Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur (C.G.)

Scheme and Syllabus

of

M.Sc. (Zoology) I, II, III and IV Semester

Program Code: MSCZOOLR1289

Semester System for affiliated college

(As per LOCF and credit system)

w.e.f. 2024-25/2025-26

अटल बिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)

कोनी पुलिस थाना के सामने, बिलासपुर–रतनपुर मार्ग, कोनी, बिलासपुर (छ.ग.) 495009

Website : www.bilaspuruniversity.ac.in

Scheme of M.Sc. (Zoology) under Semester System
Program Code: MSCZOOLR128

Semester	Course Code	Subject Name	Credit			Total Credit	Marks			
							ESE	IA	Total	
			L	P	T				Max	Min
First	MSCZOOLT101	Structure and Function of Invertebrate & Minor phyla	3	-	1	4	80	20	100	36
	MSCZOOLT102	Animal Behaviour	3	-	1	4	80	20	100	36
	MSCZOOLT103	Biosystematics, taxonomy and diversity	3	-	1	4	80	20	100	36
	MSCZOOLT104	Ecology & Environmental Physiology	3	-	1	4	80	20	100	36
	MSCZOOLP101	Lab Course-I	-	2	-	2	100	-	100	36
	MSCZOOLP102	Lab Course-II	-	2	-	2	100	-	100	36
Subtotal			**12**	**4**	**4**	**20**	**-**	**-**	**600**	
Second	MSCZOOLT201	Comparative Anatomy of Vertebrates	3	-	1	4	80	20	100	36
	MSCZOOLT202	Gamete Biology and Reproductive Physiology in Human Being	3	-	1	4	80	20	100	36
	MSCZOOLT203	Molecular Cell Biology	3	-	1	4	80	20	100	36
	MSCZOOLT204	Tools and Techniques for Biology	3	-	1	4	80	20	100	36
	MSCZOOLP201	Lab Course-I	-	2	-	2	100	-	100	36
	MSCZOOLP202	Lab Course-II	-	2	-	2	100	-	100	36
Subtotal			**12**	**4**	**4**	**20**	**-**	**-**	**600**	

M Sc Zoology
Programme Specific Outcome (PSO)

- Providing students with a comprehensive understanding of zoology starting from the fundamental biochemical, molecular, and cellular level, Extending to the study of physiology and reproduction at a organism level, and impact of ecological factors on animals across various levels of organization (individuals, populations, communities, ecosystems, etc.).
- Understand biological diversity, particularly in the animal kingdom. Understand the different forms of animals, both invertebrates and vertebrates, and how they are classified systematically. Learn Comparative structural studies emphasising comparing anatomical features and identifying patterns of evolutionary relationships.
- Learn and appreciate the processes and forces that drive evolutionary changes over the time, understand mechanisms of evolution, such as natural selection, genetic drift, and speciation.
- Understand concepts of physiology, molecular biology, endocrinology, cell biology, and ecology.
- Learn importance of developing practical skills in molecular biology, techniques which involve separation identification and estimation of biological molecules.
- Emphasizes the need to gain proficiency in biostatistics, which is essential for analyzing and interpreting biological data.
- In optional group I Students will understand fish biology and taxonomy. It focuses on introducing students to the fundamental principles and concepts of fisheries science and aquaculture, Students will learn about different aquaculture systems, species selection, and sustainable aquaculture practices.
- In the optional group II student will understand the fundamental principles of cell biology, including the structure, function, and organization of cells. Explore cell signalling and communication, focuses on the metabolic pathways within cells. Students will explore the regulation of cellular energy production and utilization.
- In the optional group III we aims to introduce students to the study of insects, their taxonomy, morphology, physiology, behaviour, and ecology and focuses on the practical applications of entomological knowledge in agriculture, forestry, public health, and other relevant fields. Students will explore how entomological principles can be utilized to address real-world challenges and improve human welfare.
- In the optional group IV students will understand the ecology, behavior, and natural history of wildlife species. Students will learn about the interactions between wildlife and their environment focuses on introducing students to the fundamental principles and concepts of wildlife conservation, learning the techniques and methods used to assess wildlife populations and monitor their status over the time.
- Overall, these PSOs provide a comprehensive roadmap for students in the post graduate programme in Zoology, ensuring that they acquire knowledge and skills in various aspects of zoology.

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Part A: Introduction				
Program: M.Sc. (Zoology)		Semester: I	Year: 2023-2024	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT101**		
2.	Course Title	**Structure and Function of Invertebrates & Minor Phyla**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	Passed B.Sc. Biology		
5.	Course Learning. Outcomes (CLO)	Learning Outcome: Upon completing the course on invertebrates and their structure and function, students will be able to: • Identify and classify major invertebrate groups based on their structural characteristics and evolutionary relationships. • Understand the diverse adaptations and specialized structures exhibited by different invertebrates for locomotion, feeding, reproduction, and defense. • Describe the functional anatomy of various invertebrate systems, including the nervous system, digestive system, circulatory system, respiratory system, and reproductive system. • Explain the physiological processes and mechanisms unique to invertebrates, such as molting, metamorphosis, and regeneration. • Recognize and discuss the impact of human activities on invertebrate populations and ecosystems, and explore strategies for conservation and sustainable management. • Communicate effectively about invertebrate structure and function through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • Develop a deeper appreciation for the diversity, complexity, and ecological significance of invertebrates, fostering a broader understanding of biodiversity and the natural world.		
6.	**Credit Value**	**3L+ 1T= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content oftheCourse		
Unit	**Topics**	**Total Hours**
I.	**Classification of invertebrate phyla up to orders with example** – Protozoa, Porifera, Coelenterate, Platyhelminths, Nemathelminthis, Annelida, Arthropoda, Mollusca, Echinodermata, Relationship – Acoelomate and coelomate, Protostomes and Deuterostomes, Bilateria and Radiate, Metamerism in Annelida	12
II.	**Canal system in sponge (porifera).** **Polymorphism in Coelendrata** **Coral reef and their formation** **Locomotion-** Amoeboid movement, Ultrastructure of cilia, Flagella and their movements, Myonemes and muscle fibres in invertebrates - structures and their movements, Hydrostatic movements in Coelenterate, Annelida and Echinodermata, Torsion in Gastropoda	12
III.	**Nutrition and Digestion-** Patterns of feeding in lower metazoan, Filter feeding in Polychaeta, Mollusca and Echinodermata, Modification of mouth parts in Insects (Cockroach, Mosquito, Housefly, Honey bee) **Respiration-** Respiratory organs – Gills, Trachea, Lung structure and their mechanism, Physiology of Respiratory Pigments.	12
IV.	**Excretion-**Excretion in lower invertebrates – simple diffusion, contractile vacuole, protonephridia, solenocytes, Excretion in higher invertebrates – Coelom, Coelomoduct, Nephridia, Coxal gland, Malpighian tubules, Organ of Bojanus and Green gland and their mechanism. **Nervous System-** Primitive Nervous System (Coelenterate, Echinodermata), Advanced Nervous System (Annelida, Arthropoda, Mollusca),	12
V.	**Invertebrate larval form-** Larval form of Trematoda and Cestoda, Larval form of Crustacea, Larval form of Echinodermata **Minor Phyla-** Organization and general characteristics of - Ctenophora, Rotifera, Branehipoda, Acanthocephala, Onychophora	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. E. J. W. Barrington , Invertebrate structure and function, English Language Book Society UK
2. Robert Barnes, Invertebrate Zoology, Robert BarnesIVth edition Holt Saunders International Edition Japan
3. S. F. Harmer, A. E. Shipley, The Cambridge Natural History Vol 1 -9 , Todays and Tomorrows Book Agency, New Delhi INDIA
4. Park Haswell, Marshall and Williams, A textbook on Zoology Invertebrate, AITBSPublishing and Distributers, Delhi
5. Libbic Henrietta Hyman, The Invertebrates Vol 1 -9 , McGraw Hill Book Company
6. Prof R. L. Kotpal, Protozoa to Echinodermata, Rastogi Publication Meerut
7. E.L. Jordan, Dr. P. S. Verma,Invertebrate Zoology , S. Chand Publications, New Delhi
8. N. Arumugam, N. C. Nair S. - Invertebrate Zoology, Saras Publication.
9. Barrington E. J. W., Invertebrate Structure and Function, Nelson London
10. Barnes, R.D., Invertebrate Zoology –Saunders Philadelphia
11. R. L. Kotpal, Invertebrate, Rastogi Publications
12. H. S. Bhampah, KavitaJuneja, Recent trends in vertebrates vol 1 – 9, Anmol Publication
13. S. N. Prasad, Life of invertebrates, Vikash Publication House Pvt Ltd New Delhi
14. G. S. Sandhu, HarshwardhanBhagskar – Advanced invertebrate zoology –Campus books international
15. G. S. Sandhu, HarshwardhanBhagskar – An Introduction to Arthropoda, Campus books international

E – resources

https://www.coursera.org/lecture/emergence-of-life/4-5-invertebrates-successes-of-life-without-a-backbone-WQHqS

https://www.classcentral.com/course/youtube-echinoderms-crinoids-starfish-sand-dollars-more-invertebrate-paleontology-geo-girl-137418

https://www.shiksha.com/online-courses/introduction-to-biology-biodiversity-course-courl5385

https://www.shortcoursesportal.com/studies/297722/invertebrate-zoology.html

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1. Dr. Shubhada Rahalkar , Professor , Govt. Bilasa Girls PG College, Bilaspur	9893303023
2. Shri A. K. Kesharwani ,Asstt. Professor Govt. Minimata Girls College, Korba	9425223212
3. Dr. AnjuTiwari, Professor Govt. Bilasa Girls PG College, Bilaspur	9424140171
4. Shri Krishan Kumar Chaudhary, Asstt. Professor Govt. GramyaBharti College, Hardibazar, Korba	9039969973
5. Dr. Ranju Gupta, Asstt. Professor Dr. J.P. Mishra Govt. Science College, Mungeli	9424146424
6. Shri Anand Kumar Sao, Asstt. Professor Govt. NiranjanKesharwani College, Kota	7987493377
7. Dr. Deshraj Singh, Professor Himachal Pradesh Vishwavidyalaya, Shimla	9418480248
8. Dr. V.K. Gupta, Retd. Professor C.M.D. PG College, Bilaspur	9424153429

Part A: Introduction				
Program: M.Sc. Zoology		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT102**		
2.	Course Title	**ANIMAL BEHAVIOUR**		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	Passed BSc Biology		
5.	Course Learning. Outcomes (CLO)	Learning Outcome: Upon completing the animal behavior course, students will be able to: • Understand the fundamental concepts and principles of animal behavior, • Demonstrate knowledge of different types of animal behavior, such as innate behaviors, learned behaviors, and social behaviors. • Analyze and interpret the factors that influence animal behavior, including genetics, environment, and social interactions. • Evaluate and discuss the role of animal behavior in evolutionary processes, ecological interactions, and conservation efforts. • Identify and explain the key theories and models in animal behavior, including foraging behavior, mating systems, and communication strategies. • Recognize and describe the diversity of animal behaviors across different taxa, highlighting examples of cooperation, aggression, territoriality, and reproductive strategies. • Demonstrate critical thinking and problem-solving skills by analyzing complex animal behavioral patterns • Communicate effectively about animal behavior through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • Develop a greater appreciation for the complexity and diversity of animal behavior, fostering empathy and ethical considerations in human-animal interactions and animal welfare.		
6.	**Credit Value**	**3L+ 1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**

As approved by academic council and executive council meetings

I.	**Introduction-**Introduction to Ethology, History of Ethology, Observation and Description, Ethology as a branch and its significance, Methods of studying behaviour **Stereotypes behavior-**Taxes, Reflexes, Instinctive behaviour, Motivation **Learning and memory-**Imprinting, Habituation, Classical conditioning, Insight learning, Reasoning and memory	12
II.	**Ecological aspects of behavior-**Food selection and feeding behaviour, Anti-predator defense, Aggression, Territoriality, Innate Behaviour **Biological Rhythms-** Circadian and circannual rhythms, Homing behaviour, Migration of bird, Migration of fish, Coloranim (Mimicry)	12
III.	**Perception of environment -**Mechanical, Electrical, Olfactory, Auditory, Visual **Communication-** Chemical, Visual, Light, Audio, Species specificity of songs, Evolution of languages	12
IV.	**Social behavior-Aggregation:**Schooling in fishes, Flocking in birds, Herdiry in Animal, **Group selection**: Kin selection, Altuarism, **Social organization:** Social organization in insect, social organization in Primates	12
V.	**Reproductive behavior-**Reproductive strategies, Mating system, Courtship, Sexual selection, The nervous system and behaviour (neuroethology), Neural control of behaviour, Human brain and behaviour, Hormonal control of behaviours	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Alcock. J Animal Behaviour: An evolutionary approach. SinauerAsoc. Sunderland, Mass, USA
2. Bradbury, J.W. and Vehrencamp S.L, Principles of animal communication, Sinauer-Assoc. Sunderland, Mass, USA
3. Clutton-Brock, T.H. The evolution of Parental CarePrincetonUniversity.Press Princeton NJ, USA
4. Eibl-Eibesfeldt, 1. Ethology. The biology of behaviour. Holt, RinehartWinston, New York
5. Goud, J.L The mechanisms and evolution of behaviour
6. Hauser, M. he evolution of communication, MIT press, Cambridge, Mass,USA
7. Hinde, R. A Animal Behaviour. The synthesis of Ethology and Comparative psychologyMcGraw Hill,New York
8. Krebs, J.R. and N.B. Davier: Behavioural Ecology. Blackwell, Oxford, UK
9. Wilson, E.O Sociobiology: The new synthesis Harvard University Press, Cambridge

10. P. R. Yadav, Text Book of Animal Behaviour , Campus Book
11. H. V. Bhaskar, Animal Behaviour, Campus Book
12. Reena Mathur, Animal Behaviour , Rastogi Publications
13. M. P. Arora, Animal Behaviour , Rastogi Publications

E – resources:

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

https://www.classcentral.com/course/animalbehav-485

https://www.coursera.org/learn/animal-welfare

https://www.sciencelearn.org.nz/topics/animal-behaviour

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Part A: Introduction				
Program: M Sc Zoology		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT103**		
2.	Course Title	**Biosystematics, Taxonomy& Biodiversity**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	Passed B.Sc. Bio		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know History of Systematics • Understand basic principles of Systemaics and Taxonomy • Practice taxonomic procedures while working in the field • Know Local Biodiversity • Develop an ability to analyze, present and interpret Biodiversity at Local, Regional, National & Global levels • Communicate effectively about Biosystematics & Biodiversity through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Taxonomy • Evaluate biodiversity of a region using indices and create inventories		
6.	**Credit Value**	**3L +1T= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Definition and basic concepts of biosystematics and taxonomy,** Historical resume of systematic, Importance and applications of biosystematics in biology **Trends in biosystematics concepts of different conventional and newer aspects** Chemotaxonomy, Cytotaxonomy, Molecular taxonomy	11
II.	**Dimensions of speciation and taxonomic characters,** Mechanisms of speciation in panmictic and apomictic species, Species concepts and species category, Theories of biological classification, Taxonomic characters and different kinds	11
III.	**Procedure keys in taxonomy,** Taxonomic procedures-taxonomic collections, preservation, curetting, Taxonomic keys-different kinds of taxonomic keys, their merits and demerits, Process of typification and different Zoological types, International code of Zoological Nomenclature (ICZN)	12

IV.	**Biodiversity,** Types of Biodiversity, Hot spots of Biodiversity in general and Hot spots of Biodiversity in India, Threats to Biodiversity, Conservation of Biodiversity	12
V.	**Current status of Biodiversity in India,** National Park and Sanctuaries of Chhattisgarh, **Evaluation of biodiversity indices,** Evaluation of Shannon Weiner Index. , Evaluation of Dominance Index. , Similarity and Dissimilarity Index.	14

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

- Principle of Animal Taxonomy G.G. Simpson, Oxford & IBH Publishing Co
- Elements of Taxonomy Earnst Mayer
- Biodiversity E.O. Vilson, Acadmic Press Washington
- The Biology of Biodiversity M. Kato, Springer
- Molecular Markers - Natural History & Evolution J.C. Avise
- Biosystematics & Taxonomy Dr.R.C.Tripathi, University Book House JAIPUR
- Theory & Practice of Animal Taxonomy V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.
- Prabodh K. Maiti and PaulamiMaiti, Biodiversity: Principles, Peril, Preservation, PHI Publishing
- Kapoor V.C., Taxonomy
- Krishnmurthi KV, An Advance Text book on Biodiversity, Oxford IBH Publishing Co Pvt Ltd

E-Resources:

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07FvlArQ==

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT104**		
2.	Course Title	**Ecology and Environmental Physiology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	Passed BSc Biology		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know the physical factors affecting ecology • Understand the functional basis of animal ecology. • Understand the physiological adaptation in different environment. • Know the basic principles of population ecology, • Analyse a biological &Physiological problems in diverse ecological conditions. • Communicate effectively about Ecology & Environmental Physiology through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Ecology. • Understand & solve the environmental problems involving interaction of humans and natural systems at local or global level.		
6.	**Credit Value**	**3L+1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Ecology**-Abiotic, Climatic, Edaphic and Biotic Factors, Limiting Factors, Biogeochemical cycle-Nitrogen, Phosphorous, Sulphur, Carbon and Water Cycle, Community Ecology-Biotic community, community structure and its characteristics, Ecotone and Edge effects, Ecological Succession **Adaptation**- Levels of adaptation, Types of adaptation, Significance of body size,	12
II.	**Physiological adaptation to different Environment-** a)Marine b)Freshwater c)Terrestrial d)Extreme aquatic e) extreme terrestrial f) Parasitic	12
III.	**Population Ecology: Population Growth-** Exponential growth, Logistic growth model, Stochastic and time lag model of population growth; **Demography-** Life table, Net reproductive rate, Reproductive value **Population regulation,** Extrinsic mechanism, Intrinsic mechanism, **Models of pray-predator dynamics**	12
IV.	**Pollution Ecology-** Definition and types of pollution, Bioindicator of pollution Environment and impact assessment, **Environmental toxicology**-Toxic chemicals, Toxicity, toxicants and mechanisms of action; **Environmental Issues-** Green House gases, Ozone Depletion , Environmental awareness programmes	12

V.	**Stress Physiology-** Basic concept of stress and strain , stress resistance, stress tolerance and stress avoidance, Adaptation-acclimatization and acclimation, Concept of homeostasis, Endothermy and Physiological mechanisms of regulation of body temperature, Osmoregulation in aqueous and terrestrial environment, Physiological response to Oxygen deficient stress, Physiological response to body exercise, Meditation, yoga and their effects	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Eckert, r Animal Physiology : Mechanism and adaptation, W.H. freeman & co, NY
2. Willmer, Grahum Stone Blackwell: Environmental Physiology, Sci Oxford
3. Hochanchka, P.W. and Somero, G.N:Biochemical Adaptation, Princeton NJ
4. Hoar, W.S General and comparative animal physiology, Prentice hall of India
5. Schiemdt Nielsen, animal Physiology : adaptation and environment, Cambridge
6. Strand, F.L Physiology: Regulatory systems approach, Macmillan Pub Co,NY
7. Pummer,L. Practical Biochemistry, Tata McGraw Hill
8. Prosser, C.L. Environmental and metabolic animal physiology, Willey-Liss Inc. NY
9. Townsend, C.R. and P. Calow : Physiology Ecology : an evolutionary approach to resource use, Blackwell Sci. Publ.Oxford, UK
10. Alexander, R.M.N., Optima for animals Princeton Univ press, Princeton NJ
11. Chapman,J.L. & Reiss M.J., Ecology: Principles and application, Cambridge University Press
12. Edward J. Kormondy,Concepts of Ecology, Pearson Education
13. Aulay Mackenzie, Andy S. Ball and Sonia R. Virdee, Ecology , Viva Publication
14. P.D. Sharma ,Ecology and Environment, Rastogi Publication
15. R.L.Kotpal& Bali, Concept of Ecology Vishal Publishing
16. S.C. Rastogi, Essentials of Animal Physiology, New Age International Publisher

E-Resources:

1. **Ecology-**

   https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07FvlArQ==
2. **Population Ecology -**

   https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
3. **Pollution Ecology-**

   https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07FvlArQ==
4. Ecology and Environmental ethics: Problems and Perspectives-

   https://onlinecourses.swayam2.ac.in/cec23_hs04/preview
5. Complex Ecosystem Dynamics-

   https://onlinecourses.swayam2.ac.in/cec22_hs31/preview

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3. Dr. Anju Tiwari, Professor Govt. Bilasa Girls PG College, Bilaspur	9424140171
4. Shri Krishan Kumar Chaudhary, Asstt. Professor Govt. GramyaBharti College, Hardibazar, Korba	9039969973
5. Dr. Ranju Gupta, Asstt. Professor Dr. J.P. Mishra Govt. Science College, Mungeli	9424146424
6. Shri Anand Kumar Sao, Asstt. Professor Govt. NiranjanKesharwani College, Kota	7987493377
7. Dr. Deshraj Singh, Professor Himachal Pradesh Vishwavidyalaya, Shimla	9418480248
8. Dr. V.K. Gupta, Retd. Professor C.M.D. PG College, Bilaspur	9424153429

Part A: Introduction				
Program: M.Sc. Zoology		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLP101**		
2.	Course Title	**LAB-COURSE** I-Invertebrates and Animal Behaviour		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	As Per University rules		
5.	Course Learning. Outcomes (CLO)	Course Learning Outcomes for "Invertebrates and Animal Behaviour": 1. Identify and classify various groups of invertebrates, understanding their key characteristics and anatomical features. 2. Apply proper methods of mounting and preserving invertebrate specimens for scientific study and display. 3. Analyze and interpret the behavior patterns, communication mechanisms, and social interactions of invertebrates. 4. Investigate the impact of environmental factors on invertebrate behavior through experimental design and data collection. 5. Communicate scientific findings effectively, using appropriate terminology and visual aids to convey information clearly and concisely.		
6.	**Credit Value**	**P-2**		
7.	**Total Marks**	**External Marks: 100**	**Min Passing Marks:36**	

Part B: Content ofthe Course		
Exercises	**Topics**	**Total Hours**
	Invertebrates Study of non-chordates through museum specimen Study of permanent slides of non-chordates Dissection of representative types (invertebrates) (any available animal)/ study through alternative methods of dissection or model any other method virtual/demonstration Squilla, Mytilus, Sepia, Aplysia, Echinus Mounting Permanent and suitable stained micro- preparation Earthworm-nerve ring, ovary, spermatheca, nephridia Cockroach-mouthparts , salivary glands, trachea Prawn appendages, statocyst Protozoan- Rhizopods, Flagellates and Ciliates (fresh water forms) Porifera- spiculesand gemrnules of fresh water sponges Crustaceans and Rotifers Larval forms of the free living invertebrates **Animal Behaviour.** Experimentsrelated to Animal Behaviour Feeding behaviour in house fly	30

	Life cycle of Lac insect and honey bee (chart model/material) Study of structural organization of the bee hive Learning behavior Conditioned and unconditioned reflex Projects a) Visit to study the management of following Fish farm, dairy farm, poultry farm, sericulture and apiculture b) Study of invertebrate local fauna c) Any other relevant topic Student should prepare a report and submit Note- 1- Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or culturable species without paining them	
	Distribution of marks in practical exam **Time-08 Hours Max. Mark100** **1. Spotting (1-10)-invertebrates (20)** **2. Mounting (10)** **3. Dissection(Virtual) (10)** **4. Exercise based on behaviour (Two Exercises) (30)** **5. Viva (10)** 6. **Sessional (20)** **Total = 100**	

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Member of Board of Studies (Zoology): Name	**Signature and Mobile No.**
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Part A: Introduction				
Program: M.Sc. Zoology		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLP 102**		
2.	Course Title	**LAB-COURSE-II** - Biosystematics, Taxonomy & Biodiversity and, Ecology and Environmental Physiology		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	Passed BSc (Bio)		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn and apply knowledge of Systematics and taxonomy to identify and arrange animals in definite strata. • To understand the real meaning of biodiversity and create the new ideas for its conservation. • Analyze and interpret ecological data: Students will learn to collect and analyze ecological data, including field observations, experimental data. • Students will study how organisms respond physiologically to environmental challenges, such as temperature changes, pollutants, and habitat alterations. • They will learn experimental techniques to measure physiological parameters, analyze physiological data, and assess the adaptive strategies employed by organisms to cope with environmental stressors. • Students will enhance their communication skills by develop collaborative skills by working in teams to conduct research or solve problems related to Biosystematics, Taxonomy, and Biodiversity & ecology.		
6.	**Credit Value**	**P-2**		
7.	**Total Marks**	**Maximum Marks: 100**	**Min Passing Marks:36**	

Part B: Content ofthe Course		
Exercises	**Topics**	**Total Hours**
	Biosystematics, taxonomy & Biodiversity 1. Study of animal diversity by field trip and excursion, extension activity to spread health awareness. Students have to submit project report. 2. Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names). 3. Collection of various insect species. 4. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report. 5. Study of adaptive characteristics of various invertebrates and vertebrates in different climate. 6. Taxonomic key formation and conversion.	30

	7. Study of biodiversity in grassland and pond water by using Shannon-Wiener index. **Ecology and Environmental Physiology** 1- Study of animals showing -adaptation, to, different environments 2- Soil analysis physical and chemical, composition of soil 3- Effect of physical exercise on blood Pressure 4- Exercise based on blood glucose level 5- Carbonates and nitrates from soil sample 6- Determination of free CO2 and salinity in pond	
	Distribution of marks in practical exam **Time-06 Hours Max.** **Marks-100** **1. Exercise related to Taxonomy (Three) (30)** **2. Exercise based on Soil & Water analysis (Two) (20)** **3. Exercise based on Physiology (Two) (20)** **4. Viva (10)** 5. **Sessional (20)** **Total = 100**	

Part C - **Learning Resource**
Reference Books, E-Resources
Reference Books: 1. VC Kapoor, "Theory and Practice of Animal Taxonomy and Biodiversity", Oxford & IBH Publishing company Pvt. Limited. 2. Ernst Mayr, Principles of Systematic Zoology, McGraw-Hill INC.,US. 3. P.D. Sharma, Ecology , S. Chand publication.

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT201**		
2.	Course Title	**COMPARATIVE ANATOMY OF VERTEBRATES**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	As Per University Rules		
5.	Course Learning. Outcomes (CLO)	Course Learning Outcome for "Vertebrates and Their Structure and Function": • Knowledge of Vertebrate Classification: Students will demonstrate a comprehensive understanding of the classification of vertebrates • Understanding of Vertebrate Anatomy: Students will acquire a detailed knowledge of vertebrate anatomy. They will be able to compare and contrast the anatomical features across different vertebrate groups. • They will be able to analyze the evolutionary trends and adaptations in vertebrate structures and functions. • Students will be able to integrate their knowledge of vertebrate structure, function, evolution, • Students will develop scientific inquiry skills and critical thinking abilities necessary for studying vertebrates. • Students will enhance their communication skills by effectively conveying their understanding of vertebrate structure and function through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to vertebrate biology. • Lifelong Learning and Professional Development: Students will appreciate the importance of lifelong learning in the field of vertebrate biology and understand the relevance of ongoing research and discoveries.		
6.	**Credit Value**	**3L+ 1T= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content ofthe Course		
Unit	**Topics**	**Total Hours**
I.	**Origin of chordates** – Fish, Amphibians, Reptiles, Aves and Mammals. **Classification of Vertebrates** upto orders with examples: Class – Fish, Amphibia, Reptilia, Aves and Mammalia	12
II.	**Extinct Reptiles. Birds are glorified reptiles. Aquatic mammals** **Skeleton system** – Comparative accounts of Jaw suspensorium, Development of vertebra and vertebral column, types of vertebra , limbs and Girdles	12

III.	**Vertebrate integument and its derivative**: Soft epidermal derivatives, Hard epidermal derivatives, Dermal Derivatives Development and General Structure and function of skin and its derivatives-Glands Scales horn, claw, nails, Hoof, Feather and Hair **Evolution of Heart, Evolution of Aortic arches** in vertebrates	12
IV.	**Digestive system** – Comparative account of digestive system. **Dentition in Mammals** **Respiratory system** – Comparative account of Respiratory systems.	12
V.	**Comparative account of Brain and Spinal cord in vertebrate series,** **Sensory Receptors,** **Urinogenital systems in vertebrate series.**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Alexander, R.M. The Chordata. Cambridge University Press, London
2. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, NY
3. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick & Jackson, London
4. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates,Central Book Depot, Allahabad.
5. MalcomJollie, Chordata morphology, East-West Press Pvt., New Delhi.
6. Milton Hilderbrand. Analysis of vertebrate structure. IV Ed. John Wiley
7. Tansley, K. Vision in Vertebrate. Chapman and Hall Ltd., London.
8. Walters, H.E. and Sayles, L.D. Biology of Vertebrates. Macmillan & Co., NY
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia.
10. Young, J.Z. Life of Vertebrates. Oxford University Press, London.
11. Montagna, W. Comparative anatomy. John Wiley & Sons Inc
12. ShobhanMitra – Biological Process –Campus Books
13. S. N. Prasad, SantikaKashyap – A text book of vertebrate zoology 0 –New Age International Publication Limited
14. H. H. Newman The phylum chordata –Satish book enterprise
15. R. L. Kotpal Modern Textbook of Zoology Vertebrates –- Rastogi Publications
16. KavitaJuneja, H. S. Bhumpah – Introduction to amphibia –Anmol publications

E- Resources :

https://swayamias.com/zoology-optional-coaching/

https://www.swayamprabha.gov.in/index.php/program/archive/9

https://www.acsedu.co.uk/Courses/Environmental/VERTEBRATE-ZOOLOGY-BEN104-528.aspx

https://www.nu.edu/degrees/mathematics-and-natural-sciences/courses/bio416/

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT202**		
2.	Course Title	**Gamete biology and reproductive physiology in Human being**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	Passed BSc Biology		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understanding the reproductive organ of male and female and its physiology & Hormonal control. • Understand the origin and characteristics of common congenital malformations. • Learn to distinguish between main stages of embryonic, foetal and neonatal development and causes of foetal disorders. • Awareness on social myth about menstrual cycle. • Awareness on population control. • Learn to give equal place to both men and women in the society to Promote gender equality through scientific attitude. • Students will enhance their communication skills by effectively conveying their understanding of Gamete Biology & Reproductive Physiology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Gamete Biology & Reproductive Physiology. • Create awareness on reproductive problems and sex transmits diseases.		
6.	**Credit Value**	**3L+1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Endocrinology of sex differentiation & judgment-**Chromosomal (genetic) basis of sex determination, Gonadal sex, Phenotypic sex, Brain sex differentiation, Role of hypothalamus and pituitary on Biosynthesis of Gonadal steroid hormones.	12
II.	**Male reproductive system-** Anatomy, physiology and morphology of male reproductive system, Spermatogenesisand development of spermatozoa, Biochemistry of semen. **Endocrine function in male-**Endocrine control of testicular function,Chemistry and biosynthesis of androgens, Secretion, transport and metabolism of testis hormone, Physiological role of androgens in : Spermatogenesis, Secondary sex characteristics & Anabolic function	12

III.	**Female reproductive system-** Anatomy of female reproductive system : Ovary, Fallopian tube, Uterus , **Oogenesis : Formation of Ova, Ovarian hormones :** Chemistry, biosynthesis, secretion, transport, function, action and metabolism of Estrogen, Progesterone and Relaxin,Control of ovarian function, Abnormalities of ovarian function.	12
IV.	**Reproductive cycle- Estrous cycle** Adrenarche, Pubarche and Puberty, Menstruation cycle: Ovarian cycle (Follicular cycle & Luteal cycle), Uterine cycle (Bleeding phase ,Proliferative phase, Secretory phase). Pregnancy, Lactation	12
V.	**Fertilization -** Pre-fertilization events, Biochemistry of fertilization, Post fertilization **Collection and cryopreservation of gamete and embryo.** **Formation and development of placenta and its endocrine function.** **Role of hormone in parturition and lactation.** **Hormonal and immune contraception.**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Leon, Developmental Biology, 2nd editionW.B. Sounders College publishing
2. R. A. Pedersen, G.P. Schatten, Current topics in Developmental Biology.
3. S.C. Goel, Principles of animal development biology , Himalaya publishing house
4. M.J. Barresi & S.F. Gilbert 12th edition, Developmental Biology
5. D.A. Ede, An introduction to developmental biology
6. Paul Weiss, Principles of developmental biology, edited by Hafner Publishing Co., NY
7. John Phillip &Trinkaus, Cells into organs, 2nd edition the forces that shape the embryo,
8. Lewis Wolpert et al 6th edition, Principles of development,
9. Patten's "Foundation of embryology": 6th edition B.M. Carlson
10. B.I. Balinsky& B.C. Fabian, an introduction to embryology: 5th edition
11. Austin & Short, Embryonic and fetal development
12. Marshall's Physiology of Reproduction : G.E. Lamming
13. Goodrick, Developmental biology
14. Mac E. Hardley, Endocrinology
15. Chandra S. Negi, Endocrinology
16. G. J. Tortora, B.H. Derrickson, Principles of Anatomy & Physiology

17. Gyton& Hall, Textbook of Medical Physiology
18. K.V. Sastry , Endocrinology & Reproductive Biology, Rastogi Publication

E-Resources:

1. Reproductive Hormones

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT203**		
2.	Course Title	**MOLECULAR CELL BIOLOGY**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	As per University Rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Develop an understanding of concepts, mechanism and evolutionary significance and relevance of molecular biology in the current scenario. • Get well versed in recombinant DNA technology which holds application in biomedical and genomic science, agriculture, environment, • Fundamental understanding of molecular biology will help in career building in all these fields. • Apply their knowledge in problem solving and future course of their career development in higher education and research. • Understanding the disease at genetic and molecular level and finding their cures. • Students will enhance their communication skills by effectively conveying their understanding of Molecular Cell Biology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Molecular Cell Biology. • Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.		
6.	**Credit Value**	**L-3+ T-1= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Biomolecules-**Structure, molecular composition and function of plasma membrane, Specialization of plasma membrane, Transport across cell membrane, diffusion, facilitated diffusion, ion channel, active transport and pumps, uniports and symports and antiports.	12
II.	**Cytoskeleton-**Microfilaments and microtubules: structure and dynamics, Role of microtubule in mitosis, Cell movements: intracellular transport, role of kinesin and dynein, Signal transduction mechanism **Celia and flagella**	12

III.	**Cell cycle and its controlling mechanism; check points in cell cycle, regulation of cell cycle by CDK's and cyclases.** **Cell-cell signaling general ideas** **Cell-cell adhesion and communication-**Ca++ dependent cell-cell adhesion**,** Ca++ independent cell-cell adhesion **Cell matrix and adhesion-**Integrins**,** Collagens **Cell organelles-**Structure and function of Mitochondria, Ribosomes, Golgi bodies, Endoplasmic reticulum.	12
IV.	**Genomic organization-**Morphological and functional elements of Eukaryotic chromosome, Morphology of Giant chromosome, DNA structure, replication, RNA structure, Genetic code, Transcription. **Intracellular protein traffic-**Protein synthesis on free and bound polysomes, Uptake into E.R.**,** Uptake into mitochondria**.** **DNA Damage and Repair**	12
V.	**Transposon** **Operon system** **Repetitive DNA** **Biology of cancer** **Biology of Ageing** **Apoptosis-**definition, mechanism and significance**.**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. J.H. Damell, H. Lodish and D. Baltimore, Molecular cell biology, Scientific American book inc USA.
2. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson, Molecular Biology of the cell, Garland Publishing Inc NY.
3. P. K. Gupta, Molecular Cell Biology.
4. D. Robertis, Molecular cell Biology.

E-Resources:

1. Molecular cell biology

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

2. Cell Biology-
https://onlinecourses.swayam2.ac.in/cec23_bt12/preview

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Part A: Introduction				
Program:M.Sc Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MSCZOOLT204**		
2.	Course Title	**Tools and techniques for biology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	As per Atal Bihari Vajpayee University rule.		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Discuss the relevant tools and techniques needed for quality planning • Understand the difference between tools and technique • Students learn how to implement and monitoring tools and technique • Learn the theoretical basis of technique, its principle of working and its correct applications • Students will able to learn how to separate organelle by centrifugation as well as cell preparation by density gradient		
6.	**Credit Value**	3L + 1T = 04		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Principal and use of analytic instruments** Ph meter, Colorimeter, Spectrometer, Ultra centrifuge	12 Hours
II.	**Microscopy** Principal of light microscope, Phase contrast, Fluorescence Scanning electron microscope, Transmission microscope	12 Hours
III.	**Histochemical technique** Design and function of tissue culture laboratory, Culture media preparation, Cell harvesting method, Cell proliferation measurement	12 Hours
IV.	**Cryotechniques** Cryopreservation For cell tissue and organisms, Polymerase chain reaction, Bio Sensor, Antigen antibody interaction	12 Hours
V.	**Separation technique in biology** Molecular separation by chromatography, Electrophoresis, Organelle separation by Centrifugation, Cell preparation by density gradient, centrifugation	12 Hours

Part C - **Learning Resource**
Reference Books, E-Resources

Reference Books:

1. Introduction to instrumental analysis-Robert Braun, McGraw Hill Publication
2. A biologist guide to principles and techniques of practical biochemistry-K. Wilson and K;HGoulding EBS Edn.
3. Clark and Swizer, Experimental Biochemistry, Freeman, 2000
4. Locquin and Langeron, Handbook of Microscopy, Butterwaths, 1983
5. Boyer, Modern Experimental Biochemistry, Benjamin, 1993

E-Resources:

- Principal of Bio technique https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- Histological and Histochemical Technique https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- Separation Technique https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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7. Dr. Deshraj Singh, Professor Himachal Pradesh Vishwavidyalaya, Shimla	9418480248
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अटलबिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)

कोनी पुलिस थाना के सामने, बिलासपुर–रतनपुर मार्ग, कोनी, बिलासपुर (छ.ग.) 495009

Website :www.bilaspuruniversity.ac.in

Part A: Introduction				
Program:M.Sc Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
•	Course Code	**MSCZOOLP201**		
•	Course Title	**Lab Course I-Comparative Anatomy of Vertebrates &Gamete Biology and Reproductive Physiology in Human Beings**		
•	Course Type	Practical		
•	Pre-requisite (ifany)	As per University rule.		
•	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn the internal anatomy of different animal through dissection / alternative methods of dissection. • Learn to identify and classify various group of chordates and understanding their key characteristics and anatomical features. • Analyze the importance of different animal in ecosystem for greater understanding of diversity of animal structure. • To evaluate how economically important all these animals are in our lives. • Understand reproductive biology and role of hormones in it • Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.		
•	**Credit Value**	P-2		
•	**Total Marks**	**Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
	Comparative Anatomy 1. Dissection of animals: Amphioxus, Scoliodon, Electric ray, Sting ray, Calotes, Bird head, Rat (Subject to availability of material)/study through alternative methods of dissection. 2. Micro preparation of suitable and available material. 3. Study of the representative examples of different classes of chordates. 4. Study of permanent slides showing whole mount or section as per theory syllabus, including embryological slides of frog and chick. 5. Osteology of Amphibia, Reptile, Bird & Mammal. **Gamete biology and reproductive physiology in human beings** 1. Study of Estrous cycle in mouse or rat 2. Preparation on Blastodisc of hen's egg	30

	3. Formation of egg window in chicken egg. 4. Collection of developmental stages of eggs of Lymnea or any gastropod. 5. Collection of developmental stages of insects/ fishes. 6. Study of development stages of frog through slides and whole mounts. 7. Study of development stages of chick through slides and whole mounts. 8. Slide preparation (earthworm ovary, amphibian, reptiles, birds and mammals testes & ovary) **Note-** 1. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act 2. External features and anatomy should be studied by digital techniques and the alternatives.. Wherever live animals is studied it should be either pest or culturable species without paining them	
	Distribution of marks in practical exam **Time : 06 Hours** **Max. Marks : 100** 1. Dissection of Vertebrates (Virtual/Other methods) (10) 2. Micropreparation (10) 3. Spotting (1-10) (20) 4. Cytological preparation/preparation of estrogen cycle. (10) 5. Exercise based on Developmental stages of Insect /Fish/Frog. (10) 6. Preparation of egg window and Blastodisc. (10) 7. Viva. (10) 8. Sessional. (20) Total = 100	

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Reference Books:

1. Dr. P.S. Verma, "A manual of practical zoology Chordates", S. Chand Publication.
2. Dr. K. Saravanan, Prof. M.P. Santhi, Dr. S. Elavarasi, Mr. R. Thangamani , "A manual of practical zoology: Chordata, Cell and Molecular Biology", Raja publication.
3. E. L. Jordan, Dr. P.S. Verma. " Revised and Enlarged edition CHORDATE ZOOLOGY", S. Chand publication.
4. S.S. Lal, "Practical zoology VERTEBRATE", Rastogi publication.

Member of Board of Studies (Zoology): Name	**Signature and Mobile No.**
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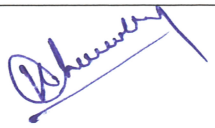
3. Dr. Anju Tiwari, Professor Govt. Bilasa Girls PG College, Bilaspur		9424140171
4. Shri Krishan Kumar Chaudhary, Asstt. Professor Govt. GramyaBharti College, Hardibazar, Korba		9039969973
5. Dr. Ranju Gupta, Asstt. Professor Dr. J.P. Mishra Govt. Science College, Mungeli		9424146424
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Part A: Introduction				
Program:M.Sc Zoology		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
•	Course Code	**MSCZOOLP202**		
•	Course Title	Lab Course II- Molecular Biology &Tools and techniques for biology		
•	Course Type	Practical		
•	Pre-requisite (ifany)	As per University rule.		
•	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Discuss the relevant tools and techniques needed for quality planning in the field of molecular biology • Understand the difference between tools and technique • Students learn how to implement and monitoring tools and technique • Students will enhance their communication skills by effectively conveying their understanding of Tools and techniques for biologythrough oral presentations, scientific writing, and discussions. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Zoology • Students will able to learn how to separate organelle by centrifugation as well as cell preparation by density gradient		
•	**Credit Value**	P-2		
•	**Total Marks**	**100**	**Min Passing Marks:36**	

Part B: **Content of the Course**		
Unit	**Topics**	**Total Hours**
	Molecular Cell biology 1. Study of Prokaryotic and Eukaryotic cells 2. Study of permanent slides -Mitosis, Meiosis and cell organelles 3. Temporary squash preparation to show mitosis and meiosis 4. Preparation of giant chromosomes, barr bodies 5. Histological study of cancer cells **Tools and techniques for biology** 1. Use of balance Ph meter, colorimeter, centrifuge spectrophotometer, camera Lucida etc. 2. Molecular separation by Chromatography, Electrophoresis 3. Media preparation 4. Cell culture 5. Colorimetric estimation of glucose, protein, RNA, DNA 6. Absorption spectrum of any coloured solution 7. Histochemical techniques **Note-** 1. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act	30

	2. External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or culturable species without paining them	
	Distribution of marks in practical exam **Time : 06 hour** **Max. Marks: 100** 1. Spotting (mitosis and meiosis, Tools & Techniques). (20) 2. Exercise based on cell Biology. (10) 3. Chromatography. (20) 4. Colorimetric estimation. (10) 5. Application of different instruments (10) 6. Viva. (10) 7. Sessional (20) Total = 100	

Part C - **Learning Resource**
Reference Books, E-Resources
Reference Books: **E-Resources:** • https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Scheme of M.Sc. (Zoology) under Semester System

Program Code: MSCZOOLR128

Third	MSCZOOLT301	General and Comparative Endocrinology of Vertebrates	3	-	1	4	80	20	100	36
	MSCZOOLT302	Quantitative Biology	3	-	1	4	80	20	100	36
	MSCZOOLT303	Immunology and Developmental Biology	3	-	1	4	80	20	100	36
	MSCZOOLT304	Population Genetics and Evolution	3	-	1	4	80	20	100	36
	MSCZOOLP301	Lab Course-I	-	2	-	2	100	-	100	36
	MSCZOOLP302	Lab Course-II	-	2	-	2	100	-	100	36
Subtotal			**12**	**4**	**4**	**20**	-	-	600	

No change

S Rahalkar

	Compulsory									
	MSCZOOLT401	General Physiology and Neurophysiology	3	-	1	4	80	20	100	36
	MSCZOOLT402	Biochemistry and Metabolic Regulation and Cell Function	3	-	1	4	80	20	100	36
	MSCZOOLP401	Lab Course-I	-	2	-	2	100	-	100	36
	Optional Group-I									
	MSCZOOLT403	Fish (Ichthyology) Structure and Function	3	-	1	4	80	20	100	36
	MSCZOOLT404	Applied Fisheries	3	-	1	4	80	20	100	36
	MSCZOOLP402	Lab Course-II	-	2	-	2	100	-	100	36
	Optional Group-II									
Fourth	MSCZOOLT405	Cell Biology	3	-	1	4	80	20	100	36
	MSCZOOLT406	Cellular Organization and Molecular Organization	3	-	1	4	80	20	100	36
	MSCZOOLP403	Lab Course-II	-	2	-	2	100	-	100	36
	Optional Group-III									
	MSCZOOLT407	Entomology	3	-	1	4	80	20	100	36
	MSCZOOLT408	Applied Entomology	3	-	1	4	80	20	100	36
	MSCZOOLP404	Lab Course-II	-	2	-	2	100	-	100	36
	Optional Group-IV									
	MSCZOOLT409	Wildlife Conservation	3	-	1	4	80	20	100	36
	MSCZOOLT410	Environment and Diversity Conservation	3	-	1	4	80	20	100	36
	MSCZOOLP405	Lab Course-II	-	2	-	2	100	-	100	36
Subtotal			12	4	4	20			600	
Total			**48**	**16**	**16**	**80**			**2400**	

Abbreviations used:

ESE: End Semester Exam
IA: Internal Assessment

Part A: Introduction			
Program:M.Sc Zoology	Semester: III	Year: 2024-25	w.e.f.: 2024-25

•	Course Code	MSCZOOLT301
•	Course Title	Paper- I, General and Comparative Endocrinology of vertebrates
•	Course Type	Theory
•	Pre-requisite (if any)	As per University rule.
•	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know the structure of endocrine system in vertebrates. • Know the function biosynthesis as well as metabolic activity of endocrine system. • Learn and understand mechanism of hormone action, homeostatic mechanism • Understand effect of hormone on human health • Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
•	**Credit Value**	L-3 + T-1
•	**Total Marks**	**Internal Marks: 20** **External Marks: 80** **Min Passing Marks:36**

Part B: Content of the Course

Unit	Topics	Total Hours
I.	Aims and Scope of Endocrine glands-Discovery of hormones Classification of endocrine glands and hormones, **Comparative study of endocrine gland**, Structure of pituitary gland, Thyroid gland, Adrenal gland, Gastrointestinal gland, Juxta-glomerular apparatus(kidney)	12 Hours
II.	**Biosynthesis Of Hormones** Biosynthesis of simple peptide hormone, Biosynthesis of amino acid hormone, Biosynthesis of steroids hormone, Concentration and transport of hormone in the blood and Hormone delivary, **General mechanism of hormone action**- Plasma membrane hormone receptor and its action, cytosolic hormone receptor and its action Termination of hormone action	12 Hours
III.	**Function, control and disorder of following endocrine gland hormone** Pituitary hormone, Adrenal hormone, Thyroid and parathyroid hormones, Gastro-intestinal hormones, Pancreas	12 Hours
IV.	**Role of hormones in metabolic activity** Role of Hormones in Carbohydrate metabolism especially Glucose metabolism, Protein metabolism, Fat metabolism, Hormone and Homeostasis, Calcium metabolism, Role of hormones in osmoregulation, Role of hormones in fasting,	12 Hours

V.	**Role of hormones in different activities** Hormones and behaviour, Role of hormone in growth and development, , Role of hormones in Gametogenesis **Neuroendocrine system**- Types of Neuro-hormones, synthesis and function of endorphins, enkephalin and Hypothalamic hormone	12 Hours

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. General & comparative endocrinology: E.J.W. Barrington, oxford, Clarendon Press
2. Text book of Endocrinology : R.H. Williams, W.B Saunders
3. Endocrine Physiology : C.R Martin, Oxford Univ. Press
4. Comparative endocrinology : A. Gorbman et al, john Wiley and sons
5. Medical Physiology : W.F. Ganong(1981) :10° edition Lange Medical Publications
6. Principles of anatomy and physiology: Torota Grabowski, 9th edition, John Wiley & sons
7. Reproductive Physiology of vertebrates: Van Tienhoven, A, (1983) 2nd edition ComellUniv.Press,NY
8. The pituitary gland :Imura. H(1994)2nd editionCompreshensive Endocrinology revised series Raven, NY
9. Comparative vertebrate endocrinology: Bentley, PJ. (1976), Cambridge Univ. press, Cambridge
10. Comparative vertebrate endocrinomental: Bentley, P.J(1976) Cambridge Univ. press, Cambridge
11. Endocrinology : Hardley
12. Endocrinology : Negi

E-Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A Introduction				
Program - M.Sc. Zoology		**Semester III**	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	**MSCZOOLT302**		
2.	Course Title	**Quantitative Biology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	As Per University Rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know basic concepts of probability and statistics. • Describe statistical methods and probability distributions relevant for biological data. • Know the applications and limitations of different statistical methods. • Know basic concept of mathematical modeling and its application. • Students will enhance their communication skills by effectively conveying their understanding of Biostastics through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Quantitative biology. • Perform and interpret statistical analyses with real biological data.		
6.	**Credit Value**	**3L+1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Introduction to Biostatistics** Statistical Application in some specific area in biology Collection of data, Tabulation, presentation of data, diagrammatic and graphical presentation	*12*
II.	General idea about normal, binomial and Poisson distribution Measures of Central tendencies –Mean, Median ,Mode, relation between mean median and mode , Variance	*12*
III.	Probability theory, distribution and their properties Correlation Regression Analysis of Variance	*12*

IV.	Measures of dispersion -range, Mean deviation, Standard deviation and coefficient of variance Hypothesis testing-t test, chi-square test, f test Matrices and vectors Exponential functions	*12*
V.	**Mathematical Modeling** Types of models-statistical, empirical and mechanistic , simulation Properties of models- generality, precision and realism Detailed treatment of model of cycling of nutrients in an ecosystem	*12*

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Batschelet, E. Introduction to mathematics fr site scientist , springer-verlag , Berling
2. Jorgenser, S.E. Fundamental of Ecological Modelling E. sevier New York
3. Lenderen D Modelling in behavioural ecology, chapman & Hall London U.K
4. Sokal, R.R and F.J Rohit Biometry Freeman San Fransisco
5. Snedecor, G. W and W.G Cochran, Statistical methods, AffliatedEast , West Press New Delhi (Indian ed.)
6. Murray, J.D Mathematical Biology, Springer Verlag Berlin
7. Pranav Kumar Banerjee , Introduction to Bio statistics, S Chand Publication

E-Resources:

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+u3y6UdbIvOJ97LFeSCmHQ==

Biostatistics and mathematical Biology- https://onlinecourses.swayam2.ac.in/cec23_bt10/preview

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Part A: Introduction				
Program - M.Sc. Zoology		**Semester III**	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	**MSCZOOLT303**		
2.	Course Title	**Immunology and Developmental Biology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	As per university rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand common procedures for culturing, purifying and diagnostics of micro-organisms understand the disease-causing potential of bacteria and viruses, and the responses of the immune system • Understand how does the immune system distinguish self from non-self. • Identify the major cellular and tissue components which comprise the innate and adaptive immune system. • Understand how are immune responses by CD4 and CD8 T cells, and B cells, initiated and regulated. • Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis. • Students will enhance their communication skills by effectively conveying their understanding of Immunology & Developmental biology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Immunology & Developmental biology. • Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms		
6.	**Credit Value**	**3L+1T =04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I	Overview of Immune System-Historical perspective of Immunology, Early theories of Immunology Innate and Acquired immunity Cells and Organs of Immune System Hematopoiesis, Lymphocyte traffic, Nature of Antigens - Antigenicity and Immunogenicity, Factor influencing immunogenicity, Antigenic determinates/epitopes and heptane	*12*
II	Antibodies (Immunoglobulin's) - Structure & Function of antibodies Immunoglobulin Classes & Subclasses Antigen- Antibody interaction, B Cell Maturation, Activation and Differentiation ,B- Cell Receptors ,B- Cell Activation and Proliferation , Humeral Immune Response , T- Cell maturation activation and differentiation ,T- Cell Receptors , T- Cell Activation and Proliferation ,T- Cellular Immune Response	*12*
III	Compliment System ,Complement Component , Regulation of Compliment System ,Consequence of Compliment Activation Major Histo- compatibility Complex ,Inheritance of HLA System, Location and Function ,Structure of MHC molecule ,Peptide interaction with MHC molecule Cytokines-Properties and functions, Hyper sensitivity - Gel and Combs' classification and Brief description of various types of hypersensitivities	*12*
IV	Basic concept of development, Gametogenesis, Fertilization and early development - Potency, commitment, Specification , Induction ,competence , determination and differentiation, cell fate and cell lineage, stem cell. Production of gamete, Types and structure of gamete, Fertilization, Cleavage, Blastulation , Gastrulation and formation of germ layers in animal.	*12*

V	Morphogenesis and organogenesis in animals Basic Feature of Vertebrate Morphogenesis Tabulation and extension of the Major Organ- forming Areas: The development of Primitive Embryonic form, Development of Primitive body form.axes and pattern formation in Drosophila, Vulva formation in Caenorhabditiselegans , Eye -lens induction, limb development and regeneration in vertebrate. Histogenesis and Morphogenesis of the Organ System The cardio vascular system , nervous system	*12*

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Kuby, W. H. Froeman , Immuniology WH FreemanUSA
2. W. Paul , Fundamental of Immunology Lippincott Williums and Wilkins Publications
3. M. Roitt, Essential Immunology Wiley BlackwelELBs Edition
4. Richard M. Hyde, Robert A. Patnode, Immunology A Wiley Medical Publications
5. Gayton,ATetBookof Medical Physiology, Saunders Publisher
6. S. Fatima, Immunology, Saras publication

E-Resources:

Immunology-

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

Immunology- https://onlinecourses.swayam2.ac.in/cec23_bt13/preview

Developmental Biology-

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A: Introduction				
Program - M.Sc. Zoology		**Semester III**	Year: 2024-25	w.e.f.: 2024-25
1	Course Code	**MSCZOOLT304**		
2	Course Title	**Population Genetics and Evolution**		
3	Course Type	**Theory**		
4	Pre-requisite (if any)	As per university rules		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand how morphological change due to change in environment helps drive evolution over a long period of time. • Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic tree. • Understand how evolutionary processes and gene function within a particular organism can provide insight into function of other organism. • Examine the evolutionary history of the texa based on developmental affinities. • Understand the causes and effect of alteration in chromosome number and structure. • Students will enhance their communication skills by effectively conveying their understanding of Evolution and Genetics through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Population genetics and evolution. • Learn different aspects to Qunatify genetic variability.		
6	**Credit Value**	**3L+1T = 04**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course

Unit	Topics	Total Hours
I	Concept of Evolution and theories of Organic Evolution with an emphasis on Darwinism, Neutral Theory of Evolution Neo-Darwinism - Hardy-Weinberg Law of genetic equilibrium. A detailed account of destabilizing forces – (i) Natural Selection (ii) Mutation (iii) Genetic drift (iv) Migration (v) Meiotic drive.	*12*
II	Genetics of speciation. Models of speciation (Allopatric, Sympatric and Parapatric). Patterns and mechanisms of reproductive isolation. Genetics of Quantitative traits in population. Analysis of quantitative traits. Inbreeding depression and heterosis.	*12*
III	Molecular Evolution Gene Evolution Origin of Higher categories Major trends in origin of higher categories. Macro and micro Evolution	*12*
IV	Molecular phylogenetics. How to construct Phylogenetic trees ? Amino acid sequence and phylogeny Molecular Clock. Molecular population Genetics Patterns of change in nucleotide and amino acid sequence	*12*
V	Quantifying genetic variability Genetic structures of natural population Phenotypic variation Emergence of non Darwinism- Neutral theory Genotype environment interaction Population Genetics and ecology Metapopulations Why small populations become extinct Conservation of genetic resources in diverse texa	*12*

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
2. Dobzhansky, Th., F.J.Ayala, G.L.Stebbines and J.M.Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutionary Biology, Suinaer Associates, INC Publishers, Dunderland.
4. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates Inc., Massachusetts.
5. Jha, A.P. Genes and Evolution, John Publication, New Delhi.
6. King, M. Species Evolution - The role of chromosomal change. Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston Inc.
8. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
9. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston, London
10. A.P. Jha, Genes and Evolution, John Publication

E-Resources:

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=Vu+b7LQyc9e/jifd2gmpPA==

Principles of Genetics- https://onlinecourses.swayam2.ac.in/cec23_bt07/preview

अटलबिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: III	Year: 2024-25	w.e.f. 2024-2025
1.	Course Code	MSCZOOLP301		
2.	Course Title	Lab course-I [General and Comparative Endocrinology of vertebrates & Quantitative Biology]		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	As per university rule		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know the structure of endocrine system in vertebrates. • Understand histological peculiarities of endocrine glands • Know the function biosynthesis as well as metabolic activity of endocrine system. • Apply quantitative methods and statistical techniques in animal research: Students will learn to use mathematical models, statistical analysis, and computational tools to analyze experimental data. • Students will develop the ability to communicate quantitative biological concepts and research findings through written reports, oral presentations, and visual representations. using appropriate visual aids and clear, concise language.		
6.	**Credit Value**	**P-02**		
7.	**Total Marks**	**Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
Exercise	**Topics**	**Total Hours**
	General & Comparative endocrinology of vertebrates 1. Dissection of various endocrine glands of vertebrates (Fishes, Amphibians, Reptiles, Birds, Mammals, any available animals/ Virtual) 2. Dissection or various endocrine glands of insects (Cockroach/any other insect, any availableanimals/study through alternative methods of dissection virtual or methods any other method) 3. Study of microscopic slides of endocrine and related structures- T.S. pituitary, T.S. of Thyroid, T.S. of Parathyroid, T.S. of Adrenal, T.S. of Testes, T.S. of Ovary, T.S. Thymus, T.S. of Kidney, T.S. of Heart, T.S. of Stomach, T.S of Intestine	30

4. Effect of epinephrine on chromatophores of fishes
5. Biochemical estimation of cholesterol content in adrenal tissue, glycogen in uterine tissue
6. Microtomy-block preparation, section cutting, stretching and straining

Quantitative Biology

1. Collection methods of different types of data
2. Data analysis- tabulation
3. Different graphical and diagrammatic methods of data presentation
4. Calculation of central tendencies based on given data,
5. Application of parametric and non-parametric tests
6. ANOVA
7. Study of model types
8. Exercises based on regression
9. Exercise based on correlation

Distribution of marks in practical exam

Time : 06 Hours Max. Marks : 100

1. Dissection of Endocrine glands/Virtual. (10)
2. Spotting (Endocrine glands& Embryology). (16)
3. Microtomy (14)
4. Exercise based on biostatistics (Three) (30)
5. Viva (10)
6. Sessional (20)

Total = 100

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Dr. P.S. Verma, "A manual of practical zoology Chordates", S. Chand Publication.
2. Dr. K. Saravanan, Prof. M.P. Santhi, Dr. S. Elavarasi, Mr. R. Thangamani , "A manual of practical zoology: Chordata, Cell and Molecular Biology", Raja publication.
3. E. L. Jordan, Dr. P.S. Verma. " Revised and Enlarged edition CHORDATE ZOOLOGY", S. Chand publication.
4. S.S. Lal, "Practical zoology VERTEBRATE", Rastogi publication.
5. PranavBanarjee, Biostatistics , S. Chand publication

अटलबिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: III	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	MSCZOOLP302		
2.	Course Title	Lab course-II [Immunology & developmental biology and population genetics & Evolution]		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	As per university rule		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn to the internal anatomy and function of Primary and Secondary immune organs. • Learn to distinguish the difference between antigen and antibody. • Analyze the importance of immune system and understand how to develop monoclonal as well as polyclonal antibody. • Get new avenues of joining research in areas such as vaccines development, antibody development, organ transplant, etc. • To understand ABO Blood group system with Rh factor and evaluate that who can donate blood to whom. • Understand the diversity and evolutionary history of a taxon by comparing similarities and differences within a strata • Understand and analyze evolution through learning construction of a basic phylogenetic tree. • Analyze gene frequencies with hardy Weinberg law • Students will enhance their communication skills by develop collaborative skills by working in teams to conduct research or solve problems related to Immunology , developmental biology , population genetics & Evolution. • Learn new ideas and new techniques as well as can also create new ideas and new techniques in fields immunology and developmental biology.		
6.	**Credit Value**	**P-02**		
7.	**Total Marks**	**Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
Exercise	**Topics**	**Total Hours**
	Immunology and Developmental Biology 1. Dissection of primary and secondary immune organ from mice: a. Preparation of single suspension from bone marrow. b. Cell counting and viability testing of the spleenocytes prepared. 2. Preparation and study of phagocytosis by spleenic peritoneal macrophage. 3. Raising polyclonal antibody in mice, serum collection and	30

estimating antibody titre in serum by following method.
a. Ouchterlony (double diffusion) assay for antigen-antibody specificity and titre.
b. ELISA

4. Antibody purification from the serum collected from immunized mice, affinity purification chromatography.
5. Blood group testing A, B, O, AB & Rh factor.
6. Induced breeding in frog.
7. Culture of chick embryo in Vitro.
8. Study of chick embryos by vital staining.
9. The technique for the whole mount preparation of chick embryo.
10. Demonstration of cell death.
11. Study of meiosis:
    a. Techniques for chromosomes preparation.
    b. Preparation of meiotic chromosomes from Grasshopper testis.
    c. Auto radiography.

Population Genetics and Evolution

12. a. an experiment related to quantitative genetica, genotypic frequencies in light of hardy Weinberg law.
    b. ABO blood group data.
13. Numeric exercise related to-
    a. Natural selection
    b. Changing gene frequency
14. Chromosomal polymorphism

Distribution of Marks in Practical Exam

Time : 06 Hours Max. Mark : 100

1. Dissection showing primary and secondary immune organ of mice virtual / other method (10)
2. Exercise related to immune response (20)
3. Exercise related to developmental biology / Preparation of egg window and Blastodisc. (10)
4. Exercise related to Quantitative genetics / Hardy Weinberg law. (20)
5. Exercise related to natural selection (10)
6. Viva (10)
7. Sessional (20)

Total = 100

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Frank C. Hay, Olwyn M.R. Westwood, " Practical immunology".
2. SenthilkumarBalakrishan, KarthikKaliaperumal, SenbagamDuraisamy, " Practical immunology A Laboratory Manual"

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Part A: Introduction			
Program: M.Sc Zoology	Semester: IV	Year: 2024-25	w.e.f.: 2024.25

1.	Course Code	**MSCZOOLT401**
2.	Course Title	General Physiology & Neurophysiology (Compulsory)
3.	Course Type	**Theory**
4.	Pre-requisite (if any)	As per University rules
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand the structure of brain and improved methods to study it. • Understand the structure of different lobes of the brain and their corresponding functions. • Understand intricacies of nerve impulse conduction. • Understand how cells, tissues, and organisms function at different levels. • Communicate effectively about Physiology through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Physiology • Develop an understanding of the related disciplines, such as physiology, neurophysiology, pharmacology, biochemistry etc.
6.	**Credit Value**	**3L+1T = 04**
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80** **Min Passing Marks:36**

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Central Nervous System Gross Anatomy of Brain & Spinal Cord-** Histological structure and Origin of Nervous tissue Neurons and Neurogalia& its function. The Meninges, Neurotrophins&Cerebro spinal Fluid (CSF) and its function. Physiological Properties of nerve fibres and mechanism of conduction of Nerve pules in Non-medullated and medullated Nerve fibre. Electrical activity of Brain (EEG) (Electic Encephalography) and its Physiological basis. Nerve endings (Bio-Analyzers)	12
II.	**The Cranial and spinal Nerves, Autonomic Nervous system:** Sympathetic and parasympathetic system with special comparison to hormonal mechanism of transmission through autonomic nerves system Reflex action and sensation. Sense organs- Eye & Physiology of Vision and Ear & mechanism of Hearting	12
III.	**Neuromuscular junctions, synapse and synaptic transmission-** Synaptic potential and synaptic integration [Electrical and Chemical Synaptic Potential], Excitatory Post Synaptic Potential (EPSP), Inhibitory Post Synaptic Potential (IPSP). Neurotransmitters–Different types– catecholamines, amino acidergic and peptidergic	12

	neurotransmitters and their biosynthesis. Physiological role and pharmacological significance of neurotransmitters. Agonist and antagonist for neurotransmitters: Acetylcholine, Dopamine, GABA and Glutamate, Neuropeptide (Endorphin and Enkephalin).	
IV.	**Feeding Mechanism and comparative Physiology of Digestion**- Various digestive juices, its composition, function and mechanism of secretion-Physiology of digestion for carbohydrate, Protein, fat & Nucleic acid and its absorption **Circulation of Body Fluid and its regulation**- Structure of Heart, Structure function, synthesis & composition of Blood & lymph. Blood group system. Blood Coagulation & De-fibrinisation. Cardiac cycle and pressure and volume changes in heart and blood vessels during Cardiac Cycle. Heart sound and ECG. **Respiratory system and Physiology of Respiration** - Structure of respiratory track. Breathing Physiology. Transport of Gases- Oxygen carriage; Carriage of Carbon di-oxide. Tissue Respiration . Respiratory diseases: Asphyxia, Hyperpnea, Anoxia etc.	12
V.	**Contractile elements and its Physiology**- Properties of Skeletal, Smooth & Cardiac Muscle. Structure of Muscle. Ultra & Molecular of Structure of Muscle. Structure of Sarcoplasmic reticulum & its role in Muscle Contraction. Physiology of muscle contraction- Changes during muscle contraction. Enzyme used in muscle contraction. **Pattern of Nitrogen Excretion and its Physiology-** Excretory Substance, Physiology of liver for excretion. Structure of kidney and its Excretory Physiology. Formation of Urine and Micturition. **Regulation of body temperature**- Pyraxia , Hypothermia.	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. The Brain : Our Nervous System by Seymour Simon, Collins Publication
2. Mass Action in the Nervous system by Walter J. Freeman, Elsevier Publisher
3. Human Anatomy and Physiology with Interactive physiology 10-system Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (jan 10, 2010)
4. Neuroanatomy by H. G. Snell, LippancottWilliums and Wilkins Publication
5. Clinical Neurophysiology- Guide for Auther- Slsevier
6. Foundations of cellular Neurophysiology (Bradford Books) Daniel Johnston
7. Medical physiology by Ganong, Saunders Publishers
8. Human Anatomy and Physiology by Tor Tora John Wiley and Sons
9. Human Physiology by G. C. Chatterji
10. DalelaVerma, Animal Physiology and Biochemistry
11. Goel and Shastry, Physiology,Rastogi Publication

E-Resources:

Neurophysiology-

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

General Physiology-

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=NuAs6SreCGryddEfs4kkBA==

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Part A: Introduction				
Program:M.Sc. Zoology		Semester: IV	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	MSCZOOLT402		
2.	Course Title	Biochemistry, Metabolic Regulation & Cell Function (Compulsory)		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per University Rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Know about the importance and scope of biochemistry. • Learn the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids. • Understand the concept of enzyme, its mechanism of action and regulation. • Understand the process of DNA replication, transcription and translation • Learn the preparation of models of peptides and nucleotides. • Analyze biomolecular components through biochemical tests for amino acids, carbohydrates, proteins and nucleic acids • Learn measurement of enzyme activity and its kinetics. • Communicate effectively about Biochemistry through oral presentations, written reports, and scientific discussions, using appropriate terminology and evidence-based arguments. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Biochemistry and Metabolic Regulation.		
6.	**Credit Value**	**3L +1T =04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Water the solvent of life**: Chemistry of water, Function and regulation of water balance **Minerals**-Macro &Micro Minerals **Lipids** - General Structure& Classification, Triglycerides, Phospholipids, Sphingolipids, Cholesterol, Biological Significance and function of Lipids, βoxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Metabolism of Glycerol, Ketogenesis	11
II.	**Carbohydrates**- General Structure of Monosaccharide: Nomenclature, Definition and Classification Formation of Monosaccharide – Formation of glucose: Linear form , Ring form, Hawarth perspective formate Occurrence, Chemistry, Properties & hydrolysis of Oligosaccharides (Sucrose, Lactose, Maltose, Cellobiose, Isomaltose&Trehalose)	13

	Structure of Polysaccharides (Starch, Glycogen, Cellulose, Hyaluronic acid, Chondroitin and Heparin) Metabolism of Carbohydrate	
III.	**Biosynthesis of Amino Acids and Structure & Properties**- Chemical bond – Peptide Bond, Secondary bond – Disulfide ,Hydrogen, Non polar or hydrophobic and Ionic or Electrostatics bond , Characteristic of Chemical bond Protein Configuration: Primary Structure (b) Secondary Structure (c) Tertiary Structure (d) Quaternary Structure Biological function and metabolism of Protein, Metabolism of Inorganic elements	12
IV.	**Nucleic Acid**- Chemistry of DNA & RNA, Nucleo Proteins, Metabolism of Nucleic Acid (Anabolism & Catabolism), Biological importance of Nucleic Acid **Eicosanoids** **Vitamin:** Water & Fat Soluble Vitamin, Chemistry, Occurrence and Physiological role of Vitamins	12
V.	**Enzymes-** Nomenclature and Classification, Co- enzyme, Isoenzyme or Isozyme& Lysozyme, Biological role of enzyme, Properties and Characteristics of enzyme, Three Dimensional Structure of enzyme, Enzyme Inhibitors and activators, Mechanism of enzyme action Biological Oxidation: Mitochondrial Electron Transport Chain, Oxidative Phosphorylation , Utilization of Krebs Cycle, Enzyme & Co – enzyme involved in oxidation & reduction	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Reference Books:

1. David L. Nelson, Michael M. Cox Lehninger Principles of Biochemistry, Fourth Edition Publisher : W. H. Freeman
2. Donald Voet, Biochemistry: Publisher : Wiley, 3rd Edition
3. Reginald H. Garrett, Charles M. Grisham Principles of Biochemistry with a Human Focus Publisher : Brooks Cole
4. Gray S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt, The Molecular Basis of Cell Cycle and Growth Control ,Publisher : Wiley- Liss
5. Harper"s Illustrated Biochemistry;McGraw Hill Publication
6. Fundamentals of Biochemistry, J L Jain , S. Chand Publication
7. Jain J.L. Biochemistry, S. Chand & Company
8. Gupta P.K., Cell and Moleular Biology, Rastogi Publication
9. Experiments in Biochemistry : A Hands – on ApproachShawn o. Farrell, T. Ranallo Publisher : Brooks Cole
10. Analysis of CD Effect on liver, Stomach and Intestine of Carp Fish by Hundet, A.
11. Histological and Histochemical staining techniques by Homason

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Part A: Introduction				
Program:M.Sc.		Semester:IV	Year: 2024-25	w.e.f..2024 - 25
1.	Course Code	MSCZOOLP401		
2.	Course Title	Lab Course I – General Physiology and Neurophysiology & Biochemistry, Metabolic Regulation and Cell Function		
3.	Course Type	Practical		
4.	Pre-requisite (ifany)	As Per University rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn to identify biomolecules by Chemical testing • Learn and practice Separation of molecules through Chromatography • Learn Quantitative analysis of Biomolecules • Learn and practice Haematologial exercises • Get new avenues of joining research in areas such as molecular separation, Enzymology, etc. • Understand principles of immunology through experiments • Students will enhance their communication skills & collaborative skills by working in teams to conduct research or solve problems related to Cytology.		
6.	**Credit Value**	**P-2**		
7.	**Total Marks**	**Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
Exercises	**Topics**	**Total Hours**
	Practical based on Paper I and Paper II as per Theory 1. Estimation of Protein by the Biuret, Lowry, Brad ford and Eosine-a comparasion 2. Determination of N-terminal Amino acids by the Sangers reagent (FDND) 3. Paper chromatographic separation of Amino acids 4. Quantitative estimation of Protein, carbohydrate, Mucosaccharide, Lipids and Enzyme (Bromphenol blue, PAS, Alcian blue, aldehyde fucsin, Acetylcholinestrase technique) 5. Identification of hypothalamic nuclei histological, hystochemical and Immunocytochemical method 6. Isolation and characterization of Pituitary cell 7. Estimation of MAC, MCH and MCHC 8. Total count of WBC and RBC 9. Differetial count of WBC 10. Haemoglobin estimation and PCV estimation or ESR estimation 11. Quantitative estimation of blood serum by Colorimetry (I) Blood Urea (II) Blood glucose (III) Blood Calcium (IV) Blood Creatine (V) Blood cholesterol (VI) Blood Protein (VII) Blood Albumin 12. Blood clotting time 13. ECG Recording	30

	14. Blood Pressure estimation 15. EEG	
	Distribution of marks in practical exam **Time: 06 Hours** **Max. Marks : 100** 1. Estimation of Protein (10) 2. Estimation of Carbohydrate, Mucosaccharides, Lipids and Enzymes (Two exercise) (20) 3. Exercise based on Histochemical and immune-cytochemical method (10) 4. Exercise based on Haematology (Two exercise) (20) 5. Exercise based on ECG/EEG (10) 6. Viva (10) 7. Sessional (20) Total = 100	

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. K. V. Chaitanya, "Cell and Molecular biology"a lab manual.
2. Farida Safadi-Chamberlain, "Cell Biology" Laboratory manual.
3. Dr. K. Saravanan, Prof. M.P. Santhi, Dr. S. Elavarasi, Mr. R. Thangamani , "A manual of practical zoology: Chordata, Cell and Molecular Biology", Raja publication.

E-Resources:

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Part A: Introduction				
Program:M.Sc Zoology		Semester: IV	Year: 2024-25	w.e.f.:2024-25
1.	Course Code	MSCZOOLT403		
2.	Course Title	Fish (Ichthyology) structure and function (Optional Group-I)		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per University rule.		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand the various organ systems of the fishes. • Understand physiology of fishes • Special adaptations in various ecological conditions in fishes. • Learn the evolution of fishes • Known about locomotory organ in fishes. • Learn about sexual cycle in fishes.		
6.	**Credit Value**	**3L +1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	Origin and evolution of fishes, Classification of fishes as proposed by Berg, Fish integument, Locomotion, Aortic arches in fishes	12 Hours
II.	Accessary respiratory organs, Air bladder and its functions, Weberianossicles there, homologies and functions, Acoustic-lateral line system, Type of tales in fishes	12 Hours
III.	Luminous organs, Colouration in fishes, Sound producing organs, Deepsea adaptions, Hill stream adaptions	12 Hours
IV.	Migration in fishes, Sexual cycle and fecundity, Parental care in fishes, Early development and hatching, Poisonous fishes.	12 Hours

V.	Alimentary canal and digestion, Excretion and osmoregulation, Induced breeding, Cranial nerves in fishes, Larvivores fish	12 Hours

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

• Induced breeding

Suggested reading materials

- Zingron-Fish and fisheries in India
- Gavelander-Fish biology
- KarkLegler-Fresh water fisheries
- Nikolaski-Fish. biology
- Identification of fishes-Days fauna
- E.Khanna-Introduction to fish
- Parihar-Fish biology
- Norman-Introduction to fishes
- Mishra-Identification of fishes in India

E-Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A: Introduction				
Program:M.Sc Zoology		Semester: IV	Year: 2024-25	w.e.f..2024-25
1.	Course Code	MSCZOOLT404		
2.	Course Title	Applied Fisheries (Optional Group-I)		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per University rule.		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • By learning this topic the students know about overviews of commercial fishing and sports fishing. • Useful to know the character of streams , riverine system in India and their fisheries. • By learning the students can easily identify the locomotion activities of the fishes. • Deals with different species of fish required different habit and food source for survival • Known about the disease and their cure in fish • Useful to know the costal and deep-sea fisheries		
6.	**Credit Value**	**3L+ 1T = 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	Colouration in fishes, Common diseases of fishes and their care, Economic importance and byproduct of fishes, Luminous organ, Drugs useful in induced breeding of fishes.	12 Hours
II.	Fresh water fishes of Chhattisgarh and their culture, Maintenance of nursery rearing and stocking Pond, Deep-sea fisheries, Coastal fisheries, Riverine and coldwater fisheries	12 Hours
III.	Reservoir fisheries, Lacustrine fisheries, Estuarine fisheries, Fish farming, composite fish culture, Types of ponds required for fish culture farms.	12 Hours
IV.	Cultivable fishes in India, Larvivorous fishes, Exotic and transplanted fishes, Planktons-it's role in pollution of water and fisheries, Role of fisheries in rural development, Sewage fed fisheries	12 Hours

V.	Fishing method in sea coast, Preparation and maintenance of aquarium. Impact of climate change in fisheries and aqua culture, Management practices on field of rural fish farmers, Method of fish preservation.	12 Hours

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

Reference Books:

1. JR. Norman - The History of fishes.
2. NagarajaRao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.
10. Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn - The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,
14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond -Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar &ManjuTernbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fisheries.
22. Jhingaran -Fish and Fisheries.

E-Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A: Introduction			
Program:M.Sc Zoology	Semester: IV	Year: 2024-25	w.e.f.:2024-2025

•	Course Code	**MSCZOOLP402**
•	Course Title	**Lab Course II- Fish structure and Applied Fisheries Group I**
•	Course Type	Practical
•	Pre-requisite (if any)	As per University rule.
•	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • By learning this topic the students know about overviews of commercial fishing and sports fishing. • Learn the character of streams , riverine system in India and their fisheries. • By learning the students can easily identify the locomotion activities of the fishes. • Deals with different species of fish required different habit and food source for survival • Useful to know the costal and deep-sea fisheries • Students will enhance their communication skills by effectively conveying their understanding of Fish structure and Applied Fisheries through oral presentations, scientific writing, and discussions. • They will also develop collaborative skills by working in teams to conduct research or solve problems related to Zoology.
•	**Credit Value**	P-2
•	**Total Marks**	**100** — **Min Passing Marks:36**

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
	1. **Anatomy of different systems of Fresh water Fishes through dissections** 2. **Osteology of Fishes** 3. **Microscopic Preparation** 4. **Taxonomic study of Fishes through Museum specimen and collection** 5. **Identification of Fresh water Fishes of Chhattisgarh up to species level** 6. **Field work/ Industry visit and preparation of Record**	30 Hours
	Distribution of marks in practical exam **Time : 06 Hours** **Max. Marks : 100** 1. Dissection of fresh water fish /Virtual. (10)	

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	2. Spotting (1 to 10). (20) 3. Slide preparation. (10) 4. Identification of fresh water fishes. (20) 5. Project Report and field visit. (10) 6. Viva. (10) 7. Sessional. (20) Total : 100	

Part C - **Learning Resource**
Reference Books, E-Resources

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Reference Books:

1. JR. Norman - The History of fishes.
2. NagarajaRao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.
10. Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn - The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,
14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond -Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
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Part A: Introduction				
Program: M.Sc. Zoology		Semester: IV	Year: 2024-25	w.e.f.:2024-2025
1.	Course Code	MSCZOOLT405		
2.	Course Title	CELL BIOLOGY (Optional Group-II)		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	As per University rules.		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanism involved. • Acquire the detail knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer. • Develop an understanding how cells work in healthy and diseased states and to give a health 'forecast' by analyzing the genetic database and cell information. • Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development , human fertility programme, organ transplant, etc. • Students will enhance their communication skills by effectively conveying their understanding of Cell Biology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Cell Biology. • Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.		
6.	**Credit Value**	**3L+ 1T= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Molecular organization of eukaryotic chromosomes:** Structure of nucleosome particles and higher order compaction of mitotic chromosomes, chromatin re-modeling. **Specialized chromosomes:** Structural organization and functional significance of polytene chromosomes, Structural organization and functional significance of lamp brush chromosome, DNA methylation on specialized chromosomes	12
II.	**Structural organization of :** Eukaryotic genes, interrupted genes and overlapping genes and their evolution. **Gene families :**Organization, Evolution, Significance.Transposable genetic elements of Prokaryotes and Eukaryotes. Organization of eukaryotic transcriptional machinery: promoter, enhancer, transcription factors, polymerase, activators and repressors. DNA binding domain of transcription apparatus: zinc finger, steroid receptors, Homeodomains, helix loop helix, helix turn helix and Leucine Zipper.	12

III.	Eukaryotic transcription and Environmental control. Environmental modulation of gene activity: DNA rearrangement, Amplification during development, Molecular basis of : Thalassemia, Muscular dystrophy, Cystic fibrosis.	12
IV.	**Dictyostelium development:** Cell aggregation, Differentiation ***Caenorhabditiselegans* development:** Cell specification, Dorsal-Ventral axis specification and P-Granules, Right-Left axis specification,.Vulva formation	12
V.	**Drosophila development:** Cleavage, Gastrulation, Axis specification :Matternal effect genes, Anteriar-Posteriar axis development and Dorsal-ventral axis development, Pattern formation: Segmentation genes, Homeotic genes, Realisator genes. Basic ideas of mutation of maternal effect genes , segmentation genes & Homeotic genes and their significance.	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Robertis, De Roberties, Cell and molecular biology.
2. Watson, Baker, Bell, Gann, Levine, Losick : Molecular Biology of the Gene .
3. Bruce alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson : Molecular biology of the cell.
4. James D. Watson, Michael Gilman: Recombinant DNA.
5. Gerald Karp, Cell Biology.
6. Krebs, Goldstein, Kilpatrick :Lewin's GENE XII.
7. DrB.King, Modern view in Cell Biology.
8. Pollard, Earnshaw, Schwartz, Johanson , Cell Biology.
9. Hard, Jones : Genetics principles and analysis.
10. Punt, Stranford, Jones, Owen :Kuby Immunology.
11. Roitt, Brostoff, David male, David Roth :Immunology.
12. Gilbert, Barresi, Developmental Biology.
13. Nelson and Cox ,Lehninger Principles of Biochemistry.

E-Resources:

1. Molecular Cell Biology

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: IV	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	MSCZOOLT406		
2.	Course Title	Cellular and molecular organization (Optional Group-II)		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per University rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Develop an understanding of concepts, mechanism and evolutionary significance and relevance of molecular biology in the current scenario. • Get well versed in recombinant DNA technology which holds application in biomedical and genomic science, agriculture, environment, etc. therefore a fundamental understanding of molecular biology will help in career building in all these fields. • Apply their knowledge in problem solving and future course of their career development in higher education and research. • Understanding the disease at genetic and molecular level and finding their cures. • Students will enhance their communication skills by effectively conveying their understanding of Cellular organization and Molecular Biology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to Cellular organization and Molecular Biology. • Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.		
6.	**Credit Value**	**3L+ 1T= 04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Viruses (Examples SV40 & HIV):** General organization and characters **Bacteria (E. coli):** Structure and chromosomal organization,Basic ideas of its applications as vectors for gene cloning, Regulation of gene activity in *lac* and *trp* operon, Basic ideas of Cell division, Biochemistry of Gram +ve and Gram-ve bacteria.	12
II.	**Yeast:** Structure, reproduction and chromosomal organization, Basic ideas of its applications as vectors for gene cloning. Molecular organization of respiratory chain assemblies in eukaryotes . Cell cycle, cell cycle control in **mammalian cells** and***Xenopus***. Cytochemistry of Golgian complex and its role in cell secretion.	12
III.	**Peroxisomes** and training of peroxysomal proteins.**Nucleolus:** Structure, biogenesis and function.**Lysosome:** Structure, biogenesis and function, intracellular digestion. Synthesis and targeting of **mitochondrial proteins.**Secretary pathway and translocation of secretory proteins across the **Endoplasmic Reticulum membrane.**	12

IV.	**Genome complexity:** C-value [paradox and cot value], DNA sequences of different complexity. **Difference between normal cells and cancer cells:** Biochemical changes, Cytoskeleton changes, Cell surface change. **Genetic basis of human cancer.**	12
V.	Chromosomal abnormalities in **human cancer,**General idea of **proto-oncogenes and oncogenes, Oncogenes and cancer,Transforming agents, Tumor suppressor genes.**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. E. D. P. De Roberties and E. M. F.DeRobertis , Cell and Molecular Biology , Lea and Febiger.
2. Watson, Hopkin, Roberts, Steitz, Weiner : Molecular biology of the gene : the Benjamin / Cummings Publishing company Inc.
3. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson : Molecular Biology of the cell : Garland publishing inc.
4. P. K. Gupta : Molecular cell biology : Rastogi publication.
5. James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller : Recombinant D.N.A : scientific American book.
6. Gerald Karp: Cell Biology.
7. Benjamin Lewin : Genes VII
8. King, Barry : Cell Biology.
9. Baniel L. Hartl, Elizabeth W. Jones : Genetics Principles and analysis: Jones and Bartlett Publisher.
10. Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell: Molecular cell biology: W.H. Freeman and company.
11. Janeway-Travers: Immuno Biology: current biology limited.
12. Kubey : Immunology : W.H. Freeman and Company.
13. Snustad, Simmons : Principle of genetics : John Weley and sons Inc.

E-Resources:

1. Molecular cell biology

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

2. Cell Biology- https://onlinecourses.swayam2.ac.in/cec23_bt12/preview

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Part A: Introduction				
Program: M.Sc. Zoology		Semester:IV [Optional Group-II]	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	MSCZOOLP403		
2.	Course Title	Lab course II- Cell Biology & Cellular and Molecular Organization [Cytology] Group II		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	As per university rule		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • To understand structure and function of different cell of vertebrate tissue. • To understand the use of contrast microscope and photomicrograph. • Identify of Giant chromosome, golgy body, mitochondria, Nucleus, DNA & RNA. • Learn to preparation temporary & permanent slides of cytology. • Application of Microbial culture for analysis of different mutants. • Get new avenues of joining research in areas such as molecular separation, Genomic study, Enzymology, etc. • Students will enhance their communication skills by develop collaborative skills by working in teams to conduct research or solve problems related toCytology. • Learn new ideas and new techniques as well as can also create new ideas and new techniques in fields of Cell biology and cellular organization and molecular organization.		
6.	**Credit Value**	**P-02**		
7.	**Total Marks**	**Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
Exercise	Topics	Total Hours
	1. **Examination of different cell types in vertebrate tissue.** 2. **Contrast Microscopy.** 3. **Photomicrography.** 4. **Study of permanent cytological preparation.** 5. **Squash preparation of chromosomes and preparing karyotype.** 6. **Preparation of giant chromosomes and demonstration of puffs.** 7. **Golgi material and Mitochondrial preparation.** 8. **Demonstration of Barr body and drum stick.** 9. **Histochemical demonstration of RNA, DNA phospholipid and enzyme.** 10. **Microbial culture media preparation and microbial growth.**	30

11. Molecular separation by chromatography and electrophoresis.

Distribution of marks in practical exam.

Time: 06 hours **Max. Marks : 100**

1. Spotting (1-10).	(20)
2. Exercise based on cytological preparation	(10)
3. Exercise based on Histochemical preparation.	(10)
4. Molecular separation by Chromatography and electrophoresis.	(20)
5. Exercise based on Microbiology / Karyotype study.	(10)
6. Viva.	(10)
7. Sessional.	(20)
Total : 100	

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. K. V. Chaitanya, "Cell and Molecular biology"a lab manual.
2. Farida Safadi-Chamberlain, "Cell Biology" Laboratory manual.
3. Dr. K. Saravanan, Prof. M.P. Santhi, Dr. S. Elavarasi, Mr. R. Thangamani , "A manual of practical zoology: Chordata, Cell and Molecular Biology", Raja publication.

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3. Dr. Anju Tiwari, Professor Govt. Bilasa Girls PG College, Bilaspur	9424140171
4. Shri Krishan Kumar Chaudhary, Asstt. Professor Govt. GramyaBharti College, Hardibazar, Korba	9039969973
5. Dr. Ranju Gupta, Asstt. Professor Dr. J.P. Mishra Govt. Science College, Mungeli	9424146424
6. Shri Anand Kumar Sao, Asstt. Professor Govt. NiranjanKesharwani College, Kota	7987493377
7. Dr. Deshraj Singh, Professor Himachal Pradesh Vishwavidyalaya, Shimla	9418480248
8. Dr. V.K. Gupta, Retd. Professor C.M.D. PG College, Bilaspur	9424153429

Part A: Introduction				
Program - M.Sc. Zoology		**Semester IV**	Year: 2024-25	w.e.f.: 2024-2025
1	Course Code	**MSCZOOLT407**		
2	Course Title	**Entomology : Morphology and Physiology of Insects (Optional Group- III)**		
3	Course Type	**Theory**		
4	Pre-requisite (if any)	As per university rules		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn general organization of insects. • Learn to identify various insect orders and their morphological characters. • Understand morphology and physiology of various organ systems. • Undertake research in any aspect of insect physiology in future. • Learn the development of insects thus integrating structure function and interplay of endocrine system. • Students will enhance their communication skills by effectively conveying their understanding of Morphology, Physiology and behavior of insect through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to entomology. • Develop skills, concepts and experience to understand all aspect of insect life.		
6	**Credit Value**	**3L+1T = 04**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

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Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I	Cephalization and theories about cephalization Head capsule, types of antennae and types of mouth parts Thorax, legs in locomotion and functional modification of legs Integument- Sclerotization and moulting	12
II	Wing venation- General and in the orders- Lepidoptera, Diptera, Hymenoptera, Coleoptera and Hemiptera Digestive system and Physiology of digestion Respiratory structure and respiration Respiratory adaptation in aquatic and endoparasitic insects	12
III	Excretory organs, excretion and osmoregulation Circulation, Haemocytes and blood coagulation Nervous system- Principle modifications Internal and external organization of reproductive organs	12
IV	Photoreception, mechanoreception chemoreception Sound producing structure and functions Bioluminescence, Diapause	12
V	Endocrine control of reproduction, Metamorphoses and Diapause Development- Embryonic and Post embryonic Types of Larvae Types of Pupae	12

Part C- Learning Resource

Reference Books, E-Resources

Reference Books:

1. V.B. Wigglerworth, Springer, Insect Physiology :
2. F. Chapman, The Insect structure and function : RCambridge University Press
3. R.E. Snodross, Principles of Insect Morphology : Cbs Publisher
4. Fox and Fox, Introduction to Comparative Entomology : Von Nostrand Reinhold Inc. U.S
5. D.B. Tembhare, A Text book of Insect Morphology, Physiology & Endocrinology : S Chand
6. A.D. Imms Revised by Richards & Davies, Springer,
7. A General Text book of Entomology 1 volumes :
8. H.H. Ross, A Text book of Entomology :

E-Resources:

Applied Entomology- https://onlinecourses.swayam2.ac.in/cec23_bt06/preview
Applied and Economic Zoology- https://swayam.gov.in/explorer?searchText=zoology

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Part A: Introduction				
Program - M.Sc. Zoology		**Semester IV**	Year: 2024-25	w.e.f.: 2024-25
1	Course Code	**MSCZOOLT408**		
2	Course Title	**Entomology :Taxonomy, Economic Entomology and Pest Control (Optional Group- III)**		
3	Course Type	**Theory**		
4	Pre-requisite (if any)	As per University Rules		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Develop an understanding of the characters used to classify besides being able to differentiate insects belonging to different order. • Understand the culture techniques and rearing of beneficial insects. • Learn the seasonal occurrence of insect pest on different crops especially regional crops. • Learn to analyse extend of damage and loses caused by insect pest on different crops. • Knowledge about the various types of infestation caused by insect pest on different crops. • Students will enhance their communication skills by effectively conveying their understanding of Applied entomology through oral presentations, scientific writing, and discussions. They will also develop collaborative skills by working in teams to conduct research or solve problems related to applied and economic entomology. • Recent advances in the field of chemical, biological and cultural control of insect pests with special reference to knowledge about integrated pest management.		
6	**Credit Value**	**3L+1T = 04**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I	History of Insect classification, Basis of classification Brief concept of all insect orders Characters and classification upto principal families of following orders- a. Thysanura b. Collembola c. Orthroptera d. Hemiptera e. Mallophaga f. Lepidoptera g. Diptera h. Hymenoptera & i. Coleoptera (Insect classification as per Essigs's College entomology)	12
II	Classification, life cycle, Control measures, and Economic Importance of the following- Important pests of Paddy Important pests of Sugarcane Important pests of Pulses in the field eg Gram, Pea, Arhar, Important pests of Vegetables- Bringel, Cabbage, Cauliflower,Lady finger and cucumber	12
III	Classification, Life cycle, economic importance and control measures of stored grain pests- namely: Sitophilousoruzae, Corcyrecephalonica, Tregedermagranarium, Triboliumcasfeneum, Callosobruchuschinensis, Stotrogacerellela Life cycle Bionomics, Damage potential and control measures of Aphids and its phases	12
IV	Phases of Locust- Schistocerca gregarine, Phase theory of locust Social life in Insects Parasitism in Insects	12
V	Pest Control Physical and cultural control Chemical control Biological control Integrated pest control	12

Part C - Learning Resource

Reference Books, E-Resources

Reference Books:

1. V.B. Wigglerworth ,Insect Physiology :, Springer
2. R.F. Chapman, The Insect structure and function :, Cambridge University Press
3. R.E. Snodross, Principles of Insect Morphology : Cbs Publisher
4. Fox and Fox ,Introduction to Comparative Entomology : Von Nostrand Reinhold Inc. U.S
5. D.B. Tembhare, A Text book of Insect Morphology, Physiology & Endocrinology : S Chand publication
6. A.D. Imms Revised by Richards & Davies, Springer, A General Text book of Entomology 2 volumes :
7. H.H. Ross , A Text book of Entomology :

E-Resources:

Applied Entomology- https://onlinecourses.swayam2.ac.in/cec23_bt06/preview
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Part A: Practical Introduction				
Program: M.Sc. Zoology		Class: **M.Sc. IV Sem**	Year: 2024-25	w.e.f.: 2024-25
1	Course Code	**MSCZOOLP404**		
2	Course Title	**Lab Course II- Optional Paper - Entomology GroupIII**		
3	Course Type	Practical		
4	Pre-requisite (if any)	As per university rules		
5	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn to identify local fauna and different types of beneficial and harmful insect. • Understand to use basic equipment used in entomological studies. • Learn field techniques used in studies of biodiversity of insect. • Get exposure to field study and collection of local insect fauna. • Learn various concept of culture techniques of beneficial insects. • Understand the relative position of individual organs and associated structures through model/alternative of dissection of the representative insect. • Learn the maintenance of laboratory, field, equipment/tools safety hazards and precaution.		
6	Credit Value	**P2**		
7	Total Marks	**Max. Marks: 100**	**Min Passing marks: 36**	

Part B:Lab Course 02		
Total No. of lecture (1hour/ week): 30		
Exercises	**Topics (Tentative List of the Lab Work is provided, the lab work may be changed by the department/ teacher concerned)**	**Total Hours**
	Practical (Special Paper – Group III Entomology) 1. Collection, Preservationand classification of the insects of order :- Thysaneura, Collembola, Orthoptera, Hemiptera, Lepidoptera, Mallophaga, Diptera, Hymenoptera and Coleoptera 2. Dissection of Grasshopper, Cockroach, Cricket, wasp, and honey bee, with special reference to their Nervous system, Salivary gland, Endocrine gland, Sting apparatus, of honey bee, reproductive organs of Grasshopper and cockroach. 3. Whole mounts of small insects eg. Collembola, Thysaneura, bedbug, louse, stored grain pests 4. Whole mount of different types of legs, antennae, wings, mouth	30

	parts, salivary glands and scales 5. Microtomy of Insect materials 6. Simple experiment on Insect Physiology 7. Identification of common insect pests 8. Collection of life cycle of the pest of any economic crop	
	Distribution of Marks in practical exam **Time : 06 Hours** — **Max, Marks :100** 1- Dissection of available insect pests/virtual (10) 2- Spotting 1-10 (20) 3- Micro preparation (10) 4- Experiment based on insect physiology (10) 5- Identification of common insect pets (10) 6- Project report and field visit (10) 7- Viva (10) 8- Sessional (20) **Total = 100**	
Keywords:		

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. SS lal, Practical zoology Invertebrates, Rastogi publication
2. PS Verma and PC Shrivastava, Practical zoology Invertebrates, S Chand publication
3. Anil Kulshreshth, Practical Zoology Shivlalagrawal and company
4. Dr. H N Baijal, Practical zoology Pioneer publication
5. PrashantKannoje, Practical zoology Navbodhprakashan
6. Dr. P S Verma , Manual of practical zoology Invertebrate S Chand publication

E-Resources:

Applied Entomology- https://onlinecourses.swayam2.ac.in/cec23_bt06/preview
Applied and Economic Zoology- https://swayam.gov.in/explorer?searchText=zoology

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Part A: Introduction				
Program: M.Sc. Zoology		Semester: IV	Year: 2024-25	w.e.f. 2024-25
1.	Course Code	MSCZOOLT409		
2.	Course Title	Wildlife Conservation (Optional Group-IV)		
3.	Course Type	Theory		
4.	Pre-requisite (ifany)	As per University Rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Develop an understanding of how animals interact with each other and their natural environment • Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues • Learn about wild life of Chhattisgarh and India • Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management • Develop an ability to analyze, present and interpret wildlife conservation management information		
6.	**Credit Value**	3L+1T		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	. **Wild life** – Values of wild life - positive and negative, Our conservation ethics Importance of conservation , Causes of depletion, World conservation strategies. **Population estimation** - Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation, Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.	12
II.	**Habitat analysis, Evaluation and management of wild life-** Physical parameters - Topography, Geology, Soil and water, Biological Parameters - food, cover, forage, browse and cover estimation , Standard evaluation procedures - remote sensing and GIS. **Management of habitats** – Setting back succession, Grazing logging Mechanical treatment, Advancing the successional process, Cover construction Preservation of general genetic diversity	12
III.	**National Organization** - Indian board of wild life, Bombay Natural History Society, Voluntary organization involved in wild life conservation **Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.**	12

	Management planning of wild life in protected areas. **Estimation of carrying capacity**	
IV.	**Concept of climax persistence.** **Ecology of protuberance.** **Management of excess population & translocation** **Bio- telemetry.** **Care of injured and diseased animal.** **Quarantine** **Common diseases of wild animal**	12
V.	**Eco tourism /wild life tourism in forests** **Protected areas National parks & sanctuaries, Community reserve** **Important features of protected areas in India.** **Tiger conservation - Tiger reserve in M.P & Chhattisgarh, in India.** **Management challenges in Tiger reserve.**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Gopal Rajesh : Fundamentals of wild life management, Natraj Publishers
2. Agrawal K.C : Wild life India, Nidhi Publishers
3. Dwivedi A.P (2008) : Management wild life in India,
4. Asthana D.K : Envionment problem and solution, S. Chand Publishing
5. Rodgers N.A &Panwar H.S : Planning of wild life / Protected area Network in India vol. the report, wild life Institute of India Dehradun
6. Odum E.P : Fundamentals of Ecology,Cengage Learning India
7. Saharia V.B : Wild life in India, Natraj Publisher
8. E.P Gee : Wild life of India, E.P.Dutton
9. Negi S.S : Wild life conservation, Natraj Publishers

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Part A: Introduction				
Program: M.Sc.Zoology		Semester: IV	Year: 2024-25	w.e.f.: 2024-25
1.	Course Code	MSCZOOLT410		
2.	Course Title	Environment and Biodiversity Conservation (Optional Group-IV)		
3.	Course Type	Theory		
4.	Pre-requisite (ifany)	As per University Rules		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Develop understanding for the environment which is largely degraded in the current scenario. • Understand the importance of bio diversity and the consequences of bio diversity loss • Learn about the judicious utilisation of natural resources • Follow the concept of green technology and the eco-friendly practises and other prospects of environment protection • understand and practice appropriate legal/regulatory and ethical issues in the context of the work environment. • design research projects to collect information to assess the effectiveness of current practices, and interpret the results of a statistical analysis of data, and use this to make informed decisions		
6.	Credit Value	3L+1T		
7.	Total Marks	Internal Marks: 20 External Marks: 80	Min Passing Marks:36	

Part B: Content of the Course		
Unit	Topics	Total Hours
I.	Basic concept of Environmental Biology Scope and Environmental Science Biosphere and Biogeochemical cycles Environmental monitoring and impact assessment Environmental and sustainable development Water conservation, rain water harvesting, water shed management	12
II.	Cause, effects and remedial measure of Air pollution, Water pollution Noise. radioactive and thermal pollution Agriculture pollution Basic concepts of Bioaccumulation Solid waste management	12
III.	Global warming and disaster management Cause of global warming Impact of global warming – acid rains and ozone depletion, green house effect Control measures of global warming- Afforestation (b) reduction in the use of CFCS Disaster management -floods, earthquake, Cyclones landslidesEnvironmental legislation	12

IV.	**Natural Resources:-** **Forest** -Use and over exploitation of forests, Timber extraction **Land-** Land degradation, Landslides, Soil-erosion and desertification **Water-** Use and over utilization of surface and ground water, Floods, Drought dams- benefits and problems	12
V.	**Mineral** - Use and exploitation, Environmental effect of extracting and using mineral resources **Food** - World food problem, Effects of modern agriculture and overgrazing **Energy-**	12

Part C - **Learning Resource**

Reference Books, E-Resources

Reference Books:

1. Arora : Fundamentals of environmental biology, KalyaniPublibation
2. Anathakrishnan : Bio-resources ecology, CRC Press
3. Bottain : Environmental studies
4. Bouhey : Ecology of populations, Collier MacMillan Ltd
5. Clark : Elements of ecology, Sagwan Press
6. Dowdoswell : An introduction to animal ecology, Littlehampton Book Services Ltd
7. Goldman : Limnology
8. Kormondy : Concepts of ecology, Pearson Education
9. Odum : Ecology, Cangage Learning India
10. Pawlosuske : Physico-chemical methods for water
11. SouthWood's Ecological methods, OUP Oxford
12. Robert Wetzal : Limnology Lake and river Ecosystem, Elsevier

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Part A: Introduction				
Program:M.Sc.		Semester: IV	Year: 2024	w.e.f.2024-25
1.	Course Code	MSCZOOLP405		
2.	Course Title	Lab Course II-Optional Paper (Wildlife Conservation and Environment & Biodiversity conservation)		
3.	Course Type	Practical		
4.	Pre-requisite (ifany)	As Per University rules		
5.	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to: • Learn to identify local fauna especially Insects fishes, Birds, Reptiles Birds • Learn to use basic equipments used in Wildlife studies • Learn field techniques used in Biodiversity studies • Practice analysis of physico-chemical factors of Soil & water • Learn to recognize animal evidences in field study and collection of biodiversity data • Analyze biodiversity data of the particular area		
6.	Credit Value	P-2		
7.	Total Marks	Marks: 100	Min Passing Marks:36	

Part B: Content of the Course		
Exercises	**Topics**	**Total Hours**
	1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna. 2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses). 3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc. 4. Demonstration of different field techniques for flora and fauna. 5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences). 6. Visit to an area to document environmental assets including natural resources/flora/fauna, etc. 7. Identification and study of common insects, fish, birds, mammals of a particular area. 8. To determine the physical conditions of water: Depth, Viscosity, Density, Buoyancy. 9. To determine the chemical conditions of water: pH, dissolved oxygen and carbon-dioxide, hardness etc. 10. To determine Cl, SO4, NO3 in soil and water samples from different locations. 11. To study acidity and alkalinity of sample water by methyl orange and phenolphthalein 12. Visit to a local pollution site (Urban /Rural /Industrial	30

	/Agricultural).	
	Distribution of marks in practical exam **Time: 06 hours** **Max. Marks : 100** 1. Exercise based on wild life conservation. (35) 2. Exercise based on environment and biodiversity conservation (35) 3. Viva (10) 4. Sessional (20) Total = 100	

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

Reference Books:

1. Gopal Rajesh : Fundamentals of wild life management, Natraj Publishers
2. Agrawal K.C : Wild life India, Nidhi Publishers
3. Pawlosuske : Physico-chemical methods for water
4. SouthWood's Ecological methods, OUP Oxford

E-Resources:

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