

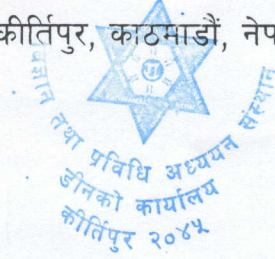


त्रिभुवन विश्वविद्यालय  
विज्ञान तथा प्रविधि अध्ययन संस्थान  
डीनको कार्यालय

कीर्तिपुर, काठमाडौं, नेपाल

पत्र सङ्ख्या

च.नं. १०२०११४०८२



मिति : ०७५।३।३१

श्री क्याम्पस प्रमुख ज्यू,

.....क्याम्पस

विषय : पाठ्यक्रम परिमार्जन गरिएको बारे ।

उपरोक्त विषयमा यस विज्ञान तथा प्रविधि अध्ययन संस्थान अन्तर्गत अध्ययन अध्यापन हुने ४ वर्षे स्नातक (B.Sc.) कार्यक्रमको तेस्रो तथा चौथो वर्षको पाठ्यक्रम परिमार्जन गरिएकोले सो अनुसार शै.स. ०७३।०७४ मा भर्ना हुने विद्यार्थीहरू देखि उक्त पाठ्यक्रम अध्ययन अध्यापन गराउने व्यवस्थाको लागि निर्णयानुसार अनुरोध गर्दछु । परिमार्जित पाठ्यक्रम यस अध्ययन संस्थानको Website : [www.tuiost.edu.np](http://www.tuiost.edu.np) बाट Download गर्न सकिने व्यहोरा समेत जानकारी गराउदछु ।

*Handwritten signature*

प्रा.डा. राम प्रसाद खतिवडा  
डीन

बोधार्थ :

श्री अध्यक्ष ज्यू,

.....विषय समिति

त्रि.वि. कीर्तिपुर ।

# **Tribhuvan University**



## **Institute of Science and Technology**

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**4 year's Bachelors of Science Revised course of Study-2073**

**Third & Fourth Year**

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**Effective form 2073 Admission Batches**

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**Dean's Office, Kirtipur**

# Zoology

Tribhuvan University  
Institute of Science and Technology  
Four Years B. Sc. Zoology Course of Study

**Course Title: Entomology and Parasitology**

**Course No. : Zool.401**

**Nature of Course : Theory**

**Instruction Lectures: 150**

**Objectives of the Course:**

At the end of course students will be able to:

- Understand value of virus, bacteria, protozoan and helminth parasites and insects.
- Explain and demonstrate general anatomy of insects and host-parasite relationship.
- Epidemiology of diseases caused by parasites/environment and concept of pharmacology.
- Identify some common pests and parasites of agriculture and understand their control measures.
- Create understanding of economic and commercial insects, vectors and vector-borne diseases.

**Full Marks : 100**

**Pass Marks : 35**

**Year : IV**

## **Group A: Entomology (75lec.)**

### **General Entomology**

**Diversity and Importance of Insects:** Introduction, Insect diversity, Importance of insects, Naming and classification of insects. **(7 lec.)**

**Insect Morphology:** General body plan, Head, Head appendages: antennae and mouthparts. Thorax, Thoracic appendages: legs and wings. Abdomen, Abdominal appendages: external genitalia and other appendages. **(11 lec.)**

**Insect Anatomy and Physiology:** Digestive system. Circulatory system. Excretory system and nitrogenous excretion. Nervous & chemical integration. Sense organs. Respiratory system. Reproductive system. **(20 lec.)**

### **Applied Entomology**

**Pest Management :** Pest damage. Economic decision levels for pest populations. Methods of pest control (legislative, physical, cultural, biological control, crop plant resistance to pest attack and chemical control). Classification of pesticides. Pesticide formulations. Effects of pesticides.

Pesticide use in Nepal. Safe use of pesticides. Integrated Pest Management. Descriptions, biology and control of selected crop pests (*Quadraspidiotus perniciosus*, *Aphis gossypii*, *Leptocorisa acuta*, *Phthorimaea operculella*, *Spodoptera litura*, *Sitophilus zeamais*). (21 lec.)

**Industrial Entomology: Apiculture:** Society organization of honey bee. Honey bee species. Morphology and life cycle of honey bee. Bee keeping. Prospects of beekeeping in Nepal. **Sericulture:** Introduction. Life cycle of silk moth. Strains of silkworm. Rearing of silkworms. Cocoons. Mulberry cultivation. Composition & uses of silk. Prospects of sericulture in Nepal. **Lac culture:** Introduction. Life cycle of the lac insect. Strains of lac. Host plants for lac insects. Lac cultivation. Composition and uses of lac.

**Yarsa Gumba** (Parasitic fungus & Ghost moth caterpillar): Introduction, economic importance & conservation. (15 lec.)

### Group B: Parasitology (75 lec.)

**General Parasitology:** Introduction, scope and historical landmarks. Host parasite inter-relationship. Types of host and parasites. Properties of parasites. (5 lec.)

**Epidemiology:** Uses, tools and measurement (mortality, morbidity, incidence and prevalence). Dynamics of disease transmission. (7lec.)

**Bacteriology and Virology: Bacteria-** Molecular characteristics. Entry and colonization in human host. Bacterial toxin and human diseases. Modes of transmission, pathogenicity and control measures bacterial diseases (Tetanus, Syphilis and Leprosy). **Virus-** Molecular characteristics. Modes of transmission, pathogenicity and control measures of viral diseases (Hepatitis, Dengue, Avian influenza, Ebola and Swine flu). (13 lec.)

**Protozoology and Helminthology:** Epidemiology of Protozoan diseases (Malaria, Leishmaniasis, Giardiasis, Amoebiasis) and helminthic diseases (Fasciolopsis, Echinococcosis, Schistosomiasis, Ancylostomiasis, Enterobiasis and Filariasis). Parasitic nematodes in citrus plants. Agricultural practices in phytonematode control. (10 lec.)

**Zoonotic Diseases:** Epidemiology of viral (Japanese encephalitis), bacterial (Brucellosis), protozoan (Theiliasis) and helminthic (Trichinelliosis). (7 lec.)

**Vector and Vector Borne Diseases:** Diseases transmitted by sandflies, mosquitoes, ticks and mites. Control of vector and vector borne diseases. (7 lec.)

**Environmental Health:** Problems, planning and management in Nepal. Excreta disposal and public health importance. Food, milk and water borne diseases. Occupational diseases due to biological agents (Anthrax and Hydatidosis). (7 lec.)

**Immunology:** Immunity. Immunizing agents. Types of vaccines. Cold chain. Current immunization practices. (8 lec.)

**Pharmacology:** Nomenclature of drugs. Routes of drug administration. Pharmacokinetics and pharmacodynamics. Antibiotics, its classification and application in medical sciences. Anthelmintic and antiprotozoan medicines. (11 lec.)

### **Suggested Readings:**

#### **Entomology (latest editions)**

- Aruga, H. Principles of Sericulture. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
- Chapman, R.F. The Insects: Structure and Function. 4<sup>th</sup> edition. Cambridge University Press.
- Delong, J. Borror and Delong, Dwight M. An Introduction to the Study of Insects.
- Fenimore, P.G. and Prakash, A. Applied Entomology. New Age International Publishers.
- Gillot, C. Entomology. Plenum Press, New York.
- Gullan P.J & Cramston P.S., The insects: An outline of Entomology, Wiley Publishers
- Hill, D.S. 1993. Agricultural Insect Pests of the Tropics and their Control. Special edition for sale in Asia only. Cambridge University Press, Cambridge.
- Metcalf, R.L. and Luckmann, W.H. Introduction to Insect Pest Management.. John Wiley & Sons, New York
- Metcalf, R.L. and Flint, W.P. Useful and Destructive Insects, their Habitats and Control. McGraw- Hill, New York.
- Pedigo, L.P. Entomology and Pest Management. Prentice Hall of India Private Limited, New Delhi.
- Richards, O.W. and Davies, R.G. IMMS' General Textbook of Entomology. vol. 1. BI Publications Pvt. Ltd., New Delhi.
- Snodgrass, R.E. Principles of Insect Morphology. CBS Publishers & Distributors.
- Verma LR (eds) Honeybees in mountain agriculture, Oxford & IBH publishing Co. Pvt. Ltd. New Delhi, India

#### **Parasitology (latest editions)**

- Arora, D.R. and Arora B. Medical Parasitology. CBS Publishers and Distributors, New Delhi.
- Arora, D.R. Text book of Microbiology .CBS Publishers and Distributor, New Delhi.
- Belding, D.L. Text book of Parasitology. Meredith, New York.
- Chatterji, K.D. Parasitology (Protozoology and Helminthology). Medical Publishers, Calcutta, India.
- Chandler, A.C. and Read, C.P. Introduction to Parasitology. John, Wiley and Sons, inc.

Mathur, J.S. Preventive and Social Medicine, A comprehensive Text book with special focus on Nepal. CBS Publication and Distributor, New Delhi.

Park, K. Text book of Preventive and Social Medicine. Banarsidas Bhanot Publishers Jabalpur, India.

Parija, S.C. Review of Parasitic Zoonoses. A.I.T.B.S. Publishers and Distributors, Delhi.

Tripathi, K.D. Essentials of Medical Pharmacology. Jaypee Brothers, Medical Publishers P. Ltd., New Delhi.

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**Course Title: Entomology and Parasitology**

**Full Marks:50**

**Course No. : Zool.402**

**Pass Marks:20**

**Nature of Course : Practical**

**Year : IV**

**Objective of the Course:** For better understanding of the topics of Zool.401.

### **Entomology**

1. Study of museum specimens/permanent slides of pest species and vectors covering important orders.
2. Identification of collected insects up to orders using keys to orders, identification of major crop pest species and their wet and dry preservation (liquid preservatives, insect pinning, labeling and storing).
3. Preparation of permanent slides: Antennae (3-5 types), Wings (3-5 types), Mouth parts (2-3 types) and Whole mount of fleas, lice, apterygotes, thrips, aphids, ticks and mites (2-5 types).
4. Dissection of common insects such as honey bees (sting), grasshoppers (nervous system).
5. Survey of varieties of synthetic chemical pesticides available in the market and write note on i) trade name, common name and chemical name composition, ii) Nature of action and target species iii) Note whether recommended to use in Nepal, and iv) note their formulations with their characteristics nature.
6. Study different kinds of sprayers and their parts with respective functions in operation.
7. Study of caste system of honey bees and different instars of silkworm.

### **Parasitology**

1. Study of museum specimens of helminthes and permanent slides of bacteria, protozoans, platyhelminthes and nematodes.
2. Collection, preservation/slide preparation and identification of parasites.
3. Examination of faecal samples for identification of intestinal parasites and eggs.
4. Preparation of thick and thin blood smears on a slide.
5. Preparation and study of protozoan culture.
6. Microphotography of parasites. Identification of photos of different stages of parasites.
7. Principle and use of *in vitro* diagnostic tools: Immunochromatographic Test (ICT) / Rapid

Diagnostic Test (RDT) for different human diseases (malaria, filariasis, dengue etc).

**Practical note book preparation as regular study.**

**Report writing:** Survey of any locality regarding any topic of Zool. 401 and write a report of about 5 -10 pages. Conduct **seminar** on the report and submit the final report accommodating suggestions made in the seminar.

Examples:

- Study of damage patterns of stored grains, field crops and vegetables caused by the insects and nematodes.
- Visit to the hospitals for the survey (general survey, status or case report) of any studied disease, immunization programs, etc. or visit of farmer plots, apiculture / sericulture/ fish/ poultry /animal husbandry in local area.

Prepare market survey report on pesticide use on vegetables or fruit trees.

**Tribhuvan University  
Institute of Science and Technology  
Four Years B. Sc. Zoology Course of Study**

**Course Title: Ecology and Fish & Fisheries**

**Course No. : Zool.403**

**Nature of Course: Theory**

**Instruction Lectures: 150**

**Objectives of the Course:**

At the end of course students will be able to:

- Understand the basic concepts and principles of ecology.
- Understand major environmental problems and issues.
- Understand the challenges, principles and practices of biodiversity conservation.
- Know basic taxonomy and status of indigenous fishes of Nepal.
- Understand the significance of limnological parameters, nutrition, fish disease and seed production in aquaculture.
- Gain knowledge on the importance of post-harvest and marketing of fishes.

**Group A: Ecology and Conservation Biology (75 hrs.)**

**Ecology**

**Introduction and Ecological factors:** Scope and development of ecological thoughts. Habitat and ecological niche. Ecological factors - Liebig's law of the minimum, Shelford's law of tolerance, Effects of ecological factors on the distribution and abundance of organisms. **(6 hrs.)**

**Ecosystem:** Concept. Structure- Biotic and abiotic components, and ecological process. Ecosystem energetic - primary productivity, secondary productivity, energy flow, food chain and food web. Biogeochemical cycles - Gaseous cycle (C, N, O<sub>2</sub>) and sedimentary cycles (S, P). Disturbances and dynamics of ecosystem. **(12 hrs.)**

**Population Ecology:** Concept. Characteristics- natality, mortality, immigration, emigration, density, fecundity. Structures - age and sex distribution, life table and survivorship curve. Dynamics- Population growth and regulation, density dependent and density independent regulation. (8 hrs.)

**Community Ecology:** Concept and characters of community. Community structure – physical and biological structures. Species interaction and their effects – Positive (mutualism, cooperation and commensalism) and negative interactions (predation, competition, parasitism). Succession/ecosystem development- Process, and concept of climax, changes in ecosystem attributes, succession and animal life. (10 hrs.)

**Pollution and Environment:** Process of ozone depletion, acid rain, and eutrophication. Concept of Reducing Emission from Deforestation and Degradation (REDD) and Clean Development Mechanism (CDM). Climate change and its impacts. Biological Invasion- Characteristics of invasive species, process and impacts of biological invasion. (8 hrs.)

**Natural Resources:** Concepts of renewable and non- renewable natural resources. Management approach- Ecosystem and/or watershed approach. (4 hrs.)

### **Conservation Biology**

**Biodiversity:** Levels and hierarchy. Values and uses. Threats: primary threats, concept of threatened species (IUCN Red List Categories). (7 hrs.)

**Biodiversity Sampling/surveys:** Concept and purpose. Biodiversity assessment and monitoring. Biodiversity indices. Sampling terrestrial vegetation - Quadrat or sample plots, belt transects and line intercept. Sampling animal populations - Trapping and collection of soil organism and insects, estimating abundance (Census, Capture- recapture, removal, line transects). Sampling indices of animal abundance. Sampling habitat - Introduction and use of map, remote sensing and GIS. (11 hrs.)

**Biodiversity Conservation:** History of conservation - Global and National. National Policy and International conventions. Conservation approaches: In-situ conservation - Concept, Protected Areas (IUCN categories), Biosphere Reserves, Protected Areas Management in Nepal, Ramsar sites of Nepal, Ex-situ conservation - Concept, gene bank, Zoo garden, botanical gardens, captive breeding. Landscape level conservation. (9 hrs.)

### **Group B. Fish and Fisheries (75 hrs.)**

**Fish Systematics:** Principles of fish taxonomy. Fish identification techniques. Classification of fishes with reference to Nepal. (4 hrs.)



Fish Biology: Digestive, Respiratory, Blood vascular system, Excretory system, Nervous system and Reproduction of typical fresh water fish. (10 hrs.)

**Fresh Water Ecology:** River systems and their zonations, Ecological validity of the river zonation.. Lakes and types, origin and ecological application. (5 hrs.)

**Limnological Parameters:** Physicochemical parameters-turbidity, temperature, pH, dissolved oxygen, dissolved CO<sub>2</sub>, alkalinity, hardness, ammonia, phosphorus, BOD, COD etc. Biological parameters– phytoplankton, zooplanktons, nekton and zoo benthos etc. (7 hrs.)

**Environment Impact Assessment:** Concept, importance and application of EIA with reference to Nepal. (3 hrs.)

### **Fisheries**

**Capture and Culture Fisheries: Capture fishery-** Introduction, warm water and cold water fishery in Nepal. Status of inland water resources and inland capture fishery. Fish exploitation, threats and management of capture fishery. **Culture fishery -** Introduction, principles and scope of culture fishery, Different systems of fish culture, status of fish culture and aquaculture. (6 hrs.)

**Pond preparation-** Pond engineering, criteria for selection of fish species for culture, characteristics of cultivable species, common cultivable fishes of Nepal, pre stocking and post stocking management. (6 hrs.)

**Fish Breeding and Management:** Maturation and spawning. Role of gonadotropin in fish breeding. Induced breeding of indigenous major carps. Management and rearing of hatchling, fry, fingerling and broodstock. (7 hrs.)

**Nutrition:** Importance of different biomolecular compounds in fish feed. Nutritional requirement of fishes in different stages of life on the basis of feeding habits. Artificial diet- Introduction, formulation. Supplementary feeding and pellet feeding. Nutrient deficient diseases in fishes. (9 hrs.)

**Fish Pathology:** Introduction, morphology, life cycle, symptoms, prophylaxis and therapy of important infectious diseases of fish: Bacterial (tail and fin rot), Fungal (Saprolegniasis and Epizootic Ulcerative Syndrome), Protozoan (Ichthyophthiriasis) and Metazoan (Argulosis). Importance of management of fish diseases in fish culture. (9 hrs.)

**Post Harvest Technology, Fish Marketing and Extension:** Post harvest technology- Introduction, Principles and importance of fish preservation. Traditional and advanced methods of fish preservation.

**Fish Marketing-** Introduction, fish transportation, status of present fish marketing in Nepal.

**Extension-** Cooperatives and their importance in fish production and marketing. (9 hrs.)

**Suggested Readings (Fish and Fisheries):**

Amlacher, E., 1970. Textbook of Fish Diseases. Translated from German by D.A. Conroy and R.L. Herman. Jersey City, N.J., T.F.H. Publications Inc., 302 p.

Gupta, S.K and Gupta, P.C. 2014. General and Applied Ichthyology (Fish and Fisheries) Pub. S. Chand & Company Pvt. Ltd. New Delhi, India.

Jhingran, V.G. 1991. Fish and Fisheries of India. 3rd ed. Hindustan Publishing Corporation New Delhi, 727 p.

Jhingran, V.G. & Pullin, R.S.V. 1985. A Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM Studies and Reviews 11, 191 pp. Asian Development Bank, Manila, Philippines and International Center for Living Aquatic Resources Management, Metro Manila, Philippines.

Khanna, S.S. 2006. An Introduction to Fishes. Silver Line Publications, New Delhi. Revised and Up-graded Edition.

Pillay, T.V.R. 1990. Aquaculture Principles and Practices (English) Pillay, T.V.R., / Oxford (UK), Fishing News Books, 575 p.

Parihar, R.P. 2009. Fish Biology and Indian Fisheries. Central Publishing House, Allahabad.

Santhanam, N. Sukumaran and Natrajan, P. 1987. Fresh Water Aquaculture. Oxford and IBH Publishing Co. Pvt. Ltd.

Shrestha, J. 1981. Fishes of Nepal. Curriculum Development Centre, Tribhuvan University, Kathmandu, Nepal.

Shrestha, J. 1994. Fishes, Fishing Implements and Methods of Nepal. ISBN 974-7315-55-6, Crafts Press Bangkok.

Shrestha, T.K. 2008. Ichthyology of Nepal – A Study of Fishes of the Himalayan Waters. Published by Himalayan Ecosphere, Kathmandu, Nepal.

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**Course Title: Ecology and Fish & Fisheries**

**Full Marks: 50**

**Course No. : Zool.404**

**Pass Marks: 20**

**Nature of Course: Practical**

**Year: IV**

**Objective of the Course:** For better understanding of the topics of Zool.403.

**Ecology**

1. Tools and techniques: Principle and applications of Sechi disc, Altimeter, Soil thermometer, Min-Max thermometer, Maps, GPS, etc.

2. Determination of minimum number and size of quadrat.
3. Determination of water holding capacity and percolation rate of soil.
4. Determination of physico-chemical properties of water (O<sub>2</sub>, CO<sub>2</sub>, chlorides, alkalinity, etc).
5. Determination of density/frequency/abundance of the vegetation by quadrat method.
6. Biodiversity assessment
7. Estimation of population density of animals from aquatic and terrestrial habitat.
8. Determination of primary productivity of aquatic and terrestrial ecosystem.

### **Fish & Fisheries**

1. Identification of fishes: Taxonomic study to identify the important locally available freshwater fishes of Nepal.
2. Study of accessory respiratory organs in locally available fishes (Clarias, Channa, Anabas, Heteropneustes fossilis etc.)
3. Identifying disease and pathogen of fishes: Collection of diseased fishes and preparation of permanent slides for disease identification (Name of the disease, symptom and causative agent/ pathogen and identifying characters of the pathogen).
4. Study of water quality parameters and planktons.
5. Determination of GSI ( Gastro-somatic index).
6. To determine and analyze the stomach contents of a given fish.

### **Practical note book preparation as regular study.**

**Report writing:** Survey of any locality regarding any topic of Zool. 403 and writing a report of about 5-10 pages. Conduct **seminar** on the report and submit the final report accommodating suggestions made in the seminar.

### **Examples:**

- Visit to riverine system, lakes/ ponds or any water bodies and fish markets for fish collection, preservation in 4% formalin and interview with fishermen communities. Prepare report on fish diversity, abundance of dominant fish species, use of local fishing gears and status of fishermen communities.
- Field visit to any freshwater fish farm (warm and cold water). Prepare report on aquaculture technology on different constituents of fish farms like hatchery system, nursery and rearing of fishes, artificial fish feed.
- Prepare market survey report to show market status/trend on any one: whole sale/retail fish market/edible fish market/fish seed market/fish feed market/processed fish product market etc.
- Fish diseases
- Hydropower dam

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**Suggested Readings:**

Krebs, C.J. Ecology: An Experimental Analysis of Distribution and Abundance of Animal Population. Addison-Wesley Educational Publishers.

Smith, R.L. Ecology and Field Biology. Harper Collins College Publisher.

Trivedi, R.K., Goel, P.K. and Trishal, C.L. 1998. Practical Methods in Ecology and Environmental Science. Environmental Publication, Karad (India).

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**Tribhuvan University**  
**Institute of Science and Technology**  
**Four Years B. Sc. Zoology Course of Study**

**Course Title: Applied Biology**

**Course No. : Zool.405**

**Nature of Course: Theory**

**Instruction Lectures: 150**

**Objectives of the Course:**

At the end of course students will be able to understand:

- The relationship between economic growth, environment and human well-being
- The value of partnership between the above ground species (huminity) and the below-ground species (earthworms) and the valuable services provided by the bees and worms.
- The basic concepts and risk factors of toxicology.
- The application of scientific principles in the processing of material by biological agents to provide goods and services.
- The contribution of the natural capital stocks to human welfare both directly and indirectly.

**Full Marks: 100**

**Pass Marks: 35**

**Year: IV**

**Introduction:** Definition, scope, areas of applied biology. Role of biology in human welfare.

**(2 lec.)**

**Biofertilizer & Green Energy:** General concept of biofertilizer, green energy and biofuels (ethanol, biodiesel, green diesel and biogas). Vermicompost Technology: Introduction to vermicompost/vermiculture, The compost worms and rearing. Methods and Products: Vermicomposting Systems. Organic wastes and Environmental management. Value and Economics of vermicomposting.

**(12 lec.)**

**Bee Keeping:** Honey bees and human beings. **Colony and its organization.** Products of the hive and bees. Bee keeping equipments. Bee keeping process and management. Rearing queens and breeding bees. Bee training for pollination. Managing maladies. **Scope of bee keeping in Nepal.**

**(15 lec.)**

**Fermentation Technology:** Introduction. Fermentation equipments. Modes of fermenter operation. Preparation of media for bioprocesses. Preservation and maintenance of industrial microorganisms. Scale up and scale down of fermentation processes. Downstream processing. Fermented products and their manufacture: Fermented dairy products (cheeses, yogurt), cereal products (breads and related products), soya products, fermented vegetables, vitamins, alcohols, and antibiotics. Indigenous fermentation technology of food and beverages of Nepal (gundruk, sinki, wine, mahi and chhurpi).

**(25 lec.)**

**Biopesticides:** Introduction. Mechanism of biocontrol (Antagonism)-(amensalism, competition, parasitism and predation). Microbial pesticides (bacterial, viral and myco pesticides). Use of Insects as biocontrol agents. Botanical pesticides. Biologically active chemical components from plants (Azadirachtins, Nicotine-sulphate, Limonene, Ryania, Rotenone, Sabadilla, Pyrethrin). Indigenous knowledge of pest management in Nepal. (15 lec.)

**Toxicology:** Introduction (definition and scope, dose response relationships, sources of toxic compounds, movements of toxicants in the environment). Classes of toxicants (exposure classes- air, water and soil pollutants, occupational toxicants; use classes-metals, pesticides, food additives and contaminants, toxins, solvents, therapeutic drugs, cosmetics). Toxicant processing in vivo (absorption and distribution). Elimination of toxicants. Toxic action (acute toxicity, chemical carcinogenesis, teratogenesis, organ toxicity). Applied toxicology (toxicity testing, forensic and clinical toxicity, prevention of toxicity). Environmental toxicology (bioaccumulation, transport and fate in the environment, environmental risk assessment, bio-remediation). (40 lec.)

**Biochemical and Molecular Techniques and their Applications:** Centrifugation. Spectrophotometry. Electrophoresis. Chromatography. Detection of nucleic acids and proteins. (25 lec.)

**Geo-informatics and Applications:** Introduction and application of Geographic Information System (GIS), Remote Sensing (RS) and Global Positioning System (GPS). (8 lec.)

**Ecosystem Services:** Introduction. Valuation of ecosystem services. (8 lec.)

### **Suggested Readings:**

- Beekeeping Basics. 2004. The Pennsylvania State University, College of Agricultural Sciences Cooperative Extension, Code # AGRS-93.
- Costanza, R., d'Arge R., de Groot R., Farber S., Grasso M., Hannon B., Naeem S., Limburg K., Paruelo J., O'Neill R.V., Raskin R., Sutton P., van den Belt M. The Value of the World's Ecosystem Services and Natural Capital, NATURE, VOL 387.
- David Cramp. A Practical Manual of Beekeeping. Spring Hill.
- Dubey, R.C. A Text Book of Biotechnology. S.Chand and Company PVT.LTD, New Delhi.
- Dubey, N.K. (Ed). Natural Products in Plant Pest Management. CABI.
- Edwards, C.A. and Lofty, J.R..1977. Biology of Earthworms. Chapman and Hall Ltd., London.
- Edwards, C.A. Arancon, N.Q., Sherman R.L. (Eds.). Vermiculture Technology: Earthworms, Organic Wastes and Environmental Management. CRC Press. Taylor and Francis group.
- Glenn, M. Manual of On-Farm Vermicomposting and Vermiculture. Organic Agriculture Centre of Canada.
- Henry C. (Ed.). Fermentation and Biochemical Engineering Hand-book. 2<sup>nd</sup> Ed. Vogel Consultant

Scotch Plains, New Jersey and Celeste L. Todaro, Noyes Pub., New Jersey, US.

Hodgson, E. (Ed.) 2004. A Textbook of Modern Toxicology. Third Ed. John Wiley & Sons, Inc.

Hui, Y.H.(Ed). Handbook of Food Products Manufacturing. John Wiley & Sons, Inc.

Jabde, P.V. 2005. Text Book of Applied Zoology. Discovery Publishing House.

Kevin, A and Lee, K.E. 1989. Earthworm for Gardeners and Fisherman. CSIRO, Australia, Division of Soils.

Lee, K.E. 1985. Earthworms: Their Ecology and Relationship with Soils and Land Use. Academic Press, Sydney.

McNeil, B. and Harvey, L. M. (eds.). Practical Fermentation Technology. John Wiley & Sons, Inc.

Prakash, A. and Rao, J. Botanical Pesticides in Agriculture. CRC Press.

Prescott, M. Harley, J. P. and Klein D.A. 2002. Microbiology. Fifth Edition. The McGraw–Hill, Companies.

Robert Costanza, Ralph d’Arge, Rudolf de Groot, Stephen Farberk, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O’Neill, Jose Paruelo, Robert G. Raskin, Paul Suttonkk& Marjan van den Belt. The Value of the World’s Ecosystem Services and Natural Capital, NATURE, VOL 387.

Thomas, M. Lillesand, Ralph W. Kiefer. Remote Sensing and Image Interpretation. John Wiley and Sons, Inc.

Valuing Ecosystem Services: Toward Better Environmental Decision-Making. The National Academies Press, Washington, D.C. ISBN: 0-309-54586-2, 2004.

Wilson, K. and Walker, J. (Eds). Principles and Technology of Biochemistry and Molecular Biology.

**Tribhuvan University**  
**Institute of Science and Technology**  
**Four Years B. Sc. Zoology Course of Study**

<b>Course Title: Project Work</b>	<b>Full Marks : 100</b>
<b>Course No. : B. Sc. Zool.406</b>	<b>Pass Marks: 40</b>
<b>Nature of Course: Research Work / Presentation</b>	<b>Year: IV</b>

**Objective of the Course:**

This course offers students to strengthen the knowledge in research based academic activities related with Zoology.

**All the matter should be as per the instruction of the IoST Dean’s Office.**

**Project Guidelines**

- 1) A student can do project work only if a faculty or a subject teacher agrees to supervise his/her project work. It is the responsibility of TU faculties to carry out educational and research activities.

2) The nature of project work can be field work, observational work and experimental work. Whatever the nature of the work, students should **critically review literature** of the area of interest and identify the problem specifically.

3) Students should prepare a proposal and submit it to the department within first two months of the fourth year or as time allocated by the concerned department head. The general format of the proposal should be as follows:

(g) Background/Introduction/Rationale

(h) Literature Review

(i) Aims & Objectives

(j) Materials and Methods

(k) Expected Results

(l) Time Frame

(m)References (format as M.Sc. dissertation of respective subject)

4) The student must complete a dissertation work and should submit it within the academic session of the fourth year.

5) The thesis format of the project should be same as the format of M.Sc. dissertation of respective subject. The format decided by the Central Department Research Committee (CDRC).

6) The final VIVA examination should be held within a couple of month of the fourth year final examination.

7) Students will have to present their work and defend it in an open viva-voce.

**Tribhuvan University**  
**Institute of Science and Technology**  
**Four Years B. Sc. Zoology Course of Study**

**Course Title: Ethnobiology & Biodiversity Conservation**  
**(Interdisciplinary course)**

**Full Marks: 50**

**Course No. : Zool. 407**

**Pass Marks: 17.5**

**Nature of Course: Theory**

**Year: IV**

**Instruction Lectures: 75**

**Objectives of the Course:** At the end of the course, the students will be able to understand:

- What is ethnobiology?
- Significance of indigenous knowledge systems in preserving biological, cultural and linguistic diversity in the world.
  
- Basic code of ethics as well as the field cum laboratory methods in ethnobiology.
- Ethnobiology as a potential contributor to rural development.
- Principles and applications of ethnobiology in human welfare.
- Untold reality of treating various diseases by the use of medicinal animals and plants



- based on indigenous knowledge system.
- Comparative advantage of collective property rights against personal property right.

### **Course Content**

**Basics of Ethnobiology:** Definition, history, evolution, civilization and ethnobiology. Concept, scope and prospective of ethnobiology. (5 lec.)

**Multi-disciplinary and Basic Sub-disciplinary Relationship of Ethnobiology** (7 lec.)

**Medico-ethnobiology:** Medico-ethnozoology; Medico-ethnobotany; Food, health and medicine in Ethnobiology; Ethnopharmacology and the marketing of traditional knowledge. (5 lec.)

**Knowledge Systems in Ethnobiology:** Indigenous knowledge system and International knowledge system. (3 lec.)

**Classification of Nature Across Cultures:** Ethnobiological Classification: Folk taxonomy and nomenclature, the recognition, classification, and naming of plants and animals in traditional societies. (3 lec.)

**Status and Field of Ethnobiology:** Status of ethnobiology in the world: European continent, American continent, Asian continent, African continent and Oceania. Field of ethnobiology. Status of ethnobiology with special reference to Nepal. (7 lec.)

**Code of Ethics, Ethnobiological Field Trips and Collections:** Code of ethics in ethnobiology. Ethnobiological guidelines for field visits, research, collections, databases and publications. (7 lec.)

**Principles of Ethnobiology** (6 lec.)

**Applications of Ethnobiology** (5 lec.)

**Research Design and Field cum Laboratory Methods in Ethnobiology:** Research design. Field cum laboratory methods in ethnobiology. (5 lec.)

**Ethnobiology Research and Education:** Ethnobiology research and development, ethnobiology education, indigenous peoples' concerns and priorities. (5 lec.)

**Intellectual Property Rights in Ethnobiology:** Intellectual property law. Patents, trademarks and copyright. Personal property rights vs. collective property rights. (5 lec.)

**Conventional and Molecular Ethnobiology:** Concept of conventional ethnobiology and molecular ethnobiology. Difference between conventional and molecular ethnobiology. Importance of conventional and molecular ethnobiology related to medico-research on animals, plants, human and microbes. **(4 lec.)**

**Ethnobiology and Biodiversity Conservation:** Ethnobiology and ethnography: A case study of Raute tribe in Nepal. Ethnobiology and biological, cultural and linguistic diversity. Ethnobiology and biodiversity conservation; The role of ethnic groups in biodiversity conservation initiatives; Indigenous peoples and nature conservation. **(7 lec.)**

**Future Directions and Careers in Ethnobiology** **(1 lec.)**

Reference Books:

Indigenous and Tribal Peoples Convention, 1989 (ILO-convention 169)

Jain, S.K. (1996): Ethnobiology in Human Welfare. Proceedings of IV International Congress of Ethnobiology held at Lucknow, India, during 17-21 November, 1994. Deep Publications, A-3/27A, D.D.A. Flats, Paschim Vihar, New Delhi-110063, India.

Martin, G.J. (1996): Ethnobotany: A Methods Manual. A 'People and Plants' Conservation Manual. Chapman & Hall, London, Weinheim, New York, Tokyo, Melbourne, Madras.

Singh, N.B. (1997): The Endangered Raute Tribe: Ethnobiology and Biodiversity. GLoRECA "ETHNOBIOLOGY", Kathmandu, Nepal.

United Nations Convention on Biological Diversity, June 5, 1992

WTO and the TRIPS Agreement, 1995

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