



**JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095**  
**DEPARTMENT OF GENETICS**  
**B.Sc. V SEMESTER GENETICS PAPER V SYLLABUS (2021 NEP BATCH)**  
**GENE REGULATION AND DNA REPAIR**

<b>COURSE TITLE</b>	<b>GENE REGULATION AND DNA REPAIR</b>
<b>COURSE CODE</b>	<b>21VGT5 (T)</b>
<b>COURSE CREDITS</b>	<b>04</b>
<b>TOTAL CONTACT HOURS</b>	<b>60 Hours</b>
<b>DURATION OF ESE</b>	<b>2 ½ Hours</b>
<b>CONTINUOUS INTERNAL ASSESSMENT (CIA)</b>	<b>40 Marks</b>
<b>END SEMESTER EXAMINATION (ESE)</b>	<b>60 Marks</b>

**COURSE OBJECTIVES:**

1. To understand the regulation of gene expression in Bacteriophages and Prokaryotes.
2. To understand different levels of gene regulation in eukaryotes.
3. To learn the various DNA repair mechanisms used to prevent DNA damage.

**COURSE OUTCOMES:**

At the end of the course the students will

1. Compare the various gene regulation steps carried out in different types of cells.
2. Analyze epigenetic gene regulation mechanism
3. interpret the DNA repair processes occurring in the cells daily.
4. Comprehend various types of DNA repair mechanisms and the associated diseases
5. Apply the obtained knowledge to advance research in gene regulation and repair.

**CO Mapping with Knowledge Levels**

<b>CO No.</b>	<b>Course outcomes statement</b>	<b>Knowledge level</b>
<b>1</b>	Compare the various gene regulation steps carried out indifferent types of cells.	<b>K1, K2, K3, K5. K6</b>
<b>2</b>	Analyze epigenetic gene regulation mechanism	<b>K1, K2, K3, K4, K5</b>
<b>3</b>	Interpret the DNA repair processes occurring in the cellsdaily.	<b>K1, K2, K3, K4, K5,K6</b>
<b>4</b>	Comprehend various types of DNA repair mechanisms andthe associated diseases	<b>K1, K2, K3, K4, K5,K6</b>

5	Apply the obtained knowledge to advance research in generegulation and repair.	K1, K2, K3, K4, K5, K6
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**Knowledge Levels-** K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of Course Outcomes (COs) with Program Outcomes (POs)

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2	✓	✓	✓	✓	✓
PO3		✓	✓		✓
PO4		✓	✓	✓	✓
PO5					
PO6					
PO7	✓	✓	✓	✓	✓
PO8					
PO9		✓	✓	✓	✓
PO10	✓	✓	✓	✓	✓

### Program Objectives aligned with Graduate attributes

PO1- Knowledge, PO2- Scientific thinking, PO3- Entrepreneurial skills  
 PO4- Analytical skills, PO5- Communication skills, PO6- Social commitment  
 PO7- Research and Inquiry, PO8- Conservation of Environment\  
 PO9- Employability, PO10- Academic orientation

### UNIT- 1 Gene regulation in Bacteriophage and Prokaryotes 15 Hrs.

**Regulation of Gene Expression Bacteriophage:** Lytic cascade in Lambda phage, lysogeny through establishment and maintenance of repressor.

Regulation of Gene Expression in *E. coli*: Leader sequence, Attenuator, Promotor, Repressor gene

Operon concept: *lac* operon, *trp* operon and *gal* operon in *E. coli*

Anti-sense RNA technology: feedback inhibition, Ribo switches for control of gene expression.

### UNIT - 2 Gene regulation in Eukaryotes – I 15 Hrs.

Regulation of Gene Expression at transcription level: Role of chromatin and euchromatin conformation in gene expression, Covalent histone modifications, Nucleosome remodeling, gene regulation through DNA methylation and hemi methylation.

**Post-transcriptional gene regulation** - RNA modification, RNAi, siRNA, miRNA, and gene silencing by knockdown

### UNIT - 3 Gene regulation in Eukaryotes – II 15 Hrs.

Post- translational modifications: Co- translational, Protein folding, modifications, packaging and targeting to cytosol and organelles

Feedback inhibition of metabolic pathway Protein degradation (N-end rule and PEST hypothesis) and turnover.

**UNIT - 4 DNA Repair****15 Hrs.**

Excision repair: Base excision repair, Nucleotide excision repair, Transcription-coupled repair, Mismatch repair, Direct demethylation Photoreactivation Daughter strand gap repair. Rewinding and repair of replication fork. Regulation of DNA repair. SOS Regulon.

**References**

1. HUMAN GENETICS, Gangane S.D. (2001), 2nd edition, Churchill Livingstone Pvt Ltd., New Delhi.
2. Principles of genetics, D. Peter Snustad, Michael J. Simmons. — 6th ed, John Wiley & Sons (2011)
3. GENETICS ESSENTIALS - Concepts & Connections, 6th edition, Benjamin A Pierce, W.H. Freeman and Company (2009)
4. Genetics: From Genes to Genomes, by Leland H. Hartwell., et al, McGraw-Hill Education; 5th edition (2014)
5. Gene Regulation: A Eukaryotic Perspective, by Professor David Latchman, Garland Science; 1st edition (2002)
6. DNA Repair and Mutagenesis, Errol C Friedberg et al, ASM Press; 2nd edition (2005)
7. HUMAN CYTOGENETICS, Rooney D.E. (2001), 3rd edition, Oxford University Press, London.
8. GENETICS IN MEDICINE, Thompson M.W. et al 5th edition, W.B. Saunders Company, London.
9. GENETIC BASIS OF COMMON DISEASES, King R.A. et al, Oxford University Press.

**Genetics Practical Paper 5**

<b>COURSE TITLE</b>	<b>GENE REGULATION AND DNA REPAIR</b>
<b>COURSE CODE</b>	<b>21VGT5 (P)</b>
<b>COURSE CREDITS</b>	<b>02</b>
<b>TOTAL CONTACT HOURS</b>	<b>4 Hours/Week</b>
<b>DURATION OF ESE</b>	<b>3 Hours</b>
<b>CONTINUOUS INTERNAL ASSESSMENT (CIA)</b>	<b>25 Marks</b>
<b>END SEMESTER EXAMINATION (ESE)</b>	<b>25 Marks</b>

## **Experiments**

- 1. DNA isolation – Liver- salt method, Cauliflower – SDS method**
- 2. Gene regulation by Lac operon**
- 3. Expression of heat shock protein and induction of puffs in polytene chromosome of Drosophila**
- 4. Study of mutants in Drosophila**
- 5. Lab visit –**
- 6. Gene modification – spotters**

## **References**

- HUMAN GENETICS, Gangane S.D. (2001), 2nd edition, Churchill Livingstone Pvt Ltd., New Delhi.
- Principles of genetics, D. Peter Snustad, Michael J. Simmons. — 6th ed, John Wiley & Sons (2011)
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