

6. Krebs, J. Ecology, II Ed., Harper International.
7. Kumar *et al.* 1995. General Ecology, Vikas Publishing House Pvt. Ltd., New Delhi.
8. Odum E., Gary W. Barrett G. W. 2004, Fundamentals of Ecology, V Edition, Cengage Learning.
9. Payne, A.I. 1986. The Ecology of Tropical lakes and Rivers, John Wiley.
10. Sharma, P.D. 2012. Ecology and Environment, Rastogi Publications, Meerut, India.

## **ESH412 ENVIRONMENTAL GEOLOGY**

**52 hrs.**

### **Course Outcomes:**

*CO1 Discuss about the importance of mineral resources and the probable impact on environment by their exploitation.*

*CO2 Study the basic aspects of environmental geology.*

*CO3 Learn the structure of earth and its processes.*

*CO4 Gain the knowledge of soil conservation.*

*CO5 Develop knowledge on geological aspects of environment which help in employability.*

### **UNIT I (13 hours)**

Environmental Geology: Objectives, scope and significance. Origin of the Earth, earth systems and its interaction with lithosphere, atmosphere, hydrosphere and biosphere. Motions of the earth, seasons. Basics of Geomorphology and edaphology,

### **UNIT II (13 hours)**

Interior of the Earth: Earth's materials – minerals and their definition. Distribution and abundance of elements in the Earth's crust, formation and classification of Rocks. Soil-characteristics, formation of soil, soil erosion and conservation.

### **UNIT III (13 hours)**

Earth's Processes: Endogenic and Exogenic processes: Earthquakes, Tsunami and Volcanism. Geological agents: River, Wind, Glaciers and Ocean action. Floods, Landslides, Cyclone and Avalanche, Concepts of major, trace and REE. Classification and mobility of trace elements, geochemical cycles, human use of trace elements and health.

### **UNIT IV (13 hours)**

Mineral resources and environment: Resources and reserves, depletion trends of natural resources. Environmental impact of exploitation. Land use Planning- Environmental aspects of terrain evolution, methods of site selection and evaluation of land in environmental planning. Geological features of India and Karnataka.

## References:

1. Asthana D.K. and Meera Asthana., 2006. A text Book of Environmental Studies, S. Chand & Co. Ltd., New Delhi.
2. Clemente, J. 2016. Earth and Environmental Sciences, Intech Publishers.
3. Dar, I.A. 2016. Earth and Environmental Science, Intech Publishers.
4. Reed Wicander and James and S. Monroe. 2002. Essentials of Geology, Wadsworth Publishing Co.
5. Richard, J. and Ordway, D. Earth Science and the Environment, Van Nostrand and Company, London.
6. Rose, D.A. Introduction to Oceanography.
7. Valdia, K.S. 1987. Environmental Geology.
8. Venkat Reddy and Winker, H.G.F. 1988. Petrogenesis of Metamorphic Rocks. McGraw Hill Publishers.
9. Venkat Reddy. 1995. Engineering Geology for Civil Engineers, Oxford and IBH Publ., Co. Pvt. Ltd., New Delhi.

## ESH413 ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY 52 hrs.

### Course Outcomes:

CO1 Study types of microorganisms, sterilization and culturing techniques.

CO2 Describe the adaptive mechanisms of microorganisms in the extreme environments.

CO3 Study in detail milk, air, soil and water microbiology and bioremediation techniques.

CO4 Describe the role of microbes in degradation of waste.

CO5 Get knowledge on microbiological aspects of environment which support employability.

CO6 Understand biotechnological aspects which help in entrepreneurship.

### UNIT I (13 hours)

Classification and characteristics of microorganisms. Microbial growth and growth curves, sterilization, culturing techniques and identification of microbes. Soil microflora and methods of their estimation. Biological nitrogen fixation (symbiotic and non-symbiotic), microbial phosphorus solubilization and their importance in soil fertility and agriculture. Microbes in water and methods of their estimation (e.g. MPN), drinking water standards, water-borne diseases and prevention.

### UNIT II (13 hours)

Microbial symbiosis, mutualism, plant-microbe interactions (e.g. mycorrhizas), animal-microbe interactions (human, ruminants and non-ruminants). Microbes in hydrothermal vents and coral reefs – adaptive mechanisms. Microorganisms as bio-indicators in the environment. Milk microflora and their estimation. Microflora of air and methods of their estimation, air-borne diseases and prevention.

### UNIT III (13 hours)

Bioremediation: Microbial bioremediation – *in situ* and *ex situ* bioremediation, phytoremediation, advantages and disadvantages. Biogas production and utilization. Biosensors and biochips –types, and applications. Intellectual property rights, traditional