Generic Elective - (GE-): 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. I 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**

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.	
Unit-IV: DNA as the hereditary material – An experimental view	**06 Hours**
Transformation: Classic work of Frederick Griffith; DNA as the Pneumococcal Transforming Factor; *In vitro* 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	
Unit-V: Solving the puzzle of DNA structure	**07 Hours**
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.	
Unit-VI: Technical advancements in biology	**07 Hours**
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	
Unit-VII: Research as a backbone of modern medicine	**07 Hours**

(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 carriedout 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.

Note: ***The Generic Electives courses offered in Semester-I are also open for Semester-II***