

## **HCB-815 Advances in Immunology 3 (3-0)**

### **Background**

1. Brief history of introduction and conduct of the existing course.

Advances in Immunology is the advanced course included in almost all biological sciences disciplines and faculties. The basic concepts and understanding of Immune system, its mechanisms is already intended to be covered in the basic course. The advances in immunology will give a depth knowledge of immunology, signaling mechanisms operating at molecular level and the way human body fights against pathogens, cancers and other ailments. The course is necessary to devise any therapeutics and makes basis for all translational researches.

### **Rationale**

2. Reasons for the proposed revision. The research and development in the field of immunology is piling up with each passing day. The more scientists and researchers are making progresses, new avenues for further research and knowledge acquisitions are opening. Thus we need to keep pace with the advancements and have to equip our students with the increasing knowledge in the field. The current course contents need a thorough revisions as per requirement of the field. Thus we have proposed the revision covering the molecular aspect of immunological pathways as well as the involvement of immune mechanisms in various diseases important to be looked for possible immunotherapies.

### **Educational Objectives**

3. Objectives of the programme under which the course is being conducted. The course is being offered under the program "HealthCare Biotechnology". The educational objectives of the Biotechnology program include:

- a. To prepare students for careers of constructive service to society in academia, government, industry and healthcare related fields.

- b. To engage committed students in areas not experienced in their previous academic lives and to bring them to a baseline that will allow them to conduct translational research, from conceptual design through in vivo testing with an eye towards clinical implementation.
- c. To provide interdisciplinary research and educational opportunities to solve problems that will improve the quality of life for those suffering from healthcare-related diseases and disorders.

The main educational objective for students is the attainment of a common core of knowledge in biotechnology, with particular emphasis on their ability to integrate knowledge across disciplinary boundaries. Specific track objectives are to provide students with didactic and practical knowledge:

- a. in genomics, proteomics, and other bio-analytical approaches (Molecular Biotechnology)
- b. in drug discovery, development, and delivery (Pharmaceutical Biotechnology)
- c. in bioprocess development and optimization (Process Development)

#### **Input Obtained from Industry/Corporate Sector**

4. Input obtained/received from Corporate Advisory Council or industrial linkages, R&D organizations, etc to be included, if applicable.

Not Applicable

#### **International Standards/Practice**

5. Specify the universities of repute where the proposed course is being conducted. All top ranked universities as well as their all programs in biological sciences and related disciplines are offering this course. A list of a few of these top universities is given below.

No	University Name
1.	Harvard University, USA
2.	University of Oxford , UK
3.	University of Cambridge , UK
4.	University of York, UK
5.	Newcastle University, United Kingdom
6.	University of Oxford, UK
7.	Cardiff University, Cardiff, United Kingdom
8.	University of Cambridge, UK
9.	National University of Singapore, NUS
10.	University of Gottingen , Germany
11.	University of California Berkeley, USA

## 6. **Course Contents**

### a. **Objectives**

The course will cover the molecular aspect of immunological pathways that are governing at cellular level to infer immune protection. Major human diseases attributed due to defects in immune system will be discussed and immunological mechanism(s) that governs the onset of key human diseases will be elucidated for their therapeutic potential.

### b. **Outcomes**

The course will help student to understand underlying mechanisms of the immunologic disease and principles for therapeutic modulation of immune

system. The student will have good understanding of the basic immunological principles underlying current therapeutic approaches including bio therapeutics, understand the common principles underlying therapies among diverse organ specific disease states, discuss the unique principles related to certain specific tissues including the mucosal immune system, and describe the mechanisms of therapeutic effect.

- c. Course Code **(HCB-815)**
- d. Credit hours **3 (3-0)**
- e. Contents with proposed contact hours

### **Course Contents:**

#### 7. Revisiting the concepts of immunology

- Components and functions of innate immunity
- Components and functions of adaptive immunity
- The immunological loop

#### The antigen recognition system

- Molecular Structures of BCR
- Molecular structure of TCR

#### Generation of lymphocyte antigen receptor

- Molecular mechanisms of Primary gene rearrangements
- Generation of diversity of antigen receptors
- Antigen recognition by T cells
- Antigen presentation to T Lymphocyte

#### Generation of Antibody diversity

#### The major histocompatibility complex and its function

## Immune signaling:

- Principles of immune signal transduction
- Lymphocyte activation and development
- Positive and negative selection of T cells
- Survival and maturation of lymphocytes

## Immunological memory

## Immune system in health and diseases

- Evasion and subversion of immune defense
- Immunodeficiency syndromes
  - Molecular basis
  - Types of SCIDs
- Infections and immunity
  - Interaction of pathogens with immune system
- Allergy and hypersensitivity immune reaction
  - Sensitization and production of IgE
  - Effector mechanism in allergic reactions
- Autoimmunity
- Immunological aspects of cancer
  - Cancer immunotherapy
  - Challenges in cancer immunotherapy

f. Details of lab work/workshop practice, if applicable  
Not Applicable, NIL

g. Recommended reading, including textbooks, reference books.  
Janeways immunobiology (Ninth Edition): Murphy, Kenneth, Paul Travers, Mark Walport, and Charles Janeway. New York: Garland Science,

### **Proposed Research Areas/Benefit(s) to the Society**

8. Specify with reference to local industry including R&D organization and private sector demands. The course is fundamental to the knowledge of biological sciences and related disciplines. Thus not only it will benefit the basic science but also critically important to the students perusing their careers to industry such as Biotechnology, pharmaceuticals, vaccine industry etc. . . . The knowledge is fundamental to the researchers working in industry where new drugs and therapies are being tested for the treatment of various diseases and vaccine production as well as immunotherapies.

### **Approval by DBS/FBS**

9. Approval of FBS will be enclosed.

- Deleted contents
- Additions
- Old carry overs

Old contents	New contents
<ul style="list-style-type: none"><li>• Musculoskeletal Diseases<ul style="list-style-type: none"><li>○ Clinical features of Rheumatoid Arthritis</li><li>○ Synovial Changes in Rheumatoid Arthritis</li><li>○ Pathogenesis of Rheumatoid</li></ul></li></ul>	<p>Revisiting the concepts of immunology</p> <ul style="list-style-type: none"><li>• Components and functions of innate immunity</li><li>• Components and functions of adaptive immunity</li><li>• The immunological loop</li></ul> <p>The antigen recognition system</p> <ul style="list-style-type: none"><li>• Molecular Structures of</li></ul>

<p>Arthritis</p> <ul style="list-style-type: none"> <li>○ Juvenile Chronic Arthritis</li> <li>○ Clinical features of Spondylarthritis</li> <li>○ Pathogenesis of Spondylarthritis</li> <li>○ Gout, Poychondritis, and Bechet's syndrome</li> </ul> <ul style="list-style-type: none"> <li>● Skin Diseases <ul style="list-style-type: none"> <li>○ Urticaria</li> <li>○ Contact Allergies</li> <li>○ Atopic Dermatitis and Leukocytoclastic vasculities</li> <li>○ Psoriasis and Bullous Skin Diseases</li> </ul> </li> <li>● Gastrointestinal Diseases <ul style="list-style-type: none"> <li>○ Atrophic Gastritis, Whipple's disease and Sprue</li> <li>○ Chronic Inflammatory Bowl Diseases</li> <li>○ Autoimmune Liver Diseases</li> </ul> </li> </ul>	<p>BCR</p> <ul style="list-style-type: none"> <li>● Molecular structure of TCR</li> </ul> <p>Generation of lymphocyte antigen receptor</p> <ul style="list-style-type: none"> <li>▪ Molecular mechanisms of Primary gene rearrangements</li> <li>▪ Generation of diversity of antigen receptors</li> <li>▪ Antigen recognition by T cells</li> <li>▪ Antigen presentation to T Lymphocyte</li> </ul> <p>Generation of Antibody diversity</p> <p>The major histocompatibility complex and its function</p> <p>Immune signaling:</p> <ul style="list-style-type: none"> <li>● Principles of immune signal transduction</li> <li>● Lymphocyte activation and development</li> <li>● Positive and negative selection of T cells</li> <li>● Survival and maturation of lymphocytes</li> </ul> <p>Immunological memory</p>
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<ul style="list-style-type: none"> <li>• Respiratory Diseases <ul style="list-style-type: none"> <li>○ Bronchial Asthma and Allergic Rhinitis</li> <li>○ Sarcoidosis and Idiopathic</li> <li>○ Pulmonary Fibrosis</li> <li>○ Extrinsic Allergic alveolitis</li> <li>○ Tuberculosis</li> </ul> </li> <li>• Renal Diseases <ul style="list-style-type: none"> <li>○ Immunological mechanisms</li> <li>○ Glomerulonephritis (I)</li> <li>○ Glomerulonephritis (II) and Interstitial Nephritis</li> </ul> </li> <li>• Metabolic Diseases <ul style="list-style-type: none"> <li>○ Autoimmune Thyroid Diseases</li> <li>○ Diabetic Mellitus and Autoimmune Polyglandular Syndrome</li> </ul> </li> <li>• Heart disease <ul style="list-style-type: none"> <li>○ Rheumatic fever, Myocarditis, and Postinfection</li> </ul> </li> </ul>	<p>Immune system in health and diseases</p> <ul style="list-style-type: none"> <li>• Evasion and subversion of immune defense</li> <li>• Immunodeficiency syndromes <ul style="list-style-type: none"> <li>○ Molecular basis</li> <li>○ Types of SCIDs</li> </ul> </li> <li>• Infections and immunity <ul style="list-style-type: none"> <li>○ Interaction of pathogens with immune system</li> </ul> </li> <li>• Allergy and hypersensitivity immune reaction <ul style="list-style-type: none"> <li>○ Sensitization and production of IgE</li> <li>○ Effector mechanism in allergic reactions</li> </ul> </li> <li>• Autoimmunity</li> <li>• Immunological aspects of cancer <ul style="list-style-type: none"> <li>○ Cancer immunotherapy</li> <li>○ Challenges in cancer immunotherapy</li> </ul> </li> </ul>
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<p style="text-align: center;">syndrome</p> <ul style="list-style-type: none"><li>• Neurological Diseases<ul style="list-style-type: none"><li>○ Multiple Sclerosis</li><li>○ Autoantibody-mediated Diseases</li><li>○ Myasthenia Gravis and Lambert-Eaton syndrome</li></ul></li><li>• Ophthalmic Diseases<ul style="list-style-type: none"><li>○ Anatomy and Pathogenesis</li><li>○ Extraocular inflammations</li><li>○ Uveitis (I)</li><li>○ Uveitis (II) and Ocular Manifestation of Systemic Disease</li></ul></li><li>• Reproduction Immunology</li></ul>	
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