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 : *B.Sc.,*

Academic Year : 2016-17

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
	LBTC 103	Laboratory - 1 (Based on Core - 1)
	LBTC 201	Paper-1 Microbiology
	LBTC 203	Laboratory (Based on Paper-1 & Paper 2)
	LBTC 301	Paper-1 Biostatistics
	LBTC 302	Paper-2 Molecular Biology
	LBTC 303	Laboratory (Based on Paper-1 & 2)
	LBTC 402	Paper-2 Biophysical Techniques
	LBTC 403	Laboratory (Based on Paper-1 & 2)
	LBTC 501	Paper- 1 Genetic Engineering
	LBTC 502	Paper-2 Bioinformatics
	LBTC 504	Paper -4a. Microbial enzymes & Therapeutics
	LBTC 504	Paper-4b. Structural Biology
	LBTC 504	Paper-4c. Medical Diagnostics
	LBTC 504	Paper-4d- Biotechnology in crop improvement
	LBTC 505	Laboratory Based on Paper -1 & 2)
	LBTC 506	Laboratory based on Elective Paper

	LBTC 601	Paper- 1 Stem Cell and Healthcare
	LBTC 602	Paper-2 Industrial Biotechnology IPR and GLP
	LBTC 603	Paper-3 Plant and Animal Tissue Culture
	LBTC 604	Paper -4a. Fermentation and Downstream processing
	LBTC 604	Paper-4b. Computer aided drug designing
	LBTC 604	Paper-4c. Clinical Biochemistry
	LBTC 604	Paper-4d- Food and Agricultural Biotechnology
	LBTC 605	Laboratory (Based on LBTC-601, 602 & 603)
	LBTC 606	Project Dissertation (Based on major elective)

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)

Integrated UG/PG Biotechnology (Five years/Ten semesters)

Code	Course Opted	Semester – I Subjects	Hours/ Semester	Hours/ Week	Credits
LBTc-101	Core-1 (Biotechnology)	Paper-1 Biomolecules	32	2	2
LBTc-102		Paper-2 Cell Biology	32	2	2
	Core-2 (Botany/Zoology)	Paper-1	32	2	2
		Paper-2	32	2	2
	Core-3 (Chemistry)	Paper-1	32	2	2
		Paper-2	32	2	2
	Ability Enhancement Compulsory Course	Hindi-I	32	2	2
		English-I	32	2	2
LBTc-103	Core-1	Laboratory (Based on Paper-1 & 2)	64	4	2
LBTc-103	Core-2	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-3	Laboratory (Based on Paper-1 & 2)	64	4	2
		Total	**448**	**28**	**22**

Code	Course Opted	Semester- II Subjects	Hours/ Semester	Hours/ Week	Credits
LBTc-201	Core-1 (Biotechnology)	Paper-1 Microbiology	32	2	2
		Paper-2 Genetics	32	2	2
LBTc-202	Core-2 (Botany/Zoology)	Paper-1	32	2	2
		Paper-2	32	2	2
	Core-3 (Chemistry)	Paper-1	32	2	2
		Paper-2	32	2	2
	Ability Enhancement Compulsory Course	Hindi-II	32	2	2
		English-II	32	2	2
LBTc-203	Core-1	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-2	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-3	Laboratory (Based on Paper-1 & 2)	64	4	2
		Total	**448**	**28**	**22**

	Semester - III				
Code	**Course Opted**	**Subjects**	Hours/Semester	Hours/Week	Credits
LBTc-301	Core-1	Paper-1 Biostatistics	32	2	2
LBTc-302		Paper-2 Molecular Biology	32	2	2
	Core-2	Paper-1	32	2	2
		Paper-2	32	2	2
	Core-3	Paper-1	32	2	2
		Paper-2	32	2	2
	Skill Enhancement Course-1	Environmental Sciences-I	32	2	2
LBTc-303	**Core-1**	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-2	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-3	Laboratory (Based on Paper-1 & 2)	64	4	2
		Total	**416**	**28**	**20**

	Semester – IV				
Code	**Course Opted**	**Subject**	Hours/ Semester	Hours/ Week	Credits
LBTc-401	Core-1	Paper-1 Immunology	32	2	2
LBTc-402		Paper-2 Biophysical Techniques	32	2	2
	Core-2	Paper-1	32	2	2
		Paper-2	32	2	2
	Core-3	Paper-1 Chemistry-VII	32	2	2
		Paper-2 Chemistry-VIII	32	2	2
	Skill Enhancement Course-1	Environmental Sciences-II	32	2	2
		Disaster Management (incorporate only if common syllabus or Academic council decision)	32	2	2
LBTc-403	Core-1	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-2	Laboratory (Based on Paper-1 & 2)	64	4	2
	Core-3	Laboratory (Based on Paper-1 & 2)	64	4	2
		Total	**448**	**32**	**22**

*Student can opt any one out of the three core papers (Biotechnology, Botany/Zoology and Chemistry) as the honours (Subject to the availability of the seats as approved by the Academic Council)
*The decision of the Dean of the school and the Head of the respective Department will be final

Code	Semester – V Course Opted	Subject	Hours/ Semester	Hours/ Week	Credits
LBTc-501	Core-1	Paper-1 Genetic Engineering	48	3	3
LBTc-502		Paper-2 Bioinformatics	48	3	3
LBTc-503		Paper-3 Inter Disciplinary life Science	48	3	3
LBTc-504	Elective	Paper-4a.Microbial enzymes & Therapeutics Paper-4b. Structural Biology Paper-4c.Medical Diagnostics Paper-4d. Biotechnology in crop improvement	48	3	3
		Laboratory			
LBTc-505	Core-1	Laboratory Based on paper-1&2	96	6	3
LBTc-506		Laboratory Based on Elective Paper	96	6	3
LBTc-507		Seminar (Based on the Proposed project topic)	32	2	2
		Total	**416**	**26**	**20**

Code	Semester- VI Course Opted	Subject	Hours/ Semester	Hours/ Week	Credits
LBTc-601	Core-1	Paper-1: Stem cell and Healthcare	48	3	3
LBTc-602		Paper-2: Industrial Biotechnology, IPR and GLP	48	3	3
LBTc-603		Paper-3: Plant and Animal Tissue culture	48	3	3
LBTc-604	Elective	Paper-4a:Fermentation and downstream processing Paper-4b:Computer aided drug designing Paper-4c:Clinical Biochemistry Paper-4d:Food and Agricultural Biotechnology	48	3	3
LBTc-605	Core-1	Laboratory Based on LBTC – 601, 602 & 603)	96	6	3
LBTc-606		Project Dissertation (Based on major elective)	192	12	6
		Total	**480**	**30**	**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: Laboratory (Based on Core-1)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-2)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-3)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-1)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3-hour	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-2)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-3)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: **Biostatistics**
Course Code:
Course Credit: **(2-0-0) 2**

Unit - 1
Introduction and definition of biostatistics, tabulation and classification of data, frequency distribution and graphical distribution of data

Unit - 2
Measures of central tendencies, mean, median, mode and their properties, measure of dispersion: mean deviation, variance, coefficient of variance and standard deviation

Unit-3
Comparison of two data sets: hypothesis, studentst-test, paired t-test, correlation coefficient,liner regression analysis, chi-square test, contingency test, testing of hypothesis

Unit - 4
Concepts and problems on probability: probability distribution function, binomial distribution, poisson distribution

Unit - 5
Comparison of three and more samples: one-way ANOVA test, least significant difference, two-way ANOVA test, hypothesis and testing of hypothesis

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Principles of Biostatistics: Mishra BN and Mishra SN
2. Biostatistics: Daniel WW
3. Principle of Biostatistics: Marcello pagano

Course: Molecular Biology
Course Code:
Course Credit: (2-0-0) 2

Unit - 1
Prokaryotic and eukaryotic genome organization, central dogma, structural organization of chromosome.

Unit - 2
The Basic Rule for Replication of all Nucleic acids, Enzymology of DNA replication, Mechanism of DNA replication in prokaryotes (Initiation, elongation and termination),

Unit - 3
Basic features of RNA synthesis, E.coli RNA polymerase, Mechanism of RNA synthesis in prokaryotes (Initiation, elongation, termination), Concept of reverse transcription.

Unit - 4
Genetic code, Translation machinery, Mechanism of protein synthesis (activation of aminoacid and aminoacylation of t-RNA, initiation, elongation and termination.

Unit - 5
Molecular Mechanism of gene regulation in prokaryotes - Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Molecular Biology of the Gene: Watson JD, Hopking N, Robast J. and Steiz, J
2. Gene X:Lewin Benjamin
3. Molecular cell Biology: Lodish H, Baltimore D, Berk A, Zipursky SL, Paul M and Darnell J
4. Cell and Molecular Biology: Gerald Karp
5. Molecular Biology: Upadhyaye
6. Molecular Biotechnology: Piramal.
7. Molecular Biology of the Gene: Watson

Course: **Biophysical Techniques**
Course Code:
Course Credit: **(2-0-0) 2**

Unit - 1
General biophysical methods – Measurement of pH, buffers, Henderson – Hasselbalch equation, isoelectric point

Unit - 2
Separation & identification of biomolecules - concept of chromatography (partition chromatography adsorption chromatography, ion exchange chromatography, gel filtration chromatography, affinity chromatography), principle and application of electrophoresis

Unit - 3
Centrifugation – basic principle of centrifugation, instrumentation of ultracentrifuge (preparative analytical), sedimentation coefficient

Unit - 4
Microscopy – light microscopy, bright & dark field microscopy, fluorescence microscopy, phas contrast microscopy, TEM, SEM

Unit - 5
Spectroscopy: Beer-Lambert's law, instrumentation, radioactive labeling & counting, autoradiography scintillation counters, Geiger-Muller counter

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings

1. Biochemical Techniques theory and practice: White R
2. Analytical Chemistry: Christion GD
3. An Introduction to Practical Biochemistry: Plummer DT
4. Undergraduate Instrumental Analysis: Robinsan, JW
5. Essentials of Biophysics: Narayanan, P
6 A Text Book of Biophysics: Roy RN
7. Biophysical chemistry: Upadhya andNath

Course: Laboratory (Based on Core-1)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-2)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: Laboratory (Based on Core-3)
Course Code:
Course Credit: (0-0-4) 2

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: **Genetic Engineering**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
History of recombinant DNA technology, Host controlled restriction modification system, restriction endonucleases, Cutting and joining of DNA molecules *in vitro*. Phosphatases, ligases and polymerases

Unit - 2
Cloning vectors: plasmid, bacteriophage, cosmids, phagemid, BAC and YAC vectors, Expression vectors, Gene transfer methods: microinjection, electroporation, microprojectile bombardment, shot gun method, ultrasonication, lipofection, micro laser, Selection and screening of recombinants by genetic, immunochemical and hybridization methods

Unit - 3
Expression of foreign genes in *E.coli* and Yeast, application of gene cloning for the analysis of gene structure and function, expression of foreign genes using strong promoters, production of protein and other therapeutics from cloned genes, artificial insulin gene, recombinant vaccine

Unit - 4
Genetic engineering in plants: use of *Agrobacterium tumefaciens* and *Agrobacteriumrhizogenes*, Ti plasmids, application of recombinant DNA technology in agriculture

Unit - 5
Genetic engineering in animals: production of transgenic mice, embryonic stem cells for gene targeting in mice, applications of gene targeting

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings

1. Molecular Biotechnology, Principles and Applications of Recombinant DNA:Glick BR & Pasternak JJ
2. Gene cloning and Manipulating: Christopler H
3. An Introduction of Genetic Engineering: Nicholl DST
4. Principles of Gene manipulation: Old. RW and Primrose SB
5. Genetic engineering in plant: Narnin R

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

Unit - 1
Introduction to Bioinformatics: definition, history of bioinformatics, applications of bioinformatics, information flow in biology. Biological databases: characteristics, categories and navigating databases

Unit - 2
Sequence databases: sequence file format, primary nucleotide database, secondary nucleotide database, primary protein sequence databases, secondary and specialized protein sequence databases. Information retrieval system: entrez and SRS. Data submission tools: nucleotide sequence submission tools, protein submission tools

Unit - 3
Structure databases: structure file formats, protein structure databases: PDB, MMDB, CATH, SCOP, FSSP, DALI. Other databases: enzyme databases (BRENDA), pathway databases (KEGG)

Unit - 4
Data analysis tools: nucleotide sequence analysis tools, protein sequence analysis tools, substitution models (BLOSUM and PAM matrix)

Unit - 5
Introduction to Genomics; DNA sequencing techniques, whole genome sequence strategies, next generation sequencing techniques, physical mapping, contig assembly, computational gene predictions

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Bioinformatics: OrpitaBosu, S.K, Thukral, Oxford Higher Education.
2. Molecular databases for protein sequence and structure studies: Sillince A and Sillince
3. Sequence analysis primers: Gribskov M and Devereux J
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount
5. Bioinformatics: Sharma &Munjal
6. Bioinformatics:Lesh M Arthur

Course: Microbial Enzymes and Therapeutic products
Course Code:
Course Credit: (2-0-0) 2

Unit - 1
Production of enzymes from microbial sources (penicillin amidases,bacteriallipases,bacterial amylases, fungal α amylases, fungal lipases, proteases, pectinases, lipooxygenases)

Unit - 2
Production of enzymes on an industrial scale, applications in food and drink industries

Unit - 3
Uses of enzymes in starch industry-HFCS, detergent industry, baking industry, dairy industry, textile, paper and pulp industry

Unit - 4
Production of chemotherapeutic agents-production, recovery and applications of antibiotics, general features of microbial polysaccharides- production, recovery. and applications (xanthan, dextran, alginate)

Unit - 5
Diagnostic and therapeutic applications of enzymes in a) medicine (assay of plasma enzymes, in born errors of metabolism), therapeutic enzymes b) Forensic sciences (seminal acid phosphatases, alcohol dehydrogenase, serum tryptase)

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Reading:

1. Enzymes: Trevor Palmer,Philip Bonner
2. Enzyme Kinetics: A.G. Marongoni
3. Biocatalysts and Enzyme technology: Klaus Buchhloz, Volker Kasche andUme.T. Born Scheuer
4. Enzyme technology:S.Shanmugam,T. Satishkumar, M. Shanmugaprakash

Course: Structural Biology
Course Code:
Course Credit: (3-0-0) 3

Unit – 1
Introduction: Amino acid building blocks, protein conformation framework, structure hierarchy (helices, beta-sheets, turns & loops, supersecondary structure, tertiary structure, quarternary structure), Ramachandran plot, protein folding, protein mis-folding, diseases arising from misfolding

Unit - 2
Experimental protein structure determination (isolation, purification, crystallization of proteins, X-ray crystallography: basic principles of X-ray diffraction studies, refinement of the structures errors in low resolution protein structures. Coordinates system for 3D representation of molecules, transformations of coordinates

Unit – 3
Covalent and non-covalent forces (H-bonding, base stacking & hydrophobic interaction, paired interaction, torsion angle, solvent interaction) in protein, role of free energy in random and natural states of polypeptide chain

Unit – 4
Structural classification of proteins, protein structure classification databases, principle of protein structure classification, protein-protein, protein-DNA and protein-RNA interactions, membrane proteins, metalloproteins, carbohydrate binding proteins and metalloenzymes: structure and function. The structure of spherical viruses and introduction to protein engineering

Unit – 5
Nucleic acid structures: introduction to RNA secondary structure, DNA tertiary structure (A- and B-DNA, major and minor grooves of DNA, Z-DNA, mechanism of specific base sequence recognition in B-DNA, triple helix DNA, tetraplex DNA

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Introduction to Protein Structure Garland Publishing Inc., New York: Carl Branden and John Tooze
2. Principles of Protein Structure:Schlutz GH and Schirmer RH
3. Molecular Modelling:Holtje and Folkers G Weinheim

Course: Medical Diagnostic
Course Code:
Course Credit: (2-0-0) 2

Unit - 1
Transportation of different clinical materials to distant Laboratories . Proper storage of samples, Chemicals, antibodies and enzymes Common anticoagulants used-composition, amount, mechanism of action and methods of preparation of different types of vials

Unit - 2
Basic Knowledge on Protozoa and helminthes. Life cycle and diseases caused by Protozoan and helminthes eg. Malaria, Filaria. Basic knowledge of AIDS, Tuberculosis and precaution during sample collections

Unit - 3
The Microscope – different types, parts of microscope, cleaning & care. Microscopical examination – Cells (RBC, WBC, Epith), casts, crystals, Detection of microalbumin

Unit - 4
Origin, development & morphology of blood cells.Composition of blood and its function.Drawing of peripheral blood smear, staining & stain preparation. Methods of estimation of Haemoglobin, Methods of total counts of WBC, RBC, Platelets& fluids used. Blood Group (ABO & Rh) – methods of grouping & reverse grouping. Principles of semi or automated blood cell counters & HPLC

Unit - 5
Biosafety measures and disposal of laboratory waste. Basics of quality control methods and Laboratory accreditation. Cytochemical Stain for diagnosis/differential diagnosis of leukemia

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Reading:

1. An introduction to the invertebrates: Moore
2. Cytology: Diagnostic Principles and Clinical Correlates: Edmund S. Cibas and Barbara S. Ducatman
3. Molecular Diagnostics: Current Research and Applications: Jim Huggett and Justin O'Grady
4. Genetics in Clinical Practice Symptoms, Diagnosis and Therapy:JayeshSheth and FrennySheth
5. Moving Molecular Diagnostics from Bench to Clinic:Ilsa Gomez-Curet
6. Modern Blood Banking & Transfusion Practices: Denise M. Harmening
7. Biophysical chemistry: Upadhya&Nath
8. A Biologist Guide to Principle and Techniques: Willson K and Gounding KH

Course: Biotechnology for Crop Improvement
Course Code:
Course Credit: (2-0-0) 2

Unit-1
Basic techniques and tools of plant tissue culture: Establishment of plant tissue culture lab: equipment, culture vessels, Composition of various tissue culture media and their preparation surface sterilization of various explants, pretreatment of explant, subculture and repeated transfer of explants and cultures, Hardening.

Unit-2
Culture techniques: Meristem tip culture, anther, embryo and ovule culture, callus culture, suspension cultures, Single cell culture, organogenesis and embryogenesis, Artificial seed (synthetic seed)

Unit-3
Tissue culture in crop improvement: Micropropagation for virus-free plants, Somaclonal variation, Somatic hybridization, Haploids in plant breeding.

Unit-4
Protoplast culture: Importance, Isolation of protoplasts, method of protoplast culture, culture media, Growth and division of protoplast, regeneration of plants

Unit-5
Biofertilizers, Plant growth promoting rhizobacteria, Biological control, Biopesticides, Biopesticides v/s chemical pesticides: advantages and disadvantages, Integrated Pest Management (IPM)

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested readings:

1. Biotechnology from A to Z. Bains.W
2. Essentials of Biotechnology for Students. Das.S.N.
3. Invitro culture of higher plants. Martinusnijhoffpublishers.Netherlands.
4. Biotechnology: Singh.B.D.
5. Chemical regulation of growth and formation in plant tissue cultured in vitro. Attidel. II Symp. On biotechnology Action of growth substance. Skoog, Y. and C.O.Miller
6. Somatic hybridization and genetic manipulation in plants. Plant regulation and world Agriculture, Vasil, T.k., M.Vasi, D.N.R While,H.R.Bery

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	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: **Laboratory (Based on Elective paper)**
Course Code:
Course Credit: **(0-0-6) 3**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hour	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: **Stem Cell & Health Care**
Course Code:
Course Credit: **(3-0-0) 3**

Unit – 1
Introduction to stem cells: Stem cells: the promising field of research, History ,Types and Possible sources of Stem Cells. Unique properties: self-renewal, Potency and Proliferation, Cell Cycle , Asymmetric Cell Division & Apoptosis

Unit - 2
Embryonic stem cells: Characteristics of ES cells: Self_renewal& Pluripotency, Sources: IVF & SCNT, Stem cells and Cloning, Isolation and Culture Techniques, Characterization Embryonic Stem Cells vsPrimordial Germ Cells. hESCs: Unique features and debate on hEScs culture Genetic Manipulation and Differentiation including signal pathways

Unit – 3
Adult stem cells: Adult Stem Cells Vs Embryonic stem cells, Types of Adult Stem Cells: Umbilical Cord Blood, Placental, Hematopoietic, Cardiac, Neural, Pancreatic Stem Cells etc.

Unit – 4
Tissue Engineering and Therapeutic Applications of Stem Cells: Tissue Engineering Techniques and Opportunity for Regenerative Medicine, Application and the problems like immunorejection, Discussion on recent development in Stem cell Research related to Healthcare: Case studies

Unit – 5
Stem cell Banking: Vision, collection and storage procedure, Insurance against life threatening diseases, Existing Centres both in India and abroad. Stem cell research in India: Stem cell research Centres and their valuable contribution. Ethical and legal issues: Both in India and abroad. Various guidelines for conducting stem cell research

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested reading:
1. Computer modeling of Biomolecular Interactions: Kothekar V
2. Molecular modeling and simulation; Tamar Schlick
3. Structural bioinformatics: Bourne and Weissig
4. Molecular Modeling: Principles and Applications: Leach AR
5. Drug Design: Structure- and Ligand-based Approaches. Merz KM, Ringe D, Reynolds CH

Course: **Industrial Biotechnology, IPR & GLP**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
Bioreactor / Fermenter – types, working & operation of Bioreactors, Fermenters (Stirred tank, bubble columns, airlift, Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations

Unit - 2
Enzyme technology – nature of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors,protein engineering of enzymes, Industrial applications of free and immobilized enzymes

Unit - 3
Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations offermentation products. Biofilms, microbial biopolymers, biosurfactants

Unit - 4
Intellectual Property Rights, International Organizations and Intellectual Property Rights Introduction to Patent and Process Involved in Patenting, Patenting Living Organisms. Traditional Knowledge, Commercial Exploitation, and Protection, Use of Genetically Modified Organisms and their Release in the Environment. Hazardous Materials used in Biotechnologytheir Handling and Disposal

Unit - 5
Introduction to Bioethics and Biosafety, Biosafety Guidelines and Regulations. Legal and Socio-economic Impacts of Biotechnology, Ethical, Legal and Social Implications of Human Genome Project,Bioethics in Biodiversity and Resource Management. Ethical Issues in Genetically Modified Organisms

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Frontiers in Microbial Technology:Bisen PS
2. Industrial Microbiology: Prescott and Dunn
3. A text of Industrial Microbiology: Crueger W and Crueger A
4. Priciples of Fermentation Technology: Stanbury PF, Ehitaker H, Hall SJ
5. Fermentation Biotechnology: Mansi
6. Principle of fermentation technology: Stanbury PF

Course: Plant & Animal Tissue Culture
Course Code:
Course Credit: (3-0-0) 3

Unit - 1
Introduction to Techniques – introductory history, laboratory organization, maintaining aseptic environment, basic concepts in cell culture - cellular totipotency, somatic embryogenesis

Unit - 2
In vitro plant tissue culture: approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture. Plant cell culture: callus culture, cell suspension culture, organ culture, micropropagation, somaclonal variations

Unit - 3
Tissue nutrition: growth hormones - plant cells (composition of culture media, growthhormones, vitamins, unidentified supplements, selection of media). Animal cells (substrate on which cells grow, feeder layer on substrate, gas phase for tissue culture, media and supplements)

Unit - 4
Basicsof animal cell culture: principle of CO_2 incubator, development of stable cells, techniques used in cell culture, media for cell culture, source of tissues, primary & secondary culture, differentiation of cells, growth kinetics, animal cell lines- their origin and characterization

Unit - 5
Cloning & selection of specific cell types – cloning, somatic cell fusion and HAT selection, medium suspension fusion, selection of hybrid clone, production of monoclonal antibodies, organ culture - culture of embryonic organs, whole embryo culture, culture of adult organs

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Plant tissue culture: Gamborg and Phillip
2. Genetic Engineering of crop plants: Lycett GW and Grierson, D
3. Culture of Animal cell: A mannual of Basic Techniques:Freshney
4. Plant tissue culture: Bhojwani and Razdan
5. Plant Biotechnology: Biswan PK
6. Plant Biotechnology: Trivedi PC

Course: **Fermentation & Down Stream Processing**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
Introduction to fermentation: aerobic and anaerobic fermentations; Kinetics of growth and product formation - chemically structured models; mass transfer diffusion,

Unit - 2
Fermenter design - operation, measurement and control in fermentation; Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, bubble aeration, mechanical agitation, immobilized cell reactors

Unit - 3
Strain development: General aspects mutation selection of mutants, recombination, regulation gene technology and use of genetic methods, Genetic engineering for strain improvements and applications in medicine, agriculture and industry

Unit - 4
MicriobialBiotransformation: types, methods and processes, analysis and isolation of products, applications in waste management, medicine and agriculture; Biogas production - pathways, regulation/modulation, advanced biomethanation systems and their applications

Unit - 5
Microbial &Bioprocess technology: Down stream processing in brief -Methods for vitamins(B_{12}& Riboflavin), amino acids (L-glutamic acid & L Lysine), organic acids (Citric acid&Gluconic acid), enzymes (Amylases& pectinases), antibiotics (Beta Lactam antibiotics & amino acid and peptide antibiotics).

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Principles of Fermentation Technology:Whittaker & Stan bury
2. Bioprocess Engineering Principles: Pauline Doran
3. Bioreactor Design & Product Yield, BIOTOL series: Butter worth Heinemann
4. Bioseparation& Bioprocessing: Subramaniam G
5. Product Recovery in Bioprocess Technology: BIOTOL series, Butter WorthHeinemann
6. Bioseparation: Down-stream Processing for Biotechnology: Paul A. Belter EL. Cussler Wei-Shou Hu

Course: **Computer Aided Drug Designing**

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

Unit – 1
Protein structure prediction: protein secondary structure prediction: Chou Fasman algorithm, GOR IV and Neural network method. CASP experiments and their findings. Homology modeling of protein structure prediction: template selection and alignment, model building, evaluating a model, application of comparative modeling. Threading method of protein structure prediction

Unit - 2
Structure and Functional Assignment: Prediction of structural classes, motifs, folds and domains,protein fold comparisons, structural motifs, detection of binding sites, binding site comparison, protein-protein interaction sites, Structure validation: Structures as model, error estimation and precision (error estimation in X-ray crystallography, NMR spectroscopy), errors in deposited structure, validation of errors

Unit - 3
Computational approaches to biomolecular structure: Empirical force field for biomolecular simulations, Potential Energy Function, Energy Minimisation techniques, Molecular Dynamics simulations, Monte Carlo Simulations, Techniques for efficient conformational search: Simulated Annealing, Calculation of Free energy using simulation techniques.

Unit – 4
Computer aided drug design: Drug design cycle, nature of drug molecules, 2D and 3D representation of drug molecules, conformation generation, drug like properties (Lipinski rule of 5), predicting solubility of drug molecules, predicting ADME properties, therapeutic target identification and validation.

Unit – 5
Structure based drug design: preparation of receptors, preparation of ligands, molecular docking and binding affinity calculation. Ligand based drug design: molecular descriptors calculation, 2D QSAR and 3D QSAR model building, concept of pharmacophore, generation of pharmacophore hypothesis, virtual screening of drugs, case studies.

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings

1. Essentials of Stem Cell Biology:Robert Lanza
2. Principles of Regenerative Medicine: Anthony Atala and R Lanza
3. Stem Cells-From bench to bedside: Ariff Bongo and EngHin Lee
4. Embryonic Stem Cells: Elena Notarianni and Martin Evans

Course: Clinical Biochemistry
Course Code:
Course Credit: (2-0-0) 2

Unit - 1
Common laboratory animals – Food, Handling, Housing, Breeding.Care of normal and experimental animals. Sacrifice, postmortem and disposal.

Unit - 2
Disorders of Cardiovascular system & their laboratory detection.(Disorders of Cholestrol metabolism measurement of plasma lipoproteins, Cardiac enzymes.)

Unit - 3
Examination of Urine – Formation of urine Physical examination – Colour, transparency, pH and Sp gravity. Chemical examination - Protein, Sugar, Ketone bodies, Bile pigment/salt, Chyle, Blood, & 24 hours urine protein estimation & Liver function test

Unit - 4
Structure and functions of endocrine glands in mammals: Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Testis, Ovary. Thyroid function (blood T3 and T4 test hormones, Pregnancy test etc)

Unit - 5
Basic concept of laboratory statistics (Reference value, mean, median, mode, standard deviation, coefficient of variation.) Basic concept of quality control in clinical biochemistry laboratory (Control material, Leavy Jennings Plot)

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Reading:

1. The Rat: Ginger Cardinal
2. Animal form and Function, Breneman: Sidhwick&Jacson
3. Animal physiology: Goger Eckert, CBS pub
4. Clinical Diagnosis for Medical Undergraduates: Shaila V. Palekar
5. Oxford Handbook of Clinical Diagnosis (Oxford Medical Handbooks): Huw Llewelyn
6. Clinical Hematology Atlas: Bernadette F. Rodak MS MLS
7. Clinical Laboratory Hematology: Shirlyn B. McKenzie
8. Macleod's Clinical Diagnosis: Japp
9. Principle of Biostatistics: Marcello pagano

Course: **Food & Agriculture Biotechnology**
Course Code:
Course Credit: **(3-0-0) 3**

Unit - 1
Introduction to Agricultural Biotechnology,Tools of Plant Genetic Engineering: Drought stress, Salt stress, flood stress, cold stress

Unit - 2
Tools of Plant Genetic Engineering:Genetic manipulation of Herbicide tolerance, Pest resistance, reducing effects of viral disease,Risk associated with virus resistant transgenic plants

Unit - 3
Long shelf life of fruits and flowers, use of ACC synthase, poly-galactorunase, ACC oxidase; Modification of Fruit and flower color, Seed storage protein quality, vitamin E fortification, Fe and mineral fortification, golden rice

Unit - 4
Molecular Farming, Marker-Assisted Selection: A non-invasive biotechnology alternative to genetic engineering of plant varieties,Biofertilizers and Biopesticides,Food Preservation Technology- canning, dehydration, ultrafiltration, sterilization, irradiation, chemical preservation, Biopreservation

Unit - 5
Food Production technology: Single cell protein, food additives & preservatives Organic acids, Vitamins, Pigments, Flavors, Probiotics: concepts and application in foods, Food packaging systems: different packaging systems for foods, their advantages and limitations

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Suggested Readings
1. Plant Biotechnology- Adrian Slater, Nigel W. Scott and Mark R. Fowler
2. Biotechnology- Expanding Horizons : Singh BD
3. Introduction to Plant Biotechnology: Chawla HS
4. Elements of Biotechnology: Gupta PK
5. Modern Food Micro-Biology: James M. Jay
6. Food Microbiology: Fundamentals and frontiers: MP Doyle LRBeuchat and Thoma J. Montville

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

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

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

Course: **Project Dissertation (Based on Electives)**
Course Code:
Course Credit: **(0-0-12) 6**

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment	2 hours	60
3	End Semester	3 hours	90