Course contents for Advanced Radiation Biology

1. **Faculty:** Dr Ambuj Tripathi (IUAC); course coordinator: Dr. Ravi Shankar Akundi (SAU)
2. **Course Code:**
3. **Course Title:** Advanced Radiation Biology
4. **Number of Credits:** Two
5. **Course objectives:**

   This course is designed to introduce the basics of Radiation Physics including interaction of radiation with matter, biological effects of radiation, radiosensitivity, radio protection and mitigation and applications in hadron therapy and space will be covered. In vitro, In vivo and In silico models and basic characterization tools for X Ray Crystallography, NMR spectroscopy and small angle X ray diffraction will be introduced.

6. **Minimum prerequisites for taking this course, if any:** Prior exposure to Class XII level Physics and biology.

(i) Introduction to Radiation Physics

Recapitulation of basic chemistry including electron shells, atomic energy levels, mass-energy equivalence, atomic mass unit, nuclear stability and radioactive disintegration laws; Radioisotopes, stability and decay; radiation quantities, dosages and units; stable isotopes, electron capture, emission, gamma and X rays, photoelectric effect, Compton scattering; Applications of radiation in health, medicine and research: X-ray Crystallography: Crystallization principle, Crystallization techniques and Crystal Systems; Small angle X-ray diffraction.

(ii) Interaction of Radiation with Matter

Classification of radiation and source of radiation; Linear Energy Transfer (LET); Direct and indirect effects of radiation; Units and limits of radiation exposure and dose; Attenuation of radiation – Range and Stopping power; Radiation chemistry of water – free radical generation and scavenging.

(iii) Biological Effects of Radiation, Radiation Protection and Mitigation

Whole body irradiation and sensitivity of tissue; Cell Survival curves and colony forming ability; Variation of Radiosensitivity with cell cycle & cell age; effect of X rays and high let radiations; Chromosomal and chromatid aberrations, Non targeted effects of radiations: Bystanders effects, chromosomal instability, Radiation induced signaling pathways, gene expression etc. Acute Radiation Syndrome (radiation sickness/poisoning), Normal tissue radioprotection and mitigation; Mechanisms of action, Therapeutics for radiation sickness symptoms.

(iv) Radiation Oncology – Carcinogenesis, Therapy Models

Oncogenes and Tumor suppressors; Secondary tumors, Signaling abnormalities, Radiotherapy, Radiation resistance, radiosensitizers; Radiation therapy, Linear Accelerators, Brachytherapy, Hadron Therapy, Space applications. Models in Radiation Biology**:** In vitro, in vivo models and In silico studies.

7. **Suggested Readings:**

Bruce Alberts, Molecular Biology of the Cell

Lehninger, Principles of Biochemistry, 8th Edition

Prasad, K.N., CRC Handbook of Radiobiology, CRC Press, Florida

Eric J Hall, Amato J Giaccia Radiobiology for the Radiologist (7th Edition)

A.H.W. Nias An Introduction to Radiobiology John Wiley and sons

Practical Radiation Oncology, Editors: S Mallick, GK Rath, R Benson, Springer nature

8. **Evaluation:**

Mid-semester Written Examination	: 40% Marks
End-semester Written Examination	: 40% Marks
Quiz / Assignment/Presentation (oral / poster)/other	: 20% Marks