



IIT Mandi
Proposal for a New Course

Course number : CE521
Course Name : Ecology and Environment Microbiology
Credit Distribution : 3-0-2-4
Intended for : PG, PhD
Prerequisite : IC230 (completed a similar course)
Mutual Exclusion : (courses with high similarity not allowed to credit by the students after or along with this course, if not relevant courses write 'None')

1. Preamble:

This course emphasizes the significance of basic concepts of ecology and microorganism in the environment and their beneficial uses. The present course will provide understanding about the interactions between microbes and their ecosystem. This curriculum will prepare aspiring professionals in the field of microbiology with fundamental knowledge in the fields of plant pathology, environmental microbiology, soil microbiology, public health microbiology, and microbial ecology. The laboratory exercises of present course are provide to the students to documentation of the various microorganism and their characteristics.

Course Modules with quantitative lecture hours:

Module 1: Fundamental of Ecology (6 hours)

Basic concept of ecology and ecosystem, level of organization, ecosystem structure, process, stability, biogeography and life zone, population, population characteristic and regulations, species interactions, community and keystone species, succession and concept of climax, fundamental of primary and secondary productivity, energy transfer and nutrient cycling, biodiversity and ecological restoration

Module 2: Introduction of Microbiology (8 Hours)

Science of microbiology, microbial cell and properties, impact of microorganism on humans, historical route of discovery of microbiology, Hooke, van Leeuwenhoek, and Cohn concepts of discovery, cell structure and history; prokaryotic, eukaryotic and viruses, DNA arrangement in microbial cell, metabolic diversity of microbes, Types of bacteria; proteobacteria gram positive and gram negative, archaea, cell morphology and size, cytoplasmic membrane;

structure and function, cell wall of prokaryotes; gram positive and gram negative, cell walls of archaea, flagella and motility

Module 3: Environment Microbiology (12 Hours)

Microorganism in the environment, bacterial nutrition and growth, specific growth rate and doubling time, type of culture media; batch and continuous culture, enzyme and catalyst, energy-rich compounds and storage, microbial metabolism- glycolysis, TCA, and ETC, fermentation, nitrogen fixation, nitrogenase, methanogenesis, acetogenesis, biodegradation, bioremediation, bioleaching or biomining, biodegradative organism, environmental factors affecting biodegradation, biodegradation of organic pollutants, biofuel, waste water treatment, water borne microbial diseases, major industrial products, flavouring agents and food supplement, vitamins and beverages, organic acids, aeromicrobiology

Module 4: Himalayan Environmental Microbiology (8 Hours)

Geography and uniqueness of Himalayan region, life in extreme environment, biogeochemical cycle of elements, high altitude lake microbiology, cryospheric microbiology, extremophile (halophile, thermophile, psychrophile), adaptations and metabolic processes under extreme condition, applications of cryospheric microbes,

Module 5: Advanced Microbiology tools and Techniques (8 hours)

Light Microscopy and its principles, compound light microscope, increasing contrast in light microscopy, phase-contrast and dark-field microscopy, fluorescence microscopy, differential interference contrast microscopy (DIC), atomic force microscopy (AFM), Confocal Scanning Laser microscopy (CSLM), electron microscopy, OMICs techniques in microbial remediation processes, genomics, proteomics and metabolomics in microbial remediation, recent advances in in silico approaches for removal of environmental pollutants

Laboratory/practical/tutorial Modules: (2 hours)

1. Method of vegetation sampling, quadrat method; shape, size and number, density, relative density, frequency, relative frequency of vegetation (6 hours)
1. Basic instrumentation, safety and disinfection and in microbiology laboratory (2 hours)
2. Preparation and sterilization of various growth media for microbial isolation (2 hours)
3. Microbial isolation and maintenance through serial dilution, plating, streaking, slant and storage of microbial culture (4 hours)
4. Morphological and biochemical characterization: Gram staining, catalase, urease, oxidase, indole, methyl red etc. (6 hours)
5. Growth curve, effect of physical parameter such as temperature, pH, carbon and nitrogen

sources on microbial growth (4 hours)

6 Isolation of environmental and industrially important microbes (2 hours)

7. Isolation of halophile, thermophile, psychrophile from Himalayan sources. (2 hours)

Text Books:

1) Madigan, M. T., Clark, D. P., Stahl, D., & Martinko, J. M. Brock biology of microorganisms 13th edition. Benjamin Cummings. United States, 2010).

2) Singh, J. S., Singh, S. P., & Gupta, S. R. Ecology, environmental science & conservation. S. Chand Publishing. India, (2014).

References:

1. Dhakar, K., & Pandey, A. (2020). Microbial ecology from the Himalayan-cryosphere perspective. Microorganisms, 8(2), 257.

2. Liu, Y., Yao, T., Jiao, N., Tian, L., Hu, A., Yu, W., & Li, S. (2011). Microbial diversity in the snow, a moraine lake and a stream in Himalayan glacier. Extremophiles, 15, 411-421.

3. Sati, S. C., & Belwal, M. Microbes: Diversity And Biotechnology, Daya Publishing House, ISBN:9788170357940

4. Maier, R.M., Pepper, I. L. and Gerba, C. P. (2000). Environmental Microbiology A Laboratory Manual. Academic Press

5. Odum, E. P., & Barrett, G. W. (1971). Fundamentals of ecology, 5th edition. Cengage Learning India

6. Pepper, I. L., Gerba, C. P., Gentry, T. J., & Maier, R. M. (Eds.) (2011). Environmental microbiology. Academic press.

7. Giri, A., & Pant, D. (2019). CO2 management using carbonic anhydrase producing microbes from western Indian Himalaya. Bioresource Technology Reports, 8, 100320.

1. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Environmental Sciences	IC230	< 5%	< 5%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: