



St. Xavier's College – Autonomous Mumbai

Syllabus For 8th Semester Courses in **M.Sc. LIFE SCIENCE** (June 2018 onwards)

Contents:

Syllabus (theory and practical) for Courses:

SLSC0801	Human Physiology I
SLSC0802	Basic Mathematics and Biostatistics
SLSC0803	Fundamentals of Immunology
SLSC0804	Microbial Diseases
SLSC08PR	Practicals

Template for theory and practical question paper
Evaluation and Assessment Grid

Percent revision:

2015-16: No revision

2016-17: No revision

2017-18: No revision

2018-19: 20% (0803) and 40-50% revision in practicals

2019-20: No revision

LIFE SCIENCE

M.Sc.

Course No.: SLSC0801

Title: Human Physiology I

Learning Objectives:

The course aims at:

1. Imparting knowledge and understanding of the structural organization of the human body and its functional segregation into various systems, and understand the physiological interdependence of various systems.
2. Introducing the students to the physiological and cellular mechanisms underlying disorders of various organ systems.

Number of lectures: 60

UNIT I (15 lectures)

1. **Introduction to Physiology:** Structural and functional organization of the human body; General characteristics of homeostatic control systems. (3)
2. **Gastrointestinal Physiology:** Overview of digestive process; Secretory functions of the alimentary canal; Cephalic, gastric and intestinal phase of stomach secretion; Digestion and absorption in the G.I. tract; Role of accessory glands – liver, pancreas, gall bladder; Neural and endocrine control of GI function; Overview of the absorptive and Post-absorptive state; Basal Metabolic Rate. (6)
3. **Disorders of the GI system:** Liver Cirrhosis, Obesity, Vitamin deficiencies (6)

UNIT II (15 lectures)

1. **Cardiovascular system:** Anatomy of the heart; Blood flow through the heart; Cardiac cycle; Rhythmic excitation of the heart. (5)
2. **Circulatory system:** Components of blood; Blood flow and resistance; Functions of the arterial and venous system; Cardiac output and venous return; Humoral and nervous control of circulation; Blood pressure control. (5)
3. **Lymphatics** (1)
4. **Cardiovascular disorders:** Atherosclerosis, Cardiac arrhythmia, Anaemia, Thalassemia. (4)

UNIT III (15 lectures)

1. **Urinary system:** Physiologic anatomy of the Kidneys; Overview of the process of urine formation – Glomerular filtration, Tubular reabsorption, Tubular secretion; Micturition reflex; GFR and Renal Blood flow; Neural control and Auto-regulation of GFR and Renal Blood Flow. (7)
2. **Disorders:** Acute and chronic renal failure (2)
3. **Physiology of Muscle Contraction:** Gross anatomy of skeletal, smooth muscles and cardiac muscles; Molecular mechanism of muscle contraction. (4)
4. Neural control of muscle contraction: the Neuromuscular Junction. (2)

UNIT IV

(15 lectures)

1. **Respiratory system:** Overview of the respiratory system; Pulmonary ventilation; Measuring lung function – Lung Compliance, Pulmonary Volumes and Capacities; Principles of gaseous exchange; Relationship between Pulmonary ventilation and Pulmonary capillary blood flow; Transport of gases in the blood - Hemoglobin and oxygen transport; Carbon dioxide and blood pH; Neural and chemical control of ventilation. **(7)**
2. **Respiratory disorders:** Chronic Obstructive Pulmonary Disorders, Cystic fibrosis **(4)**
3. **Musculoskeletal disorders:** Osteoporosis, Osteoarthritis, Duchenne's Muscular Dystrophy **(4)**

References:

1. Arthur C. Guyton, John E. Hall (2006) “Textbook of Medical Physiology” *Elsevier Saunders*.
2. Ken Saladin (2003) “Anatomy & Physiology: The Unity of Form and Function” *The McGraw–Hill Companies*.
3. Seeley R, Stephens T, Tate P (2004) “Anatomy and Physiology” *The McGraw–Hill Companies*.
4. Stuart Fox (2003) “Human Physiology” *The McGraw–Hill Companies*.
5. Rhodes R, Tanner G (2003) “Medical Physiology” *Lippincott Williams & Wilkins*.

LIFE SCIENCE

M.Sc.

Course No.: SLSC0802

Title: Basic Mathematics and Biostatistics

Learning Objectives:

1. To equip students with mathematical and statistical concepts and methods.
2. To introduce students to the display and communication of statistical data. This will include graphical and exploratory data analysis.
3. To help students understand estimation, testing and interpretation for single group summaries such as mean, median, variance, correlation and regression.
4. To promote an understanding of the basics of hypothesis testing, confidence intervals and the interpretation and application of commonly used statistical tests – Z, t, Chi square.
5. To aid in the understanding of the basic concepts of ANOVA.

Number of lectures: 60

UNIT I	(15 lectures)
1. Matrices and determinants	(5)
2. Limits and derivatives	(5)
3. Differential equations	(5)
UNIT II	(15 lectures)
1. Collection, tabulation and graphical representation of data, frequency distribution.	(2)
2. Measures of central tendency (for grouped & ungrouped data)	(3)
3. Skewness and Kurtosis	(1)
4. Measures of dispersion	(3)
5. Concept of sampling, sampling techniques, standard error	(3)
6. Simple correlation and regression	(3)
UNIT III	(15 lectures)
1. Concepts of Probability	(1)
2. Theories of Probability – Additive and multiplicative theory	(2)
3. Binomial, Poisson and Gaussian (Normal)distribution	(2)
4. Measure of location (Z score, percentile rank and percentile)	(2)
5. Hypothesis Testing - Null hypothesis, Alternative hypothesis, Levels of significance, Type I , Type II error, Critical region	(2)
6. Test of significance of Mean :(Z test and t test), Test for proportion	(6)
UNIT IV	(15 lectures)
1. One-way ANOVA, Tukey's post hoc test	(3)
2. Two-way ANOVA	(4)
3. Design of experiment : randomized design, randomized block and factorial experimental designs	(3)
4. Non- parametric tests- Chi-square test of goodness of fit. Sign test, Wilcox test for unpaired test	(5)

References:

1. Sokal R and Rahlf H (1995) 'Biometry: the principles and practice of Statistics for Biology research' *W H Freeman*.
2. Zar J (1998) 'Biostatistical analysis' *Prentice Hall*.
3. Rosner B (1995) 'Fundamentals of Biostatistics' *Duxbury Press*.
4. Daniel W (2005) ' Biostatistics: A Foundation for Analysis in Health Sciences' *Wiley*.
5. Aulay Mackenzie. (2007) 'Mathematics and Statistics for Life Scientists. Bios Instant Notes' *Taylor and Francis*.
6. Mathematics problems and study pack provided by the course instructor.

LIFE SCIENCE

M.Sc.

Course No.: SLSC0803

Course Title: Fundamentals of Immunology

Learning Objectives:

To help students:

1. Understand the concept of innate and adaptive immunity.
2. Describe the organization and the role of the various cells and organs of the immune system.
3. Understand the role of innate and adaptive immunity and the factors that contribute towards immunity.
4. Understand the disorders in immune response such as allergies, immunodeficiencies and modulation of the immune response during transplantation and for allergic responses.

Unit I: Introduction to the Immune System (15 Lectures)

1. Concept of Innate and Adaptive, Acquired and Passive Immunity (1)
2. Cells, tissues, organs of immunology. (8)
 - a. Innate Immunity:
 - i. Physicochemical barriers to infection, Antimicrobial peptides and proteins, Acute phase proteins, C-reactive proteins.
 - ii. Complement System
 - iii. Cellular players (Phagocytic cells, NK cells, Mast cells)
 - iv. Pathogen Associated Molecular Patterns, Pattern Recognition Receptors, Signalling pathways
 - v. Inflammation.
 - vi. Mechanisms by pathogens to evade innate defences.
 - b. Acquired Immunity: (3)
 - i. Lymphoid Organs
 - ii. APC, B Cell, T Cell
 - iii. Antibodies (Structure, types and functions)
 - iv. Bispecific antibodies, humanized antibodies, scFv
3. Immunological Methods: (3)
 - a. Antigen antibody interaction and its applications: Agglutination, Precipitation, Immunodiffusion, Immunoelectrophoresis, ELISA, Radioimmunoassay, Immunohistochemistry, Flow Cytometry

Unit II: Antigen recognition and diversity of the immune receptors (15 Lectures)

1. Molecular basis of Antigen recognition and binding by Immunoglobulin (1)
2. T-Cell Receptor (TCR) and Antigen recognition by TCR (2)
3. MHC restriction, MHC I and II, Non-classical MHC, Generation of T-cell receptor ligand (3)
4. Genetic diversity of the Immune receptors (7)

- a. Primary Immunoglobulin gene rearrangement
- b. Secondary diversification of antibody repertoire.
- c. TCR gene rearrangement.
- d. MHC locus and function.
5. Evolution of the adaptive immune response (2)

Unit III: Development of the Acquired Immune Response (15 Lectures)

1. Humoral Immune Response: (4)
 - a. Development of B lymphocytes.
 - b. B cell activation and antibody production.
 - i. T-cell dependent and independent pathways.
 - c. Distribution and functions of Immunoglobulin classes.
2. Cell-mediated immunity: (5)
 - a. T cell development
 - i. In the Thymus.
 - ii. Positive and negative selection of T cells
 - iii. In the peripheral lymphoid tissue and gamma-delta T cells in the gut.
 - b. Priming of naive T cells and effector T cells
 - c. T cell-mediated cytotoxicity
 - d. Macrophage activation by TH1 cells
 - e. Role of TH17 cells
3. Dynamics of the immune response to infection (3)
 - a. Course of immune response to infection
 - b. Immunological memory.
4. Mucosal Immune System: (3)
 - a. Organization of the mucosal immune system
 - b. Mucosal response to infections
 - c. Regulation of the mucosal immune response

Unit IV: Immune system in health and disease (15 Lectures)

1. Tolerance, Allergy and Hypersensitivity: (5)
 - a. Tolerance Mechanisms
 - i. Central thymic and Post-thymic T-cell tolerance
 - ii. B cell tolerance.
 - b. Regulatory T cells: CD4, T_{REGS} and CD8 alpha-alpha cells
 - c. Allergy: Effector mechanisms, IgE, mast cells and basophil mediated response.
 - d. Hypersensitivity: Types and mechanisms
2. Autoimmunity and Immunodeficiencies (4)
 - a. Cellular and Systemic Autoimmune disorders (Any 4 disorders)
 - i. Mechanisms, Clinical manifestation and management.
 - b. Deficiency in the innate and adaptive immune response (2 deficiencies each)
 - i. Clinical manifestation and management.
3. Transplantation (6)

- a. Barriers to transplantation
- b. Role of T cells in rejection
- c. Clinical manifestations of rejection
- d. Prevention of rejection.
- e. Transplantation of kidney/liver/bone marrow

References:

1. Murphy K and Weaver C (2016) “Janeway’s Immunobiology” *Garland Science*.
2. Kindt, Goldsby & Osborne (2008) “Kuby Immunology” *W. H. Freeman*.
3. Delves P.J., Martin S.J., Burton D.R. and Roitt M.I. (2017) “Roitt’s Essential Immunology” *Wiley Blackwell*.
4. Male D, Brostoff J, Roth D and Roitt I (2013) “Immunology” *Elsevier Saunders*.
5. Tizzard I (1995) “Immunology” *Saunders College Publishing*.
6. Kaufmann S. (2011) “The Immune Response to Infection” *ASM Press*.
7. Abbas A.K. (2003) “Cellular and Molecular Immunology” *Saunders*.
8. Reviews papers published recently on relevant topics.

LIFE SCIENCE

M.Sc.

Course No.: SLSC0804

Title: Microbial Diseases

Learning Objectives:

1. To understand host–parasite interactions by in-depth study of pathogenesis of various microbial parasites and immune response of the host to them
2. To study and understand infectious agents colonizing various organs and systems in human body.
3. To equip the students with a thorough knowledge of not only the clinical features and diagnosis of each of these diseases but also promote a clear understanding of the mechanisms for preventing the disease.

Number of lectures: 60

UNIT I (15 lectures)

1. Types of infectious diseases (1)
 - a. Reservoirs of Infection
 - b. Sites of entry, exit and transmission, types of transmission between humans, transmission from animals.
2. Pathogenesis of bacterial diseases (5)
 - a. Reservoirs of bacterial pathogens
 - b. Mechanisms of bacterial invasion growth and multiplication of pathogens
 - c. Regulation of bacterial virulence factors
 - d. Bacterial toxins
3. Pathogenesis of viral diseases (3)
 - a. Entry, contact, and primary replication
 - b. Viral spread and cell tropism
 - c. Cell injury and clinical illness
 - d. Recovery from infection
 - e. Virus shedding
4. Interaction of the pathogen with the Innate and Adaptive Immune System (6)
 - a. Immune response to bacterial, viral and fungal diseases.

UNIT II (15 lectures)

Detailed Study of the following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab. diagnosis, Prophylaxis, and Treatment.

1. Respiratory tract infections: (7)
 - a. The common cold
 - b. Influenza virus infection
 - c. Pneumonia- Bacterial & Viral
2. Central nervous system infections: (8)
 - a. Meningitis / Japanese Encephalitis
 - b. Tetanus
 - c. Polio
 - d. CJD, Kuru

UNIT III **(15 lectures)**

1. Urinary tract infections: Pathogenesis, clinical features, complications, laboratory diagnosis, treatment, prevention. **(4)**
2. Gastrointestinal tract infections: **(6)**
 - a. Diarrheal diseases caused by bacterial or viral infection
 - b. Helicobacter pylori and gastric ulcer disease
 - c. Round worm
 - d. Typhoid
3. Sexually transmitted diseases: **(5)**
 - a. Syphilis
 - b. Human papilloma virus infection
 - c. Human immunodeficiency virus

UNIT IV **(15 lectures)**

1. Vector borne infections: **(6)**
 - a. Malaria
 - b. Dengue
 - c. Filariasis
2. Multi system zoonosis: **(4)**
 - a. Anthrax
 - b. Plague
3. Infections of skin and soft tissue: **(3)**
 - a. Fungal infections of skin- Dermatophytosis / Candidiasis
 - b. Bacterial infections of the skin
 - c. Viral infections eg herpes simplex, chicken pox
4. Obstetric and perinatal infections **(2)**
 - a. Congenital infections – Rubella virus

References:

1. Ewald PW (1994) "Evolution of Infectious Disease" *Oxford University Press*.
2. Scheld WM, Armstrong D and Hughes JM (1998) "Emerging Infections 1" *ASM Press*.
3. Scheld WM, Craig WA and Hughes JM (1998) "Emerging Infections 2" *ASM Press*.
4. Horsburgh, CR Jr and Nelson AM (1997) "Pathology of Emerging Infections" *ASM Press*.
5. Morse SS (1993) "Emerging Viruses" *Oxford University Press*.
6. Hantavirus Herper DR and Meyer AS (1999) "Of Mice, Men, and Microbes" *Academic Press*.
7. Klenk HD (1999) "Marburg and Ebola Viruses. Current Topics in Microbiology and Immunology" *Springer*.
8. Schlesinger RW (1977) "Dengue Viruses" *Springer*.
9. Tortora, Funk and Case (1998) "Microbiology: An Introduction" *Benjamin/Cummings Publishing Company*.
10. Godkar, Praful B (1998) "Textbook of Medical Laboratory Technology Reprint" *Bhalani Publishing House*.
11. Goldsby, Richard, S. Kindt, Thomas J., Osborne, Barbara A(2000) "Immunology" *W.H. Freeman and Company*.
12. Greenwood, David, Slack, Richard C.B., Peutherer, John F (1992) "Medical Microbiology: A Guide to Microbial Infections, Pathogenesis, Immunity, Laboratory Diagnosis and Control" *English Language Book Society*.
13. Isenberg, Henry D (1998) "Essential Procedures for Clinical Microbiology" *ASM Press*.
14. Janeway, Charles A., Jr. Travers, Paul (1994) "Immunobiology: The Immune System in Health and Disease" *Blackwell Scientific Publications, Oxford*.
15. Jawetz, Melnick, Adelberg, Edward (1998) "Medical Microbiology" *Prentice Hall International Inc*.
16. Kuby and Janice (1991) "Immunology" *W.H. Freeman and Company*.
17. Mackie T J., McCartney, J.E. (1989) "Practical Medical Microbiology" *Churchill Livingstone*.
18. Koneman, Elrner W. Allen, Stephen D., Janda, William M. Schreckenberge, Paul C (1997) "Color Atlas and Textbook of Diagnostic Microbiology" *Lippincott-Raven Publishers*.
19. Mukherjee, Kanai L. (1988) "Medical Laboratory Technology" *Tata MacGraw Hill Publishing Co. Ltd*.

Practicals Semester 8: SLSC08PR

Medical Microbiology and Immunology

1. GLP, media preparation, sterilization protocols, culturing methods (aerobic and anaerobic)
2. Preservation of micro-organisms: subculturing, glycerol stocks and lyophilization
3. Antibiotic sensitivity test -
 - a. Minimum inhibitory concentration & minimum lethal concentration of an antibiotic (agar dilution/ broth dilution/ E-MIC strip agar diffusion)
4. Isolation of antibiotic resistant mutants from soil/ sewage/UV exposure
5. Medical Microbiology
 - a. Pure culture Study of Microorganisms on selective media
 - b. Study of Biochemicals for identification of microorganisms: Oxidase, Catalase, Nitrate Reduction, IMViC, TSI, Urease, Sugar Fermentation, Lysine Decarboxylase, Phenylalanine deaminase, Coagulase, Haemolysin
 - c. Identification of microorganism based on cultural characteristics on selective media and biochemical characteristics.
 - d. AST
6. Agglutination Reactions:
 - a. Study of Blood groups: Forward and reverse typing
 - b. Isohemagglutinin titre in blood
 - c. Quantitative Widal Test
7. Precipitation Reaction:
 - a. Single (Radial) immunodiffusion
 - b. Double immunodiffusion (Ouchterlony)
8. Separation of Mononuclear cells (lymphocytes) using a gradient and the determination of viable count of the same.
9. Purification of IgG from serum.
10. Innate Immunity: Testing the effects of saliva, tears, lysozyme on Staphylococcus, Streptococcus.
11. Bioassay (microbiological assay) for determination of antibiotics and or vitamin(Vit B12)
12. Use of MS Excel and SPSS for Plotting Graphs and to solve problems

Template of Theory Question paper

Courses: SLSC0801, 802, 803 & 804

CIA I – 20 marks, 45 mins.

Objectives/Short questions

CIA II – 20 marks, 45 mins.

Test (45 mins) / Survey/ Assignment/ Presentation/ Poster/ Essay/ Review

End Semester exam – 60 marks, 2 hours

Choice is internal- within a unit and could be between 50% to 100%

M.Sc. Life Science

Course: SLSC08PR

CIA & End Semester Practical Exam

Total marks: 200

CIA

80 marks

ESE

120 marks

-

For CIA: (20 marks journal + 60 marks experiments/viva etc)

Department of Life Science and Biochemistry

M.Sc. I Life Science Exam Grid Semester 8					
Course	Exam	Knowledge and Information	Understanding	Application and Analysis	Total
0801	CIA	10	6	4	20
	CIA	10	6	4	20
	End semester	30	20	10	60
Course	Exam	Knowledge and Information	Understanding	Application and Analysis	Total
0802	CIA	10	5	5	20
	CIA	10	5	5	20
	End semester	30	20	10	60
Course	Exam	Knowledge and Information	Understanding	Application and Analysis	Total
0803	CIA	10	5	5	20
	CIA	10	5	5	20
	End semester	30	20	10	60
Course	Exam	Knowledge and Information	Understanding	Application and Analysis	Total
0804	CIA	7	7	6	20
	CIA	7	7	6	20
	End semester	20	20	20	60