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

Manipal Institute of Regenerative Medicine, Bengaluru

M.Sc. By Research in Translational Immunology

Program Objectives, Scope and Motivation

Program Objectives:

- To impart strong foundation in basic and Translational immunology
- To impart integrated research-based training in cutting edge technologies related to immunology, genome/immune engineering, drug screening and precision medicine
- To provide comprehensive revolutionary understanding of diseases involving the immune system and treatment strategies
- To engage students in mentored research in Basic / Translational immunology, immune-therapeutics and degenerative diseases
- To provide skilled workforce with high entrepreneurship and research capabilities in biomedical research and health sciences
- To impart strong knowledge in principles of immunology for research in chronic metabolic diseases, progressive degenerative diseases and non-communicable diseases such as cancer which have a strong immune component in disease progression and advent

Scope:

- A strong foundation in both applied and basic aspects of immunology integrated with regenerative medicine is an ideal preparation for doctoral programs across the globe
- Integrated training experience in state -of-art immunology research and immune/cell-based therapeutics is sought out in healthcare industry and pharma sectors
- Entrepreneurship in immunodiagnostics, as vaccine developers, immune therapeutics
- As trained immunologists assisting clinicians in developing immune-based profiling for diagnosis and immune-therapeutic intervention modalities for wide range of diseases in hospital step-ups
- Clinical Research positions to support clinical trial project teams in hospitals with immunology expertise
- Research positions in biomedical fields, biopharma and pharmaceutical industries

- Researchers in Translational Health Sciences research Institutes

Motivation:

Immune mechanism intersects with several streams of biomedical sciences ranging from infectious diseases, GVHD, chronic inflammatory/degenerative diseases, vaccination and cancer to name a few. Immunology as a discipline is pivotal in developing novel disease intervention/diagnosis/screening and preventive strategies. Only few master courses across the globe cater to the need of trained immunologists with interdisciplinary knowledge and in-depth understanding of this field with huge translational potential. The motivation behind this course has been to integrate cutting edge technologies with current immunology concepts in the academic curriculum to generate workforce with in-depth knowledge in translational aspects of immunology and degenerative diseases.

Program Highlights

- Translational Immunology will be a unique course offered by MAHE covering both fundamental and translational aspects of Immunology

- The theory classes would be of 90 minutes duration comprising 1 hour of formal lecture followed by 30-minute discussion/tutorial session that shall comprise clarifications and questions from the students and evaluation of the students by faculty through short tests, quizzes, and group discussions.

- Student's performance in the discussion/tutorial sessions shall be used for their internal assessments and grading.

- The afternoon practical/skills sessions, in each module would be in line with the topics covered during the theory classes in the morning sessions.

- All key fundamental concepts and practical/skills, related to Immunology, cell and molecular biology, shall be covered during Semester-I consisting of Module 1,2,3, &4.

- Lectures in Semester II and III would be on advanced elective topics. Students shall opt for their elective subject and their allotment would be done based upon their performance in the previous semester.

- During Semester II & III students would have only 10 lectures/seminars on advanced topics in the field and would do practical/skills related to those topics. They would also do a short project with their assigned PIs which will be continued in semester IV.

- Students will be highly encouraged to submit manuscripts /publish original and review articles in peer reviewed high impact journals before the dissertation submission.

- Observer-ships /internships in hospitals. Advanced research centers and/or labs/industry will be encouraged

Minimum Qualification for Admission:

Admission is open to candidates who possess a B.Sc. in any branch of Life sciences, Biotechnology, MBBS, BDS, BE (Biotechnology), B. Pharm., Allied Health Professionals-or equivalent level of education from a recognized University.

Selection Process: Interested candidates are selected based on SOP and Qualifying examination marks. Shortlisted candidates will be called for interview during which their research aptitude will be tested. Around 30 candidates would be tested.

Duration of Program: It is a 2-year program with 4 semesters.

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.
If a student for any reason discontinues the course after 1st / 3rd semester may be permitted for 2nd / 4th semester respectively after 1 year in the following academic year, subject to the condition that the entire academic program is completed by the student within 4 years of original admission to the course.

10. Program Structure

Duration of the program: *Two-year program with 4 semesters*

PROGRAM STRUCTURE

M.Sc. by Research in Translational Immunology

SEMESTER-I

Code	Course Title	Hours per week			C	Maximum marks		
		L	T	P		IA	*UNI EXAM	TOTAL
TI 401	Fundamentals of Immunology	3	1	-	4	30	70	100
TI 403	Laboratory Methodologies.	3	1	-	4	30	70	100
TI 405	Principles of Regeneration	3	1	-	4	30	70	100
TI 407	Immune dysfunction and disorders	3	1	-	4	30	70	100
TI 409	Fundamentals in Immunology Lab	-	-	6	3	40	60	100
TI 411	Laboratory Methodologies	-	-	6	3	40	60	100
TI 413	Principles of Regeneration lab	-	-	4	2	40	60	100
TI 415	Immune dysfunction and disorders Lab	-	-	4	2	40	60	100
	TOTAL	12	4	20	26	-	-	800

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

SEMESTER-II

Code	Course Title	Hours per week	C	Maximum marks

		L	T	P		IA	UNI EXAM	TOTAL
TI 500	Elective 1	4	-	-	4	100	-	100
TI 501	Elective 1 Lab	-	-	10	5	100	-	100
TI 503	Research Project**	-	-	-	8	100		100
	TOTAL	-	-	-	17	-	-	300

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

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

T1503 would involve proposal conceptualization, proposal writing, gap identification and setting pilot experiments for project in Semester III and IV

SEMESTER-III

Code	Course Title	Hours per week			C	Maximum marks		
		L	T	P		IA	UNI EXAM	TOTAL
TI 600	Elective 2	4	-	-	4	100	-	100
TI 601	Elective 2 Lab	-	-	10	5	100	-	100
TI 603	Research Project**	-	-	-	8		100	100
	TOTAL	-	-	-	17	-	-	300

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

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

SEMESTER-IV

Code	Course Title	Hours per week			C	Maximum marks TOTAL
		L	T	P		300
TI 604	Research Project work and dissertation**	-	-	-	20	

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

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

Rules regarding the sessional examination are as follows:

No. of Sessional for each Semester: 4 /Semester (1 sessional per Module)
Pass Marks for sessional exams: 50% for both theory and practical

DETAILED SYLLABUS FOR TWO YEARS M.Sc. TRANSLATIONAL IMMUNOLOGY

SEMESTER 1

MODULE 1:

FUNDAMENTAL OF IMMUNOLOGY

Introduction to components of the immune system, Principles of innate and adaptive immunity, lymphoid organs, anatomy of the immune system, immune privileged sites.

Development of the immune system adult and fetal haematopoiesis, Self-non-self- discrimination
Innate immunity: Innate immune barriers, Mononuclear phagocytic system, Pathogen recognition PAMPS and DAMPS, receptors of the innate immune system, Anti-microbial peptides, the complement system.

Adaptive Immunity: Humoral and cell mediated immune response, B cells and Antibodies, Generation of antibody diversity, Membrane receptors for antigen (BCR, TCR), Major histocompatibility complex and polymorphism, Immune response genes and minor histocompatibility antigen, Antigen presentation, recognition and effector mechanisms of adaptive immunity, Generation of lymphocyte antigen receptors, Receptor editing, Antigen receptor structure and signaling pathways, Co-stimulation and Immunological memory.

Introduction to pathogens and immunity: Recognition of microorganisms by the immune system. NLRs, TLRs, RIG like Receptors and CLRs. Extracellular and Intracellular pathogens: Bacterial defense Mechanisms (CRISPR/CAS9), Bacterial Immune evasive strategies, Bacterial immunity to antibiotics. Immunity to extracellular bacteria and immune evasion strategies, Biofilms, Quorum sensing: formation and prevention strategies. Innate and adaptive immunity to fungal pathogens, viral infections, Viral immune-escape mechanisms, Immunopathogenesis of emerging viral infections

Principles of transplant rejection, methodologies for transplant acceptance, Types of vaccines, Vaccine hesitancy, Vaccine development and Ethical concerns, NSAIDs, biomaterials and regulation of immune response, polyclonal antibody production, Epitope mapping and therapeutic antibody development, Non-coding RNA in immunotherapies and immune regulation, Immune repertoire profiling for disease pathobiology, MHC tetramers.

FUNDAMENTALS OF IMMUNOLOGY LAB:

Practical 1: Introduction to cell culture, Freezing thawing and propagation of cell lines, Cell counting
Practical 2: Population doubling, growth kinetics/curves
Practical 3: MTT staining for cell viability, Live/dead assays
Practical 4: Immunoblotting
Practical 5: ELISA
Practical 6: Histology
Practical 7: Immuno-fluorescence
Practical 8: Basics of flow-cytometry, Identification of T and B cells in PBMCs
Practical 9: Magnetic cell sorting

MODULE 2:

LABORATORY METHADOLOGIES

Chromatography: Gel Filtration chromatography, TLC/Gas chromatography, Ion exchange and Affinity chromatography,

Principles ,Methods & Applications of Spectroscopy, UV visible spectroscopy Fluorescence spectroscopy, Mass Spectrophotometry, Circular dichroism, Nuclear magnetic resonance, Electrophoresis: Brief Introduction to types of electrophoresis Paper, Starch

Nucleic Acid Analysis: Brief Introduction to Northern, Southern and Western Blotting, PCR- Types of PCR: Hot-Start PCR, Touch Down, RACE, Long and Accurate PCR (LA), Inverse PCR; Nested PCR; Real Time PCR. Genome Analysis: NGS; DNA methylation Studies; Chromatin immunoprecipitation. RNA Analysis: RNA Sequencing, In situ RNA hybridization; Karyotyping, FISH, Microarrays, RNAZyme, RNA-protein Technology
Bimolecular Interaction Studies: Protein-Protein- Yeast two hybrid system. Protein DNA: DNA foot printing/ EMSA, Proximity Ligation assay, SILAC, Biacore

Microscopy: Types of Microscopy Light, Phase Contrast, Fluorescence, FRET (fluorescent anisotropy); FRAP and FLIP; Confocal, Electron Microscopy-Transmission and Scanning; Differential Interference Contrast Microscopy, Single and Dual Photon Microscopy, Cryo-EM

Flow Cytometry: Principles, methods and applications of flow Cytometry, Fluorescence activated Cell sorting, BrdU Incorporation, Immuno-phenotyping, Cells cycle analysis, Cell Sorting
Immunological analysis: Immunofluorescence, ELISA, Magnetic sorting, Embedding and Sectioning and Staining - Paraffin Sectioning, Cryo-sectioning, Histological Staining; IHC

Cell Culture Techniques: Isolation of Primary Cultures; Organoid Cultures, Hybridoma Technology, Gene Editing (Homologous Recombination –Cre/lox-P system; CRISPR Cas9 system, RNA Interference using siRNA, miRNA, Selection of Recombinants), Parthenoid stem cells

Animal Models - Types of Models (Spontaneous, Experimental, Humanized) Breeding Systems (Inbreed/outbreed), congenic strains. Transgenic Models: (Knock in, Knock Out). Mouse Handling Techniques. Immunocompromised mice model (NSG mice model, SCID). Biostatistics, Bioinformatics, Clinical Research, Bioethics & Regulatory Guidance.

(Lab methodologies course is a mandatary common module for all MSc courses at MIRM)

LABORATORY METHODOLOGIES LAB:

Practical 1: Spectroscopic techniques
Practical 2: Principles of Microscopy
Practical 3: Protein extraction and quantification
Practical 4: Plasmid isolation, restriction digestion confirmation
Practical 5: Genomic DNA isolation
Practical 5: RNA extraction, cDNA synthesis, Quantitative real time PCR
Practical 6: Primer design
Practical 7: Probability and probability distribution, tests of significance
Practical 8: Online tools for bioinformatic analysis: Assessment of homologous sequences using phylogenetic analysis, Visualization of genomic data using genome browsers , Protein databases and visualization

MODULE 3:

PRINCIPLES OF REGENERATION

Immune system in injury, repair and tissue resolution, EMT and wound healing, integrin and ECM interactions during regeneration and repair, Tissue re-modelling and fibrosis, adult and fetal scarless wound healing, Diabetic wounds. Immune surveillance mechanisms against tissue damage (DAMPs, cGAS-STING signaling), NETosis in wound healing.

The mononuclear phagocytic system: Tissue distribution and organ specific properties, Macrophage polarization in homeostasis and pathology

Mediators of immune system in tissue homeostasis: Overview of Tissue resident immune cells, Microglia and the central nervous system, the blood brain barrier, Osteoimmunology and osteoclast genesis, immunometabolism and tissue homeostasis, Innate Lymphoid cells and tissue barrier immunity, Gut microbiome- immune system-brain axis in health and disease, immune cell crosstalk with angiogenesis, Lymph angiogenesis in development and disease, immune cross talk with stem cells in tissue niches, niche concept in tissue repair, Hematopoietic stem cell niche and inflamaging, angiogenesis

Regenerative inflammation: Lessons from model organisms Whole body regeneration lessons from Hydra and Planaria, Structural regeneration (Zebra fish fins), Regeneration studies in Drosophila
Promoting tissue regeneration by immune-modulation, *In-situ* tissue regeneration approaches through host-stem cell mobilization, Mesenchymal stem cells and the wound healing response. Regenerative therapy using blood derived stem cells

Cell quality control mechanisms: UPS, autophagy, cellular and physiological parameters driving sterile inflammation , inflammasome pathways, pyroptotic, ferroptosis. Mitochondrial and lysosomal quality control and cell fate

Model systems: Humanized mouse models to study immune responses to human infections. Organoid models to study chronic degenerative diseases and host pathogen interactions, tumoroid models to study aberrant tissue interactions in cancers, organ-in a chip to micro-model physiological interactions

PRINCIPLES OF REGENERATION LAB:

Practical 1: Cell cycle Analysis by flow cytometry
Practical 2: Karyotyping
Practical 3: Histological identification of architectural components of different tissues
Practical 4: Characterization of MSCs
Practical 5: Detection of ROS: Mitochondrial depolarization, Intracellular ROS by DCFHDA staining
Practical 6: Lysosome detection using Lysotracker dyes
Practical 7: Drosophila mutant identification

MODULE 4:

IMMUNE DYSFUNCTION AND DISORDERS

Autoimmune diseases: Immune tolerance, Central tolerance and peripheral tolerance, Genetic mechanisms of self-tolerance, Ignorance, Immune privilege mechanisms in immune-privileged organs , breakdown of self-tolerance and pathogenesis of autoimmunity, Genetic and epigenetic influences in autoimmunity. Pathomechnaisms of key autoimmune diseases: Type 1 Diabetes, Multiple Sclerosis, Rheumatoid arthritis, Systemic lupus erythematosus

Immunodeficiencies: Primary (SCID) and secondary (by opportunistic infections *e.g.*, AIDS), Systemic autoimmune diseases, organ specific autoimmune diseases, Monogenic autoimmune diseases, Hypersensitivity reactions Chronic inflammatory diseases, Inflammasomes and sterile inflammation

Inflammatory disorders of the central nervous system, Immune dysfunction in Diabetes Miletus, Immune system in neurodegenerative diseases, Animal models to study systemic auto-immune disease, Animal models for organ specific auto-immune disease, Sepsis and Anaphylaxis, Inflamm-aging related disorders

Hematological malignancies: Extramedullary hematopoiesis, hematopoietic niches, classification of hematological malignancies, Myeloproliferative disorders, Lymphomas, Leukemias, Myelomas, Non-cancerous blood disorders: Anemias: Acquired and Inherited, Bleeding disorders, Hematopoietic cell transplantation, Drugs for treatment of hematological malignancies, Gene editing and stem cell-based approaches for treatment of hematological disorders integrated stem cell and gene editing approaches for primary immunodeficiencies and drug screening, stem cell-based precision medicine approaches for hematological malignancies, stem cell-based disease models for Inborn errors of immunity

Cancer Immunology: Tumor antigens, Cancer immune surveillance mechanisms, Tumor microenvironment, Tumor immune editing, Immunometabolism in Cancer, Autophagy and necroptosis in cancer, Role of chemokine and chemokine receptors in cancer, Immunodeficiencies and cancers, Immune cell homing to tumors, Cancer stem cells and role in tumor dormancy and immunosurveillance.

Immunotherapies for cancer: Tumour staging, Predictive immune biomarkers for cancer immunotherapy, checkpoint blockade therapies, CAR-T cell therapy, adoptive transfer of TILs. NK cell based therapeutic strategies, therapeutic antibodies. Induced Pluripotent stem cell-derived T cells for Cancer Immunotherapy.

IMMUNE DYSFUNCTION AND DISORDERS LAB:

Practical 1: HSC enumeration by flow cytometry as per ISHAGE guidelines
Practical 2: Streptozotocin induced model for Diabetes
Practical 3: Nuclear and cytoplasmic beta catenin localization
Practical 4: Histological assessment of tumour samples
Practical 5: ELISPOT analysis
Practical 6: Differential Leukocyte count and cell analysis using specific staining procedures

SEMESTER 2

Three tentative elective titles would be offered with 10 specific lectures related to the elective.

Elective# 1 Immunomodulation

Mesenchymal stem cell as cellular biotherapeutics, Allogenic transplantation of stem cell derived differentiation products
Treating the graft for host acceptance and GVHD
Targeting damage signals for immune modulation
Triggers of sterile inflammation
Tumor microenvironments
Inflammation and angiogenesis
Immunomodulatory mechanisms of MSCs
NSAID as immunomodulators and their impact on tissue stem cells
Targeting tumor immune niches
Macrophages polarization in health and disease

Elective # 2 Chronic inflammatory and metabolic diseases

Phases and components of tissue injury
Role of macrophages and mononuclear phagocytic system as tissue barrier cells
Chronic and acute injury responses
Importance of vascular niches in injury resolution
Factors initiating sterile inflammation
Diabetic models
Pathophysiology of Diabetes
Mitochondrial and lysosomal dysfunction and consequences
Role of Neuroinflammation in neurodegenerative diseases
Obesity and metabolic syndrome

Elective # 3 Host-pathogen interactions

Immuno-heterogeneity of MSCs
Fungal Pathogens commensalism vs pathogenicity
Molecular biology and bioinformatics tools used in understanding the pathogen genome
Understanding pathogen-host interactions using bioinformatics search tools
In vitro systems to study intracellular pathogens
Role of autophagy in infection and responses
Role of pathogen invasion on MSC secretome
Evolving pathogen host-evasive strategies
Biofilms

Intense literature search related to elective topic, Journal club/seminar presentation, Project proposal writing, presentation and pilot studies for project conception in Semester III and IV.

 # Industry visit for a week would be included to facilitate academia-industry interface and to develop industry R&D related projects with MIRM faculty

Semester III

Project work related to the elective below

Elective# 1 Immunomodulation
Elective # 2 Chronic inflammatory and metabolic diseases
Elective # 3 Host-pathogen interactions

Project can be done with academic or an industry collaborator as a Co-PI with the primary PI from MIRM

Semester IV

Project work related to the elective

Elective# 1 Immunomodulation
Elective # 2 Chronic inflammatory and metabolic diseases
Elective # 3 Host-pathogen interactions

Project can be done with academic or an industry collaborator as a Co-PI with the primary PI from MIRM

GUIDELINES FOR THE PREPARATION OF SYNOPSIS FOR DISSERTATION:

The following guidelines and format of the synopsis must be submitted after choosing the subject matter and topic of the project work. The synopsis is a brief outline (about four A-4 size pages or 1000 words is the maximum limit) of future research work intended to carry out either in industry, institutions, or MIRM.

The students are advised to strictly follow the guidelines and formats indicated below while strongly emphasizing the goals of the dissertation to be achieved. A synopsis must have the following headings:

1. Title of the Dissertation/Topic

The research project title should be brief but informative and reflect the study's objectives. It should neither be too short nor too long. It must be written after the whole synopsis has been written so that it is a true representative of the plan (i.e., the synopsis).

2. Introduction (Approx. 300-400 Words)

The introduction should contain brief background and explicit purpose of the proposed study. It must identify the importance of the study, its relevance, and the applicability of the results. It must clearly state the purpose of the study.

3. Review of the literature

The review of literature in a synopsis need not be exhaustive. The relevant information should be covered in about 300 words quoting 8-10 authentic, easily retrievable references.

4. Problem statement (Max 100 words)

The problem statement should address the following questions,
What prompts you to do the research? and
Why is there a need for the research?

5. Objectives

All research projects should have objectives, and every effort should be made to achieve them. There may be so many dimensions to the research problem, but one may not have enough resources or time to study all dimensions. So, one should list the objectives to draw the boundary for the research work. The objectives should be only a few (2-4). They must pertain to the study problem.

6. Research methodology

The research methodology should briefly explain the methods, tools, etc., for the study.

7. Sample size

How many subjects (human/animal) will be included? If there are groups, how many per group? Students should consult a statistician for verifying sample size calculation.

8. *The expected outcome of the study (Approx.200 Words)*

9. Ethical clearance

Wherever necessary, ethical committee clearance from the institute should be obtained. The certificate must be attached. Ethical approval is required in all human and animal studies.

10. Bibliography

All references quoted in the literature review and anywhere else in the synopsis should be in Vancouver style.

ATTENDANCE

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.
If a student for any reason discontinues the course after 1st / 3rd semester he or she may be permitted for 2nd / 4th semester respectively after 1 year in the following academic year, subject to the condition the entire academic program is completed by the student within 3 years of original admission to the course.

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.

M.Sc. in Translational Immunology, Theory Examination, Month, YearCourse Code. Course Title. 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

F	FAIL	0	< 50
I	INCOMPLETE	0	-
DT	DETAINED	0	-
AP	AUDIT PASS	-	-
S	SATISFACTORY	-	-
NS	NOT SATISFACTORY	-	-

CRITERIA:

1. **Minimum for a pass in a course:**
   A student should obtain not less than 40% marks (Internal Assessment and FinalExamination combined) in each course. A student shall be declared PASS if the candidates secure E-grade or above separately in each course.
2. **Examinations:**
   Final Examinations will be conducted for eligible students twice at the end of the semesternamely, the main examination for regular students and make up/supplementary examination for failed students. The failures can write a supplementary exam after 2 weeks of result announcement.
3. Appropriate letter grades from E to A+ are awarded in Theory and Practical courses, to candidates who have passed the course in the first attempt. However grades E to B are awarded to students who make the second attempt to pass a course; except in the case of I- grade. Students once failed or detained will fall in this category irrespective of their high performance in the subsequent attempts.
4. A candidate who is eligible and registers for the Final Examination but fails or fails to appear in the exam gets a grade 'F' indicating failure.
5. A candidate who is eligible and registers for the Final Examination but fails to appear in the exam due to valid reasons will get grade 'I' indicating incomplete. However, it needs prior approval from HOI and Registrar Evaluation, MAHE.
6. The grade 'DT' is given to a candidate who fails to put in the minimum required attendancefor appearing in the end semester examination for a course.
7. A student who has earned grade 'E' or above is declared to have successfully completedthe course. A course successfully completed cannot be repeated for the purpose of improving the grade.
8. **Revaluation of Answer papers.**
   There is a provision for revaluation of answer papers of Final Examination as per MAHE guidelines. The candidate must apply separately by paying a prescribed fee.

REFERENCE LIST OF BOOKS AND JOURNALS

SL No.	Text-Book Name
1	Kuby Immunology, 8th Edition
2	Fundamental Immunology William Paul 7th Edition
3	Cellular and Molcular Immunology 10th Edition
4	Cancer Immunology: Cancer Immunotherapy for organ specific tumors, Nima Rezae, 2nd Edition
5	Basic and Clincal Immunology By Mark Peakman
6	Text Book of Organ Transplantation Allan D Kirk 2014
7	Text book of Auto-inflammation
8	Cancer Immunology and Immunotherapy Editors: Lara Scheherazade Milane, Mansoor M. Amiji Volume 1
9	Janeways Immunobiology 9th Edition
10	Immunomodulatory Biomaterials Edited by Stephen F Badylak and Jennifer H. Elisseeff
11.	Essential Aspects of Immunometabolism in Health and Disease Editors Jose C Alves-Filho, Niels Olsen Saraiva Camara, Pedro Manoel Mendes de Moraes-Vieira, Vinicius Andrade-Oliveira
11.	The Resolution of Inflammation Editors Adriano G. Rossi, Deborah A.Sawatzky
12.	Innate Immunity: Resistance and Disease-Promoting Principles Editors Gunther Hartmann, Hermann Wagner Volume 4
14.	Immunometabolism Methods and Protocols Humana Press Editor Suresh Mishra
15.	Current Protocols in Immunology Wiley
16.	Practical Immunology By Frank C.Hay and Olwyn M.R.Westwood
17.	Encyclopedia of Infection and Immunity Publisher Elsevier Science Nima Rezaei
18.	Immunology of infectious diseases ASM Press Editors Alan Sher, Rafi Ahmed, Stefan H.E. Kaufmann
19.	Translational Immunology Edited by SENG-LAI TAN

ANNEXURE 1