# GANPAT UNIVERSITY

## FACULTY OF ENGINEERING & TECHNOLOGY

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|---|---|---|---|
| Programme | Bachelor of Technology | Branch/Spec. | Biomedical Engineering |
| Semester | V | Version | 1.0.0.0 |
| Effective from Academic Year | 2024-25 | Effective for the batch Admitted in | July 2022 |
| Course code | 2BM6109 | Course Name | Advanced Medical Imaging Techniques |

| Teaching scheme | | | | | | Examination scheme (Marks) | | | |
|---|---|---|---|---|---|---|---|---|---|
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | | CE | SEE | Total |
| | L | TU | P | TW | | | | | |
| Credit | 3 | - | 1 | - | 4 | Theory | 40 | 60 | 100 |
| Hours | 3 | - | 2 | - | 5 | Practical | 30 | 20 | 50 |

**Pre-requisites**

Basic knowledge of x-ray, radiation and physics.

**Course Outcomes**

On successful completion of the course, the students will be able to:

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|---|---|
| CO1 | **Identify** the component arrangement of CT and **distinguish** the diverse generations of CT scanners. |
| CO2 | **Summarize** the functions of magnetic gradient, RF pulse NMR coil, transmitter, and receiver in the generation and detection of NMR signals. |
| CO3 | **Understand** the principles of radiopharmaceuticals, gamma camera, PET scanner and other nuclear imaging equipment. |
| CO4 | **Demonstrate** a comprehensive **understanding** of radiation safety in CT imaging, nuclear medicine and MRI safety protocol. |

**Theory syllabus**

| Unit | Content | Hrs. |
|---|---|---|
| 1 | COMPUTED TOMOGRAPHY<br>Conventional Tomography, Basic principles of Computed Tomography, Generations of CT scan, CT system components, Collimation and filtration, Spiral CT scan principle & scanner design, Image quality & artifacts, Hounsfield unit, Windowing of CT.<br>Image reconstruction techniques: Basics of projection & radon transform, back projection, filtered back projection, iterative reconstruction.<br>Clinical use, Biological effect & safety aspects of CT imaging, Cardiology imaging. | 16 |
| 2 | MAGNETIC RESONANCE IMAGING<br>Introduction to magnetic resonance physics, NMR principle, Magnetic susceptibility & permeability, Magnetic dipole moment, Wobbling, Fourier spectrum of NMR signal, spin density, relaxation times.<br>MRI scanner components, Generation & Detection of NMR signals: Magnetic field gradient and radiofrequency coils, the NMR coil, the transmitter and the receiver.<br>MRI image formation: Spatial encoding and pulse sequences, Gradient echo and spin echo imaging, Data acquisition, Clinical use and safety aspects. | 16 |
| 3 | RADIONUCLIDE IMAGING<br>Fundamental of radioactivity, overview of radiopharmaceuticals, generation and detection of nuclear emission, diagnostic method using radiation detector.<br>Radionuclide imaging systems: Rectilinear scanner, Gamma camera, PET, SPECT. Characteristics of radionuclide images, Internal radiation dosimetry, Radiation safety and biological effects. | 13 |

**Practical Contents**

Term work and practical shall be based on the above syllabus.

**Text Books**

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|---|---|
| 1 | MRI -The Basics by Ray H. Hashemi, William G Bradley, Christopher J Lisanti Pub.: Lippincott Williams & Wilkins |
| 2 | Handbook of Biomedical Instrumentation by R. S. Khandpur Pub.: Tata McGraw-Hill |
| Reference Books | |
| 1 | Fundamentals of Medical Imaging by Paul Suctens Pub.: Cambridge University Press |
| 2 | Principles of Medical Imaging by K. Kirk Shung, Michacl B. Smith and Benjamintsui Pub.: Academic Press |
| 3 | Radiologic Science for Technologists Physics, Biology and Protection by Stewart C. Busheng Pub.: Mosby |
| 4 | Introduction to Biomedical Imaging by Andrew Webb Pub.: Wiley Interscience |
| ICT references | |
| 1 | http://nptel.ac.in/courses/108105091/2 |
| 2 | http://nptel.ac.in/courses/108101039/5 |
| 3 | https://www.youtube.com/watch?v=fNaCxhhhZTE |
| 4 | https://www.youtube.com/watch?v=wvw2TZBagDc |

**Mapping of CO with PO and PSO:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | 2 | 1 | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 2 | 3 | 1 |
| **CO2** | 1 | 3 | 1 | 0 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 1 | 3 | 1 |
| **CO3** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 2 | 2 | 1 |
| **CO4** | 1 | 2 | 0 | 0 | 0 | 3 | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 1 |