MALLA REDDY
VISHWAVIDYAPEETH
(Deemed to be University)

SCHOOL OF DIGITAL HEALTH SCIENCES & TECHNOLOGY

Fellowship in AI based Medical Imaging and Sensing

Created in 2025

Academic regulations for fellowship programmes

1. **DEFINITION**

   Fellowship: A fellowship is an advanced, structured programme focused on developing specialized competencies after the completion of a qualifying degree or equivalent experience. It offers structured learning and practical experience in a focused area. The purpose of the fellowship is to develop advanced knowledge, strengthen specialized skills, and prepare participants for professional growth within their chosen field.

2. **AIMS AND OBJECTIVES**

   The aim of the program is to provide program nurtures graduate and postgraduate candidates, building their expertise and skills to drive career excellence and impact in their chosen field.

   Full-Time Candidate: A full-time candidate is an individual who is enrolled exclusively in the fellowship program and is not engaged in any other professional, academic or employment obligations during the training period. These candidates are required to dedicate their time and effort to the structured fellowship programme, meeting the assigned outcomes through full-time participation that ensures immersive training and continuous engagement in all programme activities, including assigned duties, learning sessions, and assessments. Stipends for full-time fellowship candidates will be awarded as per MRV policy.

   Internal Candidate: An internal candidate is an individual currently employed by MRV or its affiliated institutes who wish to enhance their skills through the fellowship during their tenure at the institution. This includes faculty, residents, or staff. Internal candidates are not eligible for a stipend. Applications are subject to institutional approval.

   External Candidate: An external candidate is someone not employed by MRV or its affiliated hospitals and institutes at the time of applying for the fellowship. They may come from other academic institutions, healthcare organizations, or private practice. External candidates are required to complete all fellowship requirements as per MRV guidelines. No stipend will be provided.

   Sponsored Candidate: A sponsored candidate is nominated and financially supported by a recognized institution, organization, or employer such as a government body, healthcare institution, academic organization, or industry partner to pursue a fellowship at MRV. The sponsor typically covers fees or other program-related costs and may require the candidate to fulfill certain obligations, if any, upon completion as required by the sponsor. Employees sponsored by organizations must provide a formal no-objection certificate. Sponsored candidates are not eligible for a stipend.

3. PREREQUISITES

Criteria	Details
Eligibility	To be eligible for admission into the fellowship program at MRV, candidates must meet the following criteria: • Hold a recognized graduate or postgraduate degree with a completion certificate. • The fellowship must align with the candidate's prior qualifications and may require professional registrations. • Detailed eligibility criteria for ach fellowship, including approved qualifications are available on the MRV website.
Duration	• Undergraduate Degrees – Any recognized undergraduate degree – 12 months • Postgraduate Degrees – Any recognized undergraduate degree – 6 months • Super specialty Degrees – Any recognized speciality or advanced degree – 3 months * Duration for any category may be adjusted based on program requirements, as recommended by the Selection Committee.
Mode of Study	Theoretical, Lab-based Development, Simulation Workshops, Clinical Scenario Building, Capstone Project, Practical, Skill, Case-based

4. SELECTION AND COMMENCEMENT OF FELLOWSHIP

Fellowship Committee: The Fellowship Committee is established to uphold principles of transparency, fairness, and meritocracy in the selection process for the MRV Fellowship Program.

Composition of Fellowship Selection Committee

Sr. No.	Role/Position	Description / Designation
1	Chairperson	The Dean of the respective colleges and Schools of Eminence at MRV
2	Subject Expert	A Professor or Associate Professor from the concerned colleges and Schools of Eminence, MRV
3	Guide / Co-Guide	A Professor, Associate Professor, or Assistant Professor from the concerned colleges and Schools of Eminence, MRV
4	Convener	The Fellowship Coordinator of MRV
5	Ex officio Members	The Registrar and the Controller of Examinations,

		MRV

Duties of the Fellowship Selection Committee

- Ensure that the MRV fellowship program commences twice a year in accordance with the academic calendar issued by the university.
- Oversee the preparation and communication of the program schedule, including application deadlines, interview dates, and the start of training through the MRV website and relevant academic departments.
- Thoroughly evaluate all applications to ensure candidates meet the minimum requirements for completion.
- Assess academic credentials, prior qualifications, and overall suitability for the fellowship program.
- Conduct interviews for shortlisted candidates to evaluate knowledge, skills, and overall preparedness.
- Recommend a final list of eligible candidates for approval by the Vice-Chancellor based on the evaluation and interview outcomes.
- Oversee all aspects of the fellowship program from scheduling, implementation, to completion.

5. FEE STRUCTURE

Program Fees: The basic fee structures for each fellowship program are available on the respective program on the MRV website.

6. PROCEDURE FOR SELECTION AND ADMISSION

- **Eligibility Check:** Verify that applicants meet the basic eligibility criteria, including academic qualifications, professional experience, and relevant skills.
- **Document Review:** The Selection Committee reviews all applications for completeness and ensures they satisfy the program's eligibility requirements.
- **Personal or Virtual Interviews:** Shortlisted candidates may be invited for interviews, either in person or virtually. This allows the Committee to assess communication skills, motivation, and overall suitability for the fellowship.
- **Merit-Based Selection:** The Committee selects the most qualified candidates based on a combination of academic performance, professional experience, interview performance, and alignment of the applicant's goals with the objectives of the fellowship.

7. ALLOTMENT OF FELLOWSHIP GUIDE

Assignment of Guides: The allotment of fellowship Guides shall be undertaken by the Selection Committee, ensuring that only eligible and approved faculty members are assigned as Guides or mentors.

Criteria for Allotment are based on:

- Alignment of the fellow's area of interest with the Guide's specialization
- Availability and consent of the Guide
- Existing rotation or merit-based preferences as determined by the Committee

Role and Responsibilities of the Guide:

- Mentoring the fellow to acquire required skills and academic knowledge
- Providing guidance and support to ensure progress throughout the fellowship

- Conducting regular evaluations and offering academic and professional advice and submit periodic report to the Fellowship coordinator
- Supporting the fellow in meeting program requirements and objectives

External Collaborators: External collaborators from recognized institution may serve as fellowship co-Guides in conjunction with a Guide from MRV.

Change of Guide: Fellows may request a change of Guide, subject to approval by the Selection Committee.

8. FELLOWSHIP PROGRAM DESIGN

The fellowship program is designed to provide a structured and comprehensive learning experience that develops relevant skills, knowledge, and professional competencies. Upon completion, they should demonstrate proficiency in core skills, apply their knowledge effectively in professional settings, maintain professional standards, and document their progress.

Logbook Maintenance: Fellows must maintain a logbook throughout the program. The required entries may vary depending on the fellowship. The logbook will be reviewed and evaluated on a daily or weekly basis by the assigned Guide. Regular face-to-face feedback sessions with the Guide will be conducted to monitor progress and provide guidance.

Final Assessment and Exit Examination:

The final assessment by the assigned guides includes the following components:

1. Multiple Choice Questions (MCQs): 25 marks
2. Practical Skills Assessment: Three case scenarios with discussion; each case carries 20 marks (total 60 marks)
3. Logbook Maintenance: 15 marks

The candidate must appear and secure a minimum of 50% marks in each of the above listed components. The total marks are 100, and a minimum aggregate score of 50% is required to successfully complete the fellowship.

Any additional outputs or deliverables may be determined in consultation with the Guide and require prior written approval from the Selection Committee.

9. MINIMUM STANDARD AND CREDITS FOR THE AWARD OF THE FELLOWSHIP

- Fellows must maintain a **minimum of 80% attendance** across all program activities.
- A **minimum overall score of 50%** is required to pass the fellowship.

10. FELLOWSHIP COMPLETION CERTIFICATE

Issued by MRV: Upon successful completion of all training, periodic evaluations, and final examinations, fellows will be awarded a certificate.

The certificate should include details such as:

- Name of the candidate
- Fellowship program details
- Program completion status

Fellowship in AI based Medical Imaging and Sensing

Course Overview

The Fellowship in AI-based Medical Imaging & Sensing is designed to build advanced competencies in medical image acquisition, processing, analysis and AI-driven interpretation across modalities (like MRI, CT, PET, ultrasound, digital pathology, etc.). The program trains participants to handle raw medical image data, apply cutting-edge AI and deep learning methods (e.g. segmentation, classification, radiomics), integrate sensing and imaging with clinical workflows, and deliver clinically relevant visualizations and diagnostic insights. Through a mix of theory, practical labs, algorithm development, and a capstone project, participants will be able to contribute to modern diagnostic pipelines, research, and smart-hospital imaging systems.

The fellowship is ideal for biomedical engineers, data scientists, radiologists, healthcare technologists, and researchers aiming to lead AI-enabled imaging and diagnostic projects.

Course Objectives

1. Understand and describe major medical imaging modalities (MRI, CT, PET/SPECT, ultrasound, digital pathology, etc.) and their underlying physics and signal/image acquisition principles.
2. Acquire, handle, preprocess and manage medical imaging data (DICOM, volumetric data, multi-modal data).
3. Apply classical image processing techniques (enhancement, filtering, registration, segmentation) as well as advanced AI/deep-learning methods for medical image analysis.
4. Use AI for tasks such as segmentation, classification, detection of abnormalities, radiomics feature extraction, quantification, and diagnosis support.
5. Integrate sensing and imaging data (from wearables, medical devices, real-time imaging) with imaging pipelines to support comprehensive diagnostics.
6. Understand challenges related to data quality, bias, interpretability, generalizability, and reproducibility in medical-imaging AI.
7. Design, validate, and evaluate AI-based imaging solutions with proper metrics (sensitivity, specificity, accuracy, mIoU, recall, etc.).
8. Comply with ethical, legal, and regulatory aspects, including patient privacy, data anonymization, informed consent, and clinical deployment requirements.
9. Communicate imaging results, visualizations, and insights to clinicians, radiologists, and other stakeholders in a clinically relevant manner.
10. Lead or contribute to research, clinical deployment, or operationalization of AI-based imaging / sensing systems in healthcare settings.

Curriculum with Part-wise Syllabus & Modules

Part 1: Foundations of Medical Imaging & Image Processing

Module	Topics Covered
Medical Imaging Modalities & Fundamentals	Physics & principles of major imaging modalities (MRI, CT, PET/SPECT, ultrasound, X-ray, digital pathology imaging), signal acquisition, image formation, modalities strengths & limitations; image file formats (DICOM, others), metadata, imaging workflow
Classical Medical Image Processing	Image enhancement (filtering, contrast adjustment), noise reduction, normalization; image registration and alignment; 2D / 3D image handling, visualization, rendering, segmentation basics (thresholding, region growing, morphological operations). This is similar to what is taught in courses like the one on medical image processing
Radiomics & Feature Extraction	Concept of radiomics — converting images to quantitative data; extraction of shape, texture, intensity, statistical features; feature selection; data preparation for downstream AI/ML analysis
Data Handling, Storage & Sensing Integration	DICOM handling, metadata management, anonymization/de-identification, data storage & PACS, integration of sensor / wearable data (if present) with imaging data; data governance & management
Ethical, Legal & Regulatory Aspects	Patient privacy & data protection, informed consent, anonymization, regulatory aspects for imaging and AI use in healthcare, compliance issues, risk and bias awareness

Part 2: AI, Machine Learning & Advanced Applications in Medical Imaging & Sensing

Module	Topics Covered
Introduction to AI / ML / Deep Learning for Medical Imaging	Fundamentals of machine learning and deep learning; neural networks; convolutional neural networks (CNNs); overview of AI workflows for imaging — preprocessing, training, validation, evaluation, deployment
Segmentation, Classification & Detection using AI	Implementation of AI-based segmentation (organs, lesions, tumours), classification of pathologies (tumour vs normal, disease grading), detection tasks; evaluation metrics (accuracy, sensitivity, specificity, mIoU, dice score)
Multi-modal Imaging & Data Fusion + Sensing Integration	Hospital operations data: admissions, bed occupancy, staffing, supply chain; optimizing workflows; cost analytics; quality metrics; performance dashboards; operational decision support
Validation, Interpretability & Clinical Deployment of AI Models	Model validation, cross-validation, generalizability, reproducibility; interpretation & explainability of models; addressing bias; regulatory and ethical aspects for deployment; clinical workflow integration; quality assurance
Advanced Topics — Radiomics, Deep	Advanced AI tasks such as radiomic analysis, deep tomographic reconstruction (e.g. DL-based reconstruction

Reconstruction & Emerging Modalities	for CT/MRI/low-dose CT), generative models (GANs, diffusion models) for image enhancement, super-resolution, synthetic data generation
Capstone Project	Individual or group project implementing AI-based image analysis or sensing + imaging pipeline: sample projects could include segmentation/classification model for MRI/CT, multimodal imaging fusion for disease diagnosis, radiomics-based prognostic model, or sensor-imaging integration for real-time monitoring. Includes dataset design, model building, evaluation, report & presentation

Program Outcomes

SR.N.	Program Outcome	Detailed Description
1	Master Fundamentals of Medical Imaging	Describe and explain major imaging modalities, image acquisition, data formats, and imaging workflows
2	Perform Advanced Image Processing & Preprocessing	Apply classical image processing techniques — enhancement, segmentation, registration — on 2D/3D medical images
3	Extract Quantitative Features (Radiomics)	Derive radiomic / quantitative features from images for downstream analytics or research
4	Develop AI/ML Models for Imaging Analysis	Build, train, evaluate AI-based segmentation, classification or detection models for medical images
5	Handle Multimodal Data & Sensor-Imaging Fusion	Integrate imaging data with other modalities or sensing data, perform multimodal analysis
6	Validate, Interpret & Deploy AI Models Responsibly	Apply validation, interpretability, and ethical/regulatory standards for real-world deployment
7	Translate AI-Imaging Insights into Clinical Use-Cases	Communicate findings, generate diagnostic/prognostic insight, support clinical decision-making
8	Lead Imaging & Sensing Innovation Projects	Plan and execute AI-enabled imaging / sensing projects; integrate with hospital or research workflows

Course Outcomes

	Course Outcome	Detailed Description
1	**Describe Imaging Modalities & Data Formats**	Understand MRI, CT, PET, ultrasound, pathology imaging, DICOM / metadata / PACS fundamentals
2	**Perform Image Preprocessing & Classical Processing**	Execute image enhancement, registration, segmentation (classical methods) on sample data sets
3	**Extract Radiomic / Quantitative Features**	Compute texture, shape, intensity, and statistical features from images for analysis
4	**Build & Evaluate AI Models for Segmentation / Classification / Detection**	Implement deep-learning pipelines (CNNs), train and validate models; evaluate using clinical-relevant metrics (e.g. sensitivity, specificity, dice, mIoU)
5	**Work with Multi-modal & Sensor-Imaging Data Fusion**	Combine data from multiple imaging modalities and/or sensing devices; perform integrated analysis
6	**Understand Ethical, Regulatory & Clinical Deployment Constraints**	Ensure data privacy, model interpretability, compliance, and readiness for clinical use
7	**Present Findings & Visualizations to Clinical / Research Stakeholders**	Create reports, visualizations, and interpretation summaries understandable to clinicians/radiologists
8	**Design and Execute a Real-world AI-Imaging Project**	Complete a capstone project from data acquisition to model deployment, producing a working prototype or research-oriented output

Recommended Books & E-Resources
Textbooks:

- Fundamentals of Medical Imaging – P. Suetens (for basic imaging physics & modalities)
- Handbook of Medical Imaging: Processing and Analysis – Isaac Bankman (comprehensive resource on image processing techniques)
- Digital Image Processing for Medical Applications – Graham Dougherty (image processing tailored for medical imaging)
- Biomedical Image Analysis and Deep Learning – multiple edited volumes / recent publications (for AI-based imaging)
- Recent review articles on AI in medical imaging (e.g. AI-driven image analysis for diagnostics, segmentation, radiomics)