

Course Outline

| Course Title Zoology II: Invertebrate Diversity (Classification, Phylogeny and Organization) Course Introduction Course Introduction This course will provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms), the basic taxonomic characteristics and classification of all the invertebrate phyla, and understanding of their body organization, feeding and digestive system and other organ systems. Further, it will provide the description of mode of their reproduction and development and the information of their economic and ecological importance. Learning Outcomes On the completion of the course, the students will: 1. Acquire the basic concepts of invertebrates with explanation of evolutionary origin and diversification. 2. Understand invertebrate organismal concepts in laboratory and field. 3. Demonstrate major evolutionary innovations for invertebrates with functional importance. | Progra | mme | BS Science Education | Course Code | SE-304 | Credit Hours | 3 |
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| 3. Demonstrate major evolutionary innovations for invertebrates with functional importance. | 2. U | Understa | and invertebrate organisma | al concepts in la | boratory an | d field. | |
| importance. | 3. I | Demons | trate major evolutionary in | novations for in | vertebrates | with functional | |
| | i | mportar | nce. | | | | |

- 4. Understand how reproduction and development occurred and able to breed animals in the laboratory/field
- 5. Analyze economic and ecological importance of invertebrates.

| | Course Content Assignments/Readings | | | | |
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| Week 1 | Unit-1 Introduction 1.1. Classification of organisms 1.2. Definition, concept, evolutionary relationships and tree diagrams 1.3. Patterns of organization | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10 th , 12 th ed) (International). Singapore: McGraw Hill.} | | | |

| | Unit-2 | |
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| Week 2 | Animal-Like Protists: The Protozoa 2.1. Evolutionary perspective 2.2. Life within a single plasma membrane 2.3. Symbiotic lifestyles 2.4. Protozoan taxonomy: (up to phyla, subphyla and super classes) 2.5. Cilia and other pellicular structures 2.6. Nutrition 2.7. Genetic Control and reproduction 2.8. Symbiotic ciliates 2.9. Further phylogenetic considerations | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10 th , 12 th ed) (International). Singapore: McGraw Hill.} |
| Week 3 | Unit-3 Multicellular and Tissue Levels of Organization 2.1 Evolutionary perspective 2.2 Origins of multicellularity 2.3 Animal origins 2.4 Phylum porifera 2.5 Cell types, and skeletons 2.6 Body forms; maintenance functions, reproduction | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.} |
| Week 4 | Unit-3 Multicellular and Tissue Levels of Organization 2.7 Phylum cnidaria (coelenterata) the body wall and nematocyst 2.8 Alternation of generations; maintenance functions 2.9 Reproduction and classification up to class 2.10 Phylum ctenophore 2.11 Further phylogenetic considerations | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.} |
| Week 5 | Unit-4 The Triploblastic, Acoelomate Body Plan 4.1. Evolutionary perspective 4.2. Phylum platyhelminthes 4.3. Classification up to class 4.4. The free-living flatworms and the tapeworms 4.5. Phylum nemertea 4.6. Phylum gastrotricha 4.7. Further phylogenetic considerations. | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.} |
| Week 6 | Unit 5 | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, |

| | The Pseudo coelomate Body Plan: | 10th, 12 th ed) (International). | |
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| | Aschelminths | Singapore: McGraw Hill.} | |
| | 3.1. Evolutionary perspective | | |
| | 3.2. General characteristics | | |
| | 3.3. Classification up to phyla | | |
| | 3.4. Feeding and the Digestive System, other organ systems | | |
| | Unit 5 | | |
| | The Pseudo coelomate Body Plan: Aschelminths | | |
| | 3.5. Reproduction and Development of phylum | | |
| | 3.6. Phylum rotifera and phylum nematoda; phylum kinorhyncha | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, | |
| Week 7 | 3.7. Some important nematode parasites of humans | 10th, 12 th ed) (International). Singapore: McGraw Hill.} | |
| | 3.8. Further phylogenetic considerations | | |
| | Unit 6 | | |
| | Molluscan Success | | |
| | 6.1 Evolutionary perspective: relationships to other animals6.2 Origin of the coelom; | | |
| | Unit 6 | | |
| | Molluscan Success | | |
| | 7.1. Molluscan characteristics; | | |
| | 7.2. Classification up to class | | |
| Week 8 | 7.3. Characteristics of shell and associated structures, feeding, digestion, gas exchange, | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12 th ed) (International). | |
| | 7.4. Locomotion | Singapore: McGraw Hill.} | |
| | 7.5. Reproduction and development | | |
| | 7.6. Other maintenance functions and diversity in gastropods, | | |
| | 7.7. Bivalves and cephalopods | | |
| | 7.8. Phylogenetic considerations. | | |
| Week 9 | Unit 7 | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, | |

| Week 10 4.1 Evolutionary perspective 4.2 Relationship to other animals 4.3 Metamerism and tagmatization; 4.4 Classification up to class. 4.5 External structure and locomotion, Singapore: McGraw Hill.} Week 10 4.6 Feeding and the digestive system 4.7 Gas exchange and circulation 4.8 Nervous and sensory functions, excretoin, regeneration, 4.9 Reproduction and development, in polychaeta, oligochaeta and hirudinea; 4.10 Further phylogenetic considerations (Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.] Week 11 Furtheropods: Blueprint for Success 5.1 Evolutionary perspective 5.2 Classification and relationships to other animals [Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.] Week 12 Unit 8 Arthropods: Blueprint for Success 5.1 Evolutionary perspective 5.2 Classification and relationships to other animals [Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10 th , 12 th ed) (International). Singapore: McGraw Hill.] Week 12 Unit 8 Arthropods: Blueprint for Success 5.5 Metamorphosis 5.6 Classification up to class 5.7 Further phylogenetic considerations [Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.] Week 13 6.1 Evolutionary perspective 6.2 Classification up to class 6.3 External structure and locomotion 6.4 Nutrition and the digestive system 6.5 Gas exchange [Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th, 6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.] | | Annelida: The Metameric Body Form | 10th, 12 th ed) (International). | |
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| Week 11 | | 4.9 Reproduction and development, in | Singapore: McGraw Hill.} | |
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| 6.3 External structure and locomotion 6.4 Nutrition and the digestive system 6.5 Gas exchange | | 6.2 Classification up to class | Singapore: McGraw Hill.} | |
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| 6.5 Gas exchange | | 6.4 Nutrition and the digestive system | | |
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| | 6.6 | Circulation and temperature regulation | | |
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| | Unit 9 | | | |
| | Hexap Trium | ods and Myriapods: Terrestrial phs | {Miller, S. A., & Harley, J. B. | |
| | 6.7 | Nervous and sensory functions | | |
| Week 14 | 6.8 | Excretion | (2000). Zoology (4th, 5th,6th, | |
| WCCK 14 | 6.9 | Chemical regulation | 10th, 12 th ed) (International). | |
| | 6.10 hexaj | Reproduction and development in poda | Singapore: McGraw Hill.} | |
| | 6.11 | Insect behavior | | |
| | 6.12 | Insects and humans | | |
| | 6.13 | Further phylogenetic considerations | | |
| | Unit1(| | | |
| | Echin | oderms | | |
| Week 15 | 10.1 Evolutionary perspective: relationships to other animals; | | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12 th ed) (International). Singapore: McGraw Hill.} | |
| | 10.2 Echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development in asteroidea, ophiuroidea, echinoidea, holothuroidea and crinoidea | | | |
| | Unit1(|) | | |
| | Echinoderms | | {Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, | |
| Week 16 | 10.3 | Further phylogenetic considerations | 10th, 12 th ed) (International). | |
| | 10.4 loph chae | Some lesser-known invertebrates: the apphorates, entoprocts, cycliophores, and etognaths | Singapore: McGraw Hill.} | |
| Textbooks and Reading Material | | | | |
| Campbell, 1 Pub | N. A. (2 lishing | 002). Biology (6th ed). Menlo Park, Californ Company, Inc. | nia: Benjamin/Cummings | |
| 1 40 | | | | |
| Hickman, C ed) | C.P., Rol (Interna | berts, L.S., & Larson, A. (2004). Integrated p tional). Singapore: McGraw Hill. | principles of zoology (12th | |
| Kent, G. C. & Miller, S. (2001). Comparative anatomy of vertebrates. New York: McGraw Hill. | | | | |

Miller, S. A., & Harley, J. B. (2000). Zoology (4th, 5th,6th, 10th, 12th ed) (International). Singapore: McGraw Hill.

Pechenik, J. A. (2000). Biology of invertebrates, (5th ed) (International). Singapore: McGraw Hill.

| 1. Discussion 2. Demonstration Method 3. Lecture Method 4. Project Method Assignments: Types and Number with Calendar 1. Class presentation 2. written assignment 3. Case study. 4. 01 assignment before mid-term exam and 02 assignment after mid-term exam Assessment Sr. No. Elements Weightage 1. Midterm Assessment 2. Formative Assessment 2. Formative Assessment 3. Final Assessment | Teaching Learning Strategies | | | | |
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| 4. Project Method Assignments: Types and Number with Calendar 1. Class presentation 2. written assignment 3. Case study. 4. 01 assignment before mid-term exam and 02 assignment after mid-term exam Assessment Sr. No. Elements Weightage Details 1. Midterm Assessment Assessment Image: Class and the second se | 3 | . Lecture Method | ŀ | | |
| Assignments: Types and Number with Calendar 1. Class presentation 2. written assignment 3. Case study. 4. 01 assignment before mid-term exam and 02 assignment after mid-term exam Assessment Sr. No. Elements Weightage Details 1. Midterm Assessment Assessment 2. Formative Assessment Assessment 3. Final Assessment Image: State of the set of the se | 4 | Project Method | l | | |
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| 2. Formative Assessment 3. Final Assessment | Sr. No. 1. | Elements Midterm | Weightage | Details | |
| 3. Final Assessment | Sr. No. 1. | Elements Midterm Assessment | Weightage | Details | |
| 3. Final Assessment | Sr. No. 1. 2. | Elements Midterm Assessment Formative | Weightage | Details | |
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| 3. Final Assessment | Sr. No. 1. 2. | Elements Midterm Assessment Formative Assessment | Weightage | Details | |
| Assessment | Sr. No. 1. 2. | Elements Midterm Assessment Formative Assessment | Weightage | Details | |
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University of the Punjab, Lahore

Course Outline

| Program | ne BS Science Education | Course Code | SE-304L | Credit Hours | 1 |
|---|---|--|----------|------------------|---------|
| Course Ti | le Zoology Lab-II: Invertebrate Diversity (Classification, Phylogeny and Organization | | | | y and |
| | Course | e Introduction | | | |
| This course will provide hands on experience for learners. Students will get chance to interact with invertebrate members. Students will learn classification of each member of each phylum up to order level with adaptions in relation to habitat of the specimen. Preserved Specimen and or coloured projection slide and or CD ROM projection of computer will be used. | | | | | |
| | Learn | ing Outcomes | | | |
| On the com | pletion of the course, the stude | ents will: | | | |
| 1. | 1. Familiarized with the morphological and systematic knowledge about different principal representative classes of phylum in animals. | | | | fferent |
| 2. | 2. Learn about the general characters, structure, life history, classification and economic importance of different classes of phylum in animals | | | | on and |
| | Course Content | ` | Ass | signments/Read | lings |
| Week 1 | 1. Study of Euglena, Amoel Plasmodium, Trypanosor representative of animal- | oa, Entomoeba, na, Paramecium like protists. | as Pract | ical Copy Prepa | ration |
| Week 2 | 21.1 Study of Euglena, Amoeba, Entomoeba, Plasmodium, Trypanosoma, Paramecium as representative of animal-like protists. (CONT.)Practical Copy Preparation | | | | |
| Week 3 | 2. Study of sponges and the forms. | ir various body | Practi | cal Copy Prepara | tion |
| Week 4 | 4.1 Study of sponges and the forms. (CONT.) | ir various body | Practi | cal Copy Prepara | tion |

| Week 5 | 3. Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
|--|---|--------------------|-----------------------|----------------------------|--|
| | phylum Co | elentrata. | | | |
| Week 6 | 4. Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Pla | atyhelminthes. | | | |
| Week 7 | 4.1 | Study of principa | al representative | Practical Copy Preparation | |
| | classes of phylum Platyhelminthes. (CONT.) | | | | |
| Week 8 | 5. Study of re | presentative of p | hylum Rotifera, | Practical Copy Preparation | |
| | phylum Ne | ematoda. | | | |
| Week 9 | 5.1 Study of re | presentative of p | hylum Rotifera, | Practical Copy Preparation | |
| | phylum Ne | ematoda. (CONT | .) | | |
| Week 10 | 6. Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Mo | ollusca. | | | |
| Week 11 | 7. Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Ar | nnelida | | | |
| Week 12 | 7.1 Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Ar | nelida. (CONT.) | | | |
| Week 13 | 8. Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Ar | thropoda. | | | |
| Week 14 | 8.1 Study of pr | rincipal represent | tative classes of | Practical Copy Preparation | |
| | phylum Ar | thropoda. (CON | Г.) | | |
| Week 15 | 8.2 Study of a | representative of | classes of | Practical Copy Preparation | |
| | phylum Ec | hinodermata | | | |
| Week 16 | 8.3 Study of a | representative of | classes of | Practical Copy Preparation | |
| phylum Echinodermata (CONT.) | | | | | |
| | | Textbooks and | Reading Material | l | |
| Hickman, | C. P. & Kats, H. 1 | L. (2000). Labora | atory studies in inte | egrated principles of | |
| ZOC | ology. Singapore: | McGraw Hill. | | | |
| Miller, S. A | A. (2002). Genera | al zoology labora | tory manual (5th e | d) (International). | |
| Sin | igapore: McGraw | Hill. | | | |
| | | Tanching Las | rning Stratagies | | |
| | | | in ming Strategies | | |
| 1. | 1. Discussion | | | | |
| 2. | 2. Demonstration Method | | | | |
| 5. 4 | J. Lecture Method4. Project Method | | | | |
| Assignments: Types and Number with Calendar | | | | | |
| 1 | | 51 | | | |
| | 1. Class presentation | | | | |
| 2. | 2. written assignment | | | | |
| 5. 01 assignment before mid-term exam and 02 assignment after mid-term exam | | | | | |
| Assessment | | | | | |
| Sr. No. | Elements | Weightage | | Details | |

| 2. | Midterm | |
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| | Assessment | |
| 3. | Formative | |
| | Assessment | |
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| 4. | Final | |
| | Assessment | |
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Course Code: SE-304A Module Title: Mathematics A-II [Plane Curves & Analytic Geometry] Module Rating: 4 Cr. Hours

Plane Analytics Geometry

- · Conic section and quadratic equations
- · Classifying conic section by eccentricity
- · Translation and rotation of axis
- · Properties of circle, parabola, ellipse, hyperbola
- · Polar coordinates, conic sections in polar coordinates
- · Graphing in polar coordinates
- · Tangents and normal, pedal equations, parametric representations of curves
- **Applications of Integration**
 - · Asymptotes.
 - · Relative extrema, points of inflection and concavity
 - Singular, points, tangents at the origin
 - · Graphing of Cartesian and polar curves
 - · Area under the curve, area between two curves
 - Arc length and intrinsic equations
 - · Curvature, radius and centre of curvature
 - Involute and evolute, envelope

Analytic Geometry of Three Dimensions

- · Rectangular coordinates system in a space
- · Cylindrical and spherical coordinate system
- · Direction ratios and direction cosines of a line
- · Equation of straight lines and planes in three dimensions
- · Shortest distance between skew lines
- · Equation of sphere, cylinder, cone, ellipsoids, paraboloids, hyperboloids
- · Quadric and ruled surfaces
- · Spherical trigonometry. Direction of Qibla

Recommended Books

- 1. Thomas, *Calculus*, 11th Edition. Addison Wesley publishing company, 2005
- 2. H. Anton, I. Bevens, S. Davis, Calculus, 8th Edition, John Wiley & Sons, Inc. 2005
- 3. Hughes-Hallett, Gleason, McCallum, et al, *Calculus Single and Multivariable*, 3rd Edition. John Wiley & Sons, Inc. 2002.
- 4. Frank A. Jr, Elliott Mendelson, Calculus, Schaum's outlines series, 4th edition, 1999
- 5. C.H. Edward and E.D Penney, *Calculus and Analytics Geometry* Prentice Hall, Inc. 1988
- 6. E. W. Swokowski, *Calculus and Analytic Grometry* PWS Publishers, Boston, Massachosetts, 1983.
- 7. Dennis G. Zill & Patric D. Shanahan, Complex Analysis, Jones & Barlett Publishers, 2003