DISCIPLINE SPECIFIC CORE COURSE – 2: Photobiology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/ Practice		
Photobiology	**DSC-102**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biotechnology Biology/**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course explores the physical properties of light and its interplay with living organisms. Lightas a source of energy and information has shaped life on earth over the last 3.6 billion years. We see the world around us because the light reflected to the retina is processed to our brain (Photoreception), we breathe in oxygen because it has been evolved by the plants around us due to the light dependent Photosynthesis. Where there is no natural light, some organisms produce their own (Bioluminescence). Maintaining coordination with the changing light regime with changing seasons is fundamentally important to various aspects of living organisms across latitudes (Photoperiodism). Every part of the spectrum is used in one way or the other by different life forms. In this paper students will be able to appreciate the delicate processes of life that are dependent on light.

Learning outcomes

A student studying this course can:

- Understand and appreciate the dual nature of light.
- Comprehend the impact of light on biodiversity from pole to pole.
- Gain knowledge about the various photoreceptors in plants and animals and will appreciate and understand the mechanism of photosynthesis.
- Understand bioluminescence, photoperiodism and biological rhythms.
- Gain knowledge about the ecological and physiological responses to light.

SYLLABUS OF DSC-2

Unit 1: Introduction to Light and Life (6 hours)

Latitudinal Diversity gradient. Altitudinal and latitudinal variations in light intensity and photoperiod. Light as an ecological factor affecting distribution, physiological processes of plantsand animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems.

Unit 2: Bioluminescence and Photoreception (6 hours)

Discovery, diversity and functions of Bioluminescence. Comparative account of chemistry and functional roles of photoreceptors in plants: chlorophylls, carotenoids, phycobiliproteins, bacteriochlorophylls, etc. Photoreception in animals, evolution of eyes, color vision and visual processing in the human eye.

Unit 3: Photosynthesis (6 hours)

History, Spectrum of autotrophs, Photosynthetic equation, Photosynthetic electron transport (cyclic and non-cyclic), photolysis of water, oxygen-evolving complex (OEC), concept of Reaction centers, Q-cycle, Dark Reactions in Photosynthesis, C3, C4, CAM cycle, photorespiration (C2 cycle).

Unit 4: Photoperiodism (6 hours)

Phytochrome mediated responses in Plants, Animal responses to changing photoperiodism. Morphological, Anatomical, Physiological and behavioral adaptations to extreme light conditionsin plants and animals.

Unit 5: Ecological and physiological responses to Light (6 hours)

Morphological and physiological color change in animals. Light as an inducer for biosynthesis/activation of biomolecules (Vitamin D, Melatonin, Thymine dimer formation, RuBisCo. Three rythmn domains, Biological clocks and circadian rythmns, night shift disorders and jet lag.

Practical component: (60 hours)

1. To study light penetration in water using Secchi disc.
2. To demonstrate the effect of light on soil fauna using Berlese funnel setup.
3. To study the effect of light and darkness on the chromatophores of fish.
4. To test / survey for color blindness using Ishihara charts.
5. To study various Bioluminescent organisms using photographs- *Photinus pyralis, Aequorea victoria* , Vampire squid, Anglerfish, Lanternfish, Viperfish, Black dragonfish, *Omphalotus nidiformes*
6. Diel vertical migration using photographs
7. Measurement of light using Luxmeter under various conditions
8. To study structure of chloroplast- through photographs
9. Separation of Chloroplast pigments by Paper Chromatography/ Chemical Separation of

Chloroplast pigments

10. To study the effect of Light intensity and CO_2 concentration on the rate of Photosynthesis
11. Demonstration of Hill's Reaction and study the effect of Light intensity (any 2 light conditions).
12. Demonstration of Etiolation and de-etiolation.

Essential/ recommended Readings:

- Björn, L. O. (2015) 3rd Ed. *Photobiology: Science of Light and Life*, L.O. Bjorn.,Springer
- Buchanan, B. B., Gruissem, W., and Jones, R. L. (2000). *Biochemistry and molecular biology of plants.* Rockville, Md.: American Society of Plant Physiologists.
- Huner, N. and Hopkins, W. (2013). *Introduction to Plant Physiology.* In: 4th ed. John Wiley & Sons, Inc.
- Kohen E., Santus R., Hirschberg J.G. (1995) 1st Ed., *Photobiology* Academic Press
- Randall D., Burggren W., & French k. (2001) 5th Ed. *Eckert, Animal Physiology Mechanisms*
- *and Adaptations.* W.H. Freeman and Co.

Suggested Readings:

- Gross M. (2003). Light and Life. Oxford University Press
- Shimomura O., (2012) Bioluminescence: Chemical Principles and Methods, World Scientific,
- Taiz, L., & Zeiger, E. (1991). Plant physiology. Redwood City, Calif: Benjamin/Cummings Pub. Co.

Note: **Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

DISCIPLINE SPECIFIC CORE COURSE – 3: Diversity in lifeforms I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Diversity in L ife forms I	**DSC-103**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biotechnology Biology/**	**Nil**