

## **SEMESTER VI**

### **BSc. (Hons.) Biochemistry**

#### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credit s	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
Human Physiology (BCH-DSC-601)	4	2L	0	2P	Class XII with Science and Biology	NIL

#### **Learning Objectives**

The objective of the course is to provide a comprehensive study of the molecular and cellular mechanisms that govern the integrative working and regulation of the various organ systems in the human body. The course will provide a foundation of the physiological principles and the application of the same in real-life situations. It will prepare students for higher education in any field related to medical physiology.

#### **Learning outcomes**

On successful completion of the course, students will be able to:

1. Explain the homeostatic control and functioning of the human body systems
2. Discuss the regulatory mechanism regulating different organ system.
3. Describe the functioning of the different organ systems.
4. Explain the basis of various physiological diseases.

5. Perform and analyse various physiological tests that examine the function of various systems of the human body.

## **SYLLABUS OF DSC-16**

### **2.2 Course Contents**

**Theory (2 Credits)**

#### **BCH-DSC-16 : HUMAN PHYSIOLOGY SEMESTER - VI**

**Total Hours: 30**

**Unit I: Circulatory system (7 Hours)**

Homeostasis: definition and control mechanisms (negative and positive feedback mechanisms). Blood Composition and Blood coagulation. Anatomy of Heart. Heartbeat Coordination: Cardiac action potential and Pacemaker potential. Cardiac cycle. Cardiac output and its regulation. The role of blood vessels in circulation: Arteries, Veins and Blood capillaries.

**Unit II: Life Processes (15 Hours)**

Respiratory physiology: Ventilation and lung mechanics. Inspiration, Expiration, Lung compliance and its determinants. Transport of oxygen and carbon dioxide in blood. Regulation of respiration.

Renal physiology: Cell biology of the Bowmans' capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Urine concentration: The counter current multiplier system. Blood buffer systems.

Gastrointestinal physiology: Propulsion, motility, digestion and assimilation of food. Secretory functions of the gastrointestinal tract. Enteric nervous system. Regulation of GI tract functions. Hepatic physiology and Enterohepatic circulation.

**Unit III: Introduction to muscular and neural physiology (4 Hours)**

Molecular mechanisms of skeletal and smooth muscle contraction: role of troponin, tropomyosin, and calcium in contraction, excitation-contraction coupling. Overview of Central and Peripheral Nervous System and neural conduction.

**Unit IV: Reproductive Physiology (4 Hours)**

Sex determination and differentiation. Oogenesis, Spermatogenesis, capacitation and transport of sperm, blood-testis barrier. Fertilization, Implantation and Placentation.

**2.3 Practical (2 Credits)**

1. Hematology:

**Total Hours: 60**

- a. Determination of Packed Cell Volume, Bleeding Time and Clotting Time.
- b. Preparation of blood smear and estimation of differential leucocyte count.
- c. Enumeration of Blood cells: RBC and WBC
- d. Estimation of hemoglobin and calculation of blood indices
2. Serum Proteins Electrophoresis
3. Understanding the anatomy/structure of following: Heart, GI Tract, Kidney and Nephron, Neuron, Lung and alveoli, skeletal, smooth and cardiac muscle
4. Pulmonary function tests: Understanding Lung capacities and Lung volumes using Spirometry
5. Determination of the Blood Pressure.
6. Case studies: Renal clearance, Gastrointestinal disorder, Anemia, Jaundice (any two)
7. Virtual Lab on ECG

**2.4 Essential Readings:**

- Widmaier, E.P., Raff, H. and Strang, K.T. (2019) Vander's Human Physiology 15<sup>th</sup> ed., McGraw Hill International Publications (New York), ISBN: 978-1259903885
- Fox, S.I. (2018) Human Physiology 15<sup>th</sup> ed., McGraw Hill International Publications, (New York) ISBN 978-1259864629

### **Suggested Readings:**

- Guyton, A.C. and Hall, J.E., (2016) Reed Textbook of Medical Physiology 13<sup>th</sup> ed., Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1455770052
- Sherwood, L. (2012) Introduction to Human Physiology 8<sup>th</sup> edition; Brooks/Cole, Cengage Learning. ISBN-13: 978-1133104544.
- Gerard G Totoro. (2017). Principles of Physiology and Anatomy 15<sup>th</sup> Edition, Wiley. ISBN: 978-1-119-40006-6

### **3. Key word:**

Physiology, Homeostasis, life processes, heart, neurophysiology, reproduction

**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credi ts	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lectur e	Tutoria l	Practical / Practice		
<b>Basics of Immunology (BCH-DSC - 602)</b>	<b>4</b>	<b>2L</b>	<b>0</b>	<b>2P</b>	<b>Class XII with Science and Biology</b>	<b>NIL</b>

### **Learning Objectives**

The course is designed to understand the basic concepts in Immunology. It is important to understand the structure of the cells and organs associated with the immune system to appreciate their function in fighting infections. So, the students will study their structure and the various receptors associated with them. They will be exposed to the concept of antigen antibody and the types of immune responses generated in the body. The recognition of the antigen by B and T cells and the role of Major histocompatibility complex in generation of immune response will be elaborated.

### **Learning outcomes**

On successful completion of the course, students will be able to:

1. Explain the concept of innate and adaptive immunity.
2. Describe the structure and function of cells and organs of the immune system
3. Discuss the Attributes of an immunogen, structure and the functions associated with different isotypes of antibodies
4. Explain the humoral immune response and antibody diversity.
5. Explain the Antigen presentation mechanisms and generation of cell mediated immunity

## **SYLLABUS OF DSC-17**

### **BCH-DSC-17 : BASICS OF IMMUNOLOGY SEMESTER - VI**

#### **2.2 Theory (2 Credits)**

**Total Hours: 30**

#### **Unit 1 : Introduction to the Immune System: (8 Hours)**

Historical Perspective, Innate and Adaptive immunity and their role in generation of immune response, Primary and Secondary Immune Response, Cells and Organs of the Immune System, Hematopoiesis, Antigens, Properties of Immunogen, Haptens, Adjuvants, B Cell and T Cell Epitopes, Structure and Effector Functions of Different Types of Antibodies, Biological Activities of Subclasses of Antibodies, Antigenic Determinants on Immunoglobulins, Immunoglobulin Superfamily, B cell receptor,

#### **Unit 2 : Innate Immunity: (6 Hours)**

Anatomical Barriers, Soluble and Membrane Bound Molecular Sensors (PRRs), Inflammation, Phagocytic cells and Innate Immunity, Toll like receptors, Activation

Pathways of Complement System, Regulation and Biological Consequences of Complement Activation.

**Unit 3 : Humoral Immune Response (8 Hours)**

B Cell Development, Maturation & Differentiation, Clonal Selection theory, Genetic basis of Antibody Diversity, Class switching.

**Unit 4 : Cell mediated Immune Response (8 Hours)**

Major Histocompatibility, General Organization and Inheritance of the MHC, Antigen Presenting Cells, Processing and Presentation of Antigen by the endocytic and cytosolic pathways, Development, Maturation & Differentiation of T cells, Role of Cytotoxic T lymphocytes, T cell and B cell interactions

**2.3 Practical (2 Credits)**

**Total Hours: 60**

1. Immunodiffusion –Double immunodiffusion and Single radial immunodiffusion
2. Differential Leucocyte Count
3. Visualization of lymphoid Organs and lymphatic system (Videos)
4. Isolation of lymphocytes from blood/spleen
5. Complement mediated lysis.
6. Active and Passive agglutination reactions
7. Dot blot and ELISA

**2.4 Essential readings:**

1. Kuby Immunology (2007) 6<sup>th</sup> ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H. Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3/ISBN: 10:0-7617- 8590-0.
2. Immunology: A Short Course (2009) 6<sup>th</sup> ed., Coico, R. and Sunshine, G., John Wiley & sons, Inc. (New Jersey), ISBN: 978-0-470-08158-7.

**Suggested Readings:**

1. Janeway's Immunobiology (2012) 8<sup>th</sup> ed., Murphy, K., Mowar, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 978-0-8153-4243-4
2. Cellular and Molecular Immunology (2021), 10<sup>th</sup> edition, Abbas, A.K., Lichtman, A.H., Shiv Pillai, Elsevier, ISBN: 9780323757485

### 3. Keywords:

Immunity, innate, adaptive, antibody, MHC, Humoral and Cell mediated immune response, Processing of antigens

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### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credit s	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lectu r e	Tut oria l	Practic al/ Practi ce		
Fundamentals of Recombinant DNA Technology (BCH-DSC-603)	4	2L	0	2P	Class XII with Science and Biology	Basic course in Molecular Biology

### Learning Objectives

The objective of the course is to teach the basics of theoretical and practical aspects of recombinant DNA technology and various techniques for DNA manipulation in prokaryotes and eukaryotes.

### Learning outcomes

On successful completion of the course, students will be able to:

1. Perform restriction digestion of DNA samples.

2. Prepare genomic and cDNA libraries,
3. Perform basic cloning techniques to design a recombinant protein in a bacterial system.
4. Design primers for PCR, perform DNA amplification by PCR, and understand the principles of DNA sequencing.

## **SYLLABUS OF DSC-18**

### **BCH-DSC-18 : FUNDAMENTALS OF RECOMBINANT DNA TECHNOLOGY SEMESTER - VI**

#### **2.2 Course Contents**

##### **Theory (2 Credits)**

**Total 30 hours**

##### **Unit 1: Principles of gene cloning (14 hours)**

Restriction and modification systems, restriction endonucleases and other enzymes used in gene cloning. Cloning vectors used in *E. coli*: plasmids pBR322, pUC, pGEM3Z, Ti-plasmid, and viral vectors ( $\lambda$  bacteriophage, CMV and SV40), high-capacity vectors BAC and YAC. Ligation of DNA molecules. Linkers, adapters and homopolymer tailing.

##### **Unit 2: Selection for recombinants and clone identification (5 hours)**

Uptake of DNA by cells and selection of recombinants. Making cDNA and Genomic DNA libraries. Clone identification by colony hybridization.

##### **Unit 3: Expression of cloned genes (6 hours)**

Vectors for expression of foreign genes in *E. coli*, expression cassettes: Hybrid promoters trc, tac. Challenges in producing recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins.

##### **Unit 4: Polymerase chain reaction, DNA sequencing and Site Directed Mutagenesis**

(5

**hours)** Fundamentals of polymerase chain reaction, Types of PCR; reverse transcriptase PCR, Primer designing. DNA sequencing by Sanger's method including automated DNA sequencing, pyrosequencing. Site-directed mutagenesis (overlap extension method).

### **2.3 Practical (2 Credits)**

1. Isolation of plasmid DNA from *E. coli* cells.
2. Digestion of plasmid DNA with restriction enzymes.
3. Preparation of competent cells and transformation with plasmid DNA.
4. Amplification of a DNA fragment by PCR.

**Total: 60 hours**

5. Alpha-Complementation of  $\beta$ -galactosidase for Blue and White selection.
6. Hyper expression of a recombinant protein (SDS PAGE).
7. Poly histidine-tagged recombinant protein and purification using Ni-affinity resin

### **2.4 Essential readings:**

- Brown, T.A. (2016) Gene Cloning and DNA Analysis (7<sup>th</sup> ed.), Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
- Primrose, S.B., and Twyman, (2006) Principles of Gene Manipulation and Genomics (7th ed.), R. M., Blackwell publishing (Oxford, UK) ISBN: 978-1-4051-3544-3.
- Glick B.R., Pasternak, J.J. and Patten, C.L., (2010) *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (4<sup>th</sup> ed.), ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).
- Michael R Green and J. Sambrook (2014) Molecular Cloning: A laboratory manual, (4<sup>th</sup> ed.), Cold spring Harbor laboratory press (3vol.), ISBN: 978-1-936113-42-2.

### **Suggested readings:**

- Brown, T.A. (2007) Genomes (3<sup>rd</sup> ed.), Garland Science publishing, ISBN: 0 8153 4138 5.

### **3. Keywords**

Genetic Engineering, cloning, Recombinant Protein expression and purification, Biotechnology.

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