1.1.2

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Biotechnology*

Program Name : *M.Sc.*

Academic Year : 2016-17

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
	LBTM- 103	Bioinstrumentation
	LBTL-105	High Throughput Screening Techniques
	LBTL-106	Laboratory-I Based on Core-1 & 2
	LBTL-107	Laboratory-II Based on Core-1 & 2
	LBTM - 201	Recombinant DNA Technology
	LBTM - 202	Enzymology and Enzyme Technology
	LBTM - 203	Genomics and Proteomics
	LBTM - 204	Computational Biology
	LBTL - 206	Laboratory-III Based on Core-1 & 2
	LBTL - 207	Laboratory-IV Based on Core- & 4
	LBTM- 301	Animal Biotechnology
	LBTM- 302	Advanced Immunology
	LBTM- 303	Plant Biotechnology

	LBTM- 304	Bioprocess engineering and technology
	LBTM- 304	Molecular modeling
	LBTM- 304	Molecular diagnostics
	LBTM- 304	Plant metabolic engineering
	LBTM- 305	Laboratory – V Based on Core - Core-1 & 2
	LBTM- 306	Laboratory – VI Based on Core - Core-3 & Elective
	LBTL- 307	Review writing and Seminar
	LBTM- 401	Immunotechniques
	LBTM-402	Environmental Technology
	LBTM-403	Paper -4a Microbial and Fermentation technology
	LBTM-403	Paper-4b. Chemoinformatics and drug designing
	LBTM-403	Paper-4c. Gene therapy and Nano medicine
	LBTM-403	Paper-4d. Plant Genetics Engineering and molecular breeding
	LBTM- 404	Laboratory VII Based on Core- 1 & 2
	LBTM- 405	Project Dissertation & Viva
	LBTM- 406	Entrepreneurship and Management in Biotechnology

विभागाध्यक्ष, जैव प्रौद्योगिकी विभाग
Head, Department of Biotechnology
गुरु घासीदास विश्वविद्यालय, बिलासपुर (छ.ग.)
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

MINUTES OF THE MEETING OF BOARD OF STUDIES IN BIOTECHNOLOGY HELD ON 01/07/2015

A meeting of the BOS was held on 01.07.2015 at 3 pm to discuss the following:

1. To discuss and approve the course structure and scheme of examination of Int. UG/PG and M.Sc. courses in Biotechnology as per CBCS scheme of the UGC effective from academic session 2015-2016.
2. Any other matter by permission of the Chair.

The following member were present:

(i)	Prof. B.N. Tiwary, Head	Chairman
(ii)	Dr. Renu Bhatt, Associate Professor	Member
(iii)	Dr. D.K. Parihar, Assistant Professor	Member

A copy of the draft of course structure and scheme of examination was sent in advance by email for persual and comment to Prof. Ashok Kumar, Department of Biotechnology, BHU, the external subject expert. However, no reply was received till the time of meeting on 01.07.2015.

At the very outset the HOD and Chairman of BOS welcomed all the esteemed members and placed the draft prepared to revise course structure and scheme of examination in the light of UGC directives as per CBCS scheme to be implemented from 2015-2016. Further the chairman brought to the notice of all members about the resolution of meeting called by the Dean on **23.06.2015** regarding following changes to be made for undergraduate courses:

1. There should be 03 core subjects at entry level of integrated courses in addition to AECC (Ability Enhancement Core Courses) and elective courses.
2. There should be at least 02 groups in each undergraduate course of every Department of the school. The students may opt any one of the two groups for Biotechnology (Hons.)

The course structure and scheme of examination was approved by all members.

The chairman categorically pointed out that in UG courses only 03 core subjects have to be defined and the student shall have choice to opt for any of the subject to pursue, the Honors degree course in 05th sem.

The BOS resolved to have two groups

Group A : Biotechnology-Chemistry-Zoology

Group B: Biotechnology-Chemisrty-Botany

Each of the groups shall have a maximum of 30 seats, i.e. within the total approved seat of 60 in Biotechnology Honors. The number of students of other Departments of School of Life Sciences, opting Biotech as one of the core subjects in no case shall exceed 60.

However, one of the esteemed members, Dr. D.K. parihar, showed his descent mentioning that segregating students in Botany and Zoology will lead to incomplete and inadequate knowledge of Biological sciences, as this is an integral component of Biotechnology.

The meeting ended with a vote of thanks by the Chair.

Dr. Renu Bhatt
(Member)

Dr.D. K. Parihar
(Member)

Prof. B.N. Tiwary 01.07.2015
(Chairman)

M.Sc. Biotechnology (Four Semesters)

Semester I

Code	Course Opted	Subject	Hours/Semester	Hours/Week	Credits
LBTM-101	Core-1	Molecular Cell Biology	48	3	3
LBTM-102	Core-2	Microbial Genetics and Physiology	48	3	3
LBTM-103	Core-3	Bioinstrumentation	48	3	3
LBTM-104	Core-4	Biochemistry (Metabolism and regulation)	48	3	3
LBTM-105	Soft Skill Development Course-1	High Throughput Screening Techniques	48	3	3
LBTM-106	Core-1 & 2	Laboratory-I Based on Core-1 & 2	96	6	3
LBTM-107	Core-3 & 4	Laboratory-II Based on Core-3 & 4	96	6	3
		Total	**432**	**27**	**21**

Semester II

Code	Course Opted	Subject	Hours/Semester	Hours/Week	Credits
LBTM-201	Core-1	Recombinant DNA Technology	48	3	3
LBTM-202	Core-2	Enzymology and Enzyme Technology	48	3	3
LBTM-203	Core-3	Genomics and Proteomics	48	3	3
LBTM-204	Core-4	Computational Biology	48	3	3
LBTM-205		Seminar	32	2	2
LBTM-206	Core-1 & 2	Laboratory III (Based on Core-1 & 2	96	6	3
LBTM-207	Core-3 & 4	Laboratory IV (Based on Core-3 & 4)	96	6	3
		Total	**416**	**26**	**20**

Semester III

Code	Course Opted	Subject	Hours/ Semester	Hours/ Week	Credits
LBTM-301	Core-1	Animal Biotechnology	48	3	3
LBTM-302	Core-2	Advanced Immunology	48	3	3
LBTM-303	Core-3	Plant Biotechnology	48	3	3
LBTM-304	Elective	Paper-4a.: BioprocessEngineering and Technology Paper-4b.: Molecular modeling Paper-4c.:Molecular Diagnostics Paper-4d.: Plant Metabolic Engineering	48	3	3
LBTM-305	Core-1 & 2	Laboratory V Based on Core-1 & 2	96	6	3
LBTM-306	Core-3 & Elective	Laboratory VI Based on core-3 & elective	96	6	3
LBTM-307		Review writing and Seminar	32	2	2
		Total	**416**	**26**	**20**

Semester IV

Code		Subject	Hours/ Semester	Hours/ Week	Credits
LBTM-401	Core-1	Immunotechniques	48	3	3
LBTM-402	Core-2	Environmental Technology			
LBTM-403	Elective Paper	Paper-4a.: Microbial and fermentation technology Paper-4b.: Chemoinformaticss and drug designing Paper-4c.:Gene therapy and Nano medicine Paper-4d.: Plant Genetic Engineering and molecular breeding	48	3	3
LBTM-404	Core-1 & 2	Laboratory VII Based on Core-1 & 2	96	6	3
LBTM-405		Project Dissertation & Viva	288	18	6+3
LBTM-406	Soft Skill Development-2	Entrepreneurship & Management inBiotechnology	48	3	3
		Total	**528**	**42**	**21**

Baskets of Electives: Microbial Technology, Bioinformatics, Animal Biotechnology and Plant Biotechnology

* B.Sc Biotechnology (Hons.) students shall opt one Elective from theBasket of electives offered by the Department.

*Project work/ Field Study will be based on major elective paper (s) opted by the student, in consultation with the faculty concerned and on recommendation of the Head of the Department.

Course: **Bioinstrumentation**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
Microscopy: Principles and applications, simple, compound, phase-contrast and fluorescent microscopes. Electron microscopy: SEM and TEM.X-Ray Crystallography, X-ray diffraction, Bragg equation,Application in structural analysis of biomolecules, Centrifugation Techniques:Principles, types of centrifuges, density gradient centrifugation in isolation of cells, cell organelles and biomolecules

Unit - 2
Electromagnetic spectrum, Beer Lambert's Law, Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy, Mass spectroscopy (LC-MS, GC-MS, MALDI - TOF), Fluorescent spectroscopy, Applications of different Spectroscopic techniques in Biology

Unit - 3
Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion-exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology

Unit - 4
Paper and gel, electrophoresis, Polyacrylamide gel electrophoresis (native and SDS) Agarose gel electrophoresis,Immunoelectrophoresis,Principle and application ofblotting (Southern, Western and Northern and South Western blotting) ELISA

Unit - 5
Nature and types of radiations, preparation of labeled biological samples, Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography,Safety measures in handling radioisotopes. RIA, Non radiolabellingm,Role of ionizing and non ionizing radiation in Structural and functional analysis of biological sample

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Suggested Readings
1. Nuclear Magnetic Resonance: Williams
2. Biochemical Techniques theory and practice:White R
3. Analytical Chemistry:Christion GD
4. A Biologist Guide to Principle and Techniques:Willson K and Gounding KH
5. An Introduction to Practical Biochemistry: Plummer DT

Course: High Throughput Screening Technology
Course Code:
Course Credit: (3-0-0) 3

Unit -1
Introduction to High throughput screening techniques and applications. Microarrays: introduction to microarray technologies, the different platforms by which microarrays are manufactured, and the laboratory process involved in microarray use, sequence databases that are used for microarray design and annotation

Unit -2
Computer Design of Oligonucleotide Probes, methods by which oligonucleotide probes for microarrays can be designed, screening and evaluation of good probe. Microarray image processing: the computational algorithms used to convert microarray images into quantitative data, image segmentation and data acquisition, data normalization, data analysis and clustering

Unit -3
Measuring and Quantifying Microarray Variability, describes methods for measuring and quantifying the stratified variability that is a feature of microarray data. Analysis of Differentially Expressed Genes, looks at the analysis of microarray data where the microarray is being used to identify genes that may be up-regulated or down-regulated in different tissues or conditions

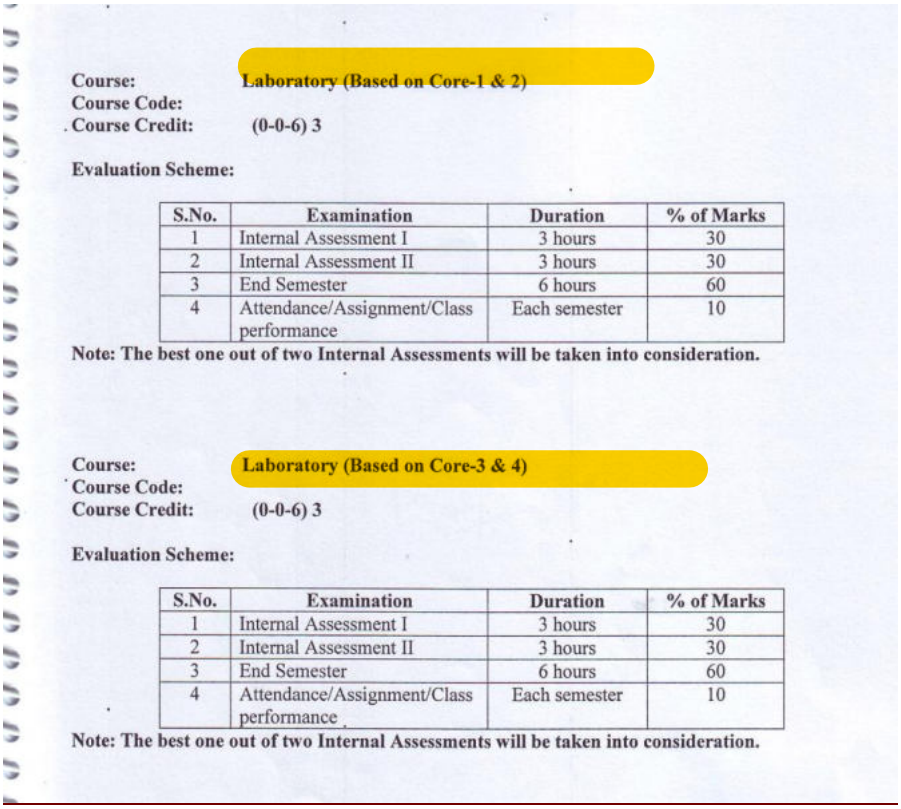
Unit -4
Analysis of Relationships Between Genes, Tissues or Treatments, describes methods that are used to explore the relationships between different genes or samples, including clustering and other related methods. Classification of Tissues and Samples, discusses methods that can be used to build predictive models that use gene expression for diagnostic or prognostic purposes

Unit - 5
Screening of proteins: protein array, antibody array, case studies. Bioinformatics approaches of screening of important genes and proteins form genome, comparative genomics, comparative metabolomics, functional annotation. Structure based and ligand based (3D QSAR and nD QSAR) techniques for screening of lead molecule, case studies

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.



Course: Laboratory (Based on Core-1 & 2)
Course Code:
Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: Laboratory (Based on Core-3 & 4)
Course Code:
Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: Recombinant DNA Technology
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Isolation of DNA and RNA, Quantification of nucleic acids,Radiolabelling of nucleic acids: End labelling, nick translation, labelling by primer extension, DNA sequencing: Maxam-Gilbert (Chemical) and Sanger- Nicolson (dideoxy/ enzymatic) sequencing method, Pyrosequencing

Unit - 2
Restriction endonucleases: Types of restriction endonucleases, classification and uses. Analysis of restriction fragments,Restriction mapping,DNA modifying enzymes, Nucleases, Polymerases, Phosphatases and Polynucleotide kinase

Unit - 3
Cloning vectors; Plasmid, Bacteriophage, and other vectors,Cosmidexpression vectors,DNA ligases; Joining of DNA Fragments*in vitro*, cohesive and blunt end ligation, linkers, adaptors, Homo polymer tailing,Preparation of the Gene construct, Construction of genomic and c-DNA libraries,Selection, screening and analysis of recombinants

Unit - 4
Principle of hybridization, Northern blotting, Southern blotting, Western blotting, South-Western blotting, Polymerase chain reaction, Restriction fragments length polymorphism, RAPD, AFLP

Unit - 5
Strategies of gene delivery, *in vitro* translation, expression in bacteria and yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants, Chromosome engineering, Targeted gene replacement, gene editing, gene regulation and silencing

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Suggested Readings
1. Principles of Gene manipulation: Old RN and Primrose SB
2. From Genes to Clones: Winnaeker EL
3. Recombinant DNA: Watson JD, Witreowski J, Gilman M and Zooller M
4. An Introduction to Genetic Engineering: Nicholl DST
5. Molecular Biotechnology: Pasternak
6. The Biochemistry of Nucleic acid: Adam
7. Genetic Engineering: JankeKswtlow

Course: Enzymology and Enzyme Technology
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Introduction to Enzymes, enzyme commission numbers, and classification of enzymes, Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes

Unit - 2
Enzyme Kinetics: Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the K_m and V_{max} and their significance

Unit - 3
Factor affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis, Enzyme inhibition.

Unit - 4
Structure and function of enzymes in brief: Enzyme regulation and control of their activity, Introduction to allosteric enzymes and isozymes

Unit - 5
Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, abzymes, Protein and Enzyme engineering.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Suggested Readings
1. Enzyme Kinetics: Palmer
2. IUPAC Enzyme nomenclature series
3. Enzyme kinetics: Dixon WB
4. General Enzymology:Kulkarni & Deshpande
5. Enzyme Assays: J Raymond
6. Biochemistry: Voet and Voet
8. Lehninger Principles of Biochemistry: Nelson, Cox

Course: **Genomics and Proteomics**
Course Code:
Course Credit: (3-0-0) 3

Unit -1

Transcription: RNA polymerase, RNA polymerase II Promoters, Eukaryotic Promoters for RNA polymerase III, Hypersensitive sites, Upstream activation sites and enhancers, Mechanism of Eukaryotic Transcription (Initiation, Elongation, Termination), Processing of RNA,

Unit – 2

Translation: Outline of Protein Synthesis, The Genetic Code, Codon Anticodon interaction, Ribosomes, Mechanism of Protein Synthesis in Eukaryotes Initiation, Elongation, Termination), Inhibitors of protein synthesis

Unit – 3

Whole Genome Sequencing Technologies (Next generation sequencing, Pyrosequencing & Reverse termination sequencing).Whole transcriptome sequencing.

Unit - 4

Proteomics: Isoelectric focusing. Protein profiling by one Dimensional and 2 Dimensional gel electrophoresis, Protein sequence analysis by mass spectroscopy.Protein microarrays.

Unit -5

Epigenetics: Definition, Mechanisms of Epigenetic control of gene expression. DNA methylation, histone methylation and histone acetylation, Genomic imprinting.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Computational Biology**
Course Code:
Course Credit: **(3-0-0) 3**

Unit -1
Introduction: sequence similarity, homology, meaning of alignment. Pairwise Sequence Alignment: Substitution matrices (PAM and BLOSUM), Pairwise Alignment: Concept of Global and Local Alignment, Dot matrix method, Dynamic programming (Needleman-Wunsch algorithm, Smith-Waterman algorithm, FASTA and BLAST algorithms

Unit -2
Multiple Sequence alignment: Multiple Sequence Alignment methods (MSA), Scoring of a MSA, Progressive (CLUSTALW), tree guided method of MSA and Pattern searching

Unit -3
Phylogenetic Analysis: Phylogenetic tree and terminology, different methods of Phylogenetic tree prediction.

Unit -4
Structural Alignment Tools and Protein Tertiary Structure Prediction: Homology modeling, simulation techniques in protein structure minimization, molecular dynamics simulation.

Unit -5
Sequence Analysis: DNA sequencing & Human Genome Project, Dinucleotide abundance, Codon biases, GC reach prediction, Pattern searches, Primer design for PCR, Methods for gene finding. RNA Structure Analysis: RNA secondary structure prediction.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Suggested Readings

1. BLAST, Oreilly Publisher, 2003: Ian Korf, Mark &Josaph
2. R. Durbin and S. Eddy and A. Krogh and G. Mitchison, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
3. Bioinformatics and Functional Genomics: J Pevsner
4. Oulette Bioinformatics – A practical guide to the Analysis of Genes and Proteins: AD Baxevanis and BFF
5. DNA and Protein Sequence Analysis---A Practical Approach: MJ Bishop and CJ Rawlings

Course: Laboratory (Based on Core-1 &2)
Course Code:
Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: Laboratory (Based on Core-3 & 4)
Course Code:
Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessment will be taken into consideration.

Course: Animal Biotechnology
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Laboratory requirements for animal cell culture: Sterile handling area. Sterilization of different materials used in animal cell culture, Aseptic concepts. Instumentation and equipments for animal cell culture, History of cell culture, Primary and secondary cell culture

Unit - 2
Media and reagents:Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growthsupplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum,Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, serumand other reagents

Unit - 3
Different types of cell cultures, Trypsinization, Cell separation,Continuous cell lines, Suspension culture, Organ culture, Development of cell lines, Characterization andmaintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants

Unit - 4
Stem cell research: Current status and application in medicine. Application of animal cell culture for *in vitro* testing of drugs; Application of cell culture technology in production ofhuman and animal viral vaccines and pharmaceutical proteins. Types of blood substituents, Artificial blood, General account of *in vitro* regulation of blood cells production

Unit - 5
Gene transfer technology in animals: Viral and non-viral methods, Production of transgenic animals and molecular pharming, current status of production of transgenic animals. Animal cloning: Techniques, relevance and ethical issues

Evaluation Scheme:

Course: Advanced Immunology
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Introduction: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organisation and structure of lymphoid organs

Unit - 2
Cells of immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dentritic cells, natural killer and lymphokine activated killer cells. Eosinophils, neutrophils and mast cells.Differentation and activation of B and T lymphocyts, cytokine structure and function, cytokine receptor.

Unit - 3
Nature and Biology of antigens and super antigens,Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA, Generation of antibody diversity and complement system,Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity

Unit - 4
Antigen processing and presentation, generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, Immunological tolerance, Hypersensitivity, Autoimmunity.

Unit - 5
Transplantation, Immunity to infectious agents (intracellular parasites, helimenths& viruses,) Tumor Immunology, AIDS and other immunodeficiences.Hybridoma Technology and Monoclonal Antibodies

Evaluation Scheme:

Course: Plant Biotechnology
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Introduction to the techniques of plant tissue culture, Concept of cellular totipotency, Nutritional requirements, single cell culture, micro-propagation, somaclonal variation, somatic embryogenesis and production of embryoids

Unit -2
Haploid and double haploid production, Protoplast isolation and culture, Somatic hybridization and cybrid production and their applications in crop improvement, Productions of virus free plants using meristem culture

Unit - 3
Basis of tumor formation, hairy roots, features of Ti and Ri plasmids, mechanisms of transformation,binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, transformation on monocots,Transgene stability and gene silencing, Herbicide and insect resistance , Plant Genetic Engineering: Transgenic plants, Genetically modified (GM) plants (Bt cotton, BtBrinjal)

Unit - 4
Photoregulation and phytochrome regulation of nuclear and chloroplast genes expression, Molecular biology of light and dark reactions of photosynthesis,Molecular mechanism of nitrogen fixation, Genetics of *nif*genes

Unit - 5
Plant secondary metabolites: Control mechanisms and manipulation metabolic pathways of production of alkaloids and industrial enzymes, biodegradable plastics, therapeutic proteins, Edible vaccines, purification strategies,-Green house Technology, Biotic and Abiotic stress

Evaluation Scheme:

Bioprocess Engineering & Technology

Course Code:

Course Credit: (3-0-0) 3

Unit - 1

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media formulation for industrial fermentation, Air and media sterilizationDesigning of a fermenter/Bioreactor

Unit - 2

Types of fermentation process, analysis of batch fed batch and continuous bioreactions, biotransformation, stability of microbial reactors, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.), Measurement and control of bioprocess parameters

Unit - 3

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization

Unit - 4

Industrial production of chemicals: alcohols, acids (citric, acetic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins

Unit - 5

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages, petro crops, Mushroom-types, isolation and culture

Course: **Molecular Modeling**
Course Code:
Course Credit: **3 0 0 (3)**

Unit - 1
The fundamental concepts of molecular modeling (chemical building blocks, structure, superstructure, folding, etc.); the physical forces that shape macromolecules; structural databases (protein data bank, SCOP database, CATH database and other structure based databases)

Unit - 2
Protein structure prediction: computational methods for secondary structure prediction (Chou-Fasmann, GOR and Neural Networks) and reliability (Q3 value and SOV score); prediction of tertiary structures of protein (Homology and Threading methods); structure quality assessment

Unit - 3
Protein structures comparison and alignment: comparison algorithm & optimization, multiple structural alignment. Analysis of 3D structures: secondary structure assignment, assignment of hydrogen bonds, coulomb hydrogen bond calculation, empirical hydrogen bond calculation, assignment methods of secondary structure (DSSP, STRIDE, DEFINE, P-Curve)

Unit - 4
Identifying structural domains in protein: first and second generation algorithms for domain assignments, domain assignment based on graph theoretical methods, prediction of binding sites and characterization; Inferring protein function from structure: enzyme/non-enzyme classification, gene ontologies, ab initio prediction, structural comparison, structural motifs.

Unit - 5
Ab initio protein structure prediction: Potential Energy Function (bond length potential, aond angle potential, torsional potential, van der wals potential and coulomb potential), Energy minimization techniques: concept of local and global minima, energy minimization protocol, energy minimization algorithms (steepest descent, conjugate gradient, Newton Raphson); Molecular Dynamics simulations, Monte Carlo Simulations, Calculation of Free energy using simulation techniques.

Evaluation Scheme:

Course: **Molecular Diagnostics**
Course Code:
Course Credit: (3-0-0) 3

Unit- 1
Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays.Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

Unit - 2
Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

Unit - 3
Laboratory tests for microbial infection, Antimicrobial Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Diffusion test procedures.Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests

Unit- 4
Rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.Immunodiagnostic tests.Immuno florescence.Radioimmunoassay, Immunohistochemistry.

Unit- 5
Genetic disorders. Molecular techniques to detect genetic disorders, Genetic test for Thalassemia, Fanconianemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	30
2	Internal Assessment II	1hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Plant Metabolic Engineering**
Course Code:
Course Credit: **(3-0-0) 3**

Unit-1
The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways

Unit-2
Flavanoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

Unit-3
Terpenoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

Unit-4
Polyketoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

Unit-5
Production of secondary metabolites from plant cell cultures; Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals; Bioreactors systems and models for mass cultivation of plant cells, Plant Therapeutic proteins, Edible vaccine, Bioplastic.

Course: **Laboratory (Based on Core 1 & 2)**
Course Code:
Course Credit: **(0-0-6) 3**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessment will be taken into consideration.

Course: **Laboratory (Based on Core-3 & elective)**
Course Code:
Course Credit: **(0-0-6) 3**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hours	30
2	Internal Assessment II	3 hours	30
3	End Semester	6 hour	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Review writing & Seminar**
Course Code:
Course Credit: **(3-0-0) 3**

Each student will select a topic after consulting with faculty members and approval of the Head of the Department for the proposed area of the dissertation work. The students shall be required to submit a synopsis of the proposed project work giving rationale of the work, methodology to be used, methods of data analysis as hard copy before seminar presentation.

Course: **Environmental Biotechnology**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
Components of Environment - Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject

Unit - 2
Global Environmental Problems - Green House Effect, Acid rain, Ozone depletion, salination, biodiversity loss; chemical and radiation hazards.

Unit - 3
Environmental pollution and degradation - Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc)

Unit - 4
Environmental Management - Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, health hazards due to pesticide and metal pollution, waste treatment, solid waste management

Unit - 5
Bioremediation - Oil spills, Wastewater treatment, chemical degradation, heavy Metals

Course: **Immunotechnology**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1

Production and engineering of antibodies: Production of monoclonal and polyclonal antibodies, hybridoma technology, specific and cross reactivity, Anti-immunoglobulin antibodies; Antibody engineering, abzymes, Antigen-antibody interaction as a basis of precipitation and agglutination reactions, blood typing, RIA, ELISA, Microscopy, Imaging-Immunohistochemistry, Immunoprecipitation and co-immunoprecipitation, Immunoblotting

Unit -2

Isolation and enrichment of specific immune cells, ELISPOT, Flow-cytometer and FACS for quantitative/qualitative analysis and sorting of different immune cell subsets, Cell functional assays-lymphoproliferation, Cell cytotoxicity, mixed lymphocyte reaction, apoptosis

Unit -3

Immune response and bacterial, parasitic and viral infections, congenital and acquired immunodeficiency; tolerance and autoimmune diseases, Transplantation and Tumor Immunology, diagnosis and therapeutic approaches. Cytokine related diseases: diagnosis and therapeutic application of cytokines

Unit -4

Manipulation of the immune response: Regulation of unwanted immune responses and immunomodulation against autoimmunity, transplantation rejections, cancer therapy, Vaccination strategies: Active immunization: Sub unit vaccines; Recombinant DNA and protein based vaccines, Peptide vaccines, conjugate vaccines; Passive Immunization: Antibody, Transfusion of immuno-competent cells, Stem cell therapy; Cell based vaccines, Immunoinformatics and vaccine design

Unit - 5

Adoptive cell transfer therapy; Animal models: Transgenic mice and gene knockout by targeted disruption, *in vivo* cell tracking techniques, Cell imaging techniques-*in vitro* and *in vivo*. Molecular diagnosis of immunological disorders: ex. DiGeorge syndrome, humoral immunodeficiency, cellular immunodeficiency (due to defects in IFNg receptor a and b chain, MHC Class I)

Evaluation Scheme:

Course: **Microbial & Fermentation Technology**
Course Code:
Course Credit: **(3-0-0) 3**

Unit-1
History and scope of microbial biotechnology, the bioreactor/fermenter-types and parts, scale-up, media design for fermentation processes, Economic aspects of fermentation

Unit-2
Biotechnological application of microorganisms, Production of chemicals and pharmaceuticals (bioconversion), Production of microbial enzymes and their applications, Microbes in mining, Ore leaching, oil recovery, Application of microbes inpharmaceutical industry

Unit-3
Role of microorganisms in the production and transformation of food and beverages -Food fermentation - Bread leavening - by yeast – by other micro organisms– chemicalleavening, Brewing: Manufacture of Beer- microbiological aspects. Wine - Kinds of wines, manufacture, microbial spoilage, Distilled liquors. Vinegar -methods of manufacture

Unit-4
Fermented vegetables - Pickles - Fermented dairy products – Fermented milk , cheese, butter and other milk products - spoilage of milk - preservation of milk.

Unit-5
Biofertilizers- manufacture, formulation and utilization, Microbes as Biofertilizers -Chemically fixed Nitrogen versus biologically fixed Nitrogen, biopesticides.

Course: **Chemoinformatics & Drug Designing**
Course Code:
Course Credit: **(3-0-0) 3**

Unit -1
Defining chemical informatics; a glimpse of the future of chemical informatics. Representing 2D structures: Kinds of 2D structure representation; atom lookup and connection tables; graph theory; SMILES; SD files; Fragment codes & Fingerprints; descriptors. 2D chemical database applications. Types of searching; substructure searching with SMARTS; similarity searching with fingerprints; demonstrations of searching systems

Unit -2
Representing 3D structures. Sources of 3D information; experimental 3D databases; conformational flexibility; distance matrices; estimation of 3D structure; conformational search and minimization; 3D descriptors and fingerprint; representation of proteins

Unit -3
Molecular Descriptors: 2D descriptors. Kinds of descriptor; "mathematical" and topological indices; biological descriptors and their application in ADME/Tox; biological properties; property prediction software, 3D descriptors, data verification and manipulation

Unit - 4
Quantitative structure-property relationships(QSPR):Feature selection, Model building, examples of QSPR studies and application. QSAR in drug design: QSAR methodology, biological and physicochemical parameters, QSAR applications in drug design, QSAR model selection and validation, CoMFA, 3D and nD-QSAR methods

Unit - 5
Pharmacophore and Drug Discovery: pharmacophore generation, database building and conformer generation, query generation and submission, searches in the database, software for pharmacophore generation, application and limitation of pharmacophore concept. De-novo design system: generating the constraints model, finding structure, sorting and selection, synthetic accessibility, experimental validation. Computational models for ADME/Tox. The application of predictive models to pharmacology and toxicity testing.

Course: **Gene Therapy and Nano medicine**
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Clinical management and Metabolic manipulation - Phenylketouria, Familial Hyper- cholesterolemia, Rickets, ADA, Congenital hypo-thyroidism

Unit - 2
Gene therapy - Ex-vivo, *In-vivo*, *In-situ* gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy - retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer. Gene therapy trials

Unit - 3
Stem cell and tissue engineering, Embroynic and adult stem cell, Potential use of stem cells - Cell based therapies

Unit - 4
Types of nanoparticles, uses in Nanomedicine and therapeutically applications in medical biotechnololgy

Unit – 5
Health and Environmental impact of Nanotechnology:Special emphasis to risk assessment and risk management of nanomaterials, ethical and legal aspects of nanotechnology, and nano-industry and nano-entrepreneurship.

Evaluation Scheme:

Course: **Plant Genetic Engineering & Molecular breeding**
Course Code:
Course Credit: **(3-0-0) 3**

Unit-1
Plant Transformation Technology: *Agrobacterium* based vectors.*Agrobacterium* mediated gene transfer; viral vectors and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment

.Unit-2
Genetic engineering for biotic stress tolerance: Insects, fungi, bacteria, viruses, weeds; abiotic stress tolerance: drought, flooding, salt, heavy metals and temperature

Unit-3
Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency

Unit-4
Genetic engineering for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients

Unit-5
Introduction to molecular markers, construction of Molecular maps, Molecular tagging of genes/traits, Marker-assisted selection of qualitative and quantitative traits, The concept of map-based cloning and their use in transgenics

Course: **Laboratory (Based on Core-1 & 2)**
Course Code:
Course Credit: **(0-0-6) 3**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3hours	30
2	Internal Assessment II	3hours	30
3	End Semester	6 hours	60
4	Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Project Dissertation (Based on Elective)**
Course Code:
Course Credit: **(0-0-18) 09**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment	2 hours	90
3	End Semester	3 hours	110