DNA DAMAGE AND REPAIR (HCB-911) **Credit Hrs 3 (3-0)**

Educational Objectives:

1. DNA damage checkpoint and repair genes are important suppressors of cancer and aging. These processes function as part of a complex interconnected network of DNA recognition and processing, checkpoint signaling cascades and DNA repair. Because these processes preserve genome integrity, how they cooperate with one another is strongly related to their ability to suppress cancer and aging. This particular course is designed to study this emerging research area and to give the students an advanced understanding of DNA damage checkpoints, DNA repair and the connections of these processes with cancer and aging.

Course Outcomes:

2. Students will learn to recognize and to explain the role of DNA repair and genome integrity for cell survival and its importance for human health. They will be able to explain the molecular mechanisms of DNA damage and repair in prokaryotes and eukaryotes and how the repair pathways are coordinated with each other and with cell cycle progression. In addition students will be able to critically assess research papers relevant to the field of DNA repair and genome instability.

3. Course Contents:

a. Introduction to DNA Replication, Repair, and Recombination
   (1) The Maintenance of DNA Sequences
   (2) DNA Replication mechanisms
   (3) Initiation and completion of DNA replication
   (4) DNA replication and cell cycle
   (5) Fidelity of DNA Replication

b. DNA Damage

(1) Damage due to alkylation
(2) Damage due to the incorporation of base analogues
(3) Damage due to deamination and
(4) Role of DNA glycosylases in deamination,
(5) Types of DNA glycosylases
(6) Damage due to the formation of pyrimidine dimmers and role of photolyase
(7) Damage due to oxidation

c. DNA Repair

d. Types of DNA Repair

(1) Direct Repair or reversal system
(2) Excision Repair

i. Molecular mechanism of nucleotide excision repair

(3) Nucleotide Excision Repair
(4) Mismatch Repair and mutator genes
(5) Double strand break (DSB) repair system

i. Genes involved in DSB

(6) Homologous recombinational Repair Systems
(7) Non Homologous recombinational Repair Systems
(8) SOS Repair system
(9) Inducible Repair system

e. Machineries for chromosomal DNA repair

(1) Repair of DNA double-strand breaks within chromatin
(2) Chromatin-modifying and remodeling enzymes

f. Histone phosphorylation is a marker for DSB repair

(1) Histone acetylation and DSB repair

g. Structural insights into the DNA damage response
h. Defective DNA damage responses and cancer
i. Cancer treatment based on knowledge about the DNA damage response – targeted therapeutics

j. Cancer treatment based on specific mutations that "drive" malignant growth – exploiting oncogene addiction

Recommended Book:

1. **Cell Cycle and Growth Control: Biomolecular Regulation and Cancer** by Gary S. Stein, Arthur B. Pardee.
2. **DNA Damage Recognition** by Wolfram Siede and Paul W. Doetsch.
3. **DNA Repair and Mutagenesis** by Errol C. Friedberg.
4. **DNA Damage Repair: Repair Mechanisms and Aging** by Thomas, Allison E.
5. **Advances in DNA Damage and Repair** by Miral Dizdaroglu and Ali Esat Karakaya.
6. **Scientific Journal: DNA Repair** by Elsevier.