

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

**Course Title: Applied Biology**

**Course No. : B.Sc. 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.

**Teaching materials** required to fulfill the objectives are boards, charts, flex prints, overhead projector (OHP), power-point projector and other basic teaching materials prepared by teachers and as provided by the campuses.

**Full Marks: 100**

**Pass Marks: 35**

**Year: IV**

<b>Unit</b>	<b>Sub-unit</b>	<b>Description of content of the sub-unit (depth)</b>	<b>Lectures</b>	<b>Text/Ref. for the topics</b> (for detail see the list of text & references)
<b>Introduction</b> (5 Lectures)	<b>Definition, scope, areas of applied biology, role of biology in human welfare.</b>	Definition, scope, areas of applied biology, role of biology in human welfare.	<b>5</b>	Jabde
<b>Biofertilizer&amp; Green Energy</b> (12 lectures)	<b>General concept of biofertilizer, green energy and biofuels (ethanol, bio-diesel, green diesel and biogas).</b>	General concept of biofertilizer, green energy and biofuels (ethanol, biodiesel, green diesel and biogas).	<b>2</b>	Dubey;
	<b>Vermicompost Technology.</b>	Introduction to vermicompost/vermiculture.	<b>1</b>	Edwards, Arancon & Sherman
	<b>The compost worms and rearing.</b>	Earthworm species suitable for composting, temperate species, tropical species, influence of environmental factors on survival and growth.	<b>2</b>	Niir Board;
	<b>Methods and Products: Vermicomposting Systems,</b>	Vermicomposting materials, preliminary treatment of composting material, small scale or indoor vermicomposting, large scale or outdoor vermicomposting, feed for earthworms, maintenance of vermicomposting beds, vermicomposting efficiency, collection of compost and separation of worms, transportation of live worms and marketing.	<b>4</b>	Niir Board;
	<b>Organic wastes and Environmental management.</b>	Role of earthworm in organic waste management.	<b>1</b>	Edwards. Arancon, & Sherman

	<b>On-farm vermiculture.</b>	Methods of harvesting worms-manual, mechanical and migration methods; use of worms directly in agriculture.	1	Glenn
	<b>Value and Economics of vermicomposting.</b>	The value of vermicompost, the commercial potential and economics of vermicomposting.	1	Glenn
<b>Bee Keeping</b> (15 Lectures)	<b>Honey bees and human beings.</b>	Honeybees and Humans, a critical and threatened relationship.	1	<i>Nicholas Low;</i> <a href="http://canadianfoodinsights.com">canadianfoodinsights.com</a>
	<b>Colony and its organization.</b>	Queen, drones, workers, bee development, brood, the politics of the hive or ‘who tells whom what to do? The birth of queen, colony nest requirements, the bee keeper’s role.	1	David Cramp; Beekeeping Basics.
	<b>Products of the hive and bees.</b>	Producing honey, Collecting pollen, Harvesting royal jelly, Producing beeswax, Collecting propolis, Producing venom, Harvesting silk.	1	David Cramp.
	<b>Beekeeping equipments.</b>	The hive, Ancillary equipment, protective clothing	1	David Cramp; Beekeeping Basics.
	<b>Bee keeping process and management</b>	Starting with Bees ; Package Bees, Colonies, Collecting Swarms, Taking Bees out of Walls and Buildings, Selecting the Bee, Apiary Location, Beekeeping in the Urban/rural Setting, Handling Bees, Honey Production and Processing ;Forms of Honey, Honey Removal and Processing, Marketing, Colony Management ; Early Spring Management of Overwintered Colonies, Swarm Management, Late Spring and Summer Management, Fall Management, Dealing with the problems.	4	David Cramp Beekeeping Basics.

	<b>Rearing queens and breeding bees</b>	Why rear queens, Choosing the time of year to re-queen, Queen rearing: an outline, Preparing the larvae, Moving the larvae, Rearing queens: methods, Inducing supersedure, Marking queens, Troubleshooting queen cells, Assessing queen cells, Assessing queens, Keeping records , Breeding queens, Practical bee breeding, A bee breeding system: an example.	2	David Cramp; Beekeeping Basics.
	<b>Bee training for pollination</b>	Moving Bees, Colony Strength, Number of Colonies Needed, Competitive Plants, Colony Distribution, Effect of Weather, Crop Characteristics and Needs, Pollination Contracts, Trapping Pollen from Colonies.	2	Beekeeping Basics.
	<b>Managing maladies</b>	Diseases, Parasites, and Pests and their Control, Brood Diseases, Diseases of Adult Bees, Parasitic Mites Pests, Protecting Honey Bees from Pesticides.	2	Beekeeping Basics.
	<b>Scope of bee keeping in Nepal</b>	Beekeeping situation in Nepal, Honey bee services to farmers, Approaches and technologies	1	ICIMOD
<b>Fermentation Technology</b> (25Lectures)	<b>Introduction</b>	An art from the past, a skill for the future.	1	McNeil and Harvey.
	<b>Fermentation equipments</b>	Fermentors (bioreactors), culture units, autoclave system,	3	
	<b>Modes of fermenter operation</b>	Batch culture, fed batch culture, continuous culture.	2	

	<b>Preparation of media for bioprocesses</b>	Types of media, microbiological culture media-synthetic, semi-synthetic, complex, medium components, sources of nutrition, medium formulation, sterilization of medium, media for specific function.	3	
	<b>Preservation and maintenance of industrial microorganisms</b>	Freezing, cryopreservation, freeze-drying, specialized cell banks.	2	Dubey; McNeil and Harvey.
	<b>Scale up and scale down of fermentation processes</b>	Introduction, variables to be considered when changing fermentation scale, implementing a scaling activity.	2	
	<b>Downstream processing</b>	Separation, cell disruption, concentration of broth, purification of metabolites, de-watering, polishing of metabolites.	2	
	<b>Fermented products and their manufacture</b>	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 beverage of Nepal (gundruk, sinki, wine, mahi and chhurpi).	10	Hui, Y.H.; Dubey; <a href="https://www.academia.edu/3845576/An_Inventory_of_Indigenous_Technology_of_Nepal">https://www.academia.edu/3845576/An_Inventory_of_Indigenous_Technology_of_Nepal</a>
<b>Biopesticides</b> (15 Lectures)	<b>Introduction</b>	Introduction of biopesticides.	1	Nabil & Wakeil; Dubey;
	<b>Mechanism of biocontrol</b>	amensalism, competition, parasitism and predation.	2	Dubey;
	<b>Microbial pesticides</b>	Bacterial, viral and myco pesticides.	3	
	<b>Use of Insects as biocontrol agents</b>	Use of Insects as biocontrol agents.	1	

	<b>Botanical pesticides</b>	Introduction, factors affecting use of botanical pesticides, resources of botanical pesticides, current botanical pesticides in use and their mode of action.	4	Nabil & Wakeil.
	<b>Biologically active chemical components from plants</b>	Azadirachtins, Nicotine, Limonene, Ryania, Rotenone, Sabadilla	3	
	<b>Indigenous knowledge of pest management in Nepal</b>	Indigenous knowledge of pest management in Nepal.	1	Thapa.
<b>Toxicology</b> (40 Lectures)	<b>Introduction</b>	Definition and scope, dose response relationships, sources of toxic compounds, movements of toxicants in the environment.	2	Hodgson.
	<b>Classes of toxicants</b>	exposure classes-air, water and soil pollutants, occupational toxicants; use classes-metals, pesticides, food additives and contaminants, toxins, solvents, therapeutic drugs, cosmetics	8	
	<b>Toxicant processing in vivo</b>	Toxicant processing in vivo (absorption and distribution).	5	
	<b>Elimination of toxicants</b>	Transport, renal elimination, hepatic elimination, respiratory elimination	5	
	<b>Toxic action</b>	acute toxicity, chemical carcinogenesis, teratogenesis, organ toxicity	5	
	<b>Applied toxicology</b>	toxicity testing, forensic and clinical toxicity, prevention of toxicity	7	
	<b>Environmental toxicology</b>	bioaccumulation, transport and fate in the environment, environmental risk assessment, bio-remediation	8	

<b>Biochemical and molecular techniques &amp; their applications</b> (25 Lectures)	<b>Centrifugation</b>	Introduction, Basic principles of sedimentation, Types, care and safety aspects of centrifuges, Preparative centrifugation, Analytical centrifugation.	4	Wilson and Walker.
	<b>Spectrophotometry</b>	Introduction, Ultraviolet and visible light spectroscopy, Fluorescence spectroscopy, Luminometry, Circular dichroism spectroscopy, Light scattering, Infrared spectroscopy, Nuclear magnetic resonance.	7	
	<b>Electrophoresis</b>	General principles, Support media, Electrophoresis of proteins, Electrophoresis of nucleic acids, Capillary electrophoresis	5	
	<b>Chromatography</b>	Principles of chromatography, Chromatographic performance parameters, Thin layer chromatography, High-performance liquid chromatography, Ion-exchange chromatography, Molecular (size) exclusion chromatography, Affinity chromatography, Gas chromatography.	7	
	<b>Detection of nucleic acids and proteins.</b>	Radioisotope, fluorescence, and chemical tagging.	2	
<b>Geo-informatics &amp; applications</b> (8 Lectures)	<b>Introduction and application of Geographic Information System (GIS), Remote Sensing (RS) and Global Positioning System</b>	Introduction and application of Geographic Information System (GIS), Remote Sensing (RS) and Global Positioning System (GPS).	8	Thomas and Ralph.
<b>Ecosystem services</b> (8 Lectures)	<b>Introduction, valuation of ecosystem services</b>	Introduction, valuation of ecosystem services	8	Costanza et al.; Valuing Ecosystem Services.

## References:

- 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. Tayloer 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.
- ICIMOD. Sustainable Management of Beekeeping in Nepal.
- 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.
- Niir Board. The complete technology Book on vermiculture and Vermicompost, National Institute of Industrial Re, Amazon.com
- Nabil, E., Wakeil, E.I. Botanical Pesticides and their Mode of Action
- 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.
- Thapa, R.B. 1994. Indigenous Knowledge of Pest Management in Nepal: A Review.J. Inst. Agric. Anim. Sci. 15:1-18
- 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.

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