

CHOICE BASED CREDIT SYSTEM
B.Sc (Hons.) Biotechnology Syllabus,

The University of Burdwan

Course	Title	Credit	Marks
CC-1	Biochemistry and Metabolism (Th) 4 CR	6	75
	Biochemistry and Metabolism (Pr) 2CR		
CC-2	Cell Biology (Th) 4 CR	6	75
	Cell Biology (Pr) 2CR		
CC-3	Mammalian Physiology (Th) 4 CR	6	75
	Mammalian Physiology (Pr) 2CR		
CC-4	Plant Physiology (Th) 4CR	6	75
	Plant Physiology(Pr) 2 CR		
CC-5	Genetics (Th) 4CR	6	75
	Genetics (Pr) 2 CR		
CC-6	General Microbiology (Th) 4 CR	6	75
	General Microbiology (Pr) 2 CR		
CC-7	Chemistry-1 (Th) 4 CR	6	75
	Chemistry-1 (Pr) 2 CR		
CC-8	Molecular Biology (Th) 4 CR	6	75
	Molecular Biology(Pr) 2 CR		
CC-9	Immunology (Th) 4 CR	6	75
	Immunology (Pr) 2 CR		
CC-10	Chemistry-II (Th) 4 CR	6	75
	Chemistry-II (Pr) 2 CR		
CC-11	Bioprocess Technology (Th) 4 CR	6	75
	Bioprocess Technology (Pr) 2 CR		
CC-12	Recombinant Biotechnology (Th) 4 CR	6	75
	Recombinant Biotechnology (Pr) 2 CR		
CC-13	Bio analytical Tools (Th) 4 CR	6	75
	Bio analytical Tools (Pr) 2 CR		
CC-14	Genomics & Proteomics (Th) 4 CR	6	75
	Genomics & Proteomics (Pr) 2 CR		

DISCIPLINE SPECIFIC ELECTIVE (Any Four)

DISCIPLINE SPECIFIC ELECTIVE	Title	Credit	Marks
DSE 1	Animal Biotechnology (Th) 4 CR	6	75
	Animal Biotechnology (Pr) 2 CR		
	OR		
	Plant Biotechnology (Th) 4CR	6	75
	Plant Biotechnology (Pr) 2CR		
DSE 2	Biostatistics (Th) 4 CR	6	75
	Biostatistics (Pr) 2 CR		
	OR		
	Bioinformatics (Th) 4 CR	6	75
	Bioinformatics (Pr) 2 CR		
DSE 3	Medical Microbiology (Th) 4CR	6	75
	Medical Microbiology (Pr) 2 CR		
	OR		
	Environmental Biotechnology (Th) 4CR	6	75
	Environmental Biotechnology (Pr) 2CR		
DSE 4	Intellectual Property Rights (Th) 4 CR	6	75
	Intellectual Property Rights (Pr) 2 CR		
	OR		
	Evolutionary Biology (Th) 4 CR	6	75
	Evolutionary Biology (Pr) 2 CR		

*** Semester V- Any one from DSE 1 & any one from DSE 2**

*** Semester VI- Any one from DSE 3 & any one from DSE 4**

GENERIC ELECTIVE [Only for the students of Biotechnology (Hons.)]

Generic Elective	Title	Credit	Marks
GE 1	Human Welfare (Th) 4 CR	6	75
	Human Welfare (Pr) 2 CR		
	Or	6	75
	Development Biology (Th) 4 CR		
	Development Biology (Pr) 2 CR		
GE 2	Microbial Physiology (Th) 4 CR	6	75
	Microbial Physiology (Pr) 2 CR		
	Or	6	75
	Biophysics & Instrumentation (Th) 4 CR		
	Biophysics & Instrumentation (Pr) 2 CR		
GE 3	Entrepreneurship Development (Th) 4 CR	6	75
	Entrepreneurship Development (Pr) 2 CR		
	Or	6	75
	Bioethics & Biosafety (Th) 4 CR		
	Bioethics & Biosafety (Pr) 2 CR		
GE 4	Human Genetics (Th) 4 CR	6	75
	Human Genetics (Pr) 2 CR		
	Or	6	75
	Immunotechnology (Th) 4 CR		
	Immunotechnology (Pr) 2 CR		

SKILL ENHANCEMENT COURSES (ANY TWO)

Skill Enhancement Courses	Title	Credit	Marks
SEC 1	Molecular Diagnostics (Th)	2	50
	Or		
	Industrial Fermentation (Th)	2	50
SEC 2	Enzymology (Th)	2	50
	Or		
	Basics of Forensic Sciences (Th)	2	50

ABILITY ENHANCEMENT COMPULSORY

AECC	Title	Credit	Marks
AECC 1	ENVS (Th)	4	100
AECC 2	English/MIL Communication (Th)	2	50

* Semester I- AECC 1

* Semester II- AECC-2

CHOICE BASED CREDIT SYSTEM

B.Sc (Hons) Biotechnology

SEMESTER -I

CC1- BIOCHEMISTRY AND METABOLISM (THEORY)

4 CREDITS

1. Carbohydrates: Definition; structure of carbohydrates- monosaccharide, aldohexoses and ketohexoses with examples; Haworth structure, anomeric structures of D-glucose, mutarotation, pyranose and furanose rings. Oligo- and polysaccharides, reducing (maltose) and non-reducing (sucrose), disaccharides; glycoproteins, proteoglycans. **10L**

2. Amino acids: Peptides and proteins; structures and important properties, classification of amino acids, important physical and chemical properties of amino acids (optical isomerism, UV-absorption, ionization, reactions due to amino group and carboxyl group). Primary structure of peptides. Primary, secondary, tertiary and quaternary structures, classification of proteins (based on solubility and composition). C and N terminal amino acid determination. **10L**

3. Lipids: Definition, distinction between fats and oils, structure of lipids (fatty acids, glycerolipids, sphingolipids) **5L**

4. Nucleic acids: Structure of nucleic acids; nucleosides, nucleotides, primary structure, A, B and Z form of DNA; preliminary idea of secondary structures of RNA and DNA; melting point and denaturation of DNA **8L**

5. Enzymes: Definition of enzymes, important terms (enzyme unit, specific activity), classification of enzymes; physico-chemical properties, factors affecting activity; mechanism of enzyme action, coenzymes, cofactors. **8L**

6. Carbohydrates metabolism: Reaction, energetic & regulation. Glycolysis: Fate of pyruvate under aerobic & anaerobic condition. Pentose phosphate pathway & its digestion. Gluconeogenesis, Glycogenolysis & Glycogen synthesis. TCA Cycle, Electron transfer chain, Oxidative phosphorylation, beta oxidation of fatty acids. **9L**

CC1- BIOCHEMISTRY (PRACTICAL)

2 CREDITS

1. Qualitative tests for sugars, amino acids, proteins & lipids; separation of amino acids by PC/TLC methods.
2. Quantitative estimation of sugars (DNS method) and proteins (Folin-Phenol).
3. Isolation and quantification of DNA (diphenylamine method) and RNA (orcinol method) analysis, saponification value of fat.
4. Quantitative assay for protease & catalase from plant source.
5. To study the effect of Ph, Temperature on the activity of salivary amylase

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.
6. Biochemistry Practical- Plummer
7. Biochemistry Practical- Swadashivam Manikap

CC2- CELL BIOLOGY (THEORY)

4 CREDITS

1. Cellular basis of life: Cell doctrine, cells in general, diversity of cell size and shape, cell theory; structure of eukaryotes and prokaryotes cells (including viruses) **6L**
2. Cellular information: The nucleus (ultra-structure), the organization of chromosomes (euchromatin and heterochromatin), nucleosome concept and chromosome packaging. **6L**
3. The cell surface: Plasma membrane, membrane fluidity, movement across plasma membrane, Modification of plasma membrane (Plasmodesmata and desmosome); Plants and bacterial cell walls; an outline of extracellular substances of animal cells. **10L**
4. Endo-membrane system: Endoplasmic reticulum, Mitochondria, Golgi apparatus, Chloroplast, lysosomal system, plant cell vacuoles, microbodies structure and function. **10L**
5. The cytoskeleton: Microtubules, microfilaments and intermediate filaments. **6L**
6. An outline of cell cycle: Mitosis and Meiosis. **4L**
7. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecules basis of cancer. **8L**

CC2- CELL BIOLOGY (PRACTICAL)

2 CREDITS

1. Preparation of Meiotic Chromosome from grasshopper.
2. Preparation of Mitotic Chromosome from onion root tip.
3. Preparation of Meiotic Chromosome from *Rhoeo* discolor.
4. Preparation and study of polytene chromosome from *Drosophila/Chironomous* salivary gland.
5. Study of sex chromatin through preparation of Barr body from buccal epithelium and Drumstick from blood film.
6. Study of chromosomal aberration induced by BHC & pesticide in onion root tips.
7. Artificial induction of polyploidy/aneuploidy in onion root through colchicines exposure.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

AECC-1 ENVS

CHOICE BASED CREDIT SYSTEM

B.Sc (Hons) Biotechnology

SEMESTER II

CC3- MAMMALIAN PHYSIOLOGY (THEORY)

4 CREDITS

Digestion and Respiration

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice

Respiration: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift. **12L**

Circulation

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Cardiac output, cardiac cycle, Origin & conduction of heart beat. **12L**

Muscle physiology and osmoregulation

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation. **10L**

Nervous and endocrine coordination

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters, Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. **16L**

C3- MAMMALIAN PHYSIOLOGY (PRACTICAL)

2 CREDITS

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of salivary amylase
6. Haemoglobin estimation [Sahli's method]

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

CC4- PLANT ANATOMY AND PHYSIOLOGY (THEORY)

4 CREDITS

Anatomy **12L**

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

Plant water relations and micro & macro nutrients **10L**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

Carbon and nitrogen metabolism **14L**

Photosynthesis- Photosynthetic pigments, concept of two photo systems, photophosphorylation, calvin cycle, C4 cycle, CAM plants, SAM, photorespiration, compensation point, Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

Growth and development **14L**

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene), Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodism and vernalization; phytochrome and its role.

CC4- PLANT ANATOMY AND PHYSIOLOGY (PRACTICAL)

2 CREDITS

1. Study of evolution of oxygen during photosynthesis
2. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
3. Demonstration of opening & closing of stomata
4. Preparation of root nodules from a leguminous plant.
5. Seed viability test using TTC.
6. Study of rate of transpiration per unit area of leaf.

SUGGESTED READING

1. Dickinson, W.C. Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, latest edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. Plant Physiology, latest edition, Sinauer Associates Inc .MA, USA

AECC-2 English/ MIL Communication

GENERIC ELECTIVE (SEMESTER I)

GE- 1:

HUMAN WELFARE (THEORY)

4 Credits

Industrial production of Alcohol and antibiotic (Penicilin)

10L

Application of biotechnology in agriculture, N₂ fixation, transfer of pest resistance genes to plants.

8L

Application of biotechnology in environments: e.g. chlorinated and non-chlorinated organic pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

14L

Application of biotechnology in forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

8L

Application of biotechnology in health, Basic concept of therapy.

8L

HUMAN WELFARE (PRACTICAL)

2 Credits

(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. Study of ethanolic fermentation using Baker's yeast
2. Study of a plant part infected with a microbe
3. Isolation and analysis of DNA from minimal available biological samples
4. Preparation of root nodules from a leguminous plant
5. Dissertation based on applications of biotechnology (any one topic from theory syllabus) and viva-voce to be conducted on whole syllabus of the practical paper

**GE-1 OR
DEVELOPMENTAL BIOLOGY (THEORY)**

4 Credits

Gametogenesis and Fertilization

10 L

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization-Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

Early embryonic development

20 L

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

Embryonic Differentiation

20 L

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

Organogenesis

10 L

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

DEVELOPMENTAL BIOLOGY (PRACTICAL)

2 Credits

(Principle & concepts can be demonstrated through videos/virtual labs or other materials)

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles*. [From permanent slides or photomicrographs]
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs..
5. Study of different types of placenta. [Photographs or models]

SUGGESTED READING

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

GENERIC ELECTIVE (SEMESTER II)

GE-2

MICROBIAL PHYSIOLOGY (THEORY)

4 Credits

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron. **12 L**

Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity **13 L**

Effect of the environment on microbial growth: Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogenoxidizing bacteria and methanogens. **12 L**

Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle. **13 L**

MICROBIAL PHYSIOLOGY (PRACTICAL)

2 Credits

1. Laboratory rules & safety for Microbiology. General idea and demonstration of media preparation and sterilization.
2. To study and plot the growth curve of *E. coli* using turbidometric method and to calculate specific growth rate and generation time.
3. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
4. To study the effect of pH on the growth of *E. coli*
5. To study the effect of temperature of *Aspergillus niger* by dry weight method.

SUGGESTED READING

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingraham JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

GE-2 OR

BIOPHYSICS & INSTRUMENTATION (THEORY)

4 Credits

General Biophysical methods – Measurement of pH, Radioactive labeling & counting, autoradiography **5 L**

Separation & Identification of Materials, Concept of Chromatography; Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography; Gel Electrophoresis, Paper Electrophoresis **15 L**

Centrifugation - Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative Analytical), Factor affecting Sedimentation Velocity, Standard Sedimentation Coefficient. **10 L**

Microscopy- Light Microscopy, Bright & Dark Field Microscopy, Phase Contrast Microscope, Fluorescence Microscopy, TEM, SEM. **10 L**

Spectroscopy- UV visible Spectroscopy, Principle, Beer-Lambert Law, Working Principle of Colorimeter, Spectrophotometer, Fluorometer. Application to biomolecules (Protein, DNA, Hb, Chlorophyll) **10 L**

BIOPHYSICS & INSTRUMENTATION (PRACTICAL)

2 Credits

1. Separation techniques- Centrifugation, Chromatography (Paper, TLC, Silica Gel Chromatography), & Electrophoresis
2. General Concept of Colorimeter, Spectrophotometer

SUGGESTED READING

1. Principles and Techniques of Biochemistry and Molecular Biology by K. Wilson and J. Walker
2. Molecular Spectroscopy by Jack D. Gray Beal

