

Fish and Fisheries

Course structure

Semester 3

Course No.	Course Title	Nature of course	Credits	Full Marks
Fis 615	Taxonomy & Molecular Genetics Adaptation	T	4	100
Fis 616	Anatomy and Physiology	T	4	100
Fis 617	Aquaculture and Fish Breeding	T	4	100
Fis 618	Freshwater Ecology & Research Methodology II	T	4	100
Fis 619	Taxonomy, Anatomy and Adaptation	P	2	50
Fis 620	Aquaculture, Fish Breeding & Freshwater Ecology	P	2	50
Fis 621	Dissertation Proposal & Seminar		1	25
Total			21	525

Semester 4

Fis 655	Fisheries Management	T	3	75
Fis 656	Thesis		4	100
Total			7	175

Semester III

Fish and Fisheries

Course Title: Anatomy and Physiology

Credits: 4

Course No.: Fis 616

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Objective

To introduce general anatomy and physiology of common fishes.

Course Contents

Digestive system: Food and feeding habit, digestive organs, morphology, histology and physiology of digestion. **10 hrs**

Respiratory system: Structure of gills in typical fresh water fishes, counter current mechanism, gas exchange, blood as a gas carrying substance, accessory respiratory organs. **8 hrs**

Blood vascular system: Structure of hearts in typical fresh water fishes and physiology of blood circulation. **5 hrs**

Excretory system: Structure of kidney and their ducts and osmo-regulation. **5 hrs**

Nervous system: Central, peripheral and autonomic nervous system and their modification in different groups of fishes. **6 hrs**

Reproduction: Structure of reproductive organs in typical fresh water fishes and different groups of fishes. **6 hrs**

Embryonic development: Cleavage, blastulation, gastrulation, fate of cells, organogenesis, hatching, yolk sac absorption mechanisms, post larval development. **10 hrs**

Endocrine glands: Secretions, functions and mechanisms of pituitary gland, thyroid gland, pancreas, testes and ovary. Roles of the hormones on the breeding processes of fish. **10 hrs**

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Semester III

Fish and Fisheries

Course Title: Aquaculture and Fish Breeding

Credits: 4

Course No.: Fis 617

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Objective

To introduce general aquaculture and fish breeding techniques.

Course Contents

Introduction of aquaculture in Nepal.

2 hrs

Monoculture and polyculture practices: Classification of aquaculture systems based on economic and commercial consideration. (extensive, semi-intensive and intensive), based on operational techniques (cage, pen, raceways culture), based on climatic factors (warm and coldwater aquaculture).

8 hrs

Existing Aquaculture systems: Culture of some important indigenous species, cage and pen culture, paddy cum fish culture, culture of air-breathing fishes or live fish culture. **Different types of integrated fish farming systems:** Fish cum duck culture, fish cum pig culture.

8 hrs

Fish Breeding: Natural breeding of fishes. Artificial breeding of commercially important indigenous and exotic fish species. Fish breeding by hypophysation, incubation and hatching, larval rearing and nursery management.

10 hrs

Culture of Carps and other important indigenous species: Catla (*Catla catla*), rohu (*Labeo Rohita*), mrigal (*Cirrhinus mrigala*), mahseer (*T. putitora* and *Tor tor*), katle (*Neolissocheilus hexagonolepis*), snow trout (*Schizothorax* and *Schizothoraichthys* spp.), catfishes (*Clarias batrachus*), perches (*Anabas testudinus*), *Channa marulius*.

16 hrs

Culture of exotic carps: Race-ways trout (*Oncorhynchus mykiss*) culture, culture techniques of *Clarias gariepinus* and *Pangasius hypothalamus*, *Tilapia* (*T. mossambica* and *T. nilotica*), Shrimp culture (*Macrobrachium rossenbergi*).

14 hrs

Invasive or Alien species: Introduction and impact upon indigenous fishes.

2 hrs

Semester III

Fish and Fisheries

Course Title: Freshwater Ecology & Research Methodology II

Credits: 4

Course No.: Fis 618

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Objective

To introduce about general aspects of limnology, freshwater ecology and impact of damming and pollution on aquatic environment.

Course Contents

A. Fresh Water Resources:

- i) **River systems** and their zonations (Carpenter, Huet and Universal Systems), General applicability of the fish zonation concept in Nepal, ecological validity of river zonation, influence of man in zonation. **6 hrs**
- ii) **Lakes and their types:** Origin of lakes, distribution and classification, ecology and application. **3 hrs**
- iii) **Ponds and reservoirs:** Origin, distribution and classification, ecology and application **3 hrs**
- iv) **Swamps and marshes:** Origin, distribution and classification, ecology and application, Wetland Ecosystem Complex -Swamps, marshes. **4 hrs**
- v) **Irrigated paddy fields:** Introduction, role of irrigated paddy fields in fisheries. **2 hrs**

B. Limnology and climate change impact:

- i) **Limnology:** pH., hardness, dissolved oxygen, free carbon dioxide BOD, COD, alkalinity, acidity, ammonia. Primary and secondary productivity, chlorophyll, plankton, periphyton, benthos and their implication on fisheries. **12 hrs**
- ii) **Impact of climatic change:** Temperature and fish physiology; Water temperature effects on limnology; Thermal habitat space, thermal refuges and changes in fish communities; Fish distribution and temperature barriers; Disease and parasitism; Water balance: The hydrologic cycle and regime; Temperature and toxicology; Socioeconomic effects **12 hrs**

C. Environment Impact Assessment: Effects of developmental activities on natural fishery resources, aquatic environment and EIA for mitigation measure. **4 hrs**

D. Fishery and Water Related Acts: Regulation and control of different types of illegal and unconventional fishing gears used in Nepal for fishery exploitation. **4 hrs**

E. Research Methodology: Fish sampling methods for survey of rivers and lakes, Research planning, data analysis, interpretation, conclusion, abstracting, literature citation, scientific paper writing, proposal writing, Application of statistical techniques for fisheries research T-test, chi-square test (X^2), contingency table, correlation, regression and analysis of variance. **10 hrs**

Semester III

Fish and Fisheries

Course Title: Taxonomy, Anatomy and Adaptation

Credits: 2

Course No. Fis 619

No. of Practicals: 30

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 25

General Objective

To provide practical knowledge of various techniques used in fish taxonomy, collection, preservation, identification, microtomy, permanent slides preparation and dissection of some common species.

Course Contents

1. Collection and identification of different species of fishes from natural habitats.
2. Study of museum specimens
3. Dissection of some fishes to study: General Anatomy, Respiratory and Accessory Respiratory organs.
4. Dissection of some siluroid and cyprinoid fishes such as *Catla* spp. *Wallago* spp., *Mystus* spp. and Rohu spp. to study Cranial nerves, Weberian ossicles and Internal ear.
5. Permanent mountings: Permanent slide preparation of scales, ampullae of Lorenzini, Respiratory membrane, eggs, hatchlings, fry and fingerlings.
6. Preparation of fish skeleton and osteological study.
7. Microtome preparation of gonads and different organ tissues.
8. Study of hill stream modifications *Glyptosternum* sp. *Pseudoecheinus sulcatus*, *Schizothorax* sp. and *Garra* sp.
9. Report writing after field visit to different fish farms (Collection of information about inbreeding and genetic analysis of common carp pedigree, excursion to Pokhara and Kali Gandaki fish farms to study about Mahaseer pedigree).

Semester III

Fish and Fisheries

Course Title: Aquaculture, Fish Breeding & Freshwater Ecology

Credits: 2

Course No.: Fis 620

No. of Practicals: 30

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 25

Objective

To provide practical knowledge of various techniques used for the study of limnological parameters, study of planktons, fishing gears, impact of damming, study of fecundity, age and growth of fishes, fish nutrition, fish diseases, pond engineering, etc.

Course Contents

1. Limnology: Measurement of temperature, pH, dissolved oxygen, free carbon dioxide, alkalinity, acidity, hardness, minerals, specific conductivity, dissolved solids.
2. Sampling preservation and identification of planktons and macro invertebrates, methods for qualitative and quantitative estimation of planktons and assessment of primary productivity by light and dark bottle method.
3. Study of the impact of damming on riverine fisheries and fish migration in Sunkosi and Kali-Gandaki rivers
4. Preparation of bathymetric map of water body.
5. Introduction of different fishing gears using models.
6. Study of fecundity of some fresh water fishes.
7. Determination of age and growth of fishes.
8. Fish nutrition: Feed composition/formulation
9. Fish diseases: study of causative agents, symptoms and preservation methods for common diseases and parasites of carps and rainbow trout.
10. Pond engineering: Study about layout, design and construction of fish ponds for carps and raceways for rainbow trout.
11. Report preparation on the basis of field visit to different fish farms (Focus should be given on breeding techniques both artificial and semi artificial, types of ponds etc.)

Semester III

Fish and Fisheries

Course Title: Dissertation Proposal & Seminar

Course No. Fis 621

Nature of the Course: Research

Credit: 1

Lectures: 60

Full Marks: 25

Pass Marks: 12.5

Objective

To strengthen the knowledge of students in research based academic activities and to develop a research proposal of thesis for semester IV.

The students will select topic for their research work related to their special/elective paper. The students will prepare a research proposal by studying published research works in the related area. The research proposal will be discussed with research committee of the department. After which the department will formally appoint supervisor/s for the research project. Each student will work for research under the supervision of assigned supervisor in the department. After completing the proposal, it is mandatory to present in a seminar.

Semester IV

Fish and Fisheries

Course Title: Fishery Management

Course No. Fis 655

Nature of the Course: Theory

Credits: 3

Lecture hrs: 45

Full Marks: 75

Pass Marks: 37.5

Objective

To share and impart basic and advanced knowledge of fishery management and to apply it in research methodology so as to obtain relevant findings to apply the research findings in production and management of fishes.

Course Contents

Management of Fish Pond: Fish Culture operation, water quality improvement, weed control, pond fertilization and manuring, feeding of cultivated fishes, fish harvesting etc. **12 hrs**

Brood Stock Improvements: Genetic Management of brood stock for hatchery, problem concerned with fish brood stocks and hatchery operations, long term and short term plans for brood stock development. **10 hrs**

Hatchery Management: Concept of fish hatchery, hatchery design, incubation, hatching and larval rearing in hatchery. **8 hrs**

Fish Nutrition: Nutritional requirement of a fish, supplementary feeding, Nutrition deficiency and symptoms in fishes and their implication on fish health. **10 hrs**

Fish Diseases: Prevention and control of bacterial, fungal and viral diseases in fishes. Treatment and control of fish leech infection, trematode disease and pancreatic necrosis etc. **12 hrs**

Fish Preservation and Processing: Different processes of fish preservation: Salting, pickling, smoking, drying, icing, freeze drying, quick freezing of fishes, refrigerated sea-water (RSW), canning and use of chemical and antibiotics and irradiation etc. Method of transport and preservation of fish during transport. Fishery policy and fishery co-operative, society etc in transport, preservation of fish and marketing. Roles and problems in fisherman co-operatives and society. **15 hrs**

Fish Marketing: Present status of fish marketing in Nepal, consumption level, fish market channel - level and trend. Marketing infrastructure – problems, prospects and potentiality of fish marketing. **8 hrs**

Semester IV

Fish and Fisheries

Course Title: Thesis

Credits: 4

Course No.: Fis 656

Full Marks: 100

Nature of Course: Research (Compulsory)

Pass Marks: 50

General Objective

To produce M.Sc. dissertation based on original research study in priority areas of Fish and Fisheries.

Specific Objective

- To develop scientific observation of natural phenomenon, skill to analyze and understand for logical interpretation
- To know various methodological tools including instruments and apply them in the field studies
- To develop confidence on seminar presentation and defend the dissertation work

Dissertation Work

The dissertation work is compulsory for all the students in order to develop skills and handle the research study independently. The students will work on the proposal developed in Zoo 621 of semester III under the formally appointed dissertation supervisor/s. However, the student will work independently and will take full responsibility of completing the proposed task on time. The supervisor will be available for consultation and review. The dissertation will be evaluated by a committee of expert including an external examiner. Students will have to present their work and defend it in an open viva-voce. Students will be encouraged to publish the dissertation findings in peer reviewed 'Nepalese Journal of Zoology' in the form of original research article.

The Student must complete a dissertation work and should submit it within the academic session of the fourth semester. The duration can however be extended by the research committee with the consent of the head of the department on request form the student and the recommendation of the concerned supervisor with reasonable explanation.

Text Books:

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Allan, J.D. 1995. Stream Ecology. Chapman and Hall London.

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Balinsky, B.J., 1975. An Introduction to Embryology (4th edition). W.B. Saunders Company 648p.

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