VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH ZOOLOGY

(MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN LIFE SCIENCES with ZOOLOGY
(*Under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sc. / with Zoology	2nd	III	**SEMESTER-III**							
			Major-A2	ZOOPMJ02	**T: Comparative Anatomy & Developmental Biology of Vertebrates; P: Practical** ***(To be studied by students taken Zoology as Discipline- A)***	4	3-1-0	15	60	75
			Major-A3	ZOOPMJ03	**T: Cytology & Immunology; P: Practical** ***(To be studied by students taken Zoology as Discipline- A)***	4	3-1-0	15	60	75
			SEC	SEC03	***To be taken from SEC-03 of Discipline C.***	3	0-0-3	10	40	50
			AEC	AEC03	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor-3 (Disc.-C3)	ZOOMIN03	**T: Applied Zoology; P: Practical** ***(To be studied by students taken Zoology as Discipline- C)***	4	3-1-0	15	60	75
					Semester-III Total	20				375
		IV	**SEMESTER-IV**							
			Major-B2		***To be decided*** ***(Same as MajorA2 for Zoology taken as Discipline-B)***	4	3-1-0	15	60	75
			Major-B3		***To be decided*** ***(Same as Major–A3 for Zoology taken as Discipline-B)***	4	3-1-0	15	60	75
			Major (Elective) -1	ZOOMJE-01	**To be chosen from the given options** ***(To be studied by students taken Zoology as Discipline- A)***	4	3-1-0	15	60	75
			AEC	AEC04	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor -4 (Disc.-C4)	ZOOMIN04	**T: Genetics & Evolutionary Biology; P: Practical** ***(To be studied by students taken Zoology as Discipline- C)***	4	3-1-0	15	60	75
			Summer Intern.	IA	Internship / Apprenticeship- **activities to be decided by the Colleges following the guidelines to be given later**	4	0-0-4	-	-	50
					Semester-IV Total	22				400
					TOTAL of YEAR-2	42	-	-	-	775

MJP = Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

PROGRAMME OBJECTIVE

The course guides Bachelor's applicants through the incredible diversity of living forms, from simple to complex. It explains how each group of organisms originated and how they established themselves in the environment with their unique traits. In addition, it addresses the differences and similarities between organisms based on their morphology and anatomy, which led to their classification into taxa and clades.

MAJOR (MJ)

(MJ-A2/B2): Comparative Anatomy & Developmental Biology of Vertebrates

About the course

This course is designed at graduation level to know comparative account of the different vertebrate systems as well as basic embryology. The primary objective is to analyze and critically evaluate the structure and functions of vertebrate systems as well as early and late embryonic developmental process in vertebrates.

Learning outcomes

After successfully completing this course, the students will be able to:

1. Learn the comparative account of integument, skeletal components, their functions and modifications in different vertebrates.
2. Understand the evolution of heart, modification in aortic arches, and structure of respiratory organs.
3. Learn the about the importance of sense organs and excretory organs of vertebrates.
4. Understand the early embryonic developmental processes such as gametogenesis, fertilization, cleavage pattern, gastrulation, induction and organization.
5. Learn about the late embryonic developmental processes such as implantation and placentation.

MJA2/B2T: Comparative Anatomy & Developmental Biology of Vertebrates (Theory)

Credits 03

Course Contents:	**Hours**
Unit 1: Integumentary System General Structure & Derivatives of integument with reference to glands from fish to Mammalia.	5hrs
Unit 2: Skeletal System General idea of axial and appendicular skeleton; Evolution of visceral arches.	3 hrs
Unit 3: Digestive System Comparative account of digestive system in vertebrates with special reference to	4 hrs

ruminant stomach in mammals. **Unit 4: Respiratory System** Brief account of gills and swim bladder in fishes; air sacs in birds and lungs in mammals. **Unit 5: Circulatory System** Comparative account of heart and aortic arch with their evolutionary significance in vertebrates. **Unit 6: Urinogenital System** Types and development of kidneys and their ducts in anamniotes and amniotes. **Unit 7: Nervous System & Sense Organs** Comparative account of brain in vertebrates; Classification of receptors, Brief account of auditory receptors in vertebrate. **Unit 8: Early Embryonic Development** Gametogenesis: Spermatogenesis and oogenesis with reference to mammals; Fertilization: Types of fertilization & process of fertilization in mammals; Cleavage: Planes and patterns of cleavage; Cleavage process in frog; Types of Blastula; Fate maps; Gastrulation: Morphometric movements and process of gastrulation in frog. **Unit 9: Late Embryonic Development** Fate of germ layers; Extra-embryonic membranes in Chick; Implantation of embryo in humans; Structure, types and functions of placenta.	5 hrs 5 hrs 3 hrs 5 hrs 10 hrs 5 hrs

Recommended readings

1. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
2. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
4. Jordon & Verma. Chordate Emcryp;gy. S. Chand Pub. New Delhi.
5. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
6. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
7. Saxena, R.A. & Saxena, S. Coperative Anatomy of Vertebrates. Viva Publication.
8. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

MJA2/B2P: Comparative Anatomy & Developmental Biology of Vertebrates (Practical)
Credits 01

1. Demonstration (through dissection/video/chart/model) & identification of different parts of Brain, Afferent and Efferent branchial system in Tilapia/*Rohu*.
2. Dissection and mounting of pituitary gland in Tilapia/*Ruhu* and Pecten in fowl.
3. Mounting of cycloid, ctenoid and placoid scale in fish.
4. Identification of limb bones, girdles and vertebrae of *Bufo*, *Collumb* and *Cavia*
5. Identification of skull of toad, turtle, poisonous snake, *Coulmba* and *Cavia.*
6. Study of developmental stages - whole mounts and sections through permanent slides or photomicrographs – cleavage stages, blastula, gastrula, tail bud stage, tadpole external and internal gill stages.
7. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.

(MJ-A3/B3): Cytology & Immunology

About the course

The course provides a detailed insight into basic concepts of cellular structure and function. This course also gives the basic mechanisms and functional interplay of innate and adaptive immunity. The students will also know the structure and function of antigen and antibody and their interaction. It also provides knowledge about vaccine and vaccination process.

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop knowledge about structures and function of cellular organelles, immune cells, immunoglobulins, antigens and their interactions with antibodies.
2. Describe the cellular/molecular pathways of humoral/cell-mediated adaptive responses including the role of Major Histocompatibility Complex.
3. know about cytokines, hyper sensitivity reactions and cellular mode of immunity development.
4. Understand the functioning of nucleus and understand the intricate cellular mechanisms of cell division &cell cycle.
5. Acquire the detailed knowledge of apoptosis and anomalies in cancer.

MJA3/B3T: Cytology & Immunology (Theory) **Credits 03**

Course Contents:	**Hours**
Unit 1: Introduction to Cytology Cell theory and its modern version and interpretation; General structure of prokaryotes and eukaryotes; Subcellular fractionation.	4 hrs.
Unit 2: Plasma Membrane Concept of Fluid Mosaic Model; Membrane Lipids (Phospholipids and Cholesterol), Membrane proteins, Glycocalyx; Tight junctions, gap Junctions and plasmodesmata; Active transport, passive transport, endocytosis and exocytosis across the membrane.	7 hrs.
Unit 3: Cytoplasmic Organelles Ultrastructure & functions of nucleus, endoplasmic reticulum, Golgi apparatus, mitochondria, centrosome, peroxisomes and lysosome.	7 hrs.
Unit 4: Cytoskeletal Structures Structure, and function of microtubules, actin filaments and intermediate filaments.	3 hrs.
Unit 5: Cell Cycle & Cancer Cell cycle; Cell division- mitosis and meiosis; Cell division check points and their regulation; Basic concept of cancer; Proto-oncogene & tumor suppressor genes; Activation of a proto-oncogene to oncogene.	5 hrs.

Unit 6: Immune System Cells and organs of the immune system; Innate and adaptive Immunity;	3 hrs.
Unit 7: Antigens & Antibody Antigens and Immunogens; Adjuvants and happens; Factors influencing immunogenicity; B and T-Cell epitopes; Structure and functions of different classes of immunoglobulins; Antigen- antibody interactions; Monoclonal antibody.	6 hrs.
Unit 8: Major Histocompatibility Complex and Cytokines Structure and functions of MHC molecules; Types, properties and functions of cytokines.	4 hrs.
Unit 9: Complement System Components and pathways of complement activation.	3 hrs.
Unit 10: Vaccines Various types of vaccines; Active & passive immunization (Artificial and natural).	3 hrs.

MJA2/B2P: Cytology & Immunology (Practical) **Credits 01**

1. Demonstration of lymphoid organs.
2. Cell viability study by Trypan Blue Exclusion method.
3. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.
4. Identification of mitochondria by Janus Green B stain.
5. Histological study of spleen, thymus and lymph nodes through slides/ photographs.
6. Preparation of stained blood film to study various types of blood cells.
7. Determination of ABO blood group.
8. Demonstration of immunotechniques: Immunoelectrophoresis, RIA, ELISA, Immunofluorescence.

Recommended readings

1. Abbas K A, Lechtman H Andrew. 2003. Cellular and Molecular Immunology. Saunders Publication.
2. Delves PJ, Martin SJ, Burton DR, Roitt I M. 2006. Roitt's Essential Immunology. Blackwell Pub.
3. Kindt TJ, Goldsby RA, Osborne BA, Kuby J 2006. Immunology, W.H. Freeman and Company.
4. Shetty N. 2005. Immunology: Introductory Textbook, New Age International Pub.

5. Virella G. 2007. Medical Immunology, Informa Healthcare
6. Lodish, H. et al (2021) Molecular Cell Biology (9th edition) W.H. Freeman & Company.
7. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
8. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
9. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
10. Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.
11. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
12. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
13. Saxena, R.A. & Saxena, S. Coperative Anatomy of Vertebrates. Viva Publication.
14. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

MAJOR ELECTIVE (MJE-01)

(MJE-01): Parasitology

About the course

This course is aimed to provide the students some basic knowledge on Parasitology. It focuses on the host parasite interaction and different types of association. Students will be able to understand regarding the life history of some important parasites, their transmission pattern, pathogenicity, prevention and control.

Learning outcomes

After successfully completing this course, the students will be able to:

1. Learn the various types of parasites and hosts.
2. Establish the relationship between a parasite and the host and their effects.
3. Learn the morphology and life cycle of medically important parasites.
4. Describe and explain the appropriate measures for the prevention and control of parasitic diseases.

MJE-01T: Parasitology (Theory) **Credits 03**

Course Contents:	**Hours**
Unit 1: Introduction to Parasitology Definition and Classification of parasite and host; Parasitism: definition, features and types.	5 hrs
Unit 2: Parasitic Protists Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica* & *Plasmodium vivax*.	8 hrs
Unit 3: Parasitic Platyhelminthes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciola hepatica* & *Taenia solium*.	8 hrs
Unit 4: Parasitic Nematodes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides* & *Wuchereria bancrofti*.	7 hrs
Unit 5: Parasitic Arthropods Biology, importance and control of Soft tick (*Ornithodoros*), Hard tick (*Ixodes*) & Mites (*Sarcoptes*).	7 hrs

Unit 6: Parasitic Vertebrates Vampire bats their parasitic behaviour and effect on host.	3 hrs
Unit 7: Host-Parasite Relationship Origin and evolution of parasitism; Host-parasite interaction; Host immune response against parasite.	7 hrs

MJE-01P: Parasitology (Practical) **Credits 01**

1. Identification of *Balantidium* sp., *Trypanosoma* sp., *Leishmania* sp., *Plasmodium* sp., *Fasciola* sp., *Taenia* sp., *Cimex* sp., *Pediculus* sp., (permanent slides/micro photographs).
2. Isolation and mounting of parasite(s) from the gills of fish.
3. Staining of any protozoan/helminth parasite from gut of cockroach.
4. Whole mount preparation of any arthropod parasite.

Recommended readings

1. Arora D R, Arora B. 2001. Medical Parasitology. II Edition. CBS Publications and Distributors.
2. Bogitsch B J, Carter CE, Oeltmann TN. 2013. Human Parasitology. 4th Edn. Elsevier.
3. Bose M. 2017. Parasitoses and zoonoses. New Central Book Agency.
4. Chatterjee K D. 2009. Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers.
5. Dailey MD. 1996. Meyer, Olsen & Schmidt's Essentials of Parasitology. W.C. Brown Publishers
6. Gunn A, Pitt SJ. 2012. Parasitology: An Integrated Approach. Wiley Blackwell.
7. John DT, Petri WA. 2006. Markell and Voge's Medical Parasitology. Elsevier.
8. Marr JJ, Nilsen TW, Komuniecki RW. 2003. Molecular Medical Parasiology. 2nd Edn. Academic Press.
9. Muller R, Wakelin D. 2002. Worms and Human Disease. CAB International Publication.
10. Noble ER, Noble GA. 1989. Parasitology: The biology of animal parasites. Lea & Febiger.
11. Smyth, J.D.2005. Animal Parasitology. Cambridge University Press.
12. Roberts, L. S., Janovy, J. and Nadler S. (2013) *Gerald D. Schmidt &Lary S. Roberts' Foundation of Parasitology*. 9th ed. McGraw-Hill International.
13. Hati, A. K. (2001). *Medical Parasitology*. Allied Book Agency, Kolkata.
14. Cox, F. E. G. (1993). *Modern Parasitology*. 2nd ed. Blackwell Scientific Publications. Lea and Febiger, Philadelphia.

OR

(MJE-01): Environment and Public Health

About the course

The course designed for Environment and Public Health at graduation level will give understanding for burning environmental issues such as climate change, indoor and outdoor pollution, Waste & its management and their effects on public health and diseases.

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop knowledge about global warming, acid rain, and smog formation and their effect on public health.
2. Gain a knowledge of waste management.
3. Understand cause, impact and remedial measures of different diseases caused by pollutants.

MJE-01T: Environment and Public Health (Theory) **Credits 03**

Course Contents:	**Hours**
Unit 1: Introduction Sources of Environmental hazards; Hazard identification and accounting; Fate of toxic and persistent substances in the environment; Dose response evaluation; Exposure assessment.	7 hrs
Unit 2: Climate Change Greenhouse gases and global warming; Cause and impact of Acid rain & Smog; Ozone layer depletion; Effect of climate change on public health	10 hrs
Unit 3: Pollution Definition & types of pollution; Cause, effects and control measures of air, water, noise, soil and indoor pollution.	10 hrs
Unit 4: Waste Management Technologies Sources, types and characteristics of waste; Sewage disposal and its management; Solid waste disposal; Biomedical waste handling and disposal; Nuclear waste handling and disposal; Waste from thermal power plants.	10 hrs
Unit 5: Diseases Causes, symptoms and control of tuberculosis, asthma, cholera, typhoid, filariasis & Minamata disease	8 hrs

MJE-01P: Environment and Public Health Practical (Practical) **Credits 01**

1. Determine pH and Cl in soil and wa ter samples from different locations.
2. Determination of Total alkalinity, and hardness of water.
3. Determination of moisture content & organic carbon of soil.
4. Conduct a waste audit by categorizing and weighing different types of waste (organic, plastic, metal, e-waste).
5. Collect and analyze data on energy usage and transportation.

Recommended readings

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

MINOR (MI)

MI-3/C3: Same as Minor-3 (ZOOSMIN03) of Zoology (Hons) programme **Credits 04**
FM: 75

MI-4/C4: Same as Minor-4 (ZOOMIN04) of Zoology (Hons) programme **Credits 04**
FM: 75

SKILL ENHANCEMENT COURSE (SEC)

(To be studied by students taken Zoology as Discipline- C)

SEC-03 P: Same as SEC-03 (ZOOSEC03) of Zoology (Hons) programme **Credits 03**
Full Marks: 50