Curriculum Framework

B.Sc. (Biotechnology Vocational)

Department of Biotechnology

Faculty of Science

2023-2024

Outline of Choice Based Credit System

(https://www.ugc.gov.in/pdfnews/8023719_guidelines-for-cbcs.pdf)

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course: Elective** courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

4. Research Component in Under-Graduate Courses

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analysing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

B. Sc BIOTECHNOLOGY (VOCATIONAL)

Programme Outcomes (PO)

On completing B.Sc. (Biotechnology) shall be able to realize the following outcomes:

PO	**Description**
PO1	Understand the basic concepts, fundamental principles, and the scientific theories related to Biotechnology and their relevance in day-to-day life.
PO2	Acquire the skills in planning, performing and handling scientific instruments during laboratory experiments
PO3	Realize how developments in one science subject help in the development of other science subjects and vice-versa.
PO4	Able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems.
PO5	Learn how an interdisciplinary approach helps in providing better solutions and new ideas for sustainable development.
PO6	Develop scientific outlook not only with respect to science subjects but also in all aspects of life.
PO7	Understand the knowledge of subjects in other faculties that can greatly and effectively influence the evolving new scientific theories and inventions.
PO8	Imbibe ethical, moral and social values in personal and social life
PO9	Develop various communication skills which will help in expressing ideas and views clearly and effectively.
PO10	Analyze the given scientific data critically and systematically and the ability to draw the objective conclusions.
PO11	The skills of observations and drawing logical inferences from scientific experiments.

PO 12	Develop an overall personality by making them participate in various social and cultural activities voluntarily.
PO 13	Prepare for higher studies and employment in chosen field

Programme Specific Outcomes (PSO)

On completing B.Sc.(Biotechnology), the students shall be able to realize the following outcomes:

PSO 1	Shall be able to design and execute experiments related to Basic Microbiology, Tissue culture. Molecular Biology, Immunology, Recombinant DNA Technology, Biochemistry, Environment, Agriculture, Medical, Industrial, and Food biotechnology.
PSO 2	Shall practice safe Biotechnology, using appropriate protective, biosafety and emergency procedures. Achieve successful technical and professional career which will turn the student into an effective researcher or as an entrepreneur.
PSO 3	Shall have in-depth theoretical and practical knowledge of huge diversity of organisms, their metabolism & physiology, concepts of molecular genetics and genetic engineering, biosynthetic pathways, enzymology, microbial pathogenicity, role of microbes/ plants/animals in food, agriculture and environment, health and disease.
PSO 4	Shall be able to apply the scientific method and hypothesis testing in the design and execution of experiments including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.
PSO 5	Shall be able to communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations. Have a life-long learning to follow novel developments in the field which will inspire high ethical values and technical standards.
PSO 6	Shall be able to perform minor research projects incorporating techniques of Basic and Advanced Biotechnology. The learners will be equipped to progress to higher studies, research and industrial/ corporate job.

LOI of Discipline-Specific Core Courses (DCC):

PSO	DCC1	DCC2	DCC3								
PSO1	**X**		**X**								
PSO2	**X**	**X**									
PSO3		**X**	**X**								
PSO4	**X**	**X**									
PSO5	**X**	**X**									
PSO6	**X**	**X**	**X**								

Semester I Biotechnology

Total 6 credits; 150 marks

Type of Course	Course Code	Title	Credit	L	P	T	Marks (External + Internal	*****Minimum Passing Marks (%)	Hours in a week
Paper I Core course (DCC) (Theory) [Biotech-T-1]	Biotech -T-1-4.5 DCCT12	Cell biology & genetics	2	2	0	0	50 (40 + 10)	Total 36%. Aggregate Students need to pass separately in External and internal examination	3
Paper II Core course (DCC) (Theory) [Biotech -T-2]	Biotech -T-2-4.5 DCCT12	Biochemistry and metabolism	2	2	0	0	50 (40 + 10)		3
Paper III Core course (DCC) (Lab) [Biotech -L-1]	Biotech-L-1-4.5DCCP13	Laboratory course	2	0	2	0	50 (40 + 10)	36% marks separately in External and Internal examinations	4
	Total	6	6	4	2	0	150 (120 + 30)		10

SEMESTER I

COURSE LEARNING OUTCOMES & CONTENTS OF THE COURSES

Discipline Centric Core(Compulsory)

Paper Code : Biotech-T-1-4.5 DCCT12 **Paper Name- Core Course- I Part- A** **CELL BIOLOGY & GENETICS(2Credits)**		
Course learning outcomes :Students will be able to - 1. acquire knowledge about the discovery, organizational and functional aspects of cell. 2. able to understand about the interactions of the cells with outside environment through exchange of information and transport of molecules. 3. learn about ultrastructure and function of cell organelles. 4. Able to learn aboutstructural organization and function of nucleas and chromosomes. 5. Acquire knowledge about the basic concepts of cell cycle and regulators involved in it and canutilize the concepts of cell signaling and communication.		
Unit–1:	Historical aspects: cell size and shape, cell as basic unit of life, cell theory, Protoplasm theory, Organismal theory.classification of cell types, Prokaryotic and eukaryotic cells. Organization, Ultrastructure of plant, animal and bacterialcell	**05 Lectures**
Unit–2:	Ultra structure and function: cell wall ,plasma membrane – fluid mosaic model, membrane fluidity, Transport across membranes - Symport, antiport, uniport, active and passive transport, Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes. Cytoskeletal structures – microtubules, microfilaments (actin, myosin), and Intermediate filament.	**07 Lectures**
Unit–3:	Ultrastructureand Functions of cell organelles: Endoplasmic Reticulum(rough & smooth ER), golgi apparatus, mitochondria, chloroplast, , lysosomes, vacuoles, microbodies (peroxysomes and glyoxysomes), ribosomes and its types, centrioles, basal bodies.	**06 Lectures**
Unit– 4:	Structure and function: nucleus, nuclear membrane, chromosomes-structural organization of chromatids, centromere, chromatin, telomere, euchromatin and heterochromatin, chromosome banding, specialized structures- polytene and lambrush chromosomes.	**05 Lectures**
Unit– 5:	Cell division: Cell cycle, mitosis and meiosis regulations of cell cycle and check points and proteins involved in cell cycle check points. Basics in cell signaling- signaling molecules and receptors, G protein coupled receptors, Tyrosine kinase receptor.	**07 Lectures**

Paper Code- Biotech -T-2-4.5 DCCT12
Paper Name- Core Course- I Part- B
BIOCHEMISTRY AND METABOLISM (2Credits)

Course learning outcomes: By the end of this course the students are able to –

1. Student are able to make buffers, Classify the carbohydrates based on structure and function
2. Have developed how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the bacterial cells
3. Well conversant about multifarious function of proteins; are able to calculate enzyme activity and other quantitative and qualitative parameters of enzyme kinetics; also knowledge about lipids and nucleic acids.
4. study enzyme kinetics and calculate Vmax, Km, Kcat values.
5. Identify the pathways involved in regulating the metabolism of molecules and have developed a very good understanding of various biomolecules which are required for development and functioning of cell.

Unit–1	Chemical foundations of biology: pH, acids, bases, buffers, Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions	**05 Lectures**
Unit–2	Amino acids & Proteins: Structure, properties & Function of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.	**05 Lectures**
Unit–3	Lipids: Structure and functions–Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Double helical model of DNA structure and forces responsible forstabilizing DNA structure.	**06 Lectures**
Unit–4	Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity and kinetics. enzyme specificity: types & theories, Role of: NAD+ , NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate,lipoic-acid, Biotin vitamin B12, various uses of enzymes (food processing, medicines and diagnosis).	**07 Lectures**
Unit–5	Carbohydrates Metabolism: Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.	**07 Lectures**

Paper Name- Core Course I-PART C
Paper Code- Biotech DCCP12 (2Credits)

1. Microscopic techniques- light microscopy.
2. Observation of permanent slides
3. Study prokaryotic and eukaryotic Cell types- Microbial, animal and plant cells
4. Cell counting using Haemocytometer
5. Study mitosis in onion root tip by using temporary acetocarmine stain.
6. Study meiosis in flower bud.
7. Study cell permeability (crenation and heamolysis) in mammalian RBC.
8. Prepare temporary slides of mitochondria in buccal smears by vital staining.
9. Preparation of standard solution of acids and bases
10. Preparation of buffers.
11. Qualitative tests for Carbohydrates, proteins, aminoacids and lipids.
12. Demonstrate catalase activity.
13. Demonstrate salivary amylase activity.

SCHEME OF PRACTICAL EXAMINATION

Practical Based on Theory Papers.

Time: - 4hrs Maximum Marks : 40 Minimum Marks : 15

Combined Practical	**Marks**
1. Exercise of Cell Biology	
Major	[06]
Minor	[04]
2. Exercise of Biochemistry	
Major	[06]
Minor	[04]
3. Spots (Four)	[08]
4. Viva-voce	[05]
5. Practical Record	[07]

- **Internal evaluation of 30 marks will be based on internal tests, assignment/seminar and application of knowledge and skills.**

Text Books:

- Cell biology, Veer Bala Rastogi, Rastogi Publication
- Concepts of Cell Biology, P.S. Verma and V.K. Agarwal, S.Chand& Company Ltd., New Delhi;
- Essential of Cytology, Powar, C. B., Himalaya Publishing House
- Textbook of Cell Biology, Samantha Granger, Callisto reference
- Fundamentals of Biochemistry, J. L. Jain, Sanjay Jain & Nitin Jain, S. Chand
- Essentials of Biochemistry, U. Satyanarayana & U. Chakrapani, Elsevier

Further Reading:

- D.E Sadava, 1993. Cell Biology - Organelle Structure and Function. Jones and Bartlett Publishers
- Cell and Molecular Biology (Eighth edition). E.D. P. De Robertis and E.M.F. De Robertis, Jr. 2012 B.I. Waverly Pvt.Ltd. New Delhi.
- Essential Cell Biology, Alberts, Bray Johnson Lewis, Raff, Robberts, Walter, Panima

Publications

- Principles of Biochemistry, Lehninger A. L., Nelson D. K. and Cox M. M., CBS Publishers & Distributors, New Delhi.
- Biochemistry (Chemistry of Life), David T. Plummer, Mc Graw Hill Book Company

SCHEME OF EXAMINATION

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks:40 **Min. Marks: 14** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 40

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 0.5 mark, word limit for answer is 50 words)	**05**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 2.5 mark, word limit for answer is 200 words)	**12.5**
Part C (total 5 questions, 1 question from each unit; each question carry 7.5 mark, word limit for answer is 500 words)	**22.5**

Note :-

The marks of the Internal Examination should be given on the basis of two-term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminars, quizzes, artwork, model preparations, student fest, science club activities etc.)

For Term-end practical examination, one external shall be appointed by the University and one examiner shall be internal. Both will conduct the examination.