



Re-Accredited 'B++' 2.86 CGPA by NAAC

**VEER NARMAD SOUTH GUJARAT UNIVERSITY**

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

**વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી**

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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**--: પરિપત્ર :-**

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc.Zoology Sem-3 & 4 નો અભ્યાસક્રમ મંજૂર કરવા અંગે ઝૂઓલોજી વિષયની અભ્યાસ સમિતિની તા.૦૭/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨૪ અન્વયે કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૪૪ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

**ઝૂઓલોજી વિષયની અભ્યાસ સમિતિની તા.૦૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૩**

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc.Zoology Sem-3 & 4 નો અભ્યાસક્રમ મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

**વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨૪**

:: આથી ઠરાવવામાં આવે છે કે, ઝૂઓલોજી વિષયની અભ્યાસ સમિતિની તા.૦૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૩ અન્વયે કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ ૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc.Zoology Sem-3 & 4 નો અભ્યાસક્રમ મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

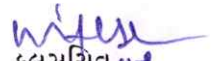
**એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૪૪**

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંક:૨૪ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણ: ઉપર મુજબ )

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૧૬૨૨૪/૨૦૨૩

તા.૩૦-૦૬-૨૦૨૩

  
કુલસચિવ વતી

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓ.

..... આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારું.

૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.

૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારું.

Cell-44  
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RM-34

TCUS/1-23

અકેડેમિક ડાઉનલોડ નં. 23/06-2023  
જાણી.....૫૫.....વિજ્ઞાપનરિશિષ્ટ..૩૫.....

# VEER NARMAD SOUTH GUJARAT UNIVERSITY

## NEP Course: M. Sc. Zoology Syllabus for Semester III

(Credit Based Semester and Grading System with effect  
from the academic year 2023-2024)

## M.Sc. Zoology Syllabus Semester-III

Credit Based and Grading System  
To be implemented from the Academic year 2023-2024

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**Z-3001: Cell Biology and Genetics (Theory) - (60hrs)**

**Unit-1: (15hrs)**

Structure and functions of cell organelles:

- Endoplasmic reticulum
- Golgi apparatus
- Lysosomes
- Micro bodies (peroxisomes and glyoxisomes)
- Vacuoles
- Ribosome
- Centriole
- Basal bodies

**Unit-2: (15hrs)**

- Cytoskeleton
- Cell Movement
- Cell Cycle
- Cell Signaling
- Cell Death Mechanisms
- Protein Sorting and Transport
- Signal amplification
- Receptor types
- Quorum sensing

**Unit-3: (15hrs)**

- Introduction to genetics: Concept of gene (Allele, multiple alleles, pseudoallele)
- Mendelian principles: Principle of dominance, Principle of segregation, Principle of independent assortment.

- Extensions of Mendelian principles:  
Codominance, Incompleteness dominance, Gene interactions, Pleiotropy, Genomic imprinting, Penetrance and expressivity, Phenocopy, Linkage and crossing over, Sex linkage, Sex limited and sex influenced characters
- Gene mapping methods: Linkage maps using crossing over, Tetrad analysis, Mapping with molecular markers, Mapping by using somatic cell hybrids

**Unit-4:**

**(15hrs)**

- Extra chromosomal inheritance: Inheritance of mitochondrial, Chloroplast genes, Maternal inheritance
- Human Genetics:  
Pedigree analysis, LOD score for linkage testing, QTL mapping, Karyotype, Banding techniques
- Genetic disorders: Single gene disorders, Multifactorial disorders, Chromosomal disorders, Mitochondrial disorders
- Mutations: **Spontaneous** vs **induced** mutations, **Germinal** vs **somatic** mutations, Mutation based on base-pairs alterations (Base substitution, Insertion, deletion, duplication, inversion, translocation)

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**SUGGESTED REFERENCES:**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons, Inc.
2. DeRobertis, E.D.P. and DeRobertis, E.M.F. 2006. Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
6. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
8. Russell, P.J. (2009). iGenetics - A Molecular Approach. III Edition. Benjamin Cummings.
9. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology - Principles and Applications of Recombinant DNA. ASM Press, Washington.
10. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
11. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis. W. H. Freeman and Co.

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**Z-3002:ChronobiologyandAnimalBehavior(Theory)**

**(60hrs)**

**Unit-1:**

**(15hrs)**

- Chronobiology:
- Biorhythms (Biological Clocks,Importance ofbiological clock)  
Pheromone
- Stimulus filtering
- Control of behavior: Neural behavior, Hormonal behavior (Hormone-brain relationship).

**Unit-2:**

**(15hrs)**

- Introduction to Animal Behavior
- Patterns of Behavior:
- Social Behavior (Altruism and selfishness, Aggression, Schooling in fishes, flocking in birds, Herding in mammals,Group selection, Kin selection, Social organization in Insects and Primates)
- SexualBehavior (Evolution of Sex, Reproductive strategies, Mating systems, Courtship Sperm competition, Sexual selection, Parental care).

**Unit-3:**

**(15hrs)**

- Elements of Sociobiology
- Communication:Introduction, Chemical, Visual, Light, Audio
- Specific specificity of Songs
- Evolution of Language (primates)
- Evolution of animal signals

**Unit-4:**

**(15hrs)**

- Foraging:Optimal Foraging theory, Foraging and predation risk:
- Defense strategies against predators,
- TerritorialityandGroupforaging
- Orientation: Navigation and Migration (fishes, turtles and birds)

**SUGGESTED REFERENCES:**

1. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
2. Manning, A. and Dawkins, M.S, An Introduction to Animal Behaviour, Cambridge, University Press. UK.
3. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
4. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3<sup>rd</sup> Ed.) Barends and Nobel Inc. New York, USA.
5. The Clock that times us. 1982. Moore Ed et al.
6. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

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**Z-3003:Project/Dissertation**

**(60hrs.)**

The learning objective of the paper will enrich the students with basic principles of research methodology which help the students to learn essential steps involved in research.

- Project work should be done individually/in the group (maximum 4) on any topic of importance related to the subject.
- Project may be done in-house or at a recognized institution outside the campus as specified in the guidelines.
- The concerned candidates must submit their Project/Dissertation in a standard Hard-Bound thesis format.
- The Thesis will be evaluated by an external examiner.
- The Project/Dissertation must be presented in a Power-Point Presentation by the concerned candidates within 15 minutes during their Dissertation Viva.

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E. G. – ZOO – 3004 - HISTOLOGY AND DEVELOPMENTAL BIOLOGY

OR

E. G. – ZOO – 3004 - ANIMAL ECOLOGY AND ENVIRONMENTAL BIOLOGY

**E. G. – ZOO – 3004  
HISTOLOGY AND DEVELOPMENTAL BIOLOGY**

**Unit 1: Tissue organization: (15 hrs)**

- Types of tissue
- Glands and their tissue organization
- Histology of mammalian digestive system and respiratory system

**Unit 2: System organization: (15 hrs)**

- Circulatory system
- Urinogenital system
- Nervous system

**Unit 3: Early Development: (15 hrs)**

- Spermatogenesis
- Oogenesis
- Fertilization
- Cleavage
- Blastulation
- Gastrulation.
- General concept of Potency
- Commitment
- Specification
- Induction

**Unit 4: Organogenesis: (15 hrs)**

- Formation of neural tube
- Axis formation in drosophila and frog
- HOX genes
- Regeneration
- Stem cells

**SUGGESTED REFERENCES:**

1. Balinsky, B.I. 1981. An Introduction to Embryology. W. B. Saunders Co., Philadelphia.
2. Karp, G. and Berrill, N.J. 1981. Development. McGraw Hill, New York.
3. Saunders, J. W. 1982. Developmental Biology. MacMillan Co., London.
4. Nagabhushanam, R. and Sarojini, R. 2002. Invertebrate Embryology. Oxford and IBAPublishing Co. 5
6. Browder, W. 1984. Developmental Physiology. Saunders College Publishing, Rinehart and Winston.
5. Gilbert, S.F. 2003. Developmental Biology. Sinauer Associates Inc. Sunderland, Massachusetts, U.S.A.
6. Oppenheimer, S. B. 1980. Introduction to Embryonic Development. Allyn and Bacon, Inc. U.S.A.

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**E. G. – ZOO – 3004**

**ANIMAL ECOLOGY AND ENVIRONMENTAL BIOLOGY (60hrs)**

**Unit1 : Introduction: (15 hrs)**

- Concepts
- Principles
- Scope
- Basic elements of ecosystems
- **Population ecology:**
- Structure
- Growth curves
- Concept of carrying capacity
- Oscillation
- Energy flow at population level
- Population interaction
- Ecological dominance
- Community analysis
- Ecotone

**Unit2 : Applied Ecology: (15 hrs)**

- Conventional and Non-conventional energy resources
- Wind solar bio-fuel and others
- Nuclear Energy – Nuclear power plants
- Bioremediation of xenobiotic (Phyto, Zoo and microbial-remediation)

**Unit3: Environment quality, its issues and sustainable development: (15 hrs)**

- Natural hazards (Earthquakes, cyclones and volcanoes)
- Tsunami
- Soil erosion (degradation and fertility)
- Forest fires
- Mining and quarrying

**Unit4:Human health and hazards:**

**(15 hrs)**

- Chemical and Biological hazards in developed and developing countries
- Risk analysis
- Scope
- General aspects
- Communication and management
- Occupational health hazards
- Industrialization
- Urbanization and globalization

**SUGGESTED REFERENCES:**

1. BougheyAS1971FundamentalEcology(IntextEducationalPub.)Pp 222
3. ChennP1999Ecology(JohnMurrayPub.)Pp213
4. CollinR, Townsend, HarperJL, andMichaelBegon2000Essentials ofecology.(BlackwellSci.Comp.)  
pp 552
5. DilipR1998EnvironmentmanagementwithIndianexperience(APHPub.Cor.)
6. KrebsCJ1994 Ecology(HarperandCollins)pp801
7. MackenzieA, BallASandVirdeeSR2002Ecology(VivaBooksPvt.Ltd.)P339
8. MillerJrandGT2002Livingintheenvironment(Wardsworth, Brooks/Cole)
9. MishraPC1990Fundamentals ofAirandWaterPollution (AshishPublishing House)
10. OdumEP1971Fundamentals ofecology(WBSaunders Co.)Pp574
11. PaulWP1948LimnologicalMethods(TheBlakistanCo.)
12. RavenPH, BergLR, Johnson GB1993Environment(SaundersCollegePub.)pp569
13. SinghMC2000EnvironmentProtectionand theLaw(AshishPublishingHouse)

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## **P – ZOO - 3005 –PRACTICALS**

### **(A) Based on P – ZOO-3001:CellBiologyandGenetics (60hrs.)**

1. Study of typical animal cell and cell organelles.
2. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
3. Mendelian laws using Drosophila crosses and gene interaction.
4. Study of Linkage, recombination, gene mapping using marker-based data from Drosophila.
5. Study of Human Karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.

### **(B) Based on P – ZOO-3002:ChronobiologyandAnimalBehavior (60hrs.)**

1. To study circadian rhythms in humans (Eating, Sleep, Temperature pattern).
2. To study Nest and Nesting behavior in Birds and Social insects.
3. To study the phototaxic behaviour in insect larvae.

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**ZOO – 3006 (Skill Based Elective Paper)**  
**Instrumentation and Techniques-I**

**(30hrs)**

**Unit 1:Electrophoresis**

**(15 hrs)**

- Principle
- Types and applications of Paper
- Starch gel and Agarose gel electrophoresis
- Polyacrylamide Gel Electrophoresis
- Native PAGE and SDS-PAGE
- Isoelectric focusing
- Isotachopheresis and gradient gel electrophoresis
- Two-dimensional gel electrophoresis and pulse field gel electrophoresis
- Capillary electrophoresis
- Microchip electrophoresis

**Unit 2:Centrifuge**

**(15 hrs)**

- Basic principles of sedimentation
- Types of Centrifuges and rotors
- Preparative centrifugation
- Sub cellular fractionation
- Affinity Purification of membrane vesicles
- Analytical centrifugation and its applications
- Relative molecular mass determination
- Sedimentation coefficient
- Care and safety aspects of centrifuges

**SUGGESTED REFERENCES:**

1. P.B. Godkar, 2014, Textbook of Medical Laboratory Technology, 3rd ed., BhalaniPublishing House, Mumbai,India.
2. Ochei J. &KolhatkarA. 2000, Medical Laboratory Science: Theory & Practice, TataMcGrawHillPub.
3. Wilson K. & Walker J., Practical Biochemistry: Principles & Technique, 5 ed.,Cambridge University Press.
4. Tambwekar S., Handbook of Quality Assurance in Laboratory medicine.,BI
5. Veerakumari L., Bio Instrumentation.,MJP

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY****Course: M. Sc. Zoology****Syllabus for Semester IV**

(Credit Based Semester and Grading System with effect  
from the academic year 2023-2024)

**M.Sc. Zoology Syllabus Semester-IV**

**Credit Based and Grading System**  
**To be implemented from the Academic year 2023 - 2024**

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**Z-4001: Human Anatomy and Parasitology (Theory) (60 hrs.)**

**Unit-1: (15 hrs)**

**Structure and functions of different organs:**

- Digestive system
- Respiratory system
- Circulatory system

**Unit-2: (15 hrs)**

**Structure and functions of different organs**

- Excretory system
- Nervous system
- Reproductive system

**Unit-3 (15hrs)**

**Introduction to Parasitology**

- Host-Parasite Interaction
- Epidemiology of Infectious Diseases
- Its pathogenicity
- Symptoms
- Control and treatment (H1N1, HIV, Zika, Polio, Chikungunya)

**Unit-4 (15hrs)**

**Study of life cycle**

- Hookworm (*Ancylostoma duodenale*)
- *Entamoeba histolytica*
- *Pediculus humanus*
- mosquito (*Culex*, *Anopheles*, *Aedes aegypti*)

**SUGGESTED REFERENCES:**

1. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
2. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributers.
3. Chaudhury, S.K. (1996) Practice of fertility Control, A Comprehensive Textbook. B.I.Churchill Livingston Pvt Ltd, India.
4. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.
5. Hafez, E. S. E. and Evans, T. N. (1973). Human Reproduction: Contraception and Conception. Harper and Row, New York.
6. Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
7. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
8. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
9. Knobil, E. & Neill, J.D. (2006) The Physiology of Reproduction. Vol. 2, Elsevier Pub.
10. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. KitabMahal publications, India.
11. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
12. Berry A. K. (2012) A Text Book of Animal Physiology. XI th ed. Reprinted. Emkay Publication , Delhi-110051.

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**Z-4002: Applied and Economic Zoology (Theory) (60 hrs.)**

**Unit-1: (15 hrs)**

**Poultry Breeding**

- Habitat of fowl
- Food and feeding of fowl
- Breeds of fowl
- Breeding in fowls
- Eggs and hatching
- Rearing of chickens
- Diseases of Poultry
- Poultry Products

**Unit-2: (15 hrs)**

**Aquaculture**

- Scope
- History and present status
- Different systems of Aquaculture
- Cultivable fish species
- Planning
- Layout and construction of fish farm
- Other culture practices

**Unit-3: (15 hrs)**

**Dairy Farming**

- Indian and Exotic Breeds of cow and buffaloes
- Breeding
- Feeding Stuffs
- Feeding of Young Stock
- Diseases
- Milk
- Milk Products

**Unit-4:****(15 hrs)****Apiculture**

- Types and cast of Honey Bee
- Social Organization of Honey Bee
- Life history Honey Bee
- Structure of bee hive
- Flora of Apiculture
- Methods of bee keeping
- Products of bee keeping
- Bee enemies (predators)
- Diseases of Honey Bee

**SUGGESTED REFERENCES:**

1. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
2. Gupta S.K., Gupta P.C.(2006) Genera and Applied Ichthyology.
3. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.
4. Tomar B.S. (2011) Introduction To Economic Zoology. Emkay Publications, Delhi- 110051.
5. Jawaid Ahsan, (1985) A Handbook on Economic Zoology, S.Chand & Company Ltd., New Delhi
6. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
7. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
8. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
9. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
10. Barbara R.L., Scott, Foreman & Company: Engaland, 1972. Essential human anatomy and Physiology
11. G.J. Tortara, John Wiley & sons, (2003), New York, Atlas of Human Anatomy/Skeleton
12. G.J. Tortara Wiley India: Private Ltd., New Delhi. Anatomy and Physiology
13. K.D. Chatterjee, K.D CBS Publishers & Distributors, Private Ltd., New Delhi. Parasitology, Protozoology and Helminthology

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## **Z-3003: Project/Dissertation**

(60hrs.)<sup>7</sup>

The learning objective of the paper will enrich the students with basic principle of research methodology which help the students to learn essential steps involved in research.

- Project work should be done individually/in the group (maximum 4) on any topic of importance related to the subject.
- Project may be done in-house or at a recognized institution outside the campus as specified in the guidelines.
- The concerned candidates must submit their Project/Dissertation in a standard Hard-Bound thesis format.
- The Thesis will be evaluated by an external examiner.
- The Project/Dissertation must be presented in a Power-Point Presentation by the concerned candidates with in 15 minutes during their Dissertation Viva.

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## **GUIDELINES AND RULES FOR DISSERTATION SUBMISSION**

8

Standard Format/Style of Submission of Manuscripts Submission of all manuscripts/thesis should be in a single MS Word file strictly adhering to the following parameters:

1. Thesis is to be printed in Times New Roman typing.
2. Font size to be kept 12.
3. Line Spacing should be 1.5
4. Thesis should contain:
  - (A) Title page with the name(s) of the candidate, their Examination Seat Number, Name of the supervising teacher and the Name of the institute.
  - (B) Authentication certificate of the institute
  - (C) Declaration
  - (D) Acknowledgement
  - (E) Chapter wise Index with Sub-heads and page numbers
  - (F) Introduction (Maximum 05 Page)
  - (G) Review of Literature. (Maximum 15 Page)
  - (H) Aim & Objectives
  - (I) Materials and Methods
  - (J) Results and Discussion
  - (K) Conclusion
  - (L) Future line of investigation
  - (M) Appendix
  - (N) References
5. All tables, charts, images should be at their appropriate places. Figures & Tables: Each figure/table Should be numbered, titled. The position of figure or table should be placed at an appropriate place within the article only.
6. Reference list should appear at the end of your paper. It provides the information necessary for a reader to locate and retrieve any source you cite in the body of the paper. Each entry in the reference list must be cited in your text and it should be in proper reference style.

7. Submit your hard copy of dissertation thesis in form spiral binding/hard bound/thermal binding/leather book binding of your respective collage.

Project may be carried out in-house, or the student, after due sanction from the supervising teacher and institute, can opt for pursuing dissertation at following recognized institutions or industries like:

(A) Any UGC recognized University PG departments

(B) Any Agriculture University

(C) All National and State level research institute

(D) ISO or FDA/USFDA industry or research center having R & D and Q.C. facilities

**E. G. – ZOO – 4004 –Advanced Fisheries**  
**OR**  
**E. G. – ZOO – 4004 –Advanced Aquatic Biology**

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**E. G. – ZOO – 4004**  
**Advanced Fisheries**

**Unit 1: Types of fish ponds** **(15hrs)**

- 1.1 Classification of ponds based on water resources ñ spring, rainwater, flood water, well water and water course ponds.
- 1.2 Functional classification of ponds, head pond, hatchery, nursery ponds.
- 1.3 Functional classification of ponds -rearing, production, stocking and quarantine ponds.
- 1.4 Fish Hatchery design.

**Unit 2: Prawn farming** **(15hrs)**

- 2.1 Systematics position of prawn, Production of seed.
- 2.2 Factors influencing the development of larvae, Methods of prawn culture.
- 2.3 Culture for commercial purposes, Fishing methods.
- 2.4 Tagging prawns, Prawn processing, Culture of freshwater prawns.

**Unit 3: Important indigenous ornamental fishes and its management** **(15hrs)**

- 3.1 Common indigenous ornamental fishes, identification of the common ornamental fishes and its maintenance, Cyprinids: *Puntius denisonii*, *Puntius fasciatus*, *Puntius filamentosus*, *Puntius curmuca*, *Danio malabaricus*.
- 3.2 Loaches: *Nemacheilus triangularis*, *Lepidocephalusthermalis*, Cichlids: *Etroplus maculatus*, *E. suratensis*.
- 3.3 Anabantids: *Anabas testudineus* and Catfishes: *Horabagrusbrachyoma*, *H. nigricollaris*.

**Unit 4: Fish toxicology** **(15hrs)**

- 4.1 Introduction to toxicology, Heavy metal toxicity in fishes, Surfactant toxicity in fishes.
- 4.2 Toxicity caused by agrochemicals, Toxicity caused by textile industries, Toxicity of drugs and chemicals used in aquaculture,
- 4.3 Maximum residue level (mrl) of drugs and chemicals in fish, Fish as a bio-indicator. Fish as a model of genotoxicity study, General methods practiced to test fish toxicity.

**E. G. – ZOO – 4004**  
**Advanced Aquatic Biology**

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**Unit 1: Present status of seed production (15hrs)**

- 1.1 Introduction: History, constraints and current status of seed production.
- 1.2 Natural seed collection.
- 1.3 Seed production of finfishes and shellfishes.

**Unit 2: Reproductive biology of Finfishes (15hrs)**

- 2.1 Gamete maturation and development: Spermatogenesis and oogenesis.
- 2.2 Hormonal pathways and mode of control.
- 2.3 Environmental and endocrine control of reproduction: Reproductive cycles.
- 2.4 Induced breeding: Brood stock availability, Methods of natural and artificial fertilization, evaluation of milt and egg, cryopreservation technique.

**Unit 3: Induced breeding of Shellfishes (15hrs)**

- 3.1 Reproductive biology: endocrinology and reproductive mechanisms in prawns, shrimps etc.
- 3.2 Age at first maturity; factors affecting maturation and spawning.
- 3.3 Broodstock: availability; improvement; nutritional requirements; transport; captive rearing and maturation.
- 3.4 Induced spawning; physical and chemical inducing agents; physiology and techniques of eyestalk ablation.

**Unit 4: Hatchery (15hrs)**

- 4.1 Hatchery design and management.
- 4.2 Criteria for site selection of hatchery and nursery, design and function of incubators.
- 4.3 Jar hatchery, Chinese hatchery and other hatchery systems- design and operation.
- 4.4 Hatchery protocols, larval rearing stages. rearing technology, packaging and transport of seed.

**SUGGESTED REFERENCES:**

1. Suggested Readings FAO. 1992. Manual of Seed Production of Carps.
2. FAO Publ. ICAR. 2006. Hand Book of Fisheries and Aquaculture.
3. ICAR. Jhingran VG & Pullin RSV. 1985.
4. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines. Jhingran VG. 1991. Fish and Fisheries of India.
5. Handbook of Mariculture. CRC Press. Pillay TVR & Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell. Rath RK. 2000.
6. Freshwater Aquaculture. Scientific Publ. Thomas PC, Rath SC & Mohapatra KD. 2003.
7. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.
8. AQC CMFRI Bulletin. 1987. National Seminar on Shellfish Resources and Farming.
9. FAO. 2007. Manual for Operating a Small-Scale Recirculation Freshwater Prawn Hatchery. ICAR. 2006.
10. Handbook of Fisheries and Aquaculture. ICAR.
11. Ujwala Jadhav (2010): Aquaculture Technology and Environment. Publ. PHI Publication Bardach EJ, Rhyther JH & Mc Larney WO. 1972.
12. Aquaculture. The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons. Chakraborty C & Sadhu AK. 2000.
13. Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn. Daya Publ. House. Diwan AD, Joseph S & Ayyappan S. 2008.
14. Physiology of Reproduction, Breeding and Culture of Tiger Shrimp. Narendra Publ. House. Gilbert B. 1990. Aquaculture. Vol. II. Ellis Harwood.
15. FAO. 2007. Manual on Freshwater Prawn Farming.
16. Midlen & Redding TA. 1998. Environmental Management for Aquaculture.
17. Kluwer. New MB. 2000. Freshwater Prawn Farming. CRC Publ.

**P – ZOO - 4005 –PRACTICALS**  
**(Based on theory Paper 4001 and 4002)**

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**(A) Z-4001: Human Anatomy and Parasitology**

(The following Practicals to be taught/studied through permanent slides/  
photomicrographs/specimens / charts /models etc.)

1. Study of human Digestive system and Respiratory system.
2. Study of human Circulatory system and Excretory system.
3. Study of human Nervous system and Reproductive system.
4. Study of Measles, HIV, Zika, Polio, Chikungunya viruses and symptoms.
5. Study of life cycle of Hookworm (*Ancylostoma duodenale*), *Entamoeba histolytica*, *Pediculus humanus*.
6. Study of life cycle of mosquito.

**(B) Z-4002: Applied and Economic Zoology**

1. Study of Poultry Diseases: Ranikhet, Fowl pox, Tick fever, Tuberculosis, Fowl cholera, Avian leucosis, Infectious coryza, Rickets, Nutritional Roup, Crop bound, Feather picking, Perosis, Coccidiosis, Round worm.
2. Study of Breeds of fowl.
3. Study of Cultivable fish species.
4. Study of Diseases seen in Cows and Buffaloes.
5. Study of Diseases of Honey Bee: Brood foul, Nosema diseases, Amoeba diseases, Acarine diseases.
6. Visit to poultry farm/ animal breeding center /fish farm/honey bee keeping.  
Submission of visit report.

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**ZOO – 4006 (Skill Based Elective Paper)  
Instrumentation and Techniques-II**

**(30hrs)**

**Unit 1 Instrumentation techniques-I (15 hrs)**

**1.1 MOLECULAR AND MEDICAL TECHNIQUES**

1.1.1 Fluorimetry and FACS (Fluorescence Activated Cell Sorting).

1.1.2 Turbidometry and Nephelometry.

1.1.3 X-Ray, CT scan, MRI and PET scan.

**1.2 Automation in Clinical Biochemistry**

1.2.1 Types of Biochemistry Analyzer and its Application.

1.2.2 Advantages and disadvantages of Automation.

1.2.3 Blood gas Analyzers.

**Unit 2 Instrumentation techniques-II (15 hrs)**

2.1 Radioisotope techniques: half-life, radioactive decay, radio active assay methods based on ionization and excitation of gases-Geiger Muller counter, liquid scintillation counter and gamma counter.

2.2 Autoradiography- principle and applications. Quenching and application of radio isotopes in biological systems.

**SUGGESTED REFERENCES:**

1. P.B. Godkar, 2014, Textbook of Medical Laboratory Technology, 3rd ed., BhalaniPublishing House, Mumbai,India.
2. Ochei J. &KolhatkarA. 2000, Medical Laboratory Science: Theory & Practice, TataMcGraw HillPub.
3. Wilson K. & Walker J., Practical Biochemistry: Principles & Technique, 5 ed.,Cambridge University Press.
4. Tambwekar S., Handbook of Quality Assurance in Laboratory medicine.,BI
5. Veerakumari L., Bio Instrumentation.,MJP

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