# AN OVERVIEW OF HUMAN PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Programme	B.Sc. Zoo	B.Sc. Zoology								
Type of Course	Major	Major								
Semester	I									
Academic Level	100-199									
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours					
	4	3		2	75					
Pre-requisites Course objectives	+2 /VHSC 1. <u>htt</u> 2. <u>htt</u> <u>hur</u> 3. <u>htt</u> <u>phr</u> 4. <u>htt</u> 5. <u>htt</u> <u>bor</u> 6. <u>htt</u> <u>tur</u> The studer	C Biology or the ps://www.course ps://learn.utoron man-physiology ps://www.classc ysiology-45834 ps://www.ivyros ps://www.ivyros ps://www.medic dy#organ-systen ps://www.carter renotes/health_s nt develops under	following online era.org/learn/phy tto.ca/programs entral.com/class ses.com/Revise// calnewstoday.com ns center.org/resour science_students erstanding in the	e courses <u>/siology</u> <u>courses/courses/</u> <u>room/youtube-as</u> <u>AnatomyPhysiologyphiologypti.p</u> <u>rces/pdfs/health/</u> <u>s/physiologypti.p</u> organization and	2159-basic- natomy- ogy/index.php s-in-the- ephti/library/lec df 1 functioning of					
	human phy experimen	ysiological systents related to it.	ems and will be a	ble to perform s	imple					

Course outcomes (CO)

СО	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the structural and functional organization of human body[PSO2]	U	F&C	
CO2	Explain the mechanism of transport and exchange of respiratory gases and its control[PSO2]	U	F&C	
CO3	Identify different components of blood and various blood groups; cardio- vascular problems[PSO1]	R	F	
CO4	Compare the different types of neurons; Explain mechanism of nerve impulse transmission; the ultrastructure of skeletal muscles and biochemical events and energetics involved in muscle contraction, the need of physical exercise in good physical and physiological condition[PSO3]	U	F&C	
CO5	Acquire skill in estimating and enumerating blood parameters; calculating BMI, measuring the respiratory volumes, etc. [PSO4]	Ар	C&P	
CO6	Explain the mechanism of excretion and its hormonal control; enumerate common renal disorders in man.[PSO2]	U	F&C	Create (C)

# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Question paper pattern for external examination: Module 1 : short answer 1 x 3 = 3marks, paragraph 1 x 6 = 6 marks; Module 2 : short answer 3 x 3 = 9 marks, paragraph 2 x 6 = 12 marks, Essay 1 x10 = 10 marks; Module 3 : short answer 3 x 3 = 9marks, paragraph 2 x 6 = 12 marks Essay 1 x10 = 10 marks; Module 4 : short answer 3 x 3 = 9 marks, paragraph 3 x 6 = 18 marks.

#### Module 1: Unit 1: Introduction to human physiology :( 3 hrs)

Branches of human physiology, Components of body system, Human body systems and functions, vital and non vital organs, Levels of physiological regulation: Intracelluar, local and extrinsic regulation. Homeostasis, Anthropometry, BMI and its significance.

#### Module 2: Physiology of Respiration & Circulation (18 hrs)

**Unit 1: Respiration (8 hrs) :** Measures of lung volume : Vital capacity, tidal volume, residual volume etc., Structure, types and functions of hemoglobin, Transport of oxygen and carbon dioxide in blood, factors influencing transport of gases, Oxygen dissociation curves and the factors influencing it; Carbon monoxide poisoning; Nervous and chemical control of respiration, Respiratory problems in new born babies and old age, COVID associated problems, COPD, Problems and adaptations at high altitude.

#### Unit 2: Circulation (10 hrs)

Pace maker and conducting system, Components of blood and their functions; Haemostasis, Biochemical pathway of Blood coagulation: Clotting factors, Disorders of blood clotting, Haemopoiesis; ESR, Haemoglobinopathies, Blood groups: Rh factor, ABO and MN; Blood transfusion and agglutination, Apherisis, ECG, Cardiovascular problems: Hyper and hypotension, Artheriosclerosis, Bradycardia and tachycardia, Myocardial infarction, Angina pectoris, Cardiac arrest.

#### Module 3: Physiology of Excitation (12 hrs)

**Unit 1: Nervous system (5 hrs)**: Structure and types of neurons, Propagation of nerve impulse, myelinated and non-myelinated nerve fibers, Types of synapse and synaptic transmissions; Saltatory conduction, Neurotransmitters, synaptic delay, synaptic fatigue, numbness, tingling, tickling.

**Unit 2: Muscular system (7 hrs) :** Types of muscles; Ultra structure of skeletal muscle; Physiology and biochemistry of muscle contraction:- Sliding filament theory, physiological changes, Muscular relaxation, Energy for muscular contraction, Neuromuscular junction; muscle twitch; summation, tetanus and Rigor mortis. Sports Physiology - Aims and its benifits, Effect of sports on physical health, Benefits of exercise, Physical ergonomics.

#### Module:4 - Physiology of Digestion and Excretion (12 hrs):

A) **Digestion (6 hrs):** Structural organization and functions of gastrointestinal tract and associated glands; Hormonal control of digestion. Nutrition in pregnancy. Nutritional disorders: Cachexia, Bulmia Nervosa, Anorexia nervosa, obesity, flatulence, Peptic ulcer; physiological causes of vomiting and hiccups

B) **Excretion (6 hrs):** Ornithine cycle, Juxta glomerulus apparatus, Urine formation and Counter current mechanism, Hormonal and enzymatic control of urine formation. Role of kidney in osmoregulation, Abnormal constituents of human urine and its significane: Glycosuria, Albuminuria, Heamaturia, Ketonuria, Haemoglobinuria, Uraemia, Pyuria. Dialysis.

# Module 5: PRACTICALS (1 CREDIT, 30 Hrs)

#### MANDATORY EXPERIMENTS

- 1. Determination of ABO Blood group
- 2. Detection of Abnormal constituents of urine (Glucose, Protein, Ketone bodies)
- 3. Determination of Lung volume, tidal volume etc. by using Spirometer
- 4. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum, liver, trachea, lung, kidney, Types of Muscles, (Virtual Model/Slide)

# Of the remaining experiments any 4 can be selected by the Institution from the following list. Two experiments other than the listed should be selected by the Supervising teacher and introduced to the students.

- 5. Estimation of haemoglobin using Sahli's haemoglobinometer
- 6. Preparation of haemin crystals
- 7. Calculation of BMI
- 8. Recording of blood pressure using a sphygmomanometer
- 9. Demonstration of Blood clotting time
- 10. Demonstration enzymatic activity of Amylase, Protease and lipase
- 11. Recording of simple muscle twitch

**Field study**: A) Visit to Anatomy Museum B) Visit to Diagonestic centres, and submission of detailed field study report at the time of semester end practical examination.

#### Virtual Labs (Suggestive sites)

https://www.vlab.co.in

https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com

#### SUGGESTED READINGS

- Hall, J.E (2015): Guyton and Hall Text book of Medical Physiology,13th Edition, ISBN- 10:1455770051, Saunders, 1168 pages
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, Mcgraw Hills
- Chatterjee, C.C (2016): Human Physiology, 11th Edition, ISBN-10 8123928726 Medical Allied Agency.
- Arthur Vander, James Sherman and Dorothy Luciano (1998) Human Physiology: The Mechanisms of Body Function, ISBN-10: 9780070670655, William C. Brown Pub., 818 pages
- Sembulingam, K and Sembulingam, P (2016): Essentials of medical physiology, 7th Edition, ISBN-10: 9789385999116, Jaypee Brothers Medical Publ, 1067p.
- Tortora, G.J. & Grabowski, S. (2006): Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

#### **ONLINE SOURCES**

- 1. <u>https://study.com/learn/anatomy-and-physiology.html</u>
- 2. <u>https://alvernia.libguides.com/oer/anatomy</u>
- 3. <u>https://www.udemy.com/course/human-physiology-notes-powerpoint-slides-practice-exams/</u>
- 4. <u>https://www.physiology.org/career/teaching-learning-resources/student-resources/what-is-physiology?SSO=Y</u>
- 5. <u>https://www.getbodysmart.com/</u>
- 6. <u>https://byjus.com/biology/human-body-anatomy/</u>

#### Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2		3					3						
CO 3	3						3						
CO 4		3					3						
CO 5				4					3				
CO6		3					3						

## FOUNDATIONS OF ENVIRONMENTAL BIOLOGY AND ANIMAL BEHAVIOR

Programme	B.Sc. Zoo	B.Sc. Zoology						
Type of Course	Minor							
Semester	Ι							
Academic Level	100-199							
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours			
	4	3		2	75			
Pre-requisites	+2 /VHS	C Biology or equ	uivalent online c	ourses				
Course objectives	The stude of ecosys biogeoch organisat	ent develops und tems, the concep emical cycle, be ion, etc.	lerstanding in the ot of population, havioural pattern	e organization ar population inter ns of animals, the	nd functioning ractions, eir social			

### **Course outcome**

CO	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the various components of ecosystem along with their interactions and flow of energy in ecosystem and the importance of productivity of ecosystem, food chain and food web, and types of biogeochemical cycles and their importance [PSO2]	U	F&C	
CO2	Identify the terms related to population, biotic community, types of community interactions; the concepts of k and r species and Keystone species, characteristics of habitat and its types, policies and laws for environmental protection [PSO1]	R	F	
CO3	Describe innate behaviour and its components, concept of FAP, learned behaviour and its various types and examples, the concept of animal communication; the types of animal communication, emphasizing the relation between animal communication and social behaviour of animals. [PSO2]	U	F&C	
CO4	Describe sociobiology of different animals, the concept of social organisation in animals, and the concept of proximate factors[PSO2]	U	F&C	
CO5	Acquire skill in estimating ecological parameters like dissolved Oxygen, Carbondioxide, pH etc [PSO4]	Ар	C&P	
CO6	Compare the characteristics of different types of ecosystems, pattern of flow of materials and energy in ecosystem, etc.	U	F&C	
* - Ren	nember (R), Understand (U), Apply (Ap), Analy	vse (An), Evalua	ate (E), Create (	(C)
# - Fac	tual Knowledge(F) Conceptual Knowledge (C	C) Procedural k	Knowledge (P)	Metacognitive

Knowledge (M)

Question paper pattern for external examination: Module 1 : short answer 3 x 3 = 9 marks, paragraph 1x 6 = 6 marks, Essay 1 x10 = 10 marks ; Module 2 : short answer 2 x 3 = 6 marks, paragraph 2x 6 = 12 marks,; Module 3 : short answer 2 x 3 = 6 marks, paragraph 3x 6 = 18 marks; Module 4 : short answer 3 x 3 = 9 marks, paragraph 2 x 6 = 12 marks, Essay 1 x10 = 10 marks

Module 1. Ecosystem (12hrs)

Unit 1: Introduction, Ecosystem & Energetics.(02 hrs) Fundamentals of Environmental Sciences. Scope of Environmental Science. Ecology as an inter-disciplinary science, Sub division of Ecology- Autoecology, Synecology, Scope of Ecology.

**Unit 2: Ecosystem-Concept, Structure and functions:**(**08 hrs**) Structure*s* - Biotic and Abiotic components. Functions - Energy flow in ecosystems & law of thermodynamics, energy flow models , energy transfer & transformations.

Productivity of ecosystem- primary (GPP, NPP, NCP), secondary productivity, standing crop, material removed and production rate. Ecological efficiencies. Trophic structures and ecological pyramids.Trophic levels, food chains and food webs.

**Unit 3: Biogeochemical cycles(02hrs)** -Concept and Basic types. Gaseous cycle -carbon & nitrogen cycles, Sedimentary cycle- phosphorus cycle. Decomposition and transformation.

#### Module 2: Ecosystem classification and Habitat Ecology (11hrs)

Unit 1: Basics of Ecosystem classification(05 hrs): *Types of Ecosystem*: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic.*Biomes:* Concept, classification and distribution. Characteristics of different biomes (mention): Tundra, Taiga, Grassland, Deciduous forest biome, Highland Icy Alpine Biome, Chaparral, Savanna, Tropical Rain forest.

#### Unit 2: Habitat ecology: (06hrs)

Terrestrial ecology -Tropical wet evergreen, tropical dry deciduous forests- its characteristics. Faunal characteristics & adaptations.

Freshwater ecology- Lentic &loitic habitats- its characteristics. Faunal characteristics & adaptations.

Marine ecology- Biotic divisions and its characteristics. Pelagic realm-Plantonic& nektonic adaptations. Benthic realm-littoral & Abyssal adaptations. Adaptations of animals on sandy, muddy & rocky seashore.

#### Module 3: Population, Community and Habitat (10 hrs)

**Unit 1: Population Ecology- (05hrs)** Characteristics of population, - Biotic potential, concept of carrying capacity, population growth (S and J shaped curves) and regulations. Population fluctuations, dispersion and metapopulation. Concept of 'r' and 'k' species. Keystone species.

**Unit 2: Community ecology**: **(03 hrs)**Biotic community: Definition, community concept, types and interaction - predation, herbivory, parasitism and allelopathy.

#### Unit 3 :Overview of Environmental Laws in India(02hrs)

National Water Policy, 2002; National Environmental Policy, 2006; The Plastic Waste Management Rules, 2016; The Solid Waste Management Rules, 2016; The e-waste (Management) Rules 2016.

#### Module 4: Animal Behaviour (12hrs)

Unit 1: Foundations of Ethology(02hrs)-Introduction and historical development of ethology, Key figures in ethological approach, its scope and relation with other branches of biology.

Unit 2: Innate/Stereotyped behaviour (02hrs)- orientation -taxes, kinesis, simple reflexes, instincts, Fixed action patterns (FAPs) and releaser stimuli. Examples of instinctive behaviours in different species.

**Unit 3: Acquired behaviour/Learned behaviour (02hrs**): Habituation, Conditioned reflex, latent learning, Imprinting, Habituation and Trial and error and learning with suitable example.

**Unit 4.: Types of communication (03 hrs)** 1.Visual 2.Auditory3.Tactile 4.Chemical with suitable examples.

Unit 5: Sociobiology (03hrs) Social organization in Animals :Termites and Elephants.

Proximate factors.

#### Module 5: PRACTICALS (1 CREDIT, 30 Hrs)

#### MANDATORY EXPERIMENTS

- 22. Estimation of dissolved oxygen in water sample using winklers method (Pond water, well-water, Tap water). Discuss the ecological significance of dissolved oxygen in water.
- 23. Identify soil micro-organisms in soil samples collected from different localities-by floatation process & Berlese funnel method. Discuss the ecological significance of soil characteristics.
- 24. Demonstration of Phototaxis by earthworm
- 25. Demonstration of alarm pheromones in ants

# Of the remaining experiments any 4 can be selected by the Institution from the following list. Two experiments other than the listed should be selected by the Supervising teacher and introduced to the students.

- 26. Estimation of dissolved CO2 in water sample (Pond water, well-water, Tap water). Discuss the ecological significance of dissolved CO2 in water.
- 27. Estimation of PH of water (Pond water, well-water, Tap water) Discuss the ecological significance of PH characteristics.
- 28. Locomotory behavior of dipteran larvae on different types of substrata
- 29. Determination of salinity of water
- 30. Determination of moisture content in different types of soil (sand, clay, laterite, etc.)

31. Estimation of water holding capacity of different types of soil.(sand, clay, laterite, etc.) **Field study**: A). Conduct a field trip to assess the biodiversity of a chosen ecosystem- by preparation of food chains and food web. Add a note on its significance, B) A visit to natural habitat of wild animals or birds, or zoo, aviary etc, and observation of behaviour patterns of those animals; and submit a detailed field study report at the time of semester end practical examination.

#### **REFERENCES:**

#### ENVIRONMENTAL BIOLOGY

• Odum, E. P. & Barrett. G. W. 2004- Fundamentals of Ecology 5tn Ed. -Brooks/ Cole 624pp

- Goyal, M. K, 2020: .Essential Environment Shri Vinod Pusstak Mandir 351pp
- Miller, G. T. & Spoolman, S.. 2010 Environmental Science 13 Ed. Brooks/ Cole 452pp
- Miller, G. T. Jr 2017 . Living in the Environment Brools/ Cole 832pp
- Molles. M. 2015 Ecology: Concepts and Applications McGraw-Hill Education 592pp
- Townsend, C. R. Begon, M. and Harpe, J. L. 2008 Essentials of Ecology John Willey & Sons 532pp.
- Cunningham, W. P & Cunningham, M. A Principles of Environmental Science McGraw-Hill Education 410pp

#### ANIMAL BEHAVIOUR

- Dugatkin, L. A. 2020 Principles of Animal Behavior 4th Ed. University of Chicago Press 576pp
- Manning, O.2016 Introduction to Animal behaviour South Asia Ed, 6th Ed. Cambridge University Press, India 456pp
- Mathur, R. 2022 Animal Behaviour -Visionias 676pp
- Alcock, J. 2005 Animal Behavior SP Oxford University Press 556pp Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3						
CO 2	3						3						
CO 3		3					3						
CO 4		3					3						
CO 5				3					3				
CO 6		3					3						

# BASICS IN CELLULAR PHYSIOLOGY

Programme	B.Sc. Zoology								
Type of Course	Minor	Minor							
Semester	Ι								
Academic Level	100-199								
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total hours				
	4	3		2	75				
Pre-requisites Course objectives	+2 /VHSC 1. htt 2. htt 4. htt 5. <u>htt</u> tur <u>https://ww</u> <u>45834/60c</u>	2 Biology or the ps://www.course ps://learn.utoron man-physiology ps://www.ivyros ps://www.medic dy#organ-systen ps://www.carter re_notes/health_s w.classcentral.c 282bd43739c e aims to studen	following online era.org/learn/phy to.ca/programs-o ses.com/Revise/A calnewstoday.com science_students om/classroom/ye ts delve into topi	e courses /siology courses/courses/ AnatomyPhysiol m/articles/organs rces/pdfs/health/ s/physiologypti.p outube-anatomy- ics such as cell b	2159-basic- ogy/index.php s-in-the- <u>ephti/library/lec</u> df - <u>physiology-</u> iology,				
course objectives	Mendeliar theoretical careers in	inheritance, ger knowledge and biology-related	netic disorders, a practical skills e fields.	and microscopy, essential for furth	gaining both her studies or				

Course outcome	CO statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain the structure and functions of a cell, plasma membrane and cell organelles, the structure of carbohydrates lipids proteins control	U	F&C	Short answer, paragraph type
	of gene activity and tissues.			
CO2	Illustrate the structure of DNA, DNA replication, Mitosis, Meiosis, Chromosomes, Gene and genetic code, types of chromosomes,	U	F&C	
CO3	Predict possible inheritance patterns, in the real life or imaginary situations	AP	C& M	
CO4	Describe the characteristics of various types of chromosomal anomalies	U	С	
CO5	Aquire skill to handle microscopes and to do biological experiments	Ар	C&P	
CO6	Compare the characteristics of mendelian and Non mendeian inheritance patterns	U	С	
* - Remen	ber (R), Understand (U), Apply (Ap), An	nalyse (An), I	Evaluate (E), C	reate (C)

\* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)
Metacognitive Knowledge (M)

Question paper pattern for external examination: Module 1 : short answer 3 x 3 = 9 marks, paragraph 2 x 6 = 12 marks, Essay1 x10 = 10 marks; Module 2 : short answer3 x 3=9 marks, paragraph 2 x 6 = marks; Module 3 : short answer 2 x 3 = 6 marks, paragraph 2 x 6 = 12marks, Essay 1x10 = 10 marks, paragraph 2 x 6 = 12marks, Essay 1x10 = 10 marks

#### Module 1: CYTOLOGY (15hrs)

**Unit 1: Cellular organization(10 Hrs)** -Cell theory, cell principle; Cell structure, plasma membrane (fluid mosaic model), Structure and function of cell organelles (Mitochondria, ribosome, ER, Golgi bodies, Lysosomes, cytoskeleton and interphase nucleus); Cell inclusions-brief description of the structure of carbohydrates, lipids and proteins; Unicellularity to multicellularity, differentiation. Brief mention of spatial and temporal control of gene activity; Tissues- brief description of major types.

**Unit 2:** . **Cell division (5 Hrs)-** Cell cycle: G1, S, G2 and M phases, Checkpoints Go Phase; Mitosis; Description of all stages and significance; Meiosis. Description of all stages and significance

#### Module 2: Genes and chromosomes (12 hrs)

Unit 1: DNA, the genetic material (5hrs) Structure of DNA, DNA replication-

Semiconservative method, Okazaki fragments, leading strand, Lagging strand, the role of enzymes in DNA replication

**Unit 2:** Concept of a gene(3hrs) – Classical and modern concept, genetic code, introns, exons.

**Unit 3:** Morphology of chromosomes(4Hrs) -size, shape, karyotype, ideogram, kinds of chromosomes; Linkage and crossing over, sex-linked chromosomes .

#### Module 3 : Elements of heredity and variation(12hrs)

**Unit 1: Mendelian principles (5hrs)-** Mendel's work and laws of inheritance (monohybrid cross, dihybrid cross), Brief explanation of terms-alleles, homozygosity, heterozygosity, genotype, phenotype.

Unit 2: Non Mendelian inheritance patterns (7hrs)- Brief description of other patterns of inheritance and genotype expression-incomplete dominance, co-dominance, multiple alleles, epistasis, pleiotropy.

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#### Module :4 Mutations and Genetic disorders (6hrs)

Unit 1: Mutations (3hrs)- Gene Mutation-Kinds of mutation, classification (Somatic, gametic, point, spontaneous, induced, dominant, recessive and silent mutations).Gene mutation disorders - albinism, phenylketonuria, alkaptonuria, galactosemia, brachydactyly. Unt 2: Chromosomal anomalies (3hrs)- Autosomal anomalies - Down's syndrome, Edward's syndrome, Cri du chat syndrome.; Sex chromosomal anomalies - Klinefelter's syndrome and Turner's syndrome.

# Module 5: PRACTICALS (1 CREDIT, 30 Hrs)

# MANDATORY EXPERIMENTS

- 1. 1 Operation and maintenance of Microscopes (Simple and Compound)
- 2. Observation of cell structure using human cheek epithelial cells.
- 3. Study of Mitosis using onion root tip.
- 4. Experiments on monohybrid and dihybrid cross (Mendelian inheritance).

Of the remaining experiments any 4 can be selected by the Institution from the following list. Two experiments other than the listed should be selected by the Supervising teacher and introduced to the students.

#### Virtual Labs (Suggestive sites)

- 5. Study of different types of tissues using permanent slides.
- 6. Determination of human blood group using ABD antisera.
- 7. Demonstration of Meiosis using grass hopper testes.
- 8. Study on models of DNA and RNA structure.
- 9. Study of normal human karyotype (Male & Female)
- 10. Study of autosomal anomalies (Down's, Edward's and Cri du-chat)
- 11. Study of sex chromosomal anomalies (Klienfelter's & Turner's)
- 12. Simple Mendelian traits in humans and its inheritance (Pedegree analysis)

#### References

1. Vijayakumaran Nair & Jayaprakash, Cell Biology, Genetics, Molecular Biology, Academia,

Thiruvananthapuram.

2. Guptha, P.K., Cell and Molecular Biology, Rastogi Publications, Meerat.

3. Dewitt-Saunders, Biology of the cell. B.Sc. Human Physiology syllabus (CCSS)

Complementary

course 5

- 4. Strickberger W.M-Mac Millon, Genetics.
- 5. Gerald Karp, Cell and Molecular Biology: Concept and Experiments.
- 6. Roothwell, Human Genetics, Prentice Hall.
- 7. Lodish; Verk; et.al; Molecular Cell Biology, W.H. Freemann publishers.
- 8. Verma, P. S. and Agarwal, V. K., Cell Biology, Genetics, Molecular Biology, Evolution and

Ecology, S. Chand and Co. New Delhi.

9. De Robertis, E. D. P. and De Robertis, E. M. F., Cell and molecular Biology, 7 thEdn, HolSaunders International Editions

### **Online Sourses:**

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	3	-	-	-	-	3					
CO 2	2	3	-	-	-	-	3					
CO 3	-	2	-	-	3	-	2				3	
CO 4	2	4	-	-	-	-	3					
CO 5	-	-	-	3	-	-	3					
CO 6	_	-	3	-	-	-	3					

#### Mapping of COs with PSOs and POs :

**Correlation Levels:** 

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High