MANIPAL
ACADEMY of HIGHER EDUCATION
BENGALURU CAMPUS
(Institution of Eminence Deemed to be University)

ADVANCED POST-GRADUATE DIPLOMA IN

DIGITAL IMAGING IN MOLECULAR DIAGNOSTIC

PROGRAM STRUCTURE AND SYLLABUS

Program Objectives, Scope, and Motivation

Objective: Digital approaches in molecular diagnostic and molecular pathology play a huge role in the advancement of health care and clinical practice. With the advancement of technology-based innovative diagnostics approaches, conventional methods to diagnose core pathology and prognostication of diseases are facing some challenges. Therefore, medical care industries are encountering growing pressure to introduce computational tools to unravel molecular and image-based pathological diagnostics. On the other hand, demands are growing for specially trained personnel in digital diagnosis, which is an inter-disciplinary domain. MAHE-Blr is initiating this interdisciplinary course through their multi-domain expert faculties in the fields of optical-based tissue imaging, clinical pathology, molecular biologists, cancer biomarkers, radiology, -omics technology, molecular imaging, image analysis, and computational technology.

Course Commencement @ Manipal Institute of Regenerative Medicine, MIRM

In collaboration with the faculties of Manipal School of Information Science, MSIS & Manipal Institute of Technology, MIT- Bengaluru

Objectives:

- An interdisciplinary course to fulfil the requirement of diverse knowledge, in the ecosystem of healthcare and clinical practice in this digital era.
- To build a specialized workforce in digital image analysis of relevance in the healthcare sector.

- Cater to the growing demand for digital analysts in medical and clinical practice in this booming digital era.

Motivation: Development of new diagnostics based on digital approaches is not linear, even though modern healthcare sectors are getting huge growing demand. At the outset, the gap between growing pressure of making healthcare digital and adequate skilled personnel to handle the newly developed technology needs to be reduced. However, requirement of diverse and interdisciplinary knowledge is the biggest barrier to make properly trained personnel. Through this course, development of unique specialized work force will also help to grow research and development in the field. University can attract the specially allocated funding that government agencies and industries are giving to make the digital based diagnostics to grow rapidly in healthcare and clinical practice.

Scope:

The molecular diagnostic market in India was evaluated at $1 million in 2023, and the prediction of growth is 7.49% from 2023 to 2030. Computational-based modernization of diagnostics will be adapted by clinical and health services rapidly. Several diagnostics and triage companies are innovating digital solutions in health. Career options would be in the following sectors:

- In advanced diagnostic facilities in hospital services, including Manipal hospitals
- In diagnostics labs related to patient care
- In various companies that work on big data handling for patient care and hospitals
- In various innovating companies related to digital health
- In the companies who work on digital imagine-based diagnostic products
- In microscope companies as an image analyst
- As entrepreneurs to start companies involved in digital molecular diagnostics in Health care

Eligibility: The course intends to foster required skills in the Digital molecular diagnostic field for immediate job market. Therefore, anyone with bachelor or master degrees in science and engineering, and MBBS, BDS, BPT, BE (Biotechnology) can be enrolled for the course. Minimum eligibility is bachelor's degree in any specialization from the field of bioscience, medicine and engineering, with 50% aggregated marks.

Selection Process: Interested candidates selected based on CV will be shortlisted for interview. Shortlisted candidates will be called for interview during which their aptitude will be tested. Around 30 candidates would be tested.

Duration of Program: It is a 1 academic year program.

Attendance Requirement: Each course of the semester will be treated as a separate unit to determine the attendance. Every student must have not less than 75% attendance in each unit to be eligible to appear for examination.

ADVANCED POST-GRADUATE DIPLOMA IN DIGITAL IMAGING IN MOLECULAR DIAGNOSTIC PROGRAM STRUCTURE

Theory Subjects

Duration of the course: 1 academic year.

Code	Course title	Hours Per Week		C	Maximum Marks		
		Lectures	Practical		IA	*UNI Exam	Total
MD 301	Core concepts of molecular diagnostics and digital imaging	6	-	6	30	70	100
MD 303	Application of digital approaches in molecular diagnosis & clinical practice	6	-	6	30	70	100
MD 305	Computational methods in molecular data and bioimage analysis	6	-	6	30	70	100
	Total	18		18			

*Minimum marks for all University Examinations for a pass credit = 50%

Practical Subjects

Code	Course title	Hours Per Week		C	Maximum Marks			
		Lectures	Practical		IA	**UNI Exam		Total
MD 302	Quantitative image analysis (with group projects)	-	4	2	40	60		100
MD 304	Highthroughput data analysis (with group projects)	-	4	2	40	60		100
MD 306	Machine learning and Deep learning in analysis (with group projects)	-	6	3	40	60		100
MD 307	**Internship / short projects	-	-	15	Dissertation	Presentation	Viva Voce	100
					40	40	20	
	Total		12	22				

*Minimum marks for all University Examinations for a pass credit = 50%

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination

Evaluation of internship/short project: ** Evaluated by Subject Experts (Internal and External)

Rules regarding the sessional examination are as follows:

No. of Sessional for the academic year: 1 sessional per Module

Pass Marks for sessional exams: 50% for both theory and practical

REGULATIONS

These regulations shall come into effect from the academic year 2024-25. These regulations are subject to modifications from time to time by authorities of Manipal Academy of Higher Education.

Eligibility: The course intends to foster required skills in the Digital molecular diagnostic field for immediate job market. Therefore, anyone with bachelor and master degrees in science and engineering can be enrolled for the course. Minimum eligibility is bachelor's degree in any specialization from the field of bioscience, medicine and engineering, with 50% aggregated marks.

Duration of the course: 1 academic year.

The curriculum includes
Module 1: Core concepts of molecular diagnostics and digital imaging
Module 2: Application of digital approaches in molecular diagnosis & clinical practice
Module 3: Computational methods in molecular data and bioimage analysis

Each of the modules will have practical-oriented studies with group projects and hands-on.

The course will include an internship/short project (3 months) on case studies, jointly with industries and hospitals.

Details of the Modules:
Each module includes 4-5 **sub-modules** and per module 15-18 classes, 3-5 classes under each sub-module.

Module 1: Core concepts of molecular diagnosis and digital imaging

a) Introduction and history of digital imaging with the evolution of the microscope
   i -ii) History of advancement in microscopes
   iii)Magnification and Resolution of imaging,
   iv)Advanced scanner and Whole slide imaging (WSI)
   v) Basics of Images, handling of images (various file formats), and Storing in the cloud
b) Patient samples/tissue imaging and prediction of pathological features
   i) Basics of tissue processing and collection of biopsy samples
   ii) Immunological-based diagnostic methods – radioimmuno assay, ELISA, western-blot, immunoprecipitation, and immunofluorescence
   iii) Concept of histology, cytology and hematology in disease diagnosis
c) Quantitative methods for detection of biomarkers
   iv) 2D and 3D imaging techniques for tissue and cell samples
   v) Microfluidics based low cost molecular diagnostics
   vi) Single cell image analysis from imaging flow cytometry in the context of stem cells and disease models
   vii) Image analysis in prediction of pathological features and artefacts in histological slides
   vi) Quantitative image analysis

d) Diagnostic based on non-invasive medical images
e) i) Lasers and ultrasonic waves in non-invasive molecular imaging

ii-iii)Types of molecular imaging-based diagnosis and their applications (x-ray, radiograph, MRI, CT-scan, PET and NMR)

Practical in Module-1

a) Hands-on light/fluorescence microscope
b) Sectioning and staining of tissues to make Immunohistochemical slide for imaging
c) Flow based image analysis

Module 2: Application of Digital Approaches in molecular diagnosis & clinical practice

a) Biomarkers in cancer diagnosis
   i) Molecular biomarkers in cancer diagnosis
   ii) IF-based detection of cancer biomarkers
   iii) Introducing imaging flow cytometry in the diagnosis of acute leukemia
   iv)Diagnosis of atypical patterns of response to cancer treatment
   v) Image-based product development in cancer detection.
   I-iii) classes

b) Flow cytometry-based approaches in pathological and molecular marker diagnosis.

i) Imaging flow cytometry and its applications
ii) Challenges using cytometric methods to understand population diversity
iii) Clinical flow cytometry with case studies
iv) Multiparametric platforms to study morphometric and functional diversity in the context of Acute leukemia

c) The integration of molecular and digital parameters: Histo-genomic
   i- ii)The integration of digital pathology images, and -omics data (Spatial transcriptomics)
   ii) Highthroughput image analysis
   iii) Case study: Covid diagnosis and digital data solutions

Practical in Module-2

Group projects: Identification of pathology patterns from IHC and image flow samples

a) Group projects: Quantitative image analysis
b) Group projects: Imaging and molecular matrices-based combined approaches in analysis

Module 3: Computational methods in molecular data and bioimage analysis

a) Introduction to image formulation

b) Image Segmentation and automated image processing (2 classes)
c) Image segmentation and Image annotations
d) (i-iii classes) Modelling and inference (Machine learning and deep learning)
e) i-ii classes) Digital data analytics in medical diagnosis using Machine learning and deep learning
f) Medical data handling of patients,
g) Data privacy issues

Practical in Module-3

a) Group projects: Programming languages R and Python and use of program languages in Image annotations and segmentation in image processing
b) Group projects: Use of Machine learning and deep learning in image analysis
d) Group projects: Digital data handling

Course includes internship @ academic and industries: The course will include a short project (3 months) on case studies, jointly with industries and hospitals.

ONE FINAL EXAM AT THE END OF THE ACADEMIC YEAR

EXAMINATION PATTERN

QUESTION PAPER PATTERN:

The question paper will be divided into 2 parts.

Part 1: Multiple Choice Questions.

Part 2: Subjective Questions.

M.Sc. in Translational Immunology, Theory Examination, Month, Year Course Code. Course Title. Part 1: Multiple Choice Questions Date: dd-mm-yyyy Duration: 15 minutes Max Mark: 20	
Instructions: Answer the following: Each question carries 1 mark. A negative mark of – ¼ will be given for a wrong answer.	
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

ADVANCED POST-GRADUATE DIPLOMA IN DIGITAL IMAGING IN MOLECULAR DIAGNOSTIC Part 2: Subjective Questions Date: dd-mm-yyyy Duration: 2 Hours 30 Minutes Max Mark: 80 Marks	
Instructions: Answer all Questions	
Answer the following:	
TYPE OF QUESTION	PROPOSED PATTERN
Essay Answer: Short Answer: Brief Answer:	10 marks x 3 = 30 marks 5 marks x 6 = 30 marks 2 marks x 10 = 20 marks

EVALUATION:

Performance grades:

The marks obtained in the Internal Assessment and Final Examination are added together and converted to a 12 point relative letter grading scheme used to allot a Grade to a student's performance in that course. The letter grades and grade points are specified in the table below.

Grade Letter	Performance	Grade point	Absolute grading
A+	OUTSTANDING	10	> 90
A	EXCELLENT	9	80-89
B	VERY GOOD	8	70-79
C	GOOD	7	60-69
D	AVERAGE	6	55-59
E	MARGINAL	5	50-54