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<th>Teaching Scheme (Hrs/Week)</th>
<th>Continuous Internal Assessment (CIA)</th>
<th>End Semester Examination</th>
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Max. Time, End Semester Exam (Theory) - 3Hrs.

**Prerequisite**
- Introduction and basic concepts evolution, ecology
- Preliminary awareness of environmental issues

**Objectives**
1. To understand the history and development of evolutionary theory.
2. To understand the evolutionary origin of biochemical disorders.
3. To create general understanding of ecological niche and its importance.
4. To familiarize the students with the concepts of environmental microbiology.
5. To describe environmental issues and apply the knowledge for developing sustainable approach to address the challenges of field.

**Unit Number** | **Details** | **Hours**
---|---|---
1 | **History and development of evolutionary theory**<br>Neo-Darwinism: Spontaneous mutation controversy, evolution of rates of mutation, types of selection, levels of selection, group selection and selfish gene. Sociobiology, kin selection, evolutionary stability of cooperation, sociality and multicellularity in microorganisms, Game theory, Evolution and stability of sex, sexual selection, parasite theory of sex and sexual selection. Co-evolutionary strategies, host-parasite co-evolution, Neutral evolution and molecular clocks, phylogeny and molecular distances, Molecular evolution: origin of life, the origin of new genes and proteins. Evolution of life histories, ageing, evolutionary trade offs, r and k selection, | 12 |
2 | **Evolutionary origin of biochemical disorders**<br>The case of insulin resistance. Speciation in sexual and asexual organisms, origin and stability of diversity, diversity of secondary metabolites Gut Microbiology: Gut Brain access., Fecal Microbial Transplant | 12 |
3 | **Community ecology**<br>Community structure, benevolent interactions (control within the microbial communities of rhizosphere), antagonistic interactions, | 12 |
(competition, antibiosis, predation etc.). Rhizosphere, rhizophane, siderophore, flavonide from plants, lectines, octapine, nipotine, indole acetic acid.  
**Mycorrhiza:** Host-fungus specificity, host fungus interactions, rhizosphere environment and recognition phenomenon, interaction of mycorrhizal fungi with non-host plants, functional capability.  

| 4 | **Wastewater Treatment:**  
Wastewater treatment system (unit process): Physical screening, flow equalization, mixing, flocculation, flotation, granular medium filtration, adsorption. Chemical precipitation, gas transfer, disinfection, dechlorination  
Biological: (aerobic and anaerobic, suspended and attached growth processes.)  
Working treatment systems and their analysis (reactions and kinetics, mass balance analysis, reactor types, hydraulic character of reactors, selection of reactor type,) Critical operating parameters like DO, hydraulic retention time, mean cell residence time, F/M ratio etc. Malfunctioning of treatment systems due to shock loading, hydraulic loading etc. and remedial measures adapted. |

| 5 | **Effluent disposal, control and reuse. Water pollution control, Regulation and limit for disposals in the lakes, rivers, oceans, and land. Direct and indirect reuse of treated effluents and solid wastes. Current industrial wastewater treatment and disposal processes (Textile, dyestuff, diary, paper and pulp manufacturing industries) |

|  | Total | 60 |

| **Course Outcome**  
Students should able to  
**CO1**  
Student will be able to demonstrate an understanding of evolution of life on earth.  
**CO2**  
Student will be able to demonstrate the basic understanding of ecological system.  
**CO3**  
Student will be able to demonstrate the basic idea and applications of ecosystem  
**CO4**  
Student will be able to develop a sense of understanding to deal with environmental issues  
**CO5**  
Student will be able to use the knowlegde of techniques and develop the problem-solving approach. |
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