodina* spp., *Trichophyra* spp., Monogeneans, *Ergasilus* spp., *Lernae* spp,)

REFERENCES:

- Lu Gaung, 2002. *Text book of Human Parasitology*. WHO report.
- Monnig, H. O, 1950. *Veterinary Helminthology and Entomology*. Third Edition, Baltimore, The Williams & Wilkins Company, Great Britain.
- Zajac, Anne M, 2012. *Veterinary Clinical Parasitology*, Eight Edition, Wiley-blackwell. A John Wiley & Sons, Inc., Publication, The Atrium, Southern Gate, Chichester, West Sussex, UK.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Core course Module No. – Zool – 3213/3113

Module Name – Entomology

SCOPE OF ENTOMOLOGY

- CLASS – INSECTA
- Study on the life history, habit and habitat of the following with emphasis on MYANMA species and their economic importance
- Exopterygota
- Dragonflies
- Grasshopper or Locust (*Locustamigratoria*)
- Cricket (*Gryllus*)
- Termite
- Bug
- Endopterygota
- Beetles
- Family Carabidae– Ground beetles
- Family Staphylinidae– Rove beetles
- Butterfly and Moth
- Housefly (*Muscanebulo*)
- Genus – *Apis*
- Economic Importance of Honey-bee
- Honey
- Economic importance of insect
- Apiculture and meliponiculture
- Control of some insect pests
- Medical entomology

REFERENCES

Britannica, 2008. Encyclopedia Inc. Termite caste and other insects. Available from:
<http://www.britannica.com>.

Gullan, P.J., Cranston. P.S., (2004). *The insect: An outline of Entomology*. 3rd Edition.

Hutchins, M., Evans, A.V., Garrison, R.W., Schlager, N., (eds), (2003). Grimke's
Animal Life Encyclopedia. 2nd Edition, Vol.III, Insects. Farmington Hills,
MI: Gale Group London.

Takumasa Kondo (2012). Introduction to the Study of Entomology, Animal and
Plant Productivity [Eds. UNESCO-EOLSS Joint Committee]. In:
Encyclopedia of Life Support Systems (EOLSS), Developed under the

Auspices of the UNESCO, Eolss Publishers, Oxford,
UK,[<http://www.eolss.net>] [Retrieved January31,2013]

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Core course Module No. – Zool – 3214/3114

Module Name – Mendelian Genetics

1. The Mechanism of inheritance

- Pre-Mendelian concepts
- Mendel's First Law
- Mendel's second Law

2. Patterns of Inheritance

- Terminology
- Allelic relationship
- Dominant and recessive alleles
- Crosses involving single genes
- Other allelic relationship
- Crosses involving two or more genes
- The genetics of sex

REFERENCES:

- Elord, Susan, Willian D. Stansfield, 2010. *Genetics*, 5th Ed., Schaum's Outline Series, McGraw-Hill, INC., Printed in Singapore.
- George, L., Fried. 1998. *Biology*, 2nd Ed. Schaum's Outline Series, McGraw-Hill, INC., Printed in Singapore. Pp. 124– 127.
- Hickman, Jr. Cleveland P., Larry S. Robert, Susan L. Keen, Allan Larson, Helen I'Anson and David J. Eisenhour, 2017. *Integrated Principles of Zoology*, 17th Ed. Published by McGraw-Hill, Inc., 1221 Avenue of the Americas, New York
- Mason, Kenneth A., Jonathan B. Losos& Susan R. Singer, 2017. *Biology*. 11th Ed. Schaum's Outline Series, McGraw-Hill Education, 2 Penn Plaza, New York
- Stansfield, Willian D., 1969. *Theory and Problems of Genetics*, 1st Ed., Schaum's Outline Series, McGraw-Hill, INC., Printed in Singapore.
- Stansfield, Willian D., 1991. *Theory and Problems of Genetics*, 3rd Ed., Schaum's Outline Series, McGraw-Hill, INC., Printed in Singapore.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Elective course Module No. – Zool. 3215/3115

Module Name – Toxicology

- Introduction
- Toxicology
- Toxicity
- Environmental pollution and health effects
- Effects of pesticides on human health
- Bioaccumulation and biomagnification

REFERENCES

- Alemu, B. and Wolde, A.T. 2007. Lecture notes for *Toxicology*. Hawassa University.
- Chowdhury, A.Z., S. Banik, B. Uddin, M. Moniruzzaman, N. Karim, and SiewHuaGan, 2012. “Organophosphorus and Carbamate Pesticide Residues Detected in Water Samples Collected from Paddy and Vegetable Fields of the Savar and DhamraiUpazilas in Bangladesh.”, *Int. J. Environ. Res. Public Health*. 2012 Sep; 9(9): 3318–3329.
- Deleon, S.D. *Artisanal Ruby Mining in Myanmar: Environmental and Social Impacts*. [Online] Available at: <http://www.uvm.edu/rsenr/gemecology/> [Accessed 19 Sep. 2016].
- Ernest, H., 2004. *A Text Book of Modern Toxicology*, Third Edition, Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
- FAO, 2011. AquaStat. Retrieved September 19, 2016, from FAO (Food and Agricultural Organisation):
http://www.fao.org/nr/water/aquastat/countries_regions/MMR/index.st
- FAOSTAT, Pesticide use in Bangladesh, digital image, FAO, accessed 18 September 19, 2016, <http://faostat3.fao.org/browse/R/RP/E>
- FAOSTAT, Pesticide use in Myanmar, digital image, FAO, accessed 18 September 19, 2016, <http://faostat3.fao.org/browse/R/RP/E>
- Hasman, “Water Allocation Assessment to Support IWRM in the Major River Basins of Myanmar: Now and in the Future.” Master’s thesis, TU Delft, 2014.
<http://repository.tudelft.nl/islandora/object/uuid:81d5fdd6-0adb-456b-ba27-902f76fd70f1?collection=education>
- Hiroshi Sakai, YatsukaKataoka, and Kensuke Fukushi, “Quality of Source Water and Drinking Water in Urban Areas of Myanmar.”, *The Scientific World Journal* 2013(4):854261

- James, R.C. 2000. General principles of toxicology in *Principles of Toxicology: Environmental and industrial Applications*. Second Edition, Edited by Philip L. Williams, Robert C. James and Stephen M. Roberts.
- Khin Wine PhyuPhyu (2016, January 04). Industrial zone waste water shows rising pollution. *The Myanmar Times*. Retrieved from <http://www.mmtimes.com>
- KyawMyintOo, 2007. *Environmental toxicology: effects of environmental pollutants on living systems*. Published by the Myanmar Academy of Arts and Science.
- Myanmar-Dutch Seminar on “Water Sector Capacity Building and Possible Collaboration” 6th July 2012, Irrigation Department. Yangon, Myanmar.
- Kampaengthong and B. Chawsithiwong, “Water Quality of the Chao Phraya River.” In V. Subramanian ed. *Surface and Sub-surface Water in Asia: Issues and Perspectives*. IOS, pp. 178–87
- The World Bank, World Development Indicators (2012). *GNI per capita, Atlas method* [Data file]. Retrieved from <http://data.worldbank.org/> indicator/NY.GNP.PCAP.CD
- Xiang Huang, Mika Sillanpää, Egil T. Gjessing, SirpaPeräniemi and Rolf D. Vogt, “Environmental impact of mining activities on the surface water quality in Tibet: Gyama valley”, *Science of The Total Environment* 2010 Sep; 408(19):4177–84
- Yu, Ming-Ho, 1928. *Environmental toxicology: biological and health effects of pollutants*/ Ming-Ho Yu. P. cm. includes bibliographical references and index.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
Zoology

BSc 3rd YEAR AND BSc (HONOURS) FIRST YEAR, SECOND SEMESTER

Elective course Module No. – Zool – 3216/3116

Module Name – Evolution

- An introduction to evolution
- Evidence of evolution
- The rise of the mammals
- Placental mammals
- The age of mammals
- Fossil evidence for organic evolution
- Microevolution

REFERENCES

Rhodes, F.H.T., 1962. "The Evolution of Life: Penguin Books Pty Ltd, Ringwood, Victoria, Australia

Raven, R.H., Johnson, G.B., 1998. *UnderstandingBiology*. Time mirror/ Mohy college Publishing.

Raven, R.H., Johnson, G.B., 2002. *Biology*. 6th Edition. McGraw Hill. Higher education, a division of the McGraw Hill Companies.

Raven, R.H., Johnson, G.B., 2015. *IntegrativeBiology*. 7th Edition. McGraw Hill education, Washington University.

<http://www.google.com.mm.search-evolution>

<http://en Wikipedia.org/wiki/evolution>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Core Course

Module No. Zool. 4101/ Zool. 4201

Module Name – Molecular Cell Biology

1. The Evolution of the cell
 - (i). Introduction
 - (ii). From molecules to the first cell
 - (iii). From Prokaryotes to Eukaryotes
 - (iv). From Single cell to multicellular Organisms
2. Small molecules, Energy, and Biosynthesis
 - (i). Introduction
 - (ii). The chemical components of a cell
 - (iii). Biological Order and Energy
 - (iv). Food and the derivation of cellular Energy
 - (v). Biosynthesis and the creation order
 - (vi). Coordination of catabolisms and Biosynthesis
3. Macromolecules; structure, shape and information
 - (i). Introduction
 - (ii). Molecular recognition process
 - (iii). Nucleic acid
 - (iv). Protein structure
 - (v). Protein as catalysis

REFERENCES

1. Bruce Alberts, Alexander. Johnson, Julian Lewis, Martin Ralt, Keinth Roberts and Peter Waltes 2012. Molecular Biology of the cell. Garland Science. New York.
2. Bruce Alberts, Denis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raft, Keinth Keinth Roberts, Peter Waltes 2015. Essential cell Biology (4th edition). Garland Science; New York.
3. Citation File III H/albert/Paginas/Indice.htm (1 to 7)
4. Curtis, H; Barnes, N.S, 1989. Biology (5th Edition), New York; Worth.
5. Darnell, J.E; Lodish, H.F; Baltimore, D. 1990. Chapter 26. New York; Scientific American Books.
6. John K Young. 2010. Introduction To Cell Biology. World Scientific Publishing Co. Pte. Ltd.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Core Course

Module No. – Zool 4102/ Zool 4202

Module name –Biodiversity and conservation

General Introduction to Biodiversity

Global overview of the status of biodiversity

Environmental trends and responses

National overview of the status of the biodiversity

Threats on Myanmar biodiversity

Biodiversity conservation

Categories of protected areas

Conservation and international cooperation

REFERENCES

Myanmar Investment opportunity in Biodiversity conversation, 2005.

Myanmar Biodiversity, 2012. Available at [https://www. Myanmar.biodiversity.com](https://www.Myanmar.biodiversity.com)

Wildlife Trade by WWF/TRAFFIC, 2014. Available at <https://www. Wildlife Trade.com>

5th National Report to the United Nation Convention on Biological Diversity, 2014

National Biodiversity Strategy and Action Plan, 2011.

Biodiversity Conservation and Management in Southeast Asia. Available at
[https://www.Asean Centre of Biodiversity \(ACB\).com](https://www.Asean Centre of Biodiversity (ACB).com)

Biodiversity. Chapter 5 PDF. Anonymous. Available at <https://www. Biodiversity.com>.

Summary on nature and biodiversity conservation in Myanmar.

Nature and Wildlife Conservation Division, April 2015.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Core Course

Module No. – Zool 4103/ Zool 4203

Module Name – Environmental Science

Environmental Science

Problem of pollution

The animals

The forestry

Education of environmental science

REFERENCES

Murthy, K..R., 2011. **A Textbook of Environmental Science**. 2nd Edition. Dominant Publishers and Distributors, New Delhi.

Srivastava.S., 2011. **Environmental Science**. 3rd Edition. S.K.Kataria&Sons®, New Delhi.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Core Course

Module No. Zool 4104/ Zool 4204

Module Name – Inferential Statistics

1. Introduction
2. Hypothesis Tests
3. Level of Significance
4. p -value
5. “z” Test
6. Student “t” Test
7. F test (Fisher’s test)
8. Chi-square Test
9. ANOVA Test
10. Correlation and Regression analysis
11. Spearman’s Rank correlation
12. Type I error
13. Type II error
14. One tailed
15. Two tailed

REFERENCES

Gurumani, N., 2004. An introduction to Biostatistics. Units of Tamilandu Book House. MJP Publisher Chennai, 289pp.

Kothari, C.R., 1990. Research methodology. Methods and Techniques, 2nded., Wishwa Prakashan, New Delhi, 468pp.

Murray R., Spiegel. Larry J. Stephens. 2018. SCHAUM's outlines statistics, sixth edition MCGraw–Hill Education.

Prasad, S., 2005. Fundamentals of Biostatistics (Biometry). Emkay Publications, Delhi. 164 pp.

Saha, T.K., 2004. Biostatistics in Theory and Practice. Emkay Publications, Delhi. 147pp.

Spiegel, M.R. and Stephens, L.J., 2008. Schaum’s outlines Statistics. 4th ed. 557pp.

Zar, J.H., 1996. Biostatistical Analysis. 3rd ed. 662pp.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Elective course

Module No. – Zool 4105/ Zool 4205

Module Name – Embryology I

1. Division, Growth and Differentiation of Cells
2. Gametogenesis
3. Fertilization
4. Cleavage and blastulation
5. Gastrulation and germ layer formation
6. Cell Signaling and Gene Functioning During Development
7. Stem Cells
8. Establishment of the Basic Body Plan
9. Coelomic cavities

REFERENCES

- Gilbert. S. F. 2010, Development Biology. Ninth Edition. Sinauer Associates, Inc. Pub.
- McGeady, T.A., Quinn, P.J., FitzPatrick, E.S., Ryan, M.T., Kilory, D., Lonergan, P., 2017. *Veterinary Embryology*. Second Edition. John Wiley & Sons, Ltd. UK.
- McGeady, T.A., Quinn, P.J., FitzPatrick, E.S., Ryan, M.T., 2006. *Veterinary Embryology*. Second Edition. John Wiley & Sons, Ltd. UK.
- Paul Hyttel, P., Sinowatz, F., Vejlsted. Vejlsted, M., Bettzidge, K., 2010. Essentials of Domestic Animal Embryology. Saneders Elsevig, London.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc 4th YEAR AND BSc (HONOURS) SECOND YEAR, FIRST SEMESTER

Elective course

Module No. – Zool 4106/ Zool 4206

Module Name – Molecular Genetics

1. The Molecular Basic of Heredity and Variation
2. Principles of Genetic Transmission
3. Genes and Chromosomes
4. The Molecular Structure and Replication of Genetic Materials
5. Gene Expression
6. Genetic Engineering and Genome Analysis

REFERENCES

1. A. Pihler and K. N. Timmis, 1984. Advanced Molecular Genetics, springer-Verlog Berlin Hlidelberg New York Tokyo.
2. Bruce Alberts, James Waston, Demis Bray, Julian Lewis, 2010. Molecular Biology of the cell. Garlan Science, Taylor & Rancis Group, Press, London.
3. Daniel L. Hartl and Elizavbeth W. Jones, 1998. Genetics: Principles and Analysis (4th Edits:), Jones and Bartleter Publishers, INC; London W 6 7 PA, UK.
4. Gurbachan Miglani 2015. Essentials of Molecular Genetics. Copublished by Alpha Science. International Oxford, UK and Narosa Publishing House, New Delhi, India.
5. Nadeen Akhtas 2015. Cell and Molecular Biology. Stadium Press. ILC, Texas, USA.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Core Course

Module No. – Zool.4111/4211

Module Name – Endocrinology I

Endocrine system

- Introduction to the endocrine system

Characteristics of hormones

Clinical significance

Anatomy of the endocrine system

- Medical definition of endocrine
- Lymphatic system
- Circulatory system

REFERENCES

Hormone Health Network (2017). "Endocrine Glands and Types of Hormones." *Hormone.org*. Retrieved on 2017-05-28 from <http://www.hormone.org/hormones-and-health/endocrine-glands-and-types-of-hormones>

Ingraham, Susan (2016). "The Exocrine System: How it Works." *Exocrine-System*. Retrieved on 2017-05-28 from <http://www.susaningraham.net/exocrine-system.html>

Hormone Health Network (2017). "The Endocrine System." *Hormone*. Retrieved on 2017-08-11 from <http://www.hormone.org/hormones-and-health/the-endocrine-system>

Sargis, Robert MD. "About the Endocrine System." *Endocrine Web*. Retrieved on 2017-08-13 from <https://www.endocrineweb.com/endocrinology/about-endocrine-system>

Open Stax College. (2018). *Anatomy & Physiology*. Houston, TX. Open Stax CNX. Retrieved from <http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@8.119>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Core Course

Module No. – Zool. 4112/4212

Module Name – Microbiology I

1. History of Microbiology
2. Microbiology Evolution and Diversity
3. Anatomy of prokaryotes
4. Nutrition of Bacteria
5. Structure of Animal Viruses
6. Pathogenesis of Viruses infection
7. Applications in Microbiology

REFERENCES

1. BSc Microbiology Syllabus (Thiruvalluvar University) 2008–2009. Bachelor of Science Degree Course.
2. Manjuyadav, 2012. Microbiology. Discovery Publishing House, 4831/24, Ansari Road, Prahlad street, Darya Ganj, New Delhi (India).
3. Joanne Willey, Linda Sherwood, Christo Pher J Woolverton, 2017. Prescott's Microbiology, 9th edition, e book.
4. Johnl, Ingrahan and Catherine, 2008. Introduction to Microbiology (2nd Edition).

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Core Course

Module No. – Zool. 4113/4213

Module Name – Biotechnology

1. Introduction to biotechnology
2. Genetics and Biotechnology
3. Bioprocess/Fermentation technology
4. Enzyme technology
5. Environmental biotechnology
6. Animal and Insect biotechnology
7. Biotechnology in medicine
8. Biosafety and Ethics

REFERENCES

1. Colin Ratiedge and Bjorn Kristiansen 2006. Basic Biotechnology. Cambridge University Press.
2. John E. Smith. 2009. Biotechnology (Fifth Edition). Cambridge University Press, Edinburgh Building, Cambridge CB2 8RU, UK.
3. Manju Yadav 2013. Biotechnology. Discovery Publishing House, New Delhi (110002). India.
4. Reinhard Rennebeg, Viola Beking; Varya Lorch, AL Demain, Tom A Rapport. Renate Fitz Raj; Darja Sussbies 2017. Saint Louis Elsevg Science Academic Press.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Core Course

Module No. – Zool. 4114/4214

Module Name – Aquaculture

Introduction

Aquaculture facilities

Aquaculture species

- Carps
- Tilapia
- Tiger shrimp, *Penaeus monodon*

Water quality in aquaculture

Nutrition

Diseases

Post-harvest technology and processing

REFERENCES

- Boyd, C.E. and Tucker, C.S., 1998. Pond aquaculture water quality management. Kluwer Academic Publishers, Boston.
- Bremner, A., Davis, C., Austin, B., 1996. Making the Most of the catch. AUSEAS, Brisbane, Australia.
- Bremner, H. A., 2002. Understanding the concepts of quality and freshness in fish.
- Bremner, H.A., 2002. Safety and quality issues and fish processing. Woodhead publishing limited, Cambridge, UK. Cambridge: Woodhead Publishing Ltd.
- Cen, F. and Zhang, D., 1998 . Development and status of the aquaculture industry in the People's Republic of China. World Aquaculture.
- D'Abramo, I.T., Mai, K., Deng, D.F., 2002. Aquaculture feeds and production in the people's Republic of China.progress and concerns. *World Aquaculture*, 32, 25-27.
- De Silva S.S. and T.A. Anderson, 1995. Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series, London, 319 pp.
- Ellis, A.E., 1988. *Fish Vaccination*, Academic Press, New York.
- FAO., 2006. State of world aquaculture 2006, by R. Subasinghe. FAO Fisheries Technical Paper No. 500. Rome.

- FAO., 2008a. FAO Expert Workshop on the Use of Wild Fish and/ or Other Aquatic Species as Feed in Aquaculture and its Implication to Food Security and Poverty Alleviation, Kochi, India.
- Halver, J.E., 2002. The vitamins. *In* J.E. Halver& R.W. Hardy, eds. *Fish nutrition*, 3rd Edn., New York, Academic Press Inc.
- Hardy, R.W., Barrows, F.T., 2002. Diet formulation and manufacturing. *In* J.E. Halver&R.W.Hardy, eds. *Fish nutrition*, 3rd Edn., New York, Academic Press Inc.
- Hasan, M.R., Hecht, T., De Silva, S.S. &Tacon, A.G.J. (eds.). 2007. Study and analysis of feeds and fertilizers for sustainable aquaculture development. FAO Fisheries Technical Paper No. 498. Rome, FAO.
- Huss, H.H., Jakobsen, M., Liston, J., 1992. Quality assurance in the fish industry. Elsevier Science Publishers, Newyork.
- Kabata, Z., 1985. Parasites and diseases of fish cultured in the tropics. Taylor & Francis. London and Philadelphia.
- Kestin, S.C. and Warriss, P.D., 2001. Farmed Fish Quality. Fishing news books, Oxford.
- Lucas, J and Southgate P., 2012. Aquaculture: farming aquatic animals and plants. Wiley-Blackwell, West Sussex, UK.
- Lundin C.G., 1997. Global attempts to address shrimp disease, Report of the Land, Water and Natural Habitats Division, Environment Department, The World Bank, Washington DC.
- Martin, A.M., 1992. Fisheries processing, biotechnological applications. Chapman and Hall, Oxford.
- National Research Council (NRC)., 1993. *Nutrient requirements of fish*. Washington, D.C., National Academy Press.
- New, M.B., Tacon, A.G.J., Csavas, I., 1993. Farm-made aquafeeds. FAO Fisheries Technical Paper No. 343. Rome, FAO.
- Sargent, J.R., Tocher, D.R., Bell, J.G., 2002. The lipids. *In*: Halver, J.E.; Hardy, R.W. (Eds.) *Fish nutrition*. USA, 2002. p.181-257.
- Sato, K., Sakaguchi, M., Bremner, H.A., 1994. Extra Cellular Matix of Fish and Shellfish. Research SingPost, Trivandrum, India.
- Sikorsi, Z.E., Pan, B.S., Shahidi, F., 1994. Seafood protein, Chapman and Hall, Newtork.
- Wilson, R.P., 2002 Amino acids and proteins. *In*: Halver, J.E.; Hasrdy, R.W. (Eds.) *Fish nutrition*. New York: Academic Press.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Elective Course

Module No. – Zool. 4115/4215

Module Name –Immunology I

History of immunology

Duty of immune system

Phagocytosis

Immunoglobulin

Immunosuppression

Innate immunity

Investigation of immunity

REFERENCES

Fudenberg, H.H., Sitter, D.P., Caldwell, J.L. and Wells, J. Vivian (1980). *Basic and Clinical Immunology*. California: Lange Medical Publications

Playfair, J.H.L. and Chain, B.M. (2005). *Immunology at a Glance*. 9th Edition. United Kingdom: A John Wiley & Sons Ltd, Publication

Walker, Sharon (2007). *Biotechnology DeMystified. A Self Teaching Guide*. New York: McGraw Hill

WHO Scientific Group (1978). *Immunodeficiency*. Technical Report Series 630. Geneva: World Health Organization

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc and BSc (Honours) Degree
ZOOLOGY

BSc (ZOOLOGY) FOURTH YEAR and SECOND YEAR HONOURS, SECOND SEMESTER

Elective Course

Module No. – Zool. 4116/4216

Module Name – Poultry Science and Management

Poultry farming

Stages of poultry production

Issue

Health management

Modern farming methods that are changing the face of agriculture

REFERENCES

Duguies, M.V., Artero,V.T. and Barcinas, J.D.T (2016). *Poultry production guide for a 500 layer operation.*

<http://www.arifarming.in/poultry-farming-guide-beginners/>

<http://www.farmcrowdy.com/modern-farming-methods/>

<http://www.poultryhub.org/health/health-management/>

<http://en.wikipedia.org/wiki/poultry-farming>

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree

Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

1. Module No. – Zool – 5201

Module Name – Embryology

- Gametogenesis
- Egg types
- Fertilization
- Embryonic development and differentiation (Frog)

REFERENCES

- Balinsky, B. I., 1970. *An Introduction to Embryology*. 3rd Edition. Toppan Printing Company Limited, Tokyo.
- Hickman, C. P., Roberts, L.S., Larson, A., 1993. *Integrated Principles of Zoology*. 9th Edition. Mosby-Year Book, Inc., Missouri.
- Raven, P. H., Johson, G. B., 2002. *Biology*. 6th Edition. McGraw– Hill Book Company, New York.
- Storer, T. I., Usinger, R. L., Stebbin, R.C., Nybakken, J. W., 1979. *General Zoology*. 6th Edition Tata McGraw–Hill Publishing Company Limited and Mohan Makhijani at Rekha Printers Pvt. Ltd., New Dehli–110020.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree

Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

2. Module No. – Zool – 5202

Module Name – Endocrinology

- Endocrine glands and hormones
- Neural and endocrine interaction
- Hypothalamic control of anterior pituitary gland
- Feed back control of anterior pituitary gland

REFERENCES

- Barrington, E. J. W., 1975. *An Introduction to general and comparative endocrinology*. London. Oxford University Press.
- Bentle, P. J., 1976. *Comparative vertebrate endocrinology*. New York, Cambridge University Press.
- Raven, P.H., Johnson, G.B., 2002. *Biology*, Sixth Edition. McGraw–Hill Higher Education, A Division of The McGraw–Hill Companies.
- Storer, I.T., Usinger, R.L., Stebbins, R.C., Nybakken, J.W., 1979. *General Zoology*, 6th Edition. McGraw–Hill Book Company, New York.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree

Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

3. Module No. – Zool – 5203

Module Name – Biodiversity

- Characterization of biodiversity
- Components of biodiversity
- Biodiversity from taxonomic and evolutionary perspectives
- Characterizing flora, fauna and microbiota
- Characterizing systematic patterns
- Characterizing species: Species concepts
- Power of taxonomy and taxonomic products

REFERENCES

- Heywood, V.H., Watson, R.T., 1995. *Global Biodiversity Assessment*. The United Nations Environment Programme. The University Press, Cambridge, Cambridge, Great Britain.
- Hyer, W. R., Donnelly, M.A., McDiarmid, R. W., Hayek, L. C., Foster, M. S., 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution Press, Washington and London.
- Hyer, W. R., Donnelly, M.A., McDiarmid, R. W., Hayek, L. C., Foster, M. S., 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Mammals*. Smithsonian Institution Press, Washington and London.
- Krebs, C. J., 2001. Ecology: The Experimental Analysis of Distribution and Abundance. Addition Wesley Longman, Inc. *Community organization I: Biodiversity*.
- Mayr, E., Ashlock, P.D., 1991. *Principles of Systematic Zoology*, International Edition. McGraw-Hill, Inc.
- Postlethwait, J. H., Hopson, J. L., 1988. *The Nature of Life*. McGraw-Hill Publishing Company.
- Raven, P.H., Johnson, G.B., 2002. *Biology*, Sixth Edition. McGraw-Hill Higher Education, A Division of The McGraw-Hill Companies.
- Storer, I.T., Usinger, R.L., Stebbins, R.C., Nybakken, J.W., 1979. *General Zoology*, Six Edition. Tata McGraw-Hill Publishing Company Limited and Mohan Makhijani at Rekha Printers Pvt. Ltd., New Dehli-110020.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree

Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

4. Module No. – Zool – 5204

Module Name – Virology and Bacteriology

(A) Virology

- Discovery of viruses
- Nature of viruses
- Bacteriophage and life cycle
- Viral diseases

(B) Bacteriology

- Introduction
- Bacteria surface
- Cell interior
- Bacterial diversity
- Bacteria metabolism
- Human bacterial diseases
- Importance of bacteria

REFERENCES

- Dubey R.C., Maheshwari, D.C., 2000. *Laboratory Microbiology*. 1st Edition. S.Chand and Company Ltd., New Delhi.
- Dubey, R.C., Maheshwari, D.C., 1999. *A Textbook of Microbiology*. 1st Edition. S.Chand and Company Ltd., New Delhi.
- Precott, L.M., Harley, J.P., Klein, D.A., 2003. *Microbiology*. 5th Edition. McGraw-Hill Companies, Sydney.
- Tortora G.J., Funk, B.R., Case, C.L., 2004. *Microbiology*. 8th Edition. Pearson Education Pte. Ltd., Singapore.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

5. Module No. – Zool – 5205

Module Name – Research Methodology

- Problem identification, analysis and statement of the problem
- Formulation of research objectives/ hypothesis
- Literature search
- Study design
- Variables
- Reliability and validity
- Data collection techniques
- Sampling and sample size
- Data management and analysis
- Data presentation

REFERENCES

- Anon., 1996. *Measuring and monitoring biological diversity: Standard methods for mammals*. Edited by Wilson D.E., F.R. Cole, J.D. Nichols, R. Rudran and M.S. Foster. Smithsonian Institution Press, London. 409 pp.
- Brower, J.E., Zar, J., von Ende, C.N., 1998. *Field and Laboratory Method for General Ecology* (4th Edition). The McGraw-Hill Companies, Inc., London. 273 pp.
- Dawson, C., 2002. *Practical research methods*. UBS Publishers Distributors, New Delhi.
- DMR, 2011. *Lecture guide on Research Methodology*. Department of Medical Research (lower Myanmar). Ministry of Health. Republic of the Union of Myanmar.
- Kothari, C.R., 1985. *Research methodology: Methods and Techniques*. Wiley Eastern Limited, New Delhi.
- Kumar, R., 2005. *Research Methodology: A step-by-step guide for beginners*. 2nd Edition. Pearson Education, Singapore.
- Martine R.E., Pine, R.H., Deblase, A.F., 2001. *A Manual of Mammalogy with Keys to Families of the World* (3rd Edition). McGraw-Hill Companies Inc., London. 333 pp.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR /MSc Qualifying, FIRST SEMESTER

Core Course

6. Module No. – Zool – 5206

Module Name – Linkage and Chromosome Mapping

(A) Linkage and Chromosome Mapping

- Recombination
- Genetic mapping
- Linkage estimates from F_2 generation

(B) Chromosome mapping

- Use of genetic map
- Cross over suppression
- Tetrad analysis
- Recombination mapping with tetrad
- Mapping the human genome

REFERENCES

Standfield, W.D. 1991. *Schavm's outline of Theory and Problems of Genetics*. 3rd Edition, McGraw-Hill Book Co, Inc, New York.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR, /MSc Qualifying, SECOND SEMESTER

Core Course

1. Module No. – Zool – 5207

Module Name – Physiology

- Introduction to animal physiology
- Animal structure and organization
- Energy transformation
- Heat control in animals
- Transport of water and solutes
- Plasma membrane transport

REFERENCES

- Campbell, N. A., Reece, J.B., 2004. *Biology*. 7th Edition. Pearson. Benjamin Cummings, San Francisco.
- Davson, H., 1964. *A text book of general Physiology*. 3rd Edition. J&A Churchill Ltd., London.
- Florey, E., 1967. *An introduction to general and comparative animal Physiology*. W.B. Saunders Company. Philadelphia, London.
- Hickman, C.P., Roberts, L.S., and Larson, A., 1995. *Integrated Principles of Zoology*. 9th Edition. Wm. C. Brown Publisher, USA.
- Kay, I., 1998. *Introduction to Animal Physiology*. Biddles Ltd., Guildford, UK.
- Withers, P.C., 1992. *Comparative Animal Physiology*. Saunder College Publishing, USA.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR/MSc Qualifying, SECOND SEMESTER

Core Course

2. Module No. – Zool – 5208

Module Name – Immunology

- Components of immune system
- Antigens and antibodies
- Antibodies and humoral immunity
- T- cells and cell mediated immunity
- Immunodeficiency
- Immune phenomena and medicine

REFERENCES

- Copper, M. and A. Lawton. 1974. *The Development of the Immune System.* Scientific American,
- Hood, L. E., I. L. Weisman, and W. B. Wood. 1982. *Immunology*. Second Edition. Menlo Park, Calif.: Benjamin-Cummings.
- Roitt, I. 1980. *Essential Immunology*, Fourth Edition. Oxford, England: Blackwell Scientific.
- Tonegawa, S. 1985. *The Molecules Immune System.* Scientific American.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR/MSc Qualifying, SECOND SEMESTER

Core Courses

3. Module No. – Zool – 5209

Module Name – Evolution

(A) Natural Selection

- Darwinian and genetic meaning of fitness
- Natural selection
- Types of selective processes
- New views on evolutionary mechanisms
- Directional and neuronal changes in gene frequency

(B) Origin of species

- Definition of species
- Preventing gene exchange
- The role of isolating mechanism
- Sorting out sexual selection
- Isolation of gene pools
- Genetic bases of speciation
- The regulatory genes and evolutionary changes
- Chromosomal changes
- Explaining macroevolution: Higher order changes, Fossil record
- Parallel, convergent, and divergent evolution
- Punctuated- equilibrium theory
- The role of micro evolution

REFERENCES

- Huxley, J. 1942. *Evolution: The Modern Synthesis*, Third Edition. New York, Hafner Press.
One of the Great Evolutionary Classes; the third edition contains a section on recent advances in evolutionary biology.
- Johnson, B. B., Losos, J. B., 2008. *The Living World*, Fifth Edition. McGraw-Hill Higher Education.
- Kent, G. C. 1992. *Comparative anatomy of the Vertebrates*, Seventh Edition. Mosby Year Book, Dedicated to Publishing Excellence.
- Mayr, E., Ashlock, P.D., 1991. *Principles of Systematic Zoology*, International Edition. McGraw-Hill, Inc. In Evolutionary Classification.
- Pianka, E. C. 1974. *Evolutionary Ecology*. New York, Harper & Row, Publisher, Incorporated.
- Romer, A. S., Parsons, T. S., 1977. *The Vertebrate Body*. W. B. Saunders Company.

Storer, I.T., Usinger, R.L., Stebbins, R.C., Nybakken, J.W., 1979. *General Zoology*, Six Edition. Tata McGraw-Hill Publishing Company Limited and Mohan Makhijani at Rekha Printers Pvt. Ltd., New Delhi-110020.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR/MSc Qualifying, SECOND SEMESTER

Core Courses

4. Module No. – Zool – 5210

Module Name – Palaeontology

(A) Introduction

- Definition
- Geological time
- Geological distribution

(B) Invertebrate Palaeontology

- The remains of animals and plants of past ages
- Mineral character of the skeleton
- Classification chart
- Examples of fossils

(C) Vertebrate Palaeontology

- Vertebrates in the fossil records
- Evolutionary theories and phenomena
- Classification chart
- Examples of fossils

(D) Palaeoecology

- Nature of Paleocology
- Economic applications
- Nature and classification of environments

REFERENCES

- Ager, D.V., 1963. *Paleoecology. An introduction to the study of how and where animals and plants lived in the past.* McGraw-Hill Book Company. New York.
- Eston, W.H., 1960. *Invertebrate Paleontology.* Harper and Row Publishers, Harper's Geoscience Series, New York.
- Imbrie, J. and Newell, N., 1964. *Approaches to Paleocology.* John Wiley and Sons, Inc., New York.
- Lane, N.G., 1978. *Life of the past.* Charles E. Merrill Publishing Company. A Bell and Howell Company, Columbus, Ohio.
- Matthews III, W.H., 1968. *Fossils.* An introduction to prehistoric life. 6th Edition. Barnes and Noble, Inc., New York.
- Moore, R., Lalicker, C.G., and Fisher, A.G., 1952. *Invertebrate fossils.* McGraw-Hill Book Company. New York.

- Romer, A.S., 1966. *Vertebrate Paleontology*. The University of Chicago Press, Chicago, Illinois.
- Storer, I. T., and Usinger, R.L., 1979. *General Zoology*. 6th Edition. McGraw-Hill Book Company. New York.
- Woods, H., 1963. *Palaeontology: Invertebrate*. Cambridge University Press, Cambridge.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR/MSc Qualifying, SECOND SEMESTER

Core Courses

5. Module No. – Zool – 5211

Module Name – Biotechnology

- Definition
- DNA Sequencing
- Cloning
- Four stages of genetic engineering experiment
- Biochips
- Medical applications
- Agricultural application
- Stem cells
- Ethics and regulation

REFERENCES

- Bloomfield, M. M., 1984. *Chemistry and the living organism*. 3rd Edition. John Wiley and Sons Inc. USA.
- Brown, T.A., 1999. *Genomes*. 1st Edition. BIOS Scientific Publishers Ltd. London.
- Brown, T.A., 2001. *Gene cloning and DNA analysis*. 4th Edition, Blackwell Science Ltd. London.
- Gupta, P.K., 2003. *Elements of Biotechnology*. 1st Edition, Reprint. Meerut University Meerut, India.
- Kuman, H.D., 1999. *Molecular Biology*. 1st Edition., Vikas Publishing House, PVT Ltd., New Delhi.
- Ramawat, K.G., Goyal, S., 2009. *Comprehensive Biotechnology*. 4th Revised Edition. S. Chand and Company Ltd. New Delhi.
- Roger, L.P., Adams, J. T., Knowler, Leader, D.P., 1986. *The Biochemistry of the nucleic acids*. 10th Edition, Chapman and Hall, London.
- Singh, B.T., 2002. *Biotechnology*. 1st Edition. Kalyani Publishers. New Delhi.
- Stryer. L., 1981. *Biochemistry*. 2nd Edition. W.H. Freeman and Company, San Francisco.
- Turner, P.C, Mclannan, A.G., Bates, A.D., and White M.R.H., 1999. *Instant notes in molecular biology*. 1st Edition, Second reprint. Niva Books Private Limited Delhi.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Syllabus for BSc (Honours) / MSc Qualifying Degree
Zoology

BSc (HONOURS) THIRD YEAR/MSc Qualifying, SECOND SEMESTER

Core Courses

6. Module No. – Zool – 5212

Module Name – Biometry

- Correlation and regression
- Sampling distribution
- Parametric and non-parametric analyses and tests
- Student's t Test
- Chi-square Test
- Z Test
- Mann-Whitney U Test
- Spearman's correlation test

REFERENCES

- Bleumen, A.G., 2007. *Statistic*. 6th Edition. McGraw-Hill, New York.
- Gurumani, N., 2004. *An introduction to Biostatistics*. HJP. Publications, Chennai, India.
- Langley, R., 1968. *Practical Statistis*. Pambook Ltd., London.
- Norusis, M.J., 1998. *Guide to data analysis*. Prentice-Hall, New Jersey.
- Prasad, S., 2005. *Fundamentals of Biostatistic(Biometry)*. Emkay Publications, New Delhi.
- Saha, T.K., *Biostatistics in Theory and Practice*. Emkay Publications, Delhi.
- Schesler, W.C., 1969. *Statistical for the biological science*. Addison-Wesley Publishing Company. London.
- Sokal, R.R., Rohlf, F.J., 1981. *Biometry*. 2nd Edition. W.H. Freeman and Company, San Francisco.
- Spiegel, M.R., 1961. *Theory and Problems of Statistics*. Schaum's outline Series. McGraw-Hill, New York.
- Zar, G.H., 1984. *Biostatistical analysis*. 2th Edition. Prentice-Hall, New Jersey.

PYAY UNIVERSITY
DEPARTMENT OF ZOOLOGY
Curriculum for MSc Course
MSc (Second Year) Semester I

Requirement	Types of requirement	Credit Units	Activities
Zool 631 Research Activities I	Proposal Submission (3 rd to 4 th Week of January)	4	to teach surveying literature and proposal writing to the student by the supervisor
Zool 632 Research Activities II	Research Outline and Presentation (Title Defense) (3 rd to 4 th Week of February)	4	to teach relevant research methodology and presentation English to the student by the supervisor and giving presentation by the student
Zool 633 Research Activities III	Seminar for Research Data as First Seminar (3 rd Week of March)	4	to teach the power point preparation and presentation English to the student by the supervisor and writing research outline and giving presentation by the student
Zool 634 Research Activities IV	Research Progress Report (4 th Week of March)	4	to teach report writing to the student by the supervisor and writing research and progress report by the student
	Total	16	

PYAY UNIVERSITY
 DEPARTMENT OF ZOOLOGY
 Curriculum for MSc Course
 MSc (Second Year) Semester II

Requirement	Types of requirement	Credit Units	Activities
Zool 641 Research Activities V	Seminar for Research Data as Second Seminar (2 nd Week of September)	8	to teach paper and thesis writing to the student by the supervisor and giving relevant seminar by student
Zool 642 Research Activities VI	Thesis and Viva Voce (End of September)	8	to edit thesis manuscript by the supervisor and thesis defense by the student
	Total	16	