Resolution No. AC/II(22-23).3.RUS12

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: F.Y.B.Sc.

Program Code: (RUSZOO)

(As per the guidelines of National Education Policy 2020-
Academic year 2023-24)

(Choice based Credit System)

GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

GA	GA Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	**Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.**
GA 2	**Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.**
GA 3	**Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.**
GA 4	**Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.**
GA 5	**Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.**
GA 6	**Apply scientific information with sensitivity to the values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.**
GA 7	**Follow ethical practices at the workplace and be unbiased and critical in the interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.**
GA 8	**Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner.**

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in Science program in the subject of ZOOLOGY will be able to:**
PO 1	Identify the major groups of organisms, discuss the basis of their biodiversity, and draw parallels with their phylogenetic relationship, using well-thought cardinal features of classification on the basis of morphology and molecular information.
PO 2	Understand and analyse the evolutionary link amongst the animals and also understand the basic classification patterns of invertebrates and vertebrates. They will be able to compare and contrast the anatomy and physiology of different invertebrates and vertebrate phylum.
PO 3	Analyse the genes, genomes, cells, cell organelles, tissues and histological studies, understand the linkage of genes, mechanisms of sex determination, various structures of DNA and apply the knowledge of genetics to the process of evolution.
PO 4	Analyse and understand the broad concepts of ecology, food webs, food chains and the interconnectedness of biotic and abiotic factors. Comprehend the concepts of Population dynamics, communities and its dependence on the ecosystems.
PO 5	Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
PO 6	Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within Zoology.
PO 7	Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

CREDIT STRUCTURE BSc

Semester	Subject 1		Subject 2	GE/ OE course (Across disciplines)	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEPCC, RP	Total Credits
	DSC	DSE						
1	4		4	4 (2*2)	VSC-2 + SEC -2	AEC- 2 (CSK) + VEC- 2 (Env Sc.) + IKS-2		22
2	4		4	4 (2*2)	VSC-2 + SEC-2	AEC-2 (CSK)+ VEC-2 (Understanding India)	CC-2	22
Total	8		8	8	8	10	2	44
Exit option: award of UG certificate in Major with 44 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
3	Major 8		Minor 4	2	VSC-2	AEC-2 MIL	FP -2, CC-2	22
4	Major 8		Minor 4	2	SEC-2	AEC-2 MIL	CEP-2, CC-2	22
Total	16		8	4	4	4	8	44
Exit option: award of UG Diploma in Major with 88 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
5	DSC 12	DSE 4	Minor 2		VSC-2		CEP/FP-2	22

6	**DSC 12**	**DS E 4**	**Minor 2**				**OJT-4**	**22**
Total	**24**	**8**	**4**		**2**		**6**	**44**
	Exit option: award of UG Degree in Major with 132 credits or Continue with Major for Honours/ Research							

Course Code: RUSZOO.O101

Course Title: LEVELS OF ORGANIZATION and NON CHORDATES

Type of Course: Discipline Specific Core Course

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Describe the Taxonomy, Systematics and classification of animals, its objectives and importance.
CO 2	Explain the importance of levels of organization in the animal kingdom.
CO 3	Enumerate the significance of scientific terminologies, the concept of ICZ and binomial nomenclature.
CO 4	Understands the importance of classification of animals and Classifies the non-chordate animal according to its systematic hierarchy.
CO 5	Justify the position of the non-chordate animal according to comparative morphology.

DETAILED SYLLABUS

Course Code	Unit	Course Title LEVELS OF ORGANIZATION and NON CHORDATES	Credits/ Hours 3/45
RUSZOO.O101	Unit I	**Animal classification and Levels of organization** **1.1 Principles of classification:** a) Taxonomy: Introduction and types - Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy, Macro taxonomy: Phenetics (numerical taxonomy, Cladistics (Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics) b) Systematics: definition introduction	1/15

		c) Linnaean system of classification (Six level classification: Phylum, class, order, family, genus, species) d) Introduction to Binomial Nomenclature e) Introduction to Five kingdom system. f) International Code of Zoological Nomenclature (ICZN), its operative principles **1.2 Levels of organization in animal kingdom:** a) Uni-cellularity versus multi-cellularity b) Colonization and organization of germ layers (Diploblastic and triploblastic condition) c) Division of labour and organization of tissues (brief fate of ectoderm, mesoderm and endoderm) d) Coelom - Types- Acoelomate - e.g. Platyhelminthes - *Planaria* Pseudocoelomate - e.g. Nematoda - *Ascaris* (Round worm) Coelomate - e.g. Annelida - *Pheretima* (Earthworm e) Symmetry – Types Asymmetry - e.g. *Amoeba* Radial – e.g. Bi-radial –*Aurelia* (Jelly – fish); Penta– radial- *Asterais* (Starfish) Bi-lateral- e.g. Simple- *Planaria*; Complex – *Mus* (Rat) f) Segmentation and metamerism – Types Homonymous– e.g. Annelida- *Pheretima* (Earthworm) Heteronomous– e.g. Crustacean- *Panulirus* (Lobster) Cephalization–e.g. Insecta- *Periplanata* (cockroach) Cephalothorax - e.g- *Penaeus* (Prawn)	
	Unit II	**Non chordates– I** Salient features with examples for phyla, sub-phyla,classes and distinguishing features 2.1 Phylum Protozoa a) Bioluminescence b) Life cycle of *Taxoplasma gambia* c) Parasitology 2.2 Phylum Porifera a) Types of canal system with example of each	**1/15**

		2.3 Phylum-Coelenterata a) Polymorphism b) Types of coral reefs depending on method of their formation c) Threats for coral reefs d) Conservation and protection of coral reefs 2.4 Phylum- Platyhelminthes a) Life cycle- Planaria b) Adaptation to the environment c) Parasitology 2.5 Phylum- Nemathelminthes a) Life cycle- *Ascaris lumbricoides* b) Adaptation to the environment c) Parasitology 2.6 Phylum- Annelida a) Regeneration b) Economic importanceAdaptation to the environment	
	Unit III	**Non chordates – II** Salient features with examples for phyla, sub-phyla,classes and distinguishing features **3.1 Phylum: Arthopoda -** a) Salient features with examples of each class. b) Metamorphosis in Arthropoda. c) Light producing insects. d) Peripatus (Connecting link annelids and arthropod) e) Economic uses of the members of phylum Arthropoda. f) Efficiency of Insects g) Insect pheromones **3.2 Phylum: Mollusca**- a) Salient features with examples of each class. b) Histology of shell and Mechanism of pearl formation. c) Economic uses of the members of phylum Mollusca. **3.3 Phylum: Echinodermata**- a) Salient features with examples of each class. b) Water vascular system c) Regeneration and metamorphosis in starfish. d) Threat of Echinoderm (Crown of thorn starfish) to coral reef.	**1/15**

Practical

Course Code: RUSZOOP.O101		
Sr. No.	**Practical Title- LEVELS OF ORGANIZATION and NON CHORDATES**	**Credit 1**
1.	Levels Of Organization a) Symmetry - Ameoba, Sea anemone,Liverfluke, Planaria b) Coelom – Planaria, Ascaris, Earthworm c) Segmentation – Tapeworm and Earthworm d) Cephalization - Cockroach e)Cephalothorax - e.g- *Penaeus* (Prawn)	
2.	Classification: a) Protozoa - Amoeba*, Paramoecium, Euglena, Plasmodium* b) Porifera - *Leucosolenia, Euspongia* c) Coelenterata – *Hydra, Obelia* colony, *Aurelia,* Sea anemone, *Fungia* d) Platyhelminthes - *Planaria, Fasciola hepatica, Taenia solium* e) Nemathelmithes - *Ascaris* f) Annelida - *Nereis,* Earthworm, Leech	
3.	Study of Bioluminescence in Firefly and gloworm.	
4	Study of metamorphosis in insects -cockroach, dragon fly, honey bee and butterfly, Lepisma	
5.	Study of general organization of insect endocrine systems.	
6.	Study of Echinoderm larvae and crustacean larvae	
7.	a) Study of Crown of thorn starfish (COTS) with reference to coral reef. **b)** Study of types of corals: Brain Coral, Organ pipe Coral, Staghorn Coral, Mushroom Coral	
8.	Study of an evolutionary link between annelids and arthropods.	
9.	Mounting of Foraminiferan shells	

References:

1. A Textbook of Zoology Invertebrates, Vol. I 1992, 7th Edn. Parker and Haswell edited by Marshall William, C B S publishers and distributors, New Delhi.
2. Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press.
3. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science Barrington, E.J.W. (1979). Blackwell Scientific, U.K.
5. Brusca, R.C andBrusca, G. J (2003): Invertebrate (2nd ed.) Sinauer Associates Inc., Publishers Sunderland. California.
6. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.college Publishing, USA.
7. Goodnight and others, General Zoology, IBH Publishing Co. Nigam H. C. and Sobti, R., Functional Organization of chordates, S. Chand and Co.
8. Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
9. Invertebrate Zoology, 1991, P.A. Meglitsch and F. R. Schram, Oxford University
10. Invertebrate Zoology, 1992 4th Edn., reprint, P.S. Dhami and J. K. Dhami, R. Chandand Co., New Delhi.
11. Invertebrate: A New synthesis, 1988, R.S.K. Barnes, P. Calow and P.J.W., Olive
12. Invertebrates Structure and Function, 2nd Edn.1979, EJW Barrington, John Wiley and
13. Invertebrates Zoology, 1994, 6th Edition, Ruppert, E. Edward, R. D. Barnes; Saunders
14. Jeffery Parker and William. A. A Textbook of Zoology, Vol. II- T, Haswell-Low Price Publications.
15. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram
16. Life of Invertebrates, 1992; S.N. Prasad, Vikas Publishing House, New Delhi.
17. Living Invertebrates, 1987: Pearse, Buchsbaum, Blackwell Scientific Publication, London
18. Modern text book of Zoology, Invertebrates 10th Edn., 2009, R.L. Kotpal, Ra stogi Nagar, New Delhi.
19. Phylum series from Protozoa to Echinodermata- R.L. Kotpal. Rastogi publ., Meerut.
20. Press;New York.publ., Meerut.
21. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. Sons Inc.

Modality of Assessment: Discipline Specific Core Course (3 Credit Theory Course for BSc)

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class Test	20
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**30**

B) External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
1	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 1
2	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 2
3	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 3
	TOTAL	**45**	

Practical Examination Pattern: Total Marks 50

A. **Internal Examination: 40%- 20 Marks**

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field report/ Presentation	10
Total	**20**

B. **External Examination: 60%- 30 Marks**

Semester End Practical Examination:

Particulars	**Practical**
Major Experiment and/or Minor Experiment, Identification and *Viva voce*	30
Total	**30**

Course Code: RUSZOO. E111

Course Title: CHORDATES AND BIODIVERSITY

Type of Course: Discipline Specific Core Course

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Classify and compare the characters of subphylums of hemichordates, Urochordata Cephalochordata and Vertebrates.
CO 2	Compare the types of scales in fishes and claws, feathers and beaks in birds.
CO 3	Understand and compare parental care in Fishes Amphibian and Mammals.
CO 4	Explain bird as flying machine model and also Echolocation(Bat,Dolphin and Whale).
CO 5	Enumerate the Adaptation of animals to desert life.
CO 6	Define the concepts of Hotspot, biodiversity values, threats to biodiversity, conservation, and management of biodiversity.
CO 7	Identify the biodiversity hotspots and describe the flora and fauna found there.
CO 8	Understand the importance of methods of conservation of locally found flora and fauna.
CO 9	Write the field report on the basis of the comparative morphology of animals by conducting the field survey.

DETAILED SYLLABUS

Course Code	Unit	Course Title - CHORDATES AND BIODIVERSITY	Credits/ Hours 3/45
RUSZOO. E111	**Unit I**	**Chordates - I** Salient features with examples for phyla, Subphylum, classes and distinguishing features **1.1. Phylum: Hemichordata** Class-Enteropneusta, Pterobranchia, Plantospheroidea, Graptolita **1.2. Phylum: Chordata** a) Subphylum: Urochordata • Class-Ascidiacea, Thaliacea and Larvacea. e.g.Herdmania. • Retrogressive metamorphosis in Ascidia. b) Subphylum: Cephalochordata • Class-Leptocardii e.g.Branchiostoma c) Subphylum Vertebrata • Super-class: Agnatha • Class Cyclostomata e.g. Petromyzon. • Migration in Petromyzon. d) Super-class: Gnathostomata • Class: Pisces (Cartilaginous e.g.Rhinobatos and bony fish e.g.Exocetus) • Parental care and biolumenscance in fishes	**1/15**
	Unit II	**Chordates - II** Salient features with examples for classes and distinguishing features 2.1 Class: Amphibia a) Salient features with examples of Frog b) Parental care in Amphibia. c) Neoteny and Paedogenesis 2.2 Class: Reptilia a) Salient features with examples of Turtle. b) Regeneration in Lizard. 2.2 Class: Aves a) Salient features with examples of Parrot. b) Migration and brood parasitism in birds. c) Birds are glorified reptiles d) Birds as flying machine. 2.3 Class: Mammalia	**1/15**

		a) Salient features with examples of.bat. b) Parental care, c) Echolocation(Bat,Dolphin and Whale) d) Adaptation to desert life	
	Unit III	**Biodiversity and Conservation** **3.1.Introduction to Biodiversity:** Definition**,** Concepts and Scope and Significance **3.2.Levels of Biodiversity:** Introduction to Genetic, Species and Ecosystem Biodiversity **3.3. Introduction of Biodiversity Hotspots:** Western Ghats (Kerala, Tamil Nadu, Karnataka, Goa Maharashtra, Gujarat) and Indo- Burma Border **(**Arunachal Pradesh, Nagaland, Mizoram, Manipur) **3.4.Values of biodiversity:** Direct and Indirect use value **3.5Threats to Biodiversity:** Habitat loss and Man-Wildlife conflict a) Case study: Elephant man conflict and Introduction to alien species b) Case study of introduction of wolf in yellowstone national park. **3.6.Biodiversity conservation and management:** a) Conservation strategies: in situ, ex-situ, National parks, Sanctuaries and Biosphere reserves. b) b) Introduction to International efforts: Convention on Biological Diversity (CBD) c) c) International Union for Conservation of Nature and Natural Resources (IUCN), d) d) United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC), wetland conservation (Ramsar sites) e) e)National Biodiversity Action Plan, 2002 **3.7.**Introduction to Indian Wildlife (Protection) Act, 1972 and Convention for International Trade of endangered species 3.8. Management strategies with special reference to Tiger and Rhinoceros in India 3.9.Ecotourism and Bio-piracy	**1/15**

Practical

Course Code: RUSZOOP. E111	
Sr. No.	**Practical Title- CHORDATES AND BIODIVERSITY**
1.	a) Hemichordata - *Balanoglossus* b) Urochordata - *Herdmania* c) Cephalochordata - *Amphioxus* d) Cyclostomato – *Petromyzon*, *Myxine* e) Pisces – Shark, Skates, Sting ray/Electric ray, Flying fish,bioluminescence in angler fish f) Amphibia – Frog, Toad, Caecilian, Salamander g) Reptilia – Chameleon, *Calotes*, Turtle, Tortoise, Snake, Crocodile h) Aves – Kite, Kingfisher, Duck i) Mammalia – Shrew, Hedgehog, Guinea pig, Bat
2.	Mounting of Scales of Fish.
3.	Parental in fishes (Tilapia, cat fish, viviparity, oviparity, ovoviviparity, sea horse, pipe fish)
4	Breeding and parental care in Amphibians (Rhacophorus, Midwife toad Darwin's frog, Caecilian)
5.	Identification of common urban birds with respect to: a) feathers b) beaks and c) claws (Models/ slide show)
6.	Estimation of population density of animals by line transect method (frequency distribution& through Pie diagram only).
7.	Estimation of population density of animals by quadrant method (frequency distribution& through Pie diagram only).
8.	Field visit to any national parks and write a report

References:

1. Animal Diversity by Kershaw, D. R., Redwood Burn Ltd., Trowbridge
2. Chordate Zoology by Jorden E. L., andVerma P. S., S. Chand and Co., New Delhi
3. Functional Organization of Chordates (Part I and II) by Nigam H. C. and Sobti, R., S. Chand and Co., New Delhi.

4. General Zoology by Goodnight and others IBH Publishing Co.
5. Introduction to Amphibia by Bhamrah, M. S., Juneja, K., Anmol Publication, Delhi Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London
6. Jeffery Parker and William. A. A Textbook of Zoology, Vol. II- T, Haswell-Low Price Publications.
7. Jordan and Verma. Vertebrate Zoology Volume I, S. Chand and Co.
8. Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London
9. Mona Purohit. Wildlife laws and its impact on tribes - Deep and deep Publication.
10. Prasad, S. N., Kashyap, V., Textbook of Vertebrate Zoology, New Age India Publishers.
11. Textbook of Vertebrate Zoology, by Kotpal, R. L., Rastogi and Co. Meerut
12. Textbook of Zoology by Parkar J. and Haswell, W., ELBS Edition
13. Textbook of Zoology by Vidyarthi, Agrasia Publishers, Agra
14. University Text Book of Zoology- Introduction to Ecology and Wildlife, F.Y.B.Sc. Semester II Course 3. University Press.
15. Young, J. Z., Life of Vertebrates, Clarendon Press, London

Modality of Assessment: Discipline Specific Core Course (3 Credit Theory Course for BSc)

C) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class Test	20
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**30**

D) External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

3. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
4. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
1	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 1
2	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 2
3	A) (OR) A) (i and ii) B)	8 OR 8(4+4)+7= 15	UNIT 3
	TOTAL	**45**	

Practical Examination Pattern: Total Marks 50

C. **Internal Examination: 40%- 20 Marks**

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field report/ Presentation	10
Total	**20**

D. **External Examination: 60%- 30 Marks**
Duration – The duration for these examinations shall be of 2 Hours.
Semester End Practical Examination:

Particulars	**Practical**
Major Experiment and/or Minor Experiment, Identification and *Viva voce*	30
Total	**30**