(052-CMT-01-03) COMPUTER SCIENCE AND MEDICAL IMAGING TECHNOLOGY

Significance of the Program

There are many diseases found by using a variety of images such as X-rays, CT scans, ultrasound, MRI, etc. Patients are being treated remotely through mobile doctor apps, symptom-checking bots for patients, and providing tailored advice, and remote consultation and tracking solutions are hitting the market fast. The deployment of AI, advanced data analytics, mainly the use of medical imaging, the Internet of Things (IoT), and other emerging technologies is changing the nature of healthcare solutions and delivery systems.

M. Tech in Computer Science and Medical Imaging Technology gives the students the expertise to work with medical imaging devices and the corresponding images. They will be able to assist the doctors in the diagnosis. The demand for medical imaging specialists has increased steadily in the last few years due to the rapid development in the field of science and health.

Career Options

The healthcare sector is looking for M. Tech graduates in Medical Imaging Technology and the following are the roles given to them.

- **Imaging Technologist** in Hospitals with Radio diagnostic facilities both in public and private sectors.
- **Application specialists** in Medical Imaging Equipment companies such as GE Health care, Philips, Seimens, etc.
- **Academicians** in educational institutions in India and abroad and pursue research activities in Medical Imaging Technology.

Program Objectives

- To impart domain knowledge for developing effective computing solutions with a broad understanding of medical imaging and its role in diagnosis, monitoring, and remedy
- To train students with good extensiveness of information in the field of computer science and related medical imaging technology so as to formulate engineering principles, offer techno commercially feasible and socially acceptable solutions to real-life engineering problems
- To impart practical skills required for a career in an imaging-related field in clinical practice, medical research, and scientific research or technological development

- To provide students with learning environment awareness for collaborative research and development activities needed for a successful professional career

Outcomes of the Program

At the end of the program, the student will be able to:

- Apply the knowledge of mathematics, science, and engineering fundamentals to solve problems in medical imaging.
- Analyze medical images using Artificial Intelligence.
- Deal with multidisciplinary projects as a member or as a leader by understating and applying the knowledge inculcated through this program.
- Develop the ability to absorb for a successful career within the fields of engineering, healthcare, and technology, but also careers in related fields such as entrepreneurship.

Major Course Outline

1. **Essential Mathematical Foundations of Imaging and Programming**
   a) Basic linear algebra (e.g., matrix arithmetic), calculus, and probability theory
   b) Competent programming skills in Python or MATLAB
2. **Machine Learning Basics for Real-world**
   a) Basic Mathematics for ML, what is Data and Model? Machine Learning Workflow and Applications
   b) Introduction to real-world signals - text, speech, image, video; Feature extraction and front-end signal processing - information-rich representations, robustness to noise and artifacts
   c) Learning as optimization, Linear Regression, Regularization, and Logistic Regression
   d) Basics of pattern recognition, Generative modelling - Gaussian and mixture Gaussian models
   e) Machine learning for physiological signal processing. Time series modelling
3. **Image processing**
   a) The focus of the module is on the registration and segmentation of medical images, alongside an overview of how biomarkers derived from image processing can be used to test scientific hypotheses or applied in clinical contexts.
4. **Introduction to Digital medical images**

a) Need, case studies, basics – mHealth (mobile Health) and eHealth (electronic Health) Impact
b) Open source/data/innovation – opportunities
c) IT infrastructure (IoT/Cloud computing)

5. Deep Learning in Medical Imaging/Vision

a) Medical Imaging Modalities: Introduction, Protocols, Work Flows, Applications
b) Medical Image Analysis: Basics, Imaging Physics-Based Methods, and Need for Deep Learning & Neuroimaging: Introduction, Challenges
c) Vision - Deep learning: Loss function, Optimization, CNNs, Training Convolutional Neural Networks, Object Detection, Segmentation
d) Deep Learning models: AlexNet, VGG, GoogleNet, ResNet, RNN/LSTM