PhD. Bio-Medical Physics

Phys 691- 3 (3+0): Biophysical Techniques

Phys 692- 3 (3+0): Radiotherapy

Phys 693- 3 (3+0): Medical Imaging Techniques

Phys 694- 3 (3+0): Magnetic Resonance Imaging

Phys 695- 3 (3+0): Biomagnetism

Phys 696- 3 (3+0): Free Radicals in Biological Systems

Phys 697- 3 (3+0): Environmental Radiation Biophysics

Phys 691- 3 (3+0): Biophysical Techniques

X-ray crystallography - Nuclear Magnetic Resonance - Fluorescence, Fluorescence Microscopy - Ultraviolet-Visible, and Infra Red and Fourier Spectroscopy - AC & DC Dielectric relaxation - Chromatography.
The aims of this course are: 1) to provide students with an understanding of the fundamental principles of a range of advanced biophysical techniques. 2) to give students an understanding of how to use these techniques to get an information about the structure of macromolecules, electronic structure, size, shape, and modes of interaction of biological molecules along with studying the dynamics of cellular processes.

Text Books:

A variety of text books explain the techniques can be chosen from the university central library and internet.

1- Biophysical Techniques in Photosynthesis, Jan Amesz & Arnold J. Hoff(Ed), Kluwer Academic Pub. 1996.
2- Biophysics Textbook Online (BTOL).

Phys 692- 3 (3+0): Radiotherapy

Radiobiology: Effects of ionizing radiations on living cells and organisms, including physical, chemical, and physiological bases of radiation cytotoxicity, mutagenicity, and carcinogenesis.
Radiological Physics and Dosimetry: Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics; principles and methods of radiation dosimetry.
Radiotherapy Physics: Ionizing radiation use in radiation therapy to cause controlled biological effects in cancer patients; physics of interaction of the various radiation modalities with body-equivalent materials; physical aspects of clinical applications.

Text Books:

1. Principles and Practice of Radiation Therapy (2009), Washington C M Leaver D T

2. Practical Radiotherapy Planning. Jane Dobbs, Ann Barrett , Dan Ash. (Hodder Arnold)

3. Handbook of Radiotherapy Physics: Theory and Practice, P Mayles, A Nahum, J.C Rosenwald (Taylor& Francis)

Phys 693- 3 (3+0): Medical Imaging Techniques

- Introduction to medical imaging, Image formation and quality, Processing and reconstruction of medical images, Imaging modalities.
- X-ray imaging: X-ray imaging methods, Computed tomography (CT), clinical applications of x-ray imaging,
- Nuclear medicine imaging: Radiopharmaceuticals materials, Single photon emission computed tomography (SPECT), Positron emission tomography (PET), and their clinical applications.
- Ultrasound imaging: Physics of ultrasound, applications of ultrasound imaging in medicine.

Text Books:

3- The Essential Physics of Medical Imaging, JT Bushberg, JA Seibert, EM Leidholt, and JM Boone Lippincott, Williams, Wilkins, 2nd edition (2002)
4- Interlocution to Biomedical Imaging (IEEE Press Series on Biomedical Engineering), Andrew G. Webb, Wiley-IEEE Press (2002)
5- Medical Imaging Physics, Wiiliam R. Hendee and E. Russell Ritenour, Wiley-Liss, 4th edition (2002)
6- Radiological Imaging, Harrison H. Barret and William Swindell, Academic Press (1996)

Phys 694- 3 (3+0): Magnetic Resonance Imaging

Electronic and nuclear spin. Electronic and nuclear magnetism. Magnetic atoms and ions. Microwave and radio frequency absorption. Magnetic resonance. Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR). Magnetic interactions, saturation and relaxation. Computerized detection of magnetic resonance. Magnetic Resonance Imaging (MRI). Image detection and enhancement. Magnetic Resonance applications in physics, chemistry and medicine.

Text Books:

1- Magnetic Resonance Imaging, Marinus, T.; Vlaardingerbroek and Jaques de Boer, Springer Verlag, Berlin, 1999.
2- A Primer of Magnetic Resonance Imaging, Hennel, J.W., Imperial College Press, 1998.
3- Methods in Biomedical Magnetic Resonance Imaging and Spectroscopy, Young, I.R. ed. John Wiley& Sons, 2000.

Phys 695- 3 (3+0): Biomagnetism

Biomagnetic fields. The Josephson effect. SQUID Magnetometers: layout, noise cancellation, rf, dc, and high Tc SQUIDs. Magnetoencephalography (MEG). Magnetocardiography (MCG). Magnetoneumography (MPG).

Text Books:

1- Bioelectricity and Biomagnetism: R.M. Gulrajani, John Wiley & Sons, Inc. 1998.
2- Biomagnetism: An Interdisciplinary Approach: Edited by S.J. Williamson, G.L. Romani, L. Kaufman, I. Modena, Plenum Press, New York, 1983.

Phys 696- 3 (3+0): Free Radicals in Biological Systems

General molecular bonding and structures - Definition of free radicals - Free radicals in chemical and biochemical interactions – Chemical properties of free radicals – Magnetic properties of free radicals – Biradicals – Generation of free radicals by spin resonance of free radicals – Hyperfine interactions of free radicals – Free radical labeling – Beneficial and damaging roles of free radicals in biological systems – Antioxidants and free radical scavengers.

Text Books:

1- Halliwell, B. and Gutteridge, J. C. "Free Radicals in Biology and Medicine", Clarendon Press, Oxford 1989.
2- Ingram, D. J. E. "Biological and Biochemical Applications of Electron Spin Resonance" , Adam and Hilger, London 1969.
3- Rice-Evans, C. A., Diplock, A. T. and Martyn, C. R. "Techniques in Free Radical Research", Elsevier Amsterdam, 1991.
4- Weil, J. A, Bolton J. R. and Wertz, J. E. "Electron Paramagnetic Resonance: Elementary Theory and Practical Applications", Wiley Interscience, ISBN 0-471-57234-9, 1994.

Phys 697- 3 (3+0): Environmental Radiation Biophysics

Radiation and environmental radioactivity. Sources of environmental radioactivity. Radioecological pollution. radiation interaction with matter. radiation effects on living system. stochastic and non-stochastic effects. delayed effects and physic-chemical properties of radiation effect in cells. environmental pathways analysis and dose assessment; radioactivity risk assessment

Text Books:

1- An Introduction to Environmental Biophysics, GS Campbell and JM Norman, 2nd edition, Springer, New York, 1998, ISBN 0-387-94937-2
2- E.L. Alpen: Radiation Biophysics, Prentice Hall, Englewood Cliffs, 1990.
3- J.E. Coggle: Biological Effects of Radiation, Taylor Francis Ltd, London, 1983.
4- Gaylon S. Campbell, John M. Norman, 2000, An Introduction to Environmental Biophysics, Springer, IS