Semester-I — Credits-24 — Marks-600

SN	Paper Code	Subject	Course Type	Weekly contact hours			Credits			Examination Scheme			
				T	P	Total	T	P	Total	T	Int	P	Total
1	25BT101	Cell Biology	CC1	04	-	04	04	-	04	70	30	-	100
2	25BT102	Biochemistry	CC2	04	-	04	04	-	04	70	30	-	100
3	25BT103	Microbiology	CC3	04	-	04	04	-	04	70	30	-	100
4	25BT104	Biotech Lab I	CC4	-	16	16	-	08	08	-	-	200	200
5	25BT105	Molecular Biology	DEC1	04	-	04	04	-	04	70	30	-	100
			Total	**16**	**16**	**32**	**16**	**08**	**24**	**280**	**120**	**200**	**600**

For details, go through the ordinance available on University website
T= Theory **P**=Practical **Int**=Internal assessment
CC= Core Course **DEC**= Discipline Elective Course
MOOC courses might also be adopted after discussion with the MOOC coordinator of the department.
Tutorials or other components implemented at the departmental level will be mentioned in the timetable.
Topics based on the Indian Knowledge System (IKS) are listed in Annex II

Semester-II — Credits-26 — Marks-650

SN	Paper Code	Subject	Course Type	Weekly contact hours			Credits			Examination Scheme			
				T	P	Total	T	P	Total	T	Int	P	Total
1	25BT201	Molecular Immunology	CC5	04	-	04	04	-	04	70	30	-	100
2	25BT202	Developmental Biology	CC6	04	-	04	04	-	04	70	30	-	100
3	25BT203	Genetic Engineering	CC7	04	-	04	04	-	04	70	30	-	100
4	25BT204	Biotech Lab 2.1	CC8 (PC-2.1)		08	08	-	04	04	-	-	100	100
5	25BT205	Biotech Lab 2.2	PC-2.2	-	08	08	-	04	04	-	-	100	100
	25BT206	Bioinformatics	DEC2 (any one#)	04	-	04	04	-	04	70	30	-	100
7	25BT207	Metabolic Engineering											
8	25BT208	Biology of Infectious Diseases											
9	25BT209	Environmental Studies and Sustainable Development	VAC/IKS (any one*#)	02	-	02	02	-	02	-	50	-	50
10	25BT210	Indian Knowledge Systems in Biotechnology - I											
11	25BT211	Indian Knowledge Systems in Biotechnology - II											
			Total	**18**	**16**	**34**	**18**	**08**	**26**	**280**	**170**	**200**	**650**

For details, go through the ordinance available on University website
T= Theory **P**=Practical **Int**=Internal assessment
CC= Core Course **DEC**= Discipline Elective Course **VAC**= Value Added Course
These courses will be offered exclusively when at least five students are registered for the particular course.
*These courses will be based on the Indian Knowledge System and Modern sciences.
MOOC courses might also be adopted after discussion with the MOOC coordinator of the department.
Topics based on the Indian Knowledge System (IKS) are listed in Annex II

Note: Exit might be taken by the student after completing 50 credits (total marks 1050), which include the credits for semesters I and II. In addition, the student will also undergo an internship to receive a PG Diploma in Biotechnology [for details, see the Multiple exit/entry options at PG level (One Year PG Diploma in Biotechnology)].

Chaudhary Bansi Lal University, Bhiwani
(A State University established under Haryana Act No. 25 of 2014)

M.Sc. Biotechnology (Semester I)

25BT105
Molecular Biology

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: It focuses on the interactions between the various systems of a cell, including the interrelationships of DNA, RNA, and protein synthesis and their regulations.

Course learning outcomes:
CLO1: Students will learn the most significant molecular mechanisms that are used in living organisms.
CLO2: This course will prepare students to seek careers in molecular laboratories, as molecular biologists in research institutions, and in major diagnostic centers.

Unit I

Replication of genetic material: Introduction of molecular biology; identification of DNA as the genetic material[DSL]; viral genome; bacterial genome; eukaryotic chromosome.

DNA replication: Replicon, enzymes and accessory proteins involved in DNA replication. Mechanism of DNA replication in prokaryotes & eukaryotes.

Unit II

Gene transcription and RNA modification: Prokaryotic & eukaryotic transcription: RNA polymerase, general and specific transcription factors, regulatory elements and mechanisms of transcription regulation[CLL]; RNA modification: processing, splicing, 5'Capping, 3'Poly A tailing, RNA editing, base modification[CLL].

Translation: The genetic code[DSL], prokaryotic and eukaryotic translation.

Unit III

Mechanisms of DNA Repair: Photo reactivation[DSL], base excision repair, nucleotide excision repair, mismatch excision repair, recombination repair, non-homologous end joining[CLL], translesion/error-prone repair; SOS response.

Recombination & transposition: Homologous recombination and Holliday junction model of recombination[CLL], site-specific recombination; illegitimate recombination; Cre-lox recombination[CLL]. Bacterial transposons, P elements in *Drosophila*; transposable elements in human[DSL]. Recombination errors and human diseases.

Unit IV

Gene regulation in prokaryotes: Transcriptional regulation: inducible and repressible controls[DSL], lac and tryptophan operons; post transcriptional regulations: leader sequences, attenuators; Co- and post-translational regulation: repressor proteins, antisense RNA, feedback inhibition and allosteric control[DSL].

Gene regulation in eukaryotes: Alternative splicing, RNA stability, DNA methylation, histone modification, riboswitches[CLL].

DSL=Digital Self Learning
CLL=Classroom and Lal Learning

Suggested readings:

1. Lewin Genes by Jocelyn E Krebs et al., Jones & Bartlett Learning.
2. Essentials of Molecular Biology by Friefelder D et al., Boston.
3. Genetics: Analysis and Principles by Brooker, Robert J, McGraw-Hill Education.
4. Concepts of genetics by William S Klug et al., Pearson NY.
5. Genetics: A molecular approach by Brown TA, Chapman and Hall, London.
6. Gene Regulation by Gurbachan S, Narosa Publishers.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
(A State University established under Haryana Act No. 25 of 2014)

M.Sc. Biotechnology (Semester II)

25BT201
Molecular Immunology

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: The objective of this course is to provide information regarding cells, molecules, and processes associated with the immune system and their role in health & diseases. In addition, exposure to the recent developments in immunology will also be an integral part of the subject.

Course learning outcomes:

CLO1: The subject will emphasize developing students' understanding of molecular, cellular, and clinical perspectives in the area of immunology.

CLO2: This course will prepare students to seek a career in the field of immunological diagnosis, vaccine development, and numerous other clinical studies.

Unit I

Preface of immunology: Primitive and advanced immunity, anatomical barriers in innate immunity, cardinal features of acquired immune system[DSL]. Internal structure and organization of the thymus, spleen, and lymph nodes.

Cellular and humoral immunity: Concept of antigen, super antigen, immunogen, epitopes and hapten carrier system. Factors affecting immunogenicity. Molecular structure of antibodies and their functions. Complement system and its evasion by microbes[DSL]. Complement deficiencies and diseases.

Unit II

Immune receptors and their diversity: Structure and functions of Toll receptor, TCR, BCR, MHC; somatic recombination and generation of antibody diversity.

Antigen presentation and tolerance: Antigen processing and presentation, self-MHC restriction[DSL]. Immunological tolerance.

Unit III

Activation of immune cells and cytotoxicity: T cell activation, negative regulation of T cell activation. Mechanism of T cell and NK cell mediated target cell lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity[DSL]. Inflammatory bowel diseases.

Regulation of the immune system: Cytokines and their role in immune regulation.

Unit IV

Transplantation and disorders of immune response: Transplantation and its rejection, autoimmunity, hypersensitivity, immunodeficiencies[DSL].

Immunotechnology: Antigen-antibody interactions, agglutination[CLL], immunoelectrophoresis[CLL], immunoblotting[CLL], ELISA[CLL], surface plasmon resonance. Abzymes, antibody engineering[DSL]. Vaccines.

DSL=Digital Self Learning
CLL=Classroom and Lab Learning

Suggested readings:

1. Immunology by Kuby J. W.H. Freeman & Co., New York.
2. Cellular and Molecular Immunology by Abul K Abbas et al., Elsevier, Inc.
3. Immunology: A Short Course by Coico, Richard and Sunshine, Geoffrey. Willey-Blackwell Press.
4. Essential Immunology by Roitt, I.M. Oxford Black Well Science, London.
5. Immunology by Raj Khanna, Oxford Press.
6. Immunology and Immunotechnology by Chakravarty AK, Oxford press.
7. The Elements of Immunology by Fahim Halim Khan, Pearson Education

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT202
Developmental Biology

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: In this course, students will study the genetic control of cell growth, differentiation, and morphogenesis that give rise to tissues, organs, and organisms.

Course learning outcomes:

CLO1: This course will impart vast knowledge of developmental processes to pursue our inquiry into the fundamentals of life.

CLO2: There are a variety of options for students, including a career as a researcher in a stem cell laboratory, developmental biologist, and stem cell banking.

Unit I

Basic concepts of development: Life cycle of *Xenopus, Drosophila, C. elegans* and mouse; embryonic development and potency, commitment, specification, induction, competence, determination and differentiation [DSL]; formation and differentiation of germ cells; structure, chemistry, dynamics and regulation of sperm locomotion, capacitation and egg-surface targeting; hormonal control of ovulation in mammals[DSL].

Unit II

Fertilization: Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity[DSL], egg activation, early cleavages and blastocyst formation in mammals, biochemical and cellular changes during the passage down the oviduct to the uterus.

Unit III

Embryonic development: Implantation and formation of the placenta in mammals; gastrulation in mammals: formation of primitive streak, morphogenetic movements and neural induction; organogenesis and fetus development; pattern forming genes and expression in *Drosophila*; Mammalian brain and lens development[DSL].

Growth factors: Growth factors and signal cascades for BMP, Wnt, and notch during gastrulation.

Unit IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem[CLL]; leaf and floral development in *Arabidopsis.*

Introduction to stem cells: Molecular basis of pluripotency and its applications; stem cell niches; stem cell renewal[DSL]; epigenetic mechanism of cellular memory[DSL]; nuclear cloning and epigenetic reprogramming.

DSL=Digital Self Learning
CLL=Classroom and Lab Learning

Suggested readings:

1. Developmental Biology by Gilbert SF, Sinauer Asso.
2. Principles of Development by Wolpert L *et al.*, Oxford University Press
3. The Art of the Genes- How Organisms Make Themselves by Coen E, Oxford University Press
4. Genetic Analysis of Animal Development by Wilkins AS, Wiley-Liss
5. Biological Physics of the Developing Embryo by Forgacs G & Newman SA, Cambridge University Press.
6. Handbook of Stem Cells by R Lanza, I Weissman, J Thomson, and R Pedersen, Academic Press.
7. Essentials of Stem Cell Biology by R Lanza, J Gearhart *et al.*, Elsevier Academic press.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT203
Genetic Engineering

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: The course also commonly known as recombinant DNA technology, is the set of molecular tools and techniques that are used for the manipulation of genes. The course also emphasizes the applications of genetic engineering, such as gene editing and gene therapy.

Course learning outcomes:

CLO1: This course will train the students for the use of molecular tools such as enzymes, various cloning vectors, library preparation, and suitable methods for the manipulation of animals and plants. Also learning strategies to study gene expression and recombinant protein production.

CLO2: Being the core area of biotechnology, this subject enables students to learn the basics of genetic manipulation tools and well-trained students can find career options in biotechnological and R&D units.

Unit I

Introduction and scope: Scope of genetic engineering; tools for genetic engineering: restriction and other modifying enzymes; vectors: basic biology of plasmids, bacteriophage vectors, cosmids, phasmids, YAC, BAC and M13; expression vectors[CLL].

Gene cloning strategies: preparation and screening of genomic and cDNA library, mRNA enrichment; PCR based cloning[CLL].

Unit II

Genetic manipulation of animals: Gene knockout and knock-in technologies; gene transfer methods to animal cells; transgenic mice and *Drosophila*; Genetic manipulation of plants: strategies for gene transfer to plants including *Agrobacterium-mediated* transformation; selectable markers for plants[DSL]; mapping the RNA by primer extension, S1 nuclease, and RNase protection methods; t-DNA and transposon tagging[DSL].

Unit III

Regulation of transgene expression: inducible expression systems; gene silencing by RNAi; strategies for heterologous gene expression in bacteria, yeast, insect, mammals, and plant cells; Gene probes: generation, labeling and usage; reporter genes[CLL].

Unit IV

Processing of recombinant proteins: *In vitro* translation; purification, refolding, characterization and stabilization of recombinant proteins; site-directed mutagenesis and protein engineering[DSL]. Analysis of protein-protein interactions by yeast two-hybrid system.

Genome editing using engineered nucleases: Zinc finger nucleases (ZFN), Transcription activator-like effector nucleases (TALEN) and clustered regularly interspaced short palindromic repeats (CRISPR); gene therapy: types and methods.

DSL=Digital Self Learning
CLL=Classroom and Lab Learning

Suggested readings:

1. Principles of gene manipulation and genomics by Primose SB and Twyman RM, Blackwell publishing.
2. Gene cloning and DNA analysis–An introduction by Brown TA, Blackwell publisher
3. Biotechnology: expanding horizons by BD Singh, Kalyani Publishers
4. Molecular cloning: A laboratory manual by J Sambrook and Michael R Green.
5. Essential genes by Benzamin Lewin, Pearson education international.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT204
Biotech Lab 2.1

Maximum Marks: 100
Duration of Exam: 08 hrs.

Objectives and Course learning outcomes:
The course is aimed to promote the confluence of areas such as immunology, genetic engineering, and Bio-informatics at one forum. It is also to promote and integrate research and development in the above-mentioned field. Also, to organize periodic experiments either exclusive to our lab or jointly with other organizations.

Practical:

1. Blood film preparation and identification of immune cells
2. Lymphoid organs and their microscopic organization
3. Immunization of animals
4. Separation of serum
5. Double diffusion and Immune-electrophoresis
6. Separation of mononuclear cells by Ficoll-Hypaque
7. Heamagglutination assay
8. ELISA
9. Immunoblotting
10. Immunodiagnostics (demonstration using commercial kits)
11. To study the different stages of development in frog and chick through permanent slides.
12. To study the spermatogenesis of rat and grasshopper through slides.
13. To prepare the permanent stained slides of developing stages from fertilized egg of hen.
14. Study of sex-chromatin Bars body from human buccal mucosa.
15. Epitope mapping

Note: This is the list of suggested practical. The final list of practicals will be declared in the running semester.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT205
Biotech Lab 2.2

Maximum Marks: 100
Duration of Exam: 08 hrs.

Objectives and Course learning outcomes:
The course is aimed to promote the confluence of areas such as immunology, genetic engineering, and Bio-informatics at one forum. It is also to promote and integrate research and development in the above-mentioned field. Also, to organize periodic experiments either exclusive to our lab or jointly with other organizations.

Practical:

1. Quantify DNA and RNA concentrations using UV-Vis spectroscopy and assess quality via agarose gel electrophoresis.
2. Analyze gene expression data from DNA microarrays and interpret results using bioinformatics tools.
3. Isolation of plasmids and purification
4. Quantitation of nucleic acids.
5. Restriction analysis and construction of the restriction map of the plasmid
6. Preparation of competent bacterial cells
7. Genetic Transformation of bacteria with a recombinant plasmid
8. PCR amplification

Note: This is the list of suggested practical. The final list of practicals will be declared in the running semester.

Chaudhary Bansi Lal University, Bhiwani
(A State University Established under Haryana Act No. 28 of 2014)

M.Sc. Biotechnology (Semester II)

25BT206
Bioinformatics

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: It applies information technology and computer science to the area of biology for the purpose of studying, analyzing, and processing information related to genomics as well as other biological processes.

Course learning outcomes:

CLO1: Students will learn the integration of computers, software tools, and databases to address biological queries.

CLO2: This course will help students to work in all sectors of pharmaceutical, biomedical organizations, biotechnology, research institutions, hospitals, industry, and even NGOs.

CLO3: They can also be a part of the leading IT companies as "Bio-informationists" along with career areas such as database design & maintenance, pharmacology, sequence assembly analysis, informatics developer, etc.

Unit I

Introduction to bioinformatics: Branches, scope and research areas of bioinformatics; introduction to various sequence file formats; introduction to PERL: scalar variables, strings and numbers, arrays, hashes, operators, loops, regular expression[CLL]; applications of PERL in bioinformatics[DSL].

Introduction to databases: Classification scheme and features of biological databases; overview of various databases dealing with biological macromolecules[DSL].

Unit II

Major biological databases: Primary databases of nucleic acid and protein: NCBI-Genbank, EMBL, DDBJ; Swiss Prot, PIR[CLL].

Other databases: Secondary protein database Prosite and PRINTS[CLL]; secondary genomic database OMIM and OMIA, literature database Pub Med, metabolic database KEGG, *Plasmodium* database Plasmo DB, specialized databases including MIPS, TIGR, TAIR[CLL].

Unit III

Sequence comparison methods: Methods for the comparison of two sequences[CLL] viz., dot matrix plots, Needleman-Wunsch & Smith-Waterman algorithms; analysis of computational complexities and the relative merits and demerits of each method[CLL]; theory of scoring matrices and their use for sequence comparison; difference between PAM and BLOSUM[DSL]; sequence similarity tools: CLUSTAL X/W[CLL]; molecular phylogeny[DSL].

Unit IV

Database search algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms; BLAST and its types; PSI-BLAST and RPS-BLAST[CLL]; concept of position-specific weight matrices and their use in sequence analysis; theory of profiles and their use with special reference to PSI BLAST[CLL]; Markov chains and models; concept of HMMs[DSL], Viterbi algorithm; forward algorithm and Baum-Welch algorithm[CLL].

DSL=Digital Self Learning
CLL=Classroom and Lal Learning

Suggested readings:

1. Essential Bioinformatics by Jin Xiong, Cambridge publisher.
2. Bionformatics: Principles and Applications) by Zhumur Ghosh and Bibekanand Mallick, Oxford University Press.
3. Bioinformatics by Orpita Bosu and Simminder Kaur Thukral, Oxford University Press publisher
4. Introduction to Bioinformatics by M Lesk, Oxford University Press publisher.
5. Fundamental Concepts of Bioinformatics by Dan E Krane, Michael L Raymer, Michaeel L Raymer, Elaine Nicpon Marieb, Benjamin/Cummings.
6. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery by P Rastogi and N Mendiritta, Prentice-Hall of India Pvt. Ltd.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT207
Metabolic Engineering

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: A typical metabolic engineering syllabus covers the principles and applications of modifying cellular metabolism to enhance the production of desired compounds, including biofuels, pharmaceuticals, and chemicals. Key topics include cellular metabolism, metabolic pathways, metabolic flux analysis, and genetic tools used in metabolic engineering.

Course learning outcomes:
CLO1. Understanding the wealth of phytochemicals, often termed as natural products.
CLO2. Understanding the specific metabolic pathways of drugs, flavouring agents, and nutraceuticals.
CLO3. Advances in biosynthetic pathways through cloning of encoding genes.
CLO4. Biotechnological approaches to design strategies to alter biosynthetic routes leading to enhanced production of desired products of pharmaceutical importance, mainly through the application of metabolic engineering strategies.

Unit 1

Introduction to metabolic engineering: cellular metabolic pathways, promoter engineering, protein engineering, Biosynthesis of Secondary Metabolites. Synthetic biology. Metabolic flux, ^{13}C metabolic flux analysis principles and their applications. Application of in pharmaceuticals, chemical bioprocess, food technology, agriculture, bioremediation and biomass conversion.

Unit 2

Genome engineering: Introduction, CRISPR, combinational engineering, applications of combinational engineering. Regulation of secondary metabolite pathways, precursor effects, prophase, and idiophase relationship. Engineering tropane, morphine, and purine alkaloid pathways in plants. Manipulation of anthocyanin pathways and creation of a blue rose.

Unit 3

Metabolic pathway modeling: Metabolic engineering with Bioinformatics. Pathway manipulation for the production of phenolic esters. Metabolic engineering for vanillin biosynthesis. Genetic engineering of the shikonin pathway. Molecular pharming for human somatotropin production in transplastomic plants.

Unit 4

Bioconversions: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Cometabolism, Mixed or sequential bioconversions, Conversion of insoluble substances, worked examples in metabolic engineering, including artemisinin and butanol.

Suggested readings:
1. Pharmacognosy Trease & Evans',
2. Biochemistry & Molecular Biology of Plants by Buchanan et al.
3. Chemicals from Plants by Walton & Brown,
4. Metabolic Engineering: Principles and Methodologies by Stephanopoulos G, Aristidou AA, and Nielsen J
5. Metabolic Engineering by Jens Nielsen
6. Metabolic Engineering (Biotechnology and Bioprocessing) by Sang Yup Lee and E Terry Papoutsakis
7. Metabolic Engineering by Ralph Becker
8. Metabolic Engineering for Bioactive Compounds by Vipin Chandra Kalia, Adesh Kumar Saini
9. Applications of Plant Metabolic Engineering. Robert Verpoorte, A.W. Alfermann, T.S. Johnson
10. Metabolic Engineering by Sang Yup Lee, E. Terry Papoutsakis

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT208
Biology of Infectious Disease

Maximum Marks: 100
Theory Examination: 70
Internal Assessment: 30
Time: 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven (fourteen marks) short-answer type questions covering the entire syllabus. Two questions (each for 14 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: This course deals with the medical and health aspects of microbes. Here, students will learn the outcomes of microbial diseases, their modes of transmission, and their impact on public health. In addition, diagnosis, therapy, and the challenges in this area will also be part of learning.

Course learning outcomes:
CLO1: Students will acquire knowledge about infectious diseases and their associated challenges.
CLO2: This course will prepare students to seek careers in the field of medical sciences, the pharma industry, disease diagnosis, and epidemiological studies

Unit I

Introduction to infectious diseases: Preface of infectious diseases; terminology and categories of diseases; normal and pathogenic microbiota; classification of infectious diseases[DSL]; reservoirs of infectious diseases; stages of infectious disease.

Host-pathogen interaction: Nature and manifestations of infectious diseases; portals of infectious agents entry and exit; virulence factors of infectious agents; pathogens mediated alteration of host cell behavior and damage.

Unit II

Symptoms, pathogenesis, diagnosis, treatment, and prevention for the representative infections[CLL]:
Bacteria: Tetanus, tuberculosis. Fungi: Superficial, subcutaneous, systemic and opportunistic mycoses. Viruses: Hepatitis, herpes simplex virus. Protozoa: Amoebiasis, plasmodiasis.

Unit III

Diagnosis of Infectious Diseases: Rationale behind the modern approaches for diagnosis of infectious diseases, basic concepts of gene probes, dot hybridization, and PCR assays.

Drug therapy and resistance: Action mechanisms of antibiotics, antivirals and antifungal agents; molecular mechanisms of drug resistance.

Unit IV

Vaccination against infectious diseases: Active and passive immunization; virus-like particles; edible vaccines; rational vaccine design based on clinical requirements and reverse vaccinology; role and properties of adjuvants; nanoparticles in vaccine delivery system[DSL].

Epidemiology of infectious diseases: Epidemiology and public health; disease burden; frequency of disease; investigation of epidemics; hospital-acquired (nosocomial) infections.

DSL= Digital Self Learning
CLL=Classroom and lab learning

Suggested readings:
1. Microbiology: An Introduction by Gerard J Tortora et al., Pearson publications.
2. Microbiology: With Diseases by Body System by Robert W Bauman, Pearson publications.
3. Microbiology: With Diseases by Taxonomy by Robert W Bauman, Pearson publications.
4. Prescott's Microbiology by Joanne M. Willey et al., McGraw-Hill publications.
5. Handbook of Disease-Causing Microbes by Paul, Jaishree, Ane Books.
6. Introduction to Molecular Vaccinology by Giese, Matthias, Springer
Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Chaudhary Bansi Lal University, Bhiwani
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M.Sc. Biotechnology (Semester II)

25BT209
Environmental Studies and Sustainable Development

Maximum Marks: 50
Total credits: 02

Note: The course will be evaluated based on the study report (30 marks) and seminars/presentations/viva, etc. (20 marks). The report will be focused on local studies that remain centered on the fieldwork/project work related to soil/air/water pollution/best out of waste theme-based work/bioremediation/or any other relevant topic related to the environment, including those mentioned below. In addition, students will also participate in environment-related activities through debate, declamation, group discussions, poster competition, seminars/ conferences/paper/poster presentation, and nukkad natak at the university/local/state/national levels. Paper/article publication in state/national/level journals, newspaper/conference/seminar proceedings is recommended.

Objectives: This course will provide fundamental knowledge about the environment and related issues that have a direct impact on the human population.

Course learning outcomes: The students will understand the environmental challenges, realize their role, and be motivated to protect the environment. This learning will prepare the students to develop their queries and ideas for a healthy environment.
CLO1. Understanding water resource management and the concept of green energy.
CLO2. Understanding the different types of waste and their management.
CLO3. To develop awareness of environmental laws and policies.
CLO4. Understanding wildlife protection and environmental impact assessment.

Unit-I

Water Resources Management: coordinated development and management of water, land, and related resources. Revival of Water Bodies: enumeration, protection, and management of water bodies in their respective States. Energy & Green Technologies: Renewable and Alternative energies such as Solar, Wind, Tidal, etc.

Unit-II

Waste Management: Solid/Liquid/Plastic/C&D/Electronic/Bio-medical/Hazardous wastes. Sanitation & Hygiene: Methods of Garbage collection, industrial/ hazardous waste management, Methods of wastewater treatment and disposal.

Unit-III

Environmental Laws & Policies and Legal Proceedings: Legislation, regulations, policies, and permits related to protecting the environment such as The National Green Tribunal Act, 2010, Water Prevention And Control of Pollution Act, 1974, Cess Act, 1974, Air Prevention And Control Of Pollution Act, 1977, Forest Conservation Act, 1980, Environmental Protection Act, 1986, Public Liability Insurance Act 1991, Government Missions for Environment Protection & Conservation (as per National Environment Policy NEP-2020) and Ministry of Environment and Forests (MoEF).

Unit-IV

Wildlife Protection & Conservation: habitat conservation, endangered and keystone species protection, ex-situ efforts, and poaching prevention. Environmental Impact Assessment: Water Environment, Biological Environment, Land Environment, Air Environment, Noise Environment, Socio-economic and Health Environment. Environment Management Plan.

Suggested readings:

1. Fundamentals of Ecology: E. P. Odum, W.B. Saunders Co
2. Concepts of Environmental Science. Sugandha Mishra, Dhirendra Kumar, Rajesh Publication.
3. Environmental Science. Jr. G. T. Mille R, Wadsworth Pub. Co
4. Fundamentals of Environmental Science: Dhaliwal GS, Sangha GS and Raina PK. Kalyani Publication
5. Environmental Science Systems & solutions, M.L. Mac-Kinney, & RM Schoch, Web-enhanced edition.
6. Environmental Chemistry: A. K. De, Wiley Eastern Ltd.
7. Journal publications

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

M.Sc. Biotechnology (Semester II)

25BT210
Indian Knowledge Systems in Biotechnology-I

Maximum Marks: 50
Total credits: 02

Note: The course will be evaluated based on the study report (30 marks) and seminars/presentations/viva, etc. (20 marks). The report will be focused on studies that remain centered on the relevant topic related to the IKS, including those mentioned below. In addition, students will also participate in debate, declamation, group discussions, or poster competition.

Objectives: This course introduces students to the integration of Indian Knowledge Systems (IKS) with modern biotechnology, focusing on Ayurvedic medicinal applications and biodiversity conservation. It aims to provide insights into traditional practices and their relevance to contemporary biotechnological advancements.

Course learning outcomes:
CLO1: Understand the application of Ayurvedic principles in modern biotechnology, particularly in drug discovery and bioprocessing.
CLO2: Gain knowledge of traditional ecological practices for biodiversity conservation and environmental biotechnology.
CLO3: Students will develop skills to apply IKS-based approaches in sustainable agriculture and ecological management.
CLO4: Students will be prepared for research careers integrating traditional and modern biotechnological methods.

Unit I

Ayurveda and Medicinal Biotechnology: Overview of Ayurvedic principles in biotechnology: Insights from ancient texts (Sushruta Samhita, Charaka Samhita) on plant and animal-based healing processes. Use of fermentation for herbal drugs and enzyme-based therapies. Case studies of traditional practices in modern medicinal contexts.

Unit II

Pharmacology and Bioprocessing in IKS: Pharmacology of bio-active compounds: Rasayana formulations and their relevance to drug discovery, bioprocessing, and secondary metabolite production. Integration of traditional fermentation (Asava-Arishta) with modern bioprocess technologies for producing antibiotics, vitamins, and enzymes.

Unit III

Ethno-biotechnology and Biodiversity: Ethno-biotechnology: Vrikshayurveda and its contributions to microbial diversity, biofertilizers (e.g., Rhizobium symbiosis), and sustainable crop improvement. Indigenous methods for genetic diversity in crops (e.g., Vavilov's centers in Indian contexts). Role of ethnozoology and ethnobotany in biodiversity conservation.

Unit IV

Sustainable Practices in Environmental Biotechnology: Traditional ecological knowledge in resource management: Bioremediation using herbs, vermicomposting, and phytoremediation for pollution control. Applications of IKS in sustainable agriculture and ecosystem management. Case studies on traditional practices for environmental sustainability.

Suggested Readings:

1. Sushruta Samhita, translated by Kaviraj Kunjalal Bhishagratna, Chowkhamba Sanskrit Series.
2. Charaka Samhita, translated by P.V. Sharma, Chaukhambha Orientalia.
3. Vrikshayurveda: The Science of Plant Life by Surapala, translated by Nalini Sadhale, Asian Agri-History Foundation.
4. Ethnomedicine and Pharmacognosy by V.K. Singh and J.N. Govil, Studium Press.
5. Biotechnology and Traditional Knowledge by S.K. Jain, Oxford & IBH Publishing.
6. Environmental Biotechnology by Bimal C. Bhattacharyya, Oxford University Press.
7. Indian Ethnobotany: Emerging Trends by A.K. Jain, Scientific Publishers.

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Chaudhary Bansi Lal University, Bhiwani
(A State University Established under Haryana Act No. 25 of 2014)

M.Sc. Biotechnology (Semester II)

25BT211
Indian Knowledge Systems in Biotechnology-II

Maximum Marks: 50
Total credits: 02

Note: The course will be evaluated based on the study report (30 marks) and seminars/presentations/viva, etc. (20 marks). The report will be focused on studies that remain centered on the relevant topic related to the IKS, including those mentioned below. In addition, students will also participate in debate, declamation, group discussions, or poster competition.

Objectives: This course explores the ethical, philosophical, and interdisciplinary dimensions of Indian Knowledge Systems (IKS) in biotechnology, emphasizing their relevance to sustainable development and modern challenges. It aims to foster a holistic approach to biotechnological innovation.

Course learning outcomes:
CLO1: Understand the ethical frameworks of IKS and their influence on modern biotechnological practices.
CLO2: Explore philosophical concepts of IKS and their application in drug design and regenerative medicine.
CLO3: Gain insights into sustainable biotechnology solutions inspired by IKS for addressing climate change and health challenges.
CLO4: Develop an interdisciplinary perspective, integrating IKS with fields like anthropology and agriculture for innovative research.

Unit I

Ethical Frameworks in IKS: Ethical principles in IKS: Ahimsa (non-violence) and its influence on genetic engineering, animal cell culture, and GM crops. Ethical considerations in modern biotechnology inspired by traditional practices. Case studies on ethical dilemmas in biotech research.

Unit II

Philosophical Dimensions of IKS: Concept of interconnectedness: Panchamahabhuta (five elements) and Tridosha (body balance) in understanding biological systems. Implications for gene editing and stem cell therapy. Samkhya philosophy and concepts of consciousness in guiding ethical biotech practices.

Unit III

Philosophy and Spirituality in Biotechnology: Integration of philosophical concepts of Prana (life force) and spiritual symbolism of plants/animals in drug design and regenerative medicine. Role of IKS in shaping holistic approaches to biotechnological research and innovation.

Unit IV

Interdisciplinary Applications and Modern Relevance: Sustainable development through IKS: Insights in pharmacognosy, bioenergy, and biodiversity for addressing climate change and health challenges. Interdisciplinary approaches: Integration of IKS with anthropology (ethnomedicine) and agriculture (sericulture/apiculture) for innovations in personalized medicine and environmental solutions.

Suggested Readings:

1. Sushruta Samhita, translated by Kaviraj Kunjalal Bhishagratna, Chowkhamba Sanskrit Series.
2. Charaka Samhita, translated by P.V. Sharma, Chaukhambha Orientalia.
3. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
4. Ethnomedicine and Pharmacognosy by V.K. Singh and J.N. Govil, Studium Press.
5. Biotechnology and Traditional Knowledge by S.K. Jain, Oxford & IBH Publishing.
6. Environmental Biotechnology by Bimal C. Bhattacharyya, Oxford University Press.
7. Bioethics and Biosafety by M.K. Sateesh, I.K. International Publishing House.

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