

ST JOSEPH'S UNIVERSITY, BENGALURU - 27



Re-accredited with '**A++**' **GRADE** with **3.79/4 CGPA** by NAAC Recognized by UGC as College of Excellence

BIOLOGY SYLLABUS

FOR UNDERGRADUATE PROGRAMME (AS PER NEP 2021)

Course Outcomes and Course Content

Semester	V
Paper Code	BY5124
Paper Title	Biology paper V
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of credits	03
Total number of teaching hours of practical per semester	45 (39 hours of teaching + 6 hours of self-study)
Number of practical credits	02

OBJECTIVES OF THE PAPER:

- To understand the basic functions and intermediary metabolism in plants.
- To gain awareness on the interdisciplinary nature of Botany and Chemistry by studying the principles of plant life, growth and reproduction.
- To recognize the interrelationship that exists between metabolic pathways, thereby gaining an understanding about the importance of plants.
- To understand various physiological processes and therefore possess the ability to understand the important life processes as well as manipulate these processes if needed.

I	TRANSPORT IN PLANTS	7 Hrs
1.1	Transpiration in plants – Introduction, Mechanism of opening and closing of stomata – K ⁺ ion pump theory.	2 hrs
1.2	Ascent of sap – Transpiration pull theory.	1 hr
1.3	Source and sink concept, vein loading and unloading; transport mechanism (protoplasmic streaming hypothesis, Mass flow hypothesis).	3 hrs
1.4	Factors affecting phloem transport (Self study).	1 hr
II	PHOTOSYNTHESIS	9 Hrs
2.1	Structure of chloroplast and ultrastructure of thylakoid membrane, photosystems I and II	2 hs
2.2	Principles of light absorption (Self study)	1 hr

2.3	Photosynthetic electron transfer and photophosphorylation, mechanism of ATP synthesis (Chemiosmotic hypothesis)	2 hrs
2.4	Mechanisms of carbon fixation and carbohydrate synthesis - C3 cycle, C4 pathway, CAM pathway and significance.	3 hrs
2.5	Photorespiration: Mechanism, organelles involved and significance	1 hr
III	RESPIRATION	6 Hrs
3.1	Glycolysis, TCA cycle	3 hs
3.2	ETS and Oxidative phosphorylation	2 hrs
3.3	Brief account of anaerobic respiration (Alcoholic fermentation), Respiratory quotient (Self-study)	1 hr
IV	FLOWERING IN PLANTS	6 Hrs
4.1	Photoperiodism: Types of plants based on photoperiod – Long day plants, short day plants, day neutral plants	2 hrs
4.2	Role of phytochromes in flowering, Vernalization (Self-study)	2 hrs
4.3	ABCDE Model of development of flower	2 hrs
V	SEED PHYSIOLOGY	3 Hrs
5.1	Seed physiology Introduction, seed dormancy and methods of breaking it	1 hr
5.2	Seed viability, seed pre-treatments, mechanism of seed germination	2 hrs
VI	PLANT GROWTH AND PLANT MOVEMENTS	7 Hrs
6.1	Physiological roles and horticultural applications of Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene (Any two hormones self-study)	5 hrs
6.2	Plant movements	2 hrs
VII	PLANT IMMUNITY	5 Hrs
7.1	Introduction - Innate and induced defense	1 hr
7.2	A brief outline on the secondary metabolites – terpenes, phenolics, alkaloids in plants, their types and role in plant immunity.	4 hrs
VIII	PLANT MICROBE INTERACTION	3 Hrs
8.1	Introduction (roles of microbes in plants) Symbiotic nitrogen fixation in legumes by <i>Rhizobium</i> .	2 hrs
8.2	A brief introduction to endophytes (fungal and bacterial).	1 hr

	Role of endophytes in enhancing plant productivity and defense responses	
--	--	--

BO5P1

--Total: 44 Hours
(11 Sessions 4hrs/Week)

1. Observation of plasmolysis and determination of osmotic potential by plasmolytic method.
2. Study of stomatal types and determination of Stomatal Index in monocot and dicot leaves.
3. Qualitative estimation of secondary metabolites.
4. Study of the effect of temperature on membrane permeability using conductivity meter.
5. Separation of photosynthetic pigments by paper chromatography and finding their R_f values.
6. Estimation of total chlorophyll by spectrophotometer method.
7. Estimation of fructose in different fruits by resorcinol method.
8. Instruments as spotters (Clinostat, Phototropic chamber, Set-up for hydrotropism, Arc auxanometer)
9. Seed viability test (TTC method) and Instruments as spotters (Ganong's potometer, Ganong's respirometer).
10. Effect of auxins on adventitious root formation in hypocotyl explants.
11. Revision

REFERENCES:

- Srivastava, H. N, (2007). Plant Physiology, Rastogi Publications
- Mukherji, S. and Gupta A. K. (2005). Plant physiology. New Central Book Agency, New Delhi.
- Salisbury F.B. and Ross C.W. 1986. Plant Physiology. CBS Pub. New Delhi.
- Dey, P.M., and Horborne, J.N., 1977. Plant Biochemistry, Academic Press, New York
- Goodwin & Mercep., 1993. Introduction to plant biochemistry, Pergamon Press, New York
- Hall, D.O., & Rao, K.K., 1999. Photosynthesis 6th ed., Published in association with the Institute of Biology, Cambridge University Press. Moore, T.C., 1989. Biochemistry and Physiology of Plant hormones, Narosa Pub. House, New Delhi.
- Singh, B.N., & Mengel, K., 1995. Plant physiology and biochemistry, Panima Pub. Corporation, New Delhi.
- Singal, G.S., Genger, G.C., Sopory, S.K., Irrgang, K.D., & Govindjee, 1999. Concepts in photobiology, photosynthesis and photomorphogenesis, Narosa Pub. House, New Delhi.

Semester	V
Paper Code	BY5224
Paper Title	Biology Paper VI
Number of teaching hours per week	03
Total number of teaching hours of theory per semester	45
Number of theory credits	03
Total number of teaching hours of practical per semester	45 (39 hours of teaching + 6 hours of self-study)
Number of practical credits	02

LEARNING OUTCOMES:

At the end of the course, the student should be able to:

1. Define, examine, and explain types of animal behavior and how it is studied.
2. Define and describe senses and sensory systems of animals, parts of the brain, their functions, and the interconnection between brain function, senses, behavior and physiology of animals.
3. Define, examine, and describe principles, laws, and methods of wildlife conservation.
4. Define and describe the types and kinds of eggs in organisms and how it influences the patterns of development.
5. Define and explain early developmental processes in model organisms.
6. Define, differentiate, and describe the different types of placentas in vertebrates.

I	NEUROBIOLOGY	12 hrs
1.1	Organization of the vertebrate Nervous system – CNS, PNS & ANS.	1 hr
1.2	Types of neuron: Unipolar, Bipolar & Multipolar - Structure and Function (self-study)	1 hr

1.3	Anatomy of Human Brain – meninges, ventricles of the brain, Cerebrospinal fluid and its function, anatomy of the human brain & its lobes and function (Self-study).	3 hrs
1.4	Nerve impulse, properties, Origin and conduction along the axon.	3 hrs
1.5	Synapse- Definition, Chemical and Electrical, Synaptic transmission, Neurotransmitters.	2 hrs
1.6	Spinal cord – Anatomy and reflex action.	1 hr
1.7	Neurological Disorders – Headaches, Seizures & Epilepsy, Parkinson's disease. Alzheimer's disease and dementia	1 hr
II	SENSORY BIOLOGY	5 hrs
2.1	ANATOMY OF THE HUMAN EYE – structures, physiology of vision. Visual abnormalities examples. (self-study)	3 hrs
2.2	ANATOMY OF THE EAR: Structure – external, middle and internal. Auditory abnormalities examples.	2 hrs
III	BEHAVIOURAL BIOLOGY	10 hrs
3.1	Introduction: Aims and objectives, contributions of Konrad Lorenz, Karl Von Frisch and Niko Tinbergen	1 hr
3.2	Stereotyped Behaviour: Characteristics, taxis, kinesis, reflexes & instincts with suitable examples	1hr
3.3	Learning Behaviour: Approaches (Mechanistic, vitalistic, and ethological). Imprinting, habituation, associative learning (Classical and instrumental conditioning) and insight learning	2 hrs
3.4	Animal Communication: Chemical, auditory, visual, tactile (Features with examples)	2 hrs
3.5	Sociobiology: Hamilton's rule and Altruism; advantages and disadvantages of social grouping. Bird Sociobiology: Cooperative breeding in birds and Brood Parasitism Primate Sociality: Social systems in primates with examples	2 hrs
3.6	Field ethology: Techniques involved in study of Animal Behaviour (Self-Study)	1 hr
IV	DEVELOPMENTAL BIOLOGY	11 hrs
4.1	Types of eggs-based on distribution and quantity of yolk with suitable examples.	2 hrs
4.2	Cleavage–Types of cleavage planes, patterns of cleavage, types	3 hrs

	of cleavages, influence of yolk on the process of cleavage (Self-study), types based on the amount of yolk with examples.	
4.3	Blastula and Gastrula in Chick	3 hrs
4.4	Structure and evolutionary significance of a Cleidoic egg with chick's egg as an example	1 hr
4.5	Placenta: Types based on foetal membranes involved (allantoic and chorionic placenta). Morphological (deciduous and non-deciduous) and Histological classification with examples.	2 hrs
V	WILDLIFE AND CONSERVATION BIOLOGY	7 hrs
5.1	Basic concepts: Mega-diverse nations, Biodiversity Hotspots in India. Endemic species in India. Keystone, Umbrella and Flagship species.	2 hrs
5.2	Wildlife protection: <ul style="list-style-type: none"> Protected areas in India, IUCN categories and criteria with Indian examples. Red and Green data book. Threats and measures to preserve Biodiversity. Conflict and mitigation, captive breeding programs, population reintroductions and translocations, wildlife Protection Act(1972), CITES	4 hrs
5.3	Environmental movements: Chipko and Appiko movements, Citizen science (Self-Study)	1hr

BIOLOGY PRACTICAL VI BY5P2

Total number of Practical classes

10 units

Life-cycle and culture of drosophila	1 unit
Observation of courtship behavior in Drosophila and Geotaxis in Drosophila.	2 units
Dissection and observation of drosophila brain.	1 unit
Camera traps, Binoculars, GPS, sound recorders. Identification of indirect evidences: pugmark (tiger, leopard and wild dog) and excrement (pellet, dung, droppings).	2 units
Field survey of diversity and problems to solve using Simpson's index.	1 unit
Placenta: Morphological types: Cotyledonary type (sheep), Monodiscoidal type (human).	
Histological types: Haemochorial (Human)	1 unit
Chick embryology: Study of 18-, 24-, 36- and 48-hours chick embryo.	1 unit
Human embryology: T.S. of fallopian tube and Uterus (Proliferative and Secretory phase).	1 unit

REFERENCES

1. AN INTRODUCTION TO ANIMAL BEHAVIOUR- Manning. 5th ed. Cambridge Press
2. ECOLOGY AND ANIMAL BEHAVIOURAL-.4 - Pandey B. N; Tata McGraw-Hill Education.
3. D. TRIALS OF LIFE: A NATURAL HISTORY OF ANIMAL BEHAVIOUR: Attenborough; Little Brown & Co
4. ANIMAL BEHAVIOUR ECOLOGY AND EVOLUTION; Bernard CJ London Croom Helme 1983
5. ANIMAL BEHAVIOUR - Dustin R Rubenstun and John Alcock. Sinauer associate publishers. 2019
6. A TEXTBOOK OF PHYSIOLOGY by D. Emslie-Smith, Churchill Livingstone publication, 1988.
7. PHYSIOLOGY by Ganong, Appleton and Lange 1989.
8. CELL PHYSIOLOGY by Giese A.C. Saunder's, Toppan and Co. Japan, 1984.
9. ANIMAL PHYSIOLOGY by Schmidt Nielson *et al*, MacGraw Hill Publ. 5th Ed.1991.
10. HUMAN PHYSIOLOGY by Vander
11. PHYSIOLOGY by Ross and Wilson, ELBS and Churchill Livingstone
12. TEXT BOOK OF ANIMAL PHYSIOLOGY by Nagabhushanam *et al.*, Oxford –IBH Publ. 2nd ed.
13. HUMAN PHYSIOLOGY FROM CELL TO SYSTEM by Lauralee Sherwood 7th ed.
14. HUMAN ANATOMY AND PHYSIOLOGY, 6thedn. By Elaine N. Marieb, 1237pages, Benjamin –Cummings publication.
15. PRINCIPLES OF HUMAN PHYSIOLOGY, Germann and Stanfield, 4thedn., 2010, Benjamin –Cummings.
16. HUMAN PHYSIOLOGY: VOLUME I &II, C.C. Chaterjee, CBS Publishers and distributors.
17. ANATOMY AND FUNCTIONAL PHYSIOLOGY by Tortora & Derrickson.
18. TEXTBOOK OF ANATOMY AND PHYSIOLOGY FOR NURSES AND ALLIED HEALTH SCIENCES by Indu Khurana &Arushi, CBS publishers and distributors, 2010.
19. TEXTBOOK OF MEDICAL PHYSIOLOGY by Guyton & Hall, Elsevier

Semester	VI
Paper Code	BY6124
Paper Title	Biology paper VII
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of credits	03
Total number of teaching hours of practical per semester	45 (39 hours of teaching + 6 hours of self-study)
Number of practical credits	02

OBJECTIVES OF THE PAPER:

- To understand the origin, development and basic concepts of Biotechnology.
- To understand the fundamental aspects of plant tissue culture and plant secondary metabolites production using biotechnology and their application.
- To understand molecular biology of plants and production of transgenic plants and their application.
- To understand the concepts of modern technology pertaining to large scale production of plant products.
- To apply the concepts of molecular biology and plant biotechnology to the field of plant sciences.

I	GENETICS	15 hrs
1.1	Gene interactions – intragenic (Incomplete dominance, co-dominance, multiple allelism, lethal genes, pleiotropy)	3 hrs
1.2	Gene interactions – intergenic (supplementary, complementary, dominant epistasis, polymeric gene interaction)	4 hrs
1.3	Linkage and crossing over, Recombination frequency, Gene mapping (two point and three-point test cross). Construction of a genetic map in Maize using three-point test cross.	5 hrs
1.4	Concept of forward and reverse genetics (Self study)	1 hr
1.5	Mutation: Introduction and types, Mutagenesis (to study the	1 hr

	function of a gene) (Self study)	
1.6	Polyploidy in plants and its significance (Self study)	1 hr
II	PLANT BREEDING	8 Hrs
2.1	Hybridization - basics of hybridisation, self and cross pollination	2 hrs
2.2	Back cross and its significance in plant breeding.	1 hr
2.3	Marker Assisted Selection (MAS) in Plant breeding - basics of markers, Types of markers - morphological, biochemical and DNA markers.	4 hrs
2.4	Role of apoximis in plant breeding (Self study)	1 hr
III	PLANT PROPAGATION	7 Hrs
3.1	Propagation by seed, advantages and disadvantages (Self study).	1 hr
3.2	Artificial Propagation techniques - Grafting (Bark grafting, Cleft grafting, Whip grafting, Tongue grafting)	2 hrs
3.3	Budding (T-budding, Chip budding); Cutting (Leaf cutting & Stem cutting)	2 hrs
3.4	Layering - (Mound layering, Air layering, simple layering and compound layering)	2 hrs
IV	PLANT TISSUE CULTURE	7 Hrs
4.1	Basic concepts related to lab organization, culture media, inoculation, incubation and acclimatization.	1 hr
4.2	Applications of Plant Tissue Culture in plant improvement and conservation: Callus, single cell and suspension culture and its significance.	2 hrs
4.3	Organ culture: Anther, Embryo and Meristem culture.	3 hrs
4.4	Artificial seeds (Self study)	1 hr
V	PLANT BIOTECHNOLOGY	8 Hrs
5.1	Molecular tools involved in rDNA technology – restriction enzymes and vectors (plasmid pBR322, cosmid, BAC)	3 hrs
5.2	<i>Agrobacterium</i> mediated genetic transformation in plants.	2 hrs
5.3	Engineering plants for crop improvement - resistance to pest and disease, tolerance abiotic stresses (drought, salinity).	3 hrs

BY6P1:

Total: Hours
(10 Sessions 4hrs/Week)

1. Genetic problems – Gene interactions – part 1
2. Genetic problems – Gene interactions – part 2
3. Genetic problems – Linkage mapping, recombination frequency
4. Emasculation, artificial pollination, bagging, tagging
5. Artificial plant propagation – part 1
6. Artificial plant propagation – part 2
7. Surface sterilization and inoculation of explant in culture media
8. Production of artificial seeds
9. Isolation of plasmid DNA and restriction digestion of plasmid DNA
10. Agarose gel electrophoresis
11. Revision

REFERENCES:

- Gupta, P. K. 1994. Elements of Biotechnology. Rastogi Publications. Meerut.
- Maheshwari, P. and Rangaswamy, N.S. (Eds.) 1963. Plant, Tissue and organ culture.
- Old, R.W., and Primrose, S.B. (5th Ed.) 1994. Principles of gene manipulations Blackwell Science
- Razdan, M.K. 1993. An introduction to plant tissue culture. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Reinert, J.R., and Bajaj, Y.P.S. 1977. Applied and fundamental aspects of plant cell, tissue and organ culture. Springer-Verlag, Berlin
- Sen, S.K. and Giles, K.L. (Ed.) 1983. Plant cell culture in crop improvement. Plenum Press, New York.
- Kalyan Kumar De., 1997. Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.
- Mascarenhas A.F., 1991. Hand book of Plant Tissue Culture. Indian Council of Agricultural Research. New Delhi.
- Bajaj, Y.P.S. (Ed.) Biotechnology in agriculture and forestry. Various volumes published time to time. Springer-Verlag. Berlin
- Bhojwani, S.S. 1990. Plant tissue culture: Applications and limitations. Elsevier Publishers, Amsterdam

Semester	VI
Paper Code	BY6224
Paper Title	Biology Paper VIII
Number of teaching hours per week	03
Total number of teaching hours of theory per semester	45
Number of theory credits	03
Total number of teaching hours of practical per semester	45 (39 hours of teaching + 6 hours of self-study)
Number of practical credits	02

LEARNING OUTCOMES:

At the end of the course, students should be able to:

1. Define, describe, and explain the different organ systems, their components, how they function, and how organ systems are integrated.
2. Define and explain what is cancer, its types, and the organs it affects.
3. Define and describe the components and functions of the male and female reproductive system.

I	CARDIO-VASCULAR & LYMPHATIC BIOLOGY	9 hrs
1.1	Heart – Shape, Location and surrounding organs	1 hr
	External and Internal structure – Double circulation	2 hrs
1.2	Origin and conduction of heartbeat - Pacemaker natural (SAN) and artificial	1 hr
1.3	Cardio vascular adaptation of Hemoglobin	1 hr
1.4	Disorders: Anemia, Hypertension, Leukemia (Self-study).	
1.5	Ischemic heart diseases, Mitral stenosis, Atherosclerosis, Coronary heart disease, Angina pectoris - Angioplasty and Bypass surgery.	1 hr
1.6	Anatomy of Lymphatic System. Gross Structure of Spleen, Thymus and Lymph nodes. Functions of lymphatic system – Immune response -	3 hrs

	Phagocytosis.	
II	MUSCLE BIOLOGY	4 hrs
2.1	Muscle - types and characteristics. Composition and ultra structure of the muscle including bandings- sarcomere. Filaments of a muscle fibre and muscular proteins - actin and myosin.	2 hrs
2.2	Muscle contraction: Physico-chemical changes during muscle contraction, electrical activity and Excitation - contraction theory.	2 hrs
III	RESPIRATORY BIOLOGY	6 hrs
3.1	Definition - external and internal respiration. Anatomy of respiratory system. <i>Branches of the respiratory tree</i> – Bronchi, bronchioles – [Primary, secondary, tertiary (respiratory / alveolar bronchioles)], layers of tissue covering the branches of the respiratory tree.	3 hrs
3.2	Brief view on Transportation of Respiratory gases – O ₂ & CO ₂	2 hrs
3.3	Respiratory disorders - A brief account of Asthma and Pneumonia – anatomical changes, Etiology and treatment. (Self-study).	1 hr
IV	GASTROINTESTINAL BIOLOGY	11 hrs
4.1	A detailed account of the human digestive system. Gross structure of the tongue. Structure of tooth and dentition. (Self-study). Alimentary canal: gross structure and outlines of histology with reference to its function. Digestive secretions and their control.	5 hrs
4.2	Associated glands: Liver and Pancreas – shape, gross structure, location and outlines of its internal structure.	2hrs
4.3	Role of microorganisms in digestion in ruminants and termites.	2 hrs
4.4	Gastrointestinal disorders- Hyperacidity, ulcers, cirrhosis of liver, Jaundice, gall stones and appendicitis.	2 hrs
V	EXCRETORY BIOLOGY	4 hrs
5.1	The Kidneys: Renal anatomy, Structure of the nephron and functions. Physiology of urine formation, Urine- composition and factors affecting the composition (Self-study).	2 hrs
5.2	Types and formation of nitrogenous wastes: Ammonia –deamination, Uric acid and Urea.	1 hr
5.3	Renal failure- Dialysis and brief account of ketosis.	1 hr

VI	REPRODUCTIVE BIOLOGY	8 hrs
6. 1	Reproductive patterns: Parthenogenesis (haploid, diploid and artificial).	1 hr
6.2	Asexual (Budding, fission, regeneration), Sexual (conjugation, oviparity, viviparity and ovoviviparity) (Self-study).	1 hr
6.3	Gametogenesis – Spermatogenesis & Oogenesis, Fertilization. Histology of testis and ovary.	3 hrs
6.4	Gonadotropin hormones involved in regulating testicular and ovarian function	3 hrs
VI	CANCER BIOLOGY	3 hrs
6.1	Cancer biology-Definition, metastasis, types of cancer, General properties of cancer cells and carcinogens. Treatment of cancer (Self-study).	

BIOLOGY PRACTICAL VIII BO6P2

Total number of Practical classes

10 units

- Qualitative analysis of carbohydrates and proteins 2 units
- Tests for ammonia, Urea and Uric acid. 1 unit
- Qualitative analysis of urine for the presence of reducing sugars and albumin (protein).
1 unit
- Qualitative analysis of urine for the presence of ketone bodies. 1 unit
- Qualitative analysis of ascorbic acid in various biological samples. 1 unit
- Estimation of creatinine in the urine sample. 1 unit
- Estimating the amount of total glycogen in the muscle by anthrone method. 1 unit
- Effect of temperature on the rate of respiration by opercular movement in an aquarium fish. 1 unit
- Histology: T.S of testis and ovary. 1 unit

REFERENCES

1. A TEXT BOOK OF PHYSIOLOGY by D. Emslie-Smith, *et al.*, ELBS low priced edition 1988.
2. PHYSIOLOGY by Ganong, Appleton and Lange 1989.
3. CELL PHYSIOLOGY by Giese A.C. Saunder's, Toppan and Co. Japan, 1984.

4. ANIMAL PHYSIOLOGY by Schmidt Nielson *et al.*, MacGraw Hill Publ. 5th Ed.1991.
5. HUMAN PHYSIOLOGY by Vander
6. PHYSIOLOGY by Ross and Wilson, ELBS and Churchill Livingstone
7. TEXT BOOK OF ANIMAL PHYSIOLOGY by Nagabhushanam *et al.*,Oxford –IBH Publ. 2nd edition.
8. HUMAN PHYSIOLOGY FROM CELL TO SYSTEM by Lauralee Sherwood 7th ed.
9. HUMAN ANATOMY AND PHYSIOLOGY, 6thedn. By Elaine N. Marieb, Benjamin – Cummings publication.
10. PRINCIPLES OF HUMAN PHYSIOLOGY, Germann and Stanfield, 4thedn.,2010, Benjamin –Cummings.
11. HUMAN PHYSIOLOGY: VOLUME I &II, C.C. Chaterjee, CBS Publishers and distributors.
12. ANATOMY AND FUNCTIONAL PHYSIOLOGY by Tortora & Derrickson.

BIOLOGY PRACTICAL VIII BY6P2