DELHI PHARMACEUTICAL SCIENCES AND RESEARCH UNIVERSITY

School of Allied Health Sciences and Management

Programme Structure

B.Sc. (Biomedical Sciences)

(2022-23)

Preamble

Any Higher Education Institute has an objective to prepare their students for serving the society at large. The DPSR University envisions all its courses and programs in the best interest of students. Continuous efforts are made to offer a new vision to all its Under-Graduate courses.

The course curriculum of newly proposed course of B.Sc. Biomedical sciences offers a comprehensive skill and knowledge based for the students keeping in view the employability of the students. The syllabus of this proposed course will take the advantage of credit system to progressively make transition from simple to complex concepts relevant to the interdisciplinary nature of undergraduate programs in biomedical sciences. DPSRU is very much hopeful that the course curriculum of this new course of B.Sc. Biomedical sciences will help the students in making informed decisions regarding goals that they wish to pursue in further education and life at large.

Introduction to B.Sc Course in Biomedical sciences

The course will be structured to reinforce the basic exposure that students get in the higher secondary school and to gradually build on this knowledge-base. The course will comprise of core courses in the first two semesters which will provide introduction to courses in organic chemistry relevant to biology, cell biology, human physiology, and bird's eye view on the functioning of organ system and importance of genetic in nature.

In the second year, knowledge base of the students will be further enhanced based on the introductory courses of Semester I and II. Emphasis will be given on basic understanding of bioorganic chemistry and the students will understand about proteins, and understanding of biochemical functioning. At the end of the second year, a student will have basic knowledge of cell biology, genetics, bioorganic chemistry, human physiology, biochemistry, medicinal chemistry, basic molecular and immuno-biology.

Along with this they will have hands-on training in medical lab techniques, epidemiological data analysis, tools used in forensic science and modern biology under the Skill enhancement courses (SEC). The concepts in pharmacology, medicinal chemistry, toxicology, pathology and biophysics are vital to Bio medical sciences and these are introduced in the final year of the course. In the third year, the courses include more complex concepts of mechanisms of achieving regulated functioning of the biological systems, biophysical principles of biological systems, human genetics, genome organization, medical biotechnology and biochemistry and some of the recent excitement in biology and the application of bioinformatics in Biomedical sciences as part of Discipline specific elective (DSE) courses along with project work. One or two papers in the final year therefore will have a longer list of learning material to be drawn from different sources; however, the actual length of the material for reading/teaching will be maintained optimal. This will also introduce the students to resources for self-study.

The Generic Elective (GE) courses will be designed to give the essential exposure to theinter disciplinary nature of Biomedical sciences. For example, biological chemistry, bioethics and bio safety, biostatistics, immunology, biotechnology, pharmacology and toxicology are combined into one paper, bioinformatics, IPR, pathophysiology combining human physiology in the context of diseases, tools and model organism in biomedical research are part of GE courses.

Aims of the B.Sc. Biomedical sciences Programme

The overall aim(s) of the Bachelor's degree in Biomedical sciences are:
To help develop an inherent interest in the field of Biomedical sciences. The course aims to enhance understanding of key concepts, theories and principles that will help them to find answers to challenges being faced today in Biomedical sciences. The course will help the students develop a broad base understanding of various fields that the bachelor's degree opens up for them, so that they can take up their field of specialization in higher studies.
To help students to develop thinking and application skills to apply the knowledge thus gained in finding practical solutions to present day challenges.
To inculcate true scientific temperament in students, such that they apply their knowledge in interdisciplinary fields like Bioinformatics, Biophysics, and Data Science.

Structure of B.Sc. Biomedical sciences

1.1 Semester-wise Distribution of Courses

SEMESTERI		**SEMESTERII**	
C1	BioorganicChemistry	**C3**	PrinciplesofGenetics
C2	CellandRadiationBiology	**C4**	HumanPhysiologyand AnatomyI
AECC1	English/MILCommunicationorEVS	**AECC2**	EVSorEnglish/MILCommunication
GE1	GenericElective	**GE2**	GenericElective

SEMESTERIII		**SEMESTERIV**	
C5	Biochemistry	**C8**	Immunobiology
C6	HumanPhysiologyandAnatomyII	**C9**	MolecularBiology
C7	MedicalMicrobiology	**C10**	MedicinalChemistry
SEC1	Skill-EnhancementElectiveCourse	**SEC2**	Skill-EnhancementElectiveCourse
GE3	GenericElective	**GE4**	GenericElective

SEMESTERV		**SEMESTERVI**	
C11	Biophysics	**C13**	HumanPathology
C12	Pharmacology	**C14**	Toxicology
DSE1	DisciplineSpecificElective	**DSE3**	DisciplineSpecificElective
DSE2	DisciplineSpecificElective	**DSE4**	DisciplineSpecificElective

C:CoreCourses;**AECC:**AbilityEnhancementCompulsoryCourse;**SEC:**Skill-EnhancementElectiveCourses;**DSE:**DisciplineSpecificElective;**GE:**GenericElective

SEC1-2: Skill-EnhancementElective Courses(anyonepersemesterinsemesters3-4)

1. Method sin Epidemiological Data Analysis(EDA)
2. Medical Laboratory Diagnostics(MLD)
3. Techniques for Forensic Science
4. Tools in Modern Biology

DSE1-4: Discipline Specific Elective (any two per semester in semesters5-6)

1. Computational Biology and Drug Design
2. Genome Organization and Function
3. Human Genetics
4. Medical Biochemistry
5. Medical Biotechnology
6. Project Work (can be chosen only in semester 6)

GE1-2: Generic Electives (any one per semester in semesters1-2)

1. Basics of Immunology

2. Biological Chemistry
3. Bio safety and Bioethics
4. Biostatistics
5. Bridging Information Technology and Biotechnology
6. Concepts in Biotechnology

GE3-4: Generic Electives (any one per semester in semesters 3-4)

1. Concepts in Medicinal Chemistry and Drug Development
2. Intellectual Property Rights(IPR)for Biologists
3. Pathological Basis of Diseases
4. Pharmacology and Toxicology
5. Tools and Model Organisms in Biomedical Research

***Practicals: (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.)**

SEMESTER I

Paper Code	Name of the subject	Credit Units	Evaluation Scheme		
			Internal	External	Total
BMS 101 T	Bioorganic Chemistry	4	20	80	100
BMS 102 T	Cell and Radiation Biology	4	20	80	100
BMS-G1 T **BMS-G2 T** **BMS-G3 T** **BMS-G4 T** **BMS-G5 T** **BMS-G6 T**	***General Elective Subject** Basics of Immunology Biological Chemistry Bio safety and Bioethics Biostatistics Bridging Information Technology and Biotechnology Concepts in Biotechnology	4	20	80	100
****BMS-AECC 1** ****BMS-AECC 2**	English/Communication Environmental Studies	2	50*	----	50*
BMS 101 P	Bioorganic chemistry Practical	2	20	30	50
BMS 102 P	Cell and Radiation Biology Practical	2	20	30	50
BMS-G1 P **BMS-G2 P** **BMS-G3 P** **BMS-G4 P** **BMS-G5 P** **BMS-G6 P**	Basics of Immunology Practical Biological Chemistry Practical Biosafety and Bioethics Practical Biostatistics Practical Bridging Information Technology and Biotechnology Practical Concepts in Biotechnology Practical	2	20	30	50
		20	**TOTAL MARKS**		**500**

*General elective subject: Bio safety and Bio Ethics (BMS G3) selected in academic session 2022-23.
** BMS AECC 1/ BMS AECC 2 are NON-University exam. Evaluation to be conducted by internal faculty/examiner.

B.Sc. Course in Biomedical sciences

Semester I

Bioorganic Chemistry
(Paper Code: BMS 101 T)

Theory **Credit: 4**

Course Overview

Bioorganic Chemistry is a discipline that integrates organic chemistry and biochemistry. It aims at understanding the relevance of biological processes using the fundamental concepts of organic chemistry. This course includes basic principles of organic chemistry like concepts of acids and bases, molecular forces responsible for the activities of biomolecules, principles of stereochemistry and their importance in understanding various bio- molecular reactions along with introduction to bio molecules.

Course Outcomes:

The student at the end of the course will be able to understand:

CO 1: The concept of pH and its effect on structure of bio molecule. The application of Henderson- Hassel Bach equation.

CO 2: Explain the different acid-base theories and concept of leveling solvent.

CO 3: Describe chemical bonding and its role in biological systems. Identify and differentiate various inter and intra molecular forces and their effect on structure of different bio molecules.

CO 4: Identify, asses and analyze different types of stereoisomer's and their properties in organic compounds and bio molecules

CO 5: Explain the structures and function of bimolecular (carbohydrates, amino acids, lipids and nucleotide)

Course Content

Unit-I: Aqueous Solutions

Water, pH and buffers, concept of pKa (titration curves of amino acids), Henderson-Hasselbach equation, buffering zone, buffer index, concept of pI and zwitter ion.

Unit-II: Concept of Acids and Base

Arrhenius concept, Bronsted Lowry concept, Lewis concept , the levelling effect, effect of pH on the structure of bio molecules.

Unit-III: Chemical Bonding and Molecular Forces

Introduction to ionic interactions and covalent bond, inter-molecular and intra-molecular forces, types of intermolecular forces and their characteristics: ion-dipole, dipole-dipole, dipole-induced dipole and dispersion (London) forces, hydrogen bond (intra-molecular and inter-molecular), effect of inter/intra-molecular forces on structure of different bio molecules.

Unit-IV: Stereochemistry

Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diastereoisomers.

Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity.

Geometrical isomerism: Definition, nomenclature– E and Z.

Unit-V: Introduction to Biomolecules

Carbohydrates: Monosaccharides- cyclization of aldosesand ketoses, conformations, concept of mutarotation, anomers, epimers.

Disaccharides- structure, reducing and non-reducing sugars. Polysaccharides- Starch, glycogen and cellulose.

Lipids: Fatty acids, triacylglycerols, steroids (cholesterol)

Amino Acids: Structure and classification of amino acids, ionization, chemistry of peptide bond, non- ribosomal peptide bond formation, essential and non-essential amino acids, amino acids as precursors of other bioactive compounds, zwitterion, isoelectric point, optical properties of amino acids, Definition of a peptide, peptide unit, peptide group, bond length, cis and trans conformation, primary, secondary (alpha helix, beta sheet, beta turn, collagen helix), tertiary and quaternary structures (with examples).

Nucleotides: Sugars and Bases, conformation of sugar phosphate backbone, hydrogen bonding by bases, tautomers of bases.

Unit-VI: Biologically significant name reactions

Aldol (Glucogenesis), retro-aldol (Glycolysis), benzoin condensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (synthesis of fatty acids), Michael addition (Dehydrases), Cannizzaro (Sugar metabolism), Bayer Villiger reaction (FAD dependent ketone synthesis), Pinacol-pinacolone rearrangement (1,2-carbon carbon shift).

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Bioorganic Chemistry
(Paper Code: BMS 101 P)

Practicals **Credit: 2**

1. Preparation of solutions based on molarity, normality, percentage, dilutions etc.
2. Preparation of buffers.
3. Estimation of Mohr's salt/ oxalic acid by titrating with $KMNO_4$.
4. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
5. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Mohlisch, Barfoed, Fehling/ Tollen/ Benedict, Selvinoff, Osazone, Bial's tests.
6. To determine the Iodine number of the given oil/ fat.
7. To find pKa value of given acetic acid/ amino acid.
8. Absorption spectrum of DNA/ Protein

Cell and Radiation Biology
(Paper Code: BMS 102 T)

Theory **Credit: 4**

Course Overview

Cell biology is essentially the study of life in all of its varied forms. Cells are the basic unit of life, the study of cells can be considered one of the most important areas of biological research. This course will provide information about cells, including their composition, their function and cell-cycle checkpoints. The radiation biology will help to explore and gain insight into radiation-induced biological responses at molecular, cellular and tissue levels.

Course Outcomes:

The student at the end of the course will be able to understand:

CO 1: Students will learn about cell theory, cell cycle mechanisms and role of Mitosis and Meiosis.
CO 2: Students will acquire insight into structure of plasma membrane, the processes of transport across cell membranes.
CO 3: Students will learn the structure and function of various cell organelles in detail.
CO 4: Students will understand cell junctions and cytoskeleton elements and overview of cell signalling and various cellular signal transduction pathways.
CO 5: Students will also gain insight into radiation-induced biological responses at molecular, cellular and tissue levels. The course also covers knowledge of applications of radiations in biomedicine and radiation bio-safety.

Course Content

Unit-I: The Cell

Historical background, significant landmarks, cell theory, structure of prokaryotic and eukaryotic cells, mycoplasma, viruses, viroids, prions.

Unit-II: Cell Membrane and Membrane Transport

Functions, different models of membrane structure, types of membrane lipids, membrane proteins: types, methods to study membrane proteins (detergents, RBC ghosts), RBC membrane as a model, membrane carbohydrates, membrane asymmetry and fluidity, lipid rafts.

Transport of small molecules: Passive transport (simple diffusion and facilitated diffusion) and active transport and their types (P, V, F and ABC transporter) with example of Na+/K+ pump.

Transport of macromolecules: Endocytosis (pinocytosis, phagocytosis), exocytosis.

Unit-III: Cell Organelles

Structure and functions of various organelles:

Nucleus: Different components, nuclear envelope- its structure, pore complex, nucleo cytoplasmic interaction (NLS and NES), nucleolus- structure and functions.

Chromosome: Structure- centromere and telomere, types of chromosomes based on centromere, diversity in structure and significance of polytene and lampbrush chromosomes, mitosis and meiosis: different phases and their significance.

Endoplasmic reticulum: RER- Biosynthesis and processing of proteins, co-translational and post-translational transport of proteins, signal hypothesis, protein sorting. SER- detoxification , biosynthesis of membrane , carbohydrate metabolism, steroid synthesis.

Golgi apparatus: Golgi stack (cis, trans and medial cisternae), flow of proteins through Golgi body , glycosylation and protein sorting.

Lysosomes: Development of different forms of lysosomes, role in cellular digestion, lysosomal storage diseases- Hurler syndrome, Hunter syndrome, Tay-Sachs disease and Inclusion cell disease (I-cell disease).

Peroxisomes: Assembly, functions- H2O2 metabolism, oxidation of Fatty acids, glyoxysomes.

Mitochondria: Detailed structure, endosymbiotic theory, its genome and functions in brief.

Chloroplast: Detailed structure, its genome and functions in brief.

Unit-IV: Cell Junctions and Cytoskeletal Elements

Basics concepts of anchoring junctions, tight junctions, communication junctions (gap junction and plasmodesmata).

Structure, assembly and functions of:

Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies).

Microfilaments: Globular and filamentous actin, general idea about myosin.

Intermediate filaments: Different classes.

Unit-V: Cell Cycle and Overview of Cell Signaling

Different phases of cell cycle and their significance, checkpoints and regulation of cell cycle, signaling molecules and their receptors (extracellular and intracellular), functions of extracellular receptors. Intracellular signal transduction pathways (cAMP, cGMP, steroid hormone response element).

Unit-VI: Radiation Biology

Introduction to radiation biology: Introduction of radiations, basic concept of radioisotopes, types of radioactive decay (gamma and beta emitter), half-life.

Biological effects of radiation: Effects of Ionizing and non-ionizing radiation on cells, acute, delayed and late radiation effects (with particular reference to nervous system, gastrointestinal and hematopoietic syndrome).

Application in biomedicine: Use of radioisotopes in biology, autoradiography, radioisotopes in diagnosis (thyroid disorders, cancer) and therapy (radiotherapy).
Radiation bio safety: Precautions and safety measures in handling radioisotopes.

References

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Cell and Radiation Biology
(Paper Code: BMS 102 P)

Practicals **Credit: 2**

1. Microscopy- Theoretical knowledge of Light and Electron microscope.
2. To study the following techniques through electron/ photomicrographs: fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching shadow casting, endocytosis and phagocytosis.
3. To explain mitosis and meiosis using permanent slides.
4. Measurement of cell size using stage micrometer.
5. To cytochemically demonstrate presence of proteins in cheek cells or onion peel using mercuric bromophenol blue or fast green.
6. To cytochemically demonstrate presence of carbohydrates in cheek cells or onion peel using periodic acid Schiff's reagent.
7. To cytochemically demonstrate presence of DNA in cheek cells or onion peel using Feulgen reagent.
8. To study the effect of isotonic, hypotonic and hypertonic solutions on cells.
9. To prepare polytene chromosomes.

Bio safety and Bioethics
(Paper Code: BMS-G3 T)

Theory **Credit: 4**

Course Objective

Recent advances in the field of biotechnology have brought into focus several safety and ethical issues. The inventions in the field of genetic engineering and related fields of molecular biology not only affect us but also the plants, micro flora, animals and the entire environment and the way we practice agriculture, medicine and food processing. An increase in our ability to change life forms in recent years has given rise to the new science of bioethics.

The present paper focuses on the bio safety and bioethical issues the modern society confronts. Topics such as bio safety levels, GM food debate, impact of biotechnology on bio safety, biotech products and ethical issues, governance of bio safety, environmentally responsible use of biotechnology, clinical ethics will be discussed in the curriculum.

Course Outcomes

The student at the end of the course will be able to understand:

CO 1: This will enable students to understand various hazardous biological substance they can come across while working in laboratory or day today life, and what are the steps to minimize the risk.

CO 2: The course should kindle the inquisitiveness in students about genetically modified and living modified organisms (GMO & LMO) and their impact on environment.

CO 3: This should give students idea of different regulation for handling biohazard and radioactive material.

CO 4: The students should be familiar with various aspects of bioethics followed in day to day life as well as while handling animals in laboratory.

CO 5: Student should understand their ethical and social, rights and responsibilities for medical care. They should also understand moral and ethical conflicts related to ICU care and HIV infection.

Course Content

Unit-I: Introduction

Historical background, introduction to biological safety cabinets, primary containment for biohazards, bio safety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals.

Unit-II: Bio safety Guidelines and Management

Government of India definition of genetically modified organisms (GMOs) and living modified organisms (LMOs), roles of institutional bio safety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs.

The GM-food debate and bio safety assessment procedures for biotech foods and related products, including transgenic food crops, case studies of relevance.

Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.

Key to the environmentally responsible use of biotechnology and its ethical implications.

Unit-III: Handling and Transportation of GM, Infectious and Radioactive Materials

Risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant international agreements including Cartagena Protocol.

Unit-IV: Codes, Covenants, Declarations and Guidelines

Reason to apply its principles to study cause of health problems and suggest appropriate intervention/ solution to problem. Definition, historic evolution, codes and guidelines, universal principles. Define the term “Bioethics” in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms from simpler to higher levels for initiating right actions to "first do no harm‟ and learn about prayers, oaths, covenants, declarations, guidelines and codes which have relevance to bioethics. Ethical use of animals in the laboratory.

Unit-V: Clinical Ethics

Describe the sanctity of human life and the need to preserve human life, explain about issues related to prenatal screening, clinical trials (Phase I/II/III/IV) studies. Vulnerability of women with respect to health care, examination and screening of women for disease, social issues like domestic violence and female genital mutilation and abortion.

Unit-VI: Critical Care Ethics

Medical error and medical negligence difference, remedies against medical negligence, protection and compensation related to it. History and need for ICU care, functioning and ethical principles of an ICU care, triage and futility, end of life care, ethical principles related to withholding treatment and withdrawing treatment (euthanasia), legal position regarding policies in ICU and handling of conflicts in the ICU. Basics of HIV infection, identify ethical issues in clinical practice of HIV medicine and its prevention, research ethics related to HIV.

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2. Helga, K. and Peter, S. (2012). 2nd edition. A companion to bioethics. New Jersey, USA: John Wiley and Sons.
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6. Tristram, E.H. (1996). 2nd edition. Foundation of Bioethics. Oxford, UK: Oxford University Press.

Bio safety and Bioethics
(Paper Code: BMS-G3 P)

Practical **Credit: 2**

1. A case study based on genetic modified organism (Bt- Cotton).
2. A case study based on genetic modified organism (Bt- Brinjal).
3. A case study based on terminator seeds.
4. A case study based on clinical trials of vaccines with emphasis on ethical issues.
5. A case study on clinical trials of drugs in India with emphasis on ethical issues.
6. A case study on women health ethics.
7. A case study on medical errors and negligence.
8. A case study on critical care ethics.
9. A case study on ethical issues in clinical practice of AIDS.
10. A case study on handling and disposal of radioactive waste.

English/Communication
(BMS-AECC 1)

Theory **Credit: 4**

Course Objective

This course's goal is to introduce students to communication theory, fundamentals, and tools while also helping them acquire critical communication skills that should be present in all of their interactions—personal, social, and professional.

Unit -I Introduction to Communication
Basic forms of communication; Process of communication; Principles of effective communication, 7Cs; Types of Communication; Barriers of communication.

Unit-II Fundamental of Grammar and their Usage
Improve command over spoken and written communication with emphasis on nouns, verbs, tenses and adjectives; Correcting sentence errors, punctuation; Building vocabulary to communicate effectively; common errors in writing.

Unit -III Business Letter Writing
Types and layouts of letter Writing: Persuasive Letters, Request Letters, Sales Letters, Complaints and Adjustments; Interview Letters, Promotion. Letters, Resignation Letters, News Letters, Circulars, Agenda, Notice, Office Memorandums, Office Orders, Press Release.

Unit -IV Business Etiquettes and Public Speaking
Business manners; Body language gestures, Email; Etiquettes on internet; Etiquettes on the Telephone; Group Meetings.

Unit –V Reading and Listening Skills
Close Reading, Comprehension, Summary writing, Paraphrasing, Analysis and Interpretation; Self Awareness, Active Listening.

Unit –VI Audience to Communication
Intrapersonal, Interpersonal, Group and Mass Communication; Devising feedbacks in Communication; Interviews – Types, Do’s and Dont’s in an Interview.

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3. Lesikar, (2009), Business Communication: Making Connections in a Digital World, McGraw Hill Education.
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