

Generic Elective : Landmark Discoveries in Science

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Landmark Discoveries in Science	04	03	0	01	Class XII pass	NIL

LEARNING OBJECTIVES:

The objective of the course is to ensure students appreciate the convenience and comfort that they have is all because of discoveries and inventions of the past. Meticulous execution of historical experiments in very little resources would also motivate them towards doing valuable research with enormous facilities that they have. The historical accounts of science provide grounds for interpretation and may be useful in arousing appreciation of science. The course would provide: Detailed analysis of classically designed and executed experiments in Life Sciences over the years. It will provide a foundation of biology by uncovering various players in the machinery of biological processes. It will also be helpful in technical, scientific analysis with historical background for a robust understanding of various discoveries. Critical analysis of the history of biology would surely help students comprehend futuristic scientific discoveries.

COURSE OUTCOMES

- Students will be able to learn how was light manipulated during the past to peer into previously invisible world—those too small or too far away to be seen by the naked eye.
- Students will learn about experiments that had fundamental contribution to our present understanding of key molecular elements of life. They will understand how to examine microbial cells and colonies, using various techniques to manipulate color, size, and contrast in ways that helped Scientists to identify species and diagnose disease.
- Studying this unit, students would come to know that there were three group of Naturalists working simultaneously to find answers to inheritance, evolution and basic composition of life.

Students will be divulged with hereditary aspects of life. They will get familiar with genes and their roles in living organisms.

- Having understood the relationship of genes and inheritance, students would find interesting to learn the mystical molecule that make up these genes. Sequential study of these experiments would step by step unravel the mystery of genetic material.
- Students at this point of course would be curious to know the structure of molecule that forms the genetic material. They would learn how the information present on DNA manifests itself as specific characteristic features and help in diversity among organisms.
- Students will be explained how the in depth knowledge about DNA became the most important tool for *in vitro* research, modification and applications thereof.
- Students will be briefed about some landmark discoveries which helped the field of medicine to grow tremendously and played a significant role in improving the overall health of the human population.
- Students can be given small projects to write discoveries done in conventional way.
- They will be required to provide a descriptive view of the topics assigned to them. Students should highlight the research topic with reference to current understanding.

COURSE CONTENT:

Unit I: View of the invisible Biology	04 Hours
Rudimentary microscopes to magnify objects; Use of eye glasses as simplest microscopes - Flea or fly glasses; Observing nature in the new world under lens; Book of Optics; Scientific use of Microscopes; Importance of Malphigi microscope that used field lens; Compound Microscope; Robert Hooke’s observations in Micrographia; Foldscope by Manu Prakash	
Unit-II: Origin of Life – A question	03 Hours
Spontaneous generation versus biogenesis; Problem of spores; Microbiology and Medicine - Germ theory of Disease; Recognition of agents of infection – Koch’s Postulates.	
Unit-III: Understanding Biology by observations	04 Hours

<p>A) Study of evolution of life: Darwins Theory (B) Study of Inheritance of Life: classical era with contributions of Aristotle, Epicurus, and others; Modern genetics: Gregor JohannMendel, his work on pea plants, theory of Mendelian inheritance (C) Study of compositionof Life : Levels of cellular and molecular organization; Cells, tissues and organs in our body; Pioneers of chromosome studies; Discovery of nucleic acids; Nuclein verified as a distinct chemical entity; Early identification of purines and pyrimidines; building blocks of Nucleic acids and proteins; Chemistry of Nucleic acids; Levene’s tetranucleotidehypothesis.</p>	
<p>Unit-IV: DNA as the hereditary material – An experimental view</p>	<p>06 Hours</p>
<p>Transformation: Classic work of Frederick Griffith; DNA as the Pneumococcal Transforming Factor; <i>In vitro</i> Transformation system; Announcement that the transformingPrinciple was DNA; Mirsky’s Criticism; The Avery, MacLeod and McCarty proclamation;Additional experiments that supported DNA as the transforming principle; Hershey and Chase clinched the role of DNA as the Genetic Material</p>	
<p>Unit-V: Solving the puzzle of DNA structure</p>	<p>07 Hours</p>
<p>Early studies of diffraction of X Rays by DNA fibers – contributions of Rosalind Franklin; Use of X – rays in medicines and research; Erwin Chargaff’s discovery of base complementarity in DNA; Watson and Crick model of DNA; Contribution of Linus Pauling; DNA is replicated in Semi-conservative Fashion; Deciphering the Genetic Code; One Gene One Enzyme Edict.</p>	
<p>Unit-VI: Technical advancements in biology</p>	<p>07 Hours</p>
<p>Polymerase Chain Reaction – a revolution in modern biology; DNA Manipulations using Restriction enzymes; Discovery of reverse transcriptase leading to development of RT-PCR for RNA amplification; Work of Stanley Cohen and Herbert Boyer; Advent of gene cloning - History and current applications</p>	
<p>Unit-VII: Research as a backbone of modern medicine</p>	<p>07 Hours</p>

(A) Discovery of antimicrobial agents; Contribution of Joseph Lister and later by Alexander Flemming leading to Discovery of Magic bullets; (B) Control of Infectious Diseases – Variolation, mithridatism and vaccination from the view of Edward Jenner; Vaccine production strategies – with examples of BCG and SARS-CoV2 vaccines; Historical timeline of vaccination strategies;(C) Marie Curie – Use of radiation in medicine.	
Unit VIII: Project Work [On any one topic]	07 Hours
Study historical research papers and provide a descriptive view of research that was carried out by Scientists as Minor Project. (A) Ancient system of medicine (B) Contribution of any one Indian Scientists in Biology (C) Contribution of any Physicists or Chemists in Biology (for topics listed above)	

PRACTICAL – 30 Hours

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Comparison of invisible life under the view of microscopes versus foldscope.
2. Cells as a unit of life and observation under the microscopes.
3. How do the cells divide – a view under the microscope: (mount of an onion root tip, onion bud cells or grasshopper testis).
4. Mendel's laws of inheritance – clues from nature.
5. Extraction of genomic DNA
6. Use of electric field to analyse DNA and other biomolecules.
7. Sneak Peek through the discovery of Polymerase chain reaction (PCR): Demonstration of original method and comparison with today's sophistication.
8. To test Flemming's hypothesis that the mold killed the bacteria.
9. Group Discussion on Research Topics assigned to students.

SUGGESTED READINGS:

- Watson, J. D. (2011) *The Double Helix – A personal account of the discovery of the structure of DNA*. Scribner. ISBN 9780743219174.
- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Karp, G. (2013). 7th Edition. *Cell and molecular biology: Concepts and experiments*. New Jersey,USA: Wiley Publishers. ISBN-978-0470483374.
- Cox, M. M. Doudna J. A. and Donnell, M. O. (2012). 1st Edition. *Molecular Biology: Principles and Practice*. London, United Kingdom: W H Freeman & Co Publishers, ISBN-13: 978-0-716- 7998-8.
- Watson, J. D. Baker T. A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2013). 7th Edition. *Molecular Biology of the Gene*. New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

BOOK FOR BASIC CONCEPTUAL READING

- Alberts, B et al. (2014). 6th edition. *Molecular Biology of the Cell*. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Bryson, B. (2003) *A short history of nearly everything*. Transworld Publishers. London W5 5SA. A Random House Group Company. ISBN: 9780552997041.
- Lodish H et al. (2003). 5th Revised edition. *Molecular Cell Biology*. W.H.Freeman& Co Ltd; ISBN-13 : 978-0716743668
- Green, M. R. and Sambrook, J. (2012). 4th Edition. *Molecular Cloning: A Laboratory Manual*, New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13:978-1936113422.
- Kornberg, A. (2005). 2nd Edition. *DNA Replication*. California, United States: University ScienceBooks, ISBN-13: 978-1891389443.

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

GENERIC ELECTIVES : PANDEMIC: CHALLENGES AND PREPAREDNESS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Pandemic: Challenges and Preparedness	4	3	-	1	XII Passed	Basic knowledge of Biology-

Learning Objectives

The Learning Objectives of this course are as follows:

- Current scenario of covid outbreak all over the world made everyone curious about pandemic, its challenges and how to prepare for dealing with it.
- In this context we designed this paper to make students aware about pandemics caused by various pathogens.
- Course describes different pandemic outbreaks and strategies adapted to combat the transmission of pathogen and their neutralization.
- The course also explains the different therapeutic approaches for the elimination and cure of patients suffering from pandemic infections.

Learning outcomes

The Learning Outcomes of this course are as follows:

- This unit helps students to understand the difference between endemic, epidemic and pandemic.
- It makes students familiar with various pandemics that have spread in last century and are caused by different types of pathogens such as virus, bacteria and fungi.
- Students will learn extent of spread of pandemic worldwide, its timeline, death rate and other statistical data.
- This unit will explain about the infectious diseases and process of invasion by microbes.

- It will also helpful to understand preventive measures of infection transmission and about mutant strains which are associated with recurrent outbreaks.
- Students will learn about different treatment strategies for the patients suffering from any infection, along with specific precautions for handling patients with co-morbidities/ elderly persons. The content of this unit will be helpful to explain about plasma therapy and booster doses. Some basic concept of psychological counselling will help to reduce the depression and anxiety faced by individuals during pandemic outbreak.
- This unit describes different methods and equipments used during an out breaks to minimize the contamination and cross transmission of infection and its spread.
- This will help students to learn the usage of PPE kits, mask, sanitization, quarantine and significance of social distancing.
- Current unit, emphasizes about the history of vaccine, process of active and passive immunization, different types of vaccines and their effectiveness to control any pandemic, vaccines developed in India against covid-19.
- Students will learn hands-on training for important techniques used in the detection and diagnosis of various types of pathogens and associated protocols.
- Last unit of the course will focus on awareness and sensitization programs (eg. SOPs), health and hygiene and many issues related to public health. Also possible global approach to strengthening the health infrastructure and disease surveillance shall be elaborated.

SYLLABUS OF BIOMED-GE-04

Unit I: Introduction to Pandemics: (07 Hrs)

General concepts of endemic, epidemic and pandemic; Historical background of pandemics: Rabies, plague, small pox, cholera, Spanish Influenza, AIDS, Avian bird flu, Swine flu, MERS, SARS and covid-19 pandemic. Timeline of Covid- 19. Extent of spread, worldwide statistics and death rate. Statistics of affected nations worldwide and in India; symptoms, extent of spread and containment

Unit II: Infectious Disease: (05 Hrs)

Structure of causative agent, invasion into human body, etiology and strategies currently used to block infection process, common mutant strains responsible further outbreaks of the pandemics

Unit III: Emerging Therapies, Natural Protection and strengthening immune system: (06 Hrs)

Drugs used to cure Avian bird flu, Swine flu and covid-19. First line of treatment at home additional care of person with co-morbidities / elderly person. Convalescent plasma therapy, Placebo effect, alternative therapies and immunity boosters used during pandemic and psychological counseling and countering depression.

Unit IV: Precautions and Prevention: (06 Hrs)

Quarantine protocol at home, for frequent fliers, hospital exposure, and workplace exposure. Precautionary measures such as PPE clothing, gloves, masks, social distancing, frequent washing of hands with soap, use of sanitizers, disinfection strategies.

Unit V: Vaccines: An effective tool for prevention of pandemics: (09 Hrs)

Historical perspective of vaccination, active and passive immunization; Vaccination drive, types of vaccines: Live attenuated vaccines, inactivated vaccines, subunit vaccines, multivalent vaccine, recombinant vector vaccines and DNA vaccines. Types of vaccines developed against Covid-19 worldwide, Their effectiveness and side effects. Vaccines developed in India for adults (Covaxin and Covishield) and vaccines for children. Limitations in effective development of covid-19 vaccine.

Unit VI: Techniques for diagnosis and detection of disease: (06 Hrs)

Antigen-antibody based detection techniques: Lateral flow technique, RAPID and RT-PCR test with complete protocol. Probes for virus detection.

Unit VII: Challenges and Preparedness: (06 Hrs)

Awareness and sensitization programs (SOPs) about general health and hygiene. Funding in research on issues related to public health and protection of environment. Global health approach with multidisciplinary collaborations. Pandemic preparedness and disease surveillance with strong health infrastructure.

Practical component (30 Hrs)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. A case study of any one pandemic of past.
2. A case study of any one emerging pandemic.

3. Detection and diagnosis using antigen and antibody in the sample.
4. Demonstration of the PCR machine
5. Video demonstration of Covid-19 lateral flow technique
6. Demographic analysis of extent of spread both national and international.
7. Project work

Essential readings:

- Park, K. (2021), 26th Edition, *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publisher, ISBN-13 : . 978-9382219163
- Madigan M. T, Bender K.S, Buckley D.H, Sattley W.M, Stahl D.A (2021) 16th edition, Brock Biology of Microorganisms, Pearson Publisher, ISBN-139780135861717.
- Punt, J. Stranford, S. Jones, P. and Owen, J. (2019). 8 th Edition. Kuby Immunology. New York, USA: W.H. Freeman and Company. ISBN- 13: 978-1464189784.
- Willey, J., Sherwood, L., and Woolverton, C.J. (2016). 10th Edition. Prescott's microbiology. New York, USA: McGraw-Hill Education. ISBN-13: 978-1259281594.

Suggestive readings:

- Bonita, Ruth, Beaglehole, Robert, Kjellström, Tord & World Health Organization. (2 (2006nd edition. *Basic Epidemiology*, World Health Organization, ISBN 978 92 4 154707 9.

**GENERIC ELECTIVE UNDERSTANDING THE HUMAN BODY
SYSTEMS**

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
UNDERSTANDING THE HUMAN BODY SYSTEM	4	3	0	1	XII Passed	Basic knowledge of human physiology

Learning objectives

The Learning Objectives of this course are as follows:

- This is an introductory course dealing with the structure and function of the human organism and the issues facing the human in today's world.
- It is intended for students with limited science background. It would make them familiar with basic physiological concepts.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will have an increased understanding and appreciation for the workings of the human body. They will be familiar with the terminology and physiology of the major organ systems
- They will be able to explain the relation between form and function in biology, as expressed in molecular, cellular, and whole-organism physiology.
- Students will be able to recognize the anatomical structures and explain the physiological functions of the body systems.
- Recognize the anatomical structures and explain the physiological functions of the body systems. Develop scientific terminology to describe the parts and processes of the human body.

SYLLABUS OF BIOMED-GE- 06

Unit I: Body organization and integumentary system (05 hrs)

General anatomy of the body, introduction to various kinds of body planes, cavities and their membranes, tissues level of organization and classification (types, origin, function & repair). Structure and functions of human skin. Blood as connective tissue

Unit II: Nervous and Endocrine system (10 hrs)

Organization of the central and peripheral nervous system. Nerve physiology, motor and sensory physiology (special senses). General mechanism of hormone action, structure, function and regulation of the major gland of the body: pituitary, hypothalamus, thyroid, pancreas and adrenals. Basic concepts about hypo and hyper secretion of hormones.

Unit III: Muscular and skeletal system (05 hrs)

Functional anatomy of muscular system, types of muscles, neuromuscular junction structure, property and transmission, general characteristics of muscle contraction using skeletal muscle as example.

Unit IV: Cardiovascular and respiratory system (08 hrs)

Functional anatomy of heart, the cardiac cycle, electrocardiogram. Circulatory system: Blood vessels, hemodynamics and regulatory mechanisms. Lymphatic circulation - hemodynamics and regulation, micro-circulation, functional anatomy of the respiratory system. Mechanisms of pulmonary and alveolar, gaseous exchange, transport of gases, respiratory and nervous control and regulation of respiration.

Unit V: Gastrointestinal system and Renal physiology (11 hrs)

Anatomy and histology of the digestive tract. General principles of gut motility secretion, digestion, absorption and assimilation. Functional anatomy of kidney, histology of nephron and its physiology, process of urine formation. Urinary bladder: structure, micturition and its regulation

Unit VI: Reproductive System (06 hrs)

Structure and function of male and female reproductive organs. Basic concepts of gametogenesis (oogenesis and spermatogenesis), fertilization, implantation, menopause and contraception.

Practical (30 hrs)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated

through any other material or medium including videos/virtual labs etc.)

1. To prepare a blood smear and identify different types of white blood cells.
2. Estimation of hemoglobin (Sahli's method)
3. Physiological data acquisition based experiments (ECG/PFT/EMG).
4. Blood Pressure recordings in humans.
5. To study a simple reflex arc
6. To study the sensation of taste, touch and smell.
7. To study various types of contraceptives (condoms, IUDs, oral and injectable contraceptives)
8. To study different human organs and their sections through permanent histological slides
T.S. of brain, spinal cord, skeletal fibers, cardiac muscles, skeletal muscles, T. S. of thyroid, liver, thymus, spleen, ovary, artery, vein, capillaries, testis, pancreas, esophagus, adrenal, kidney (cortex and medulla), urinary bladder, fallopian tubes, epididymis, lungs, trachea, heart. (minimum 8 slides covering the systems mentioned in theory).

Essential readings:

- Guyton and Hall Textbook of Medical Physiology, 14th edition (2020), J. E. Hall; W B Saunders and Company, ebook ISBN: 978-0-3236-4003-9; Hardcover ISBN: 978-0-3235-9712-8
- Principles of Anatomy and Physiology, 16th edition (2020), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN: 978-1-119-66268-6. (e book), ISBN: 978-1-119-70438-6 (for print book).
- Textbook of Practical Physiology, 9th edition (2019), CL Ghai; Jaypee Publication, ISBN-9789352705320.
- Human Physiology, 16th edition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN10: 1260720462; ISBN13: 978-1-26-072046-4.

Suggestive readings:

- Ganong's Review of Medical physiology, 26th edition (2019), K. E. Barrett, S. M. Barman, S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-26-012240-4 (for ebook) ISBN:978-1-26-012241-1 (for print Book)