MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL - 624 102
Tamil Nadu.

UGC-Non-SAP, DST-CURIE and DST-FIST Assisted

DEPARTMENT OF BIOTECHNOLOGY

Curriculum Framework and Syllabi for

M.SC. BIOTECHNOLOGY (FIVE YEAR INTEGRATED)

(For the candidates to be admitted from the academic year 2020-2021 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

PREAMBLE

Mother Teresa Women's University, whose foundation stone was laid by St. Mother Teresa herself, stands as an epitome of Women empowerment. The University stands as the first and the only Women's University in the State, and the third University in the Nation. With emphasis on research, supported by strong postgraduate programs in various disciplines, the University fosters high quality research activities in various disciplines at M.Phil. and Ph.D. levels.

Department of Biotechnology was started in 2002 with a vision to make an impact through research and technology based training. It is DST Curie, DST-FIST and UGC-Non-SAP sponsored Department. The Department is equipped with sophisticated instruments like GC-MS, HPLC, Multiplex PCR, Fluorescence Microscope, FTIR, XRD and many more. Skill and Employability based curriculum is the specialty of M.Sc Biotechnology (Integrated).

VISION

- To emerge into a top-notch International Women's University by creating empowered and socially responsible woman achievers through excellence in teaching, research and extension and enabling them to attain gender equity.

MISSION

- Striving for excellence in the tripartite goal of teaching, research and extension
- Promoting the educational standard of women at all levels
- Identifying and addressing the emerging trends and needs
- Providing community based learning experience
- Promoting community issues-based research activities with global standards
- Developing intellectual professionals with ethics for the benefit of mankind and environment.
- Extending collaborative and innovative research work for National Development.
- Equipping the learners with employability skills and groom them as Capacity Builders.
- Promoting global entrepreneurs addressing the market challenges.

MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL

M.SC. BIOTECHNOLOGY (FIVE YEAR INTEGRATED)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1. To train the graduates to be the best practitioners of their chosen field

PEO2. To enable the learners to be socially responsible and accountable professionals

PEO3. To motivate the graduates to contribute to the economic growth of the country

PEO4. To encourage the students to pursue higher studies in their chosen field

PEO5. To enable them to be sustainable citizens and professionals in their chosen fields

PROGRAMME SPECIFIC OUTCOMES (PSOs):

On completion of M.Sc Biotechnology (5yr. Integrated) programme, graduates will be able to

PSO1: gain and apply knowledge to plan, analyze and find innovative solutions in the field of biological sciences.

PSO2: explore problems and provide valid solutions through the industry-academia interactions.

PSO3: acquire interdisciplinary knowledge in the areas of biological, chemical, environmental and technical sciences for the benefit of society.

PSO4: use modern software tools for sequence alignment and structure prediction, molecular modeling and data acquisition for genome and proteome analysis.

PSO5: realize personal and social responsibilities related to modern biotechnological research, environmental safety, ethical issues and intellectual property and develop entrepreneurial skills.

PROGRAMME OUTCOMES (POs):

On completion of M.Sc Biotechnology (5yr. Integrated) programme, graduates will be able to

PO1: demonstrate knowledge of basic concepts, principles and application of the specific science discipline.

PO2: cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.

PO3: ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures and safety measures.

PO4: demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyze and interpret data and provide solutions.

PO5: exhibit the potential to effectively accomplish tasks in diverse teams

PO6: communicate effectively to ascertain their professional acumen

PO7: analyze the impact of scientific and technological advances on the environment and society, and contribute towards sustainable development.

PO8: emerge as professionally, ethically strong and integral personalities

Regulations:

1. Qualification for Admission:

i. Candidate should have passed a Higher Secondary Examination conducted by the Board of Higher Secondary Education, Government of Tamil Nadu/CBCS/ICS within the following science subject group Physics, Chemistry, Botany/Zoology or relevant subjects.

ii. Candidates sponsored by industries/hospitals/Clinical laboratories may be considered for admission.

2. **Duration of the course:**

The students will undergo the prescribed course of study for a period of not less than five academic years (Ten semesters).

3. **Medium of Instruction**: English

4. **Subject of Study**: As given in Appendix A

5. PASSING MINIMUM

THEORY

University Semester Examination (ESE) - 75 marks

Continuous Internal Assessment (CIA) - 25 marks

Classification of Internal Assessment Structure

Marks

3 internals each 10 marks - 30 Marks

Seminar - 10 Marks

Assignment - 10 Marks

Average - 50/2 Marks

Total = 25 Marks

Passing minimum (CIA) 50% - 13 Marks

Passing minimum (ESE) 50% - 37 Marks

Total Passing minimum = 50 Marks

PRACTICAL

University Semester Examination (ESE) **- 60 Marks**

Continuous Internal Assessment (CIA) **- 40 Marks**

6. **Eligibility of the degree**:

Candidates will be eligible if they complete the course with the required credits and pass in the prescribed examinations.

7. The candidate requires 75% of attendance to attend the semester exam.

8. The passing minimum is 50 % (both in internal and external separately) in each paper.

9. The candidate has to undergo projects individually.

10. Extra credit courses are all compulsory to complete the degree.

MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

IPG-MBT- M.Sc INTEGRATED BIOTECHNOLOGY

SYLLABUS 2020-2021

Appendix A

Course Code	COURSE TITLE	Hours/ Week		Credits	MARKS		
		L	P		CIA	ESE	Total
Semester -I							
ITAM11	Language : Tamil-1/other lanaguage-1	4		3	25	75	100
IENG11	Language :English-1	4		3	25	75	100
IBTT11	Core 1 : Professional English	4		4	25	75	100
IBTT12	Core 2 : Cell biology	5		4	25	75	100
IBTT13	Core 3: Biodiversity	5		4	25	75	100
IBTA11	Allied Theory 1: Chemistry	5		4	25	75	100
IVAE11	Value Education	3		3	25	75	100
Total Credits		**30**		**25**			
Semester -II							
ITAM22	Language :Tamil-2/ other lanaguage-2	4		3	25	75	100
IENG22	Language : English-2	4		3	25	75	100
IBTT21	Core 4 : Professional English	5		4	25	75	100
IBTT22	Core 5 : Basic microbiology and genetics	5		4	25	75	100
IBTP21	Core practical -I: Cell biology and microbiology		5	4	25	75	100
IBTA22	Allied practical -I: Chemistry		5	4	25	75	100
IEVS21	Environmental Studies	2		2			
Total Credits		**30**		**24**			
Semester -III							
ITAM33	Language :Tamil-3 / other lanaguage-3	6		3	25	75	100
IENG33	Language: English-3	6		3	25	75	100
IBTT31	Core 6 : Fundamental Biochemistry	5		4	25	75	100
IBTA31	Allied Theory 2: Plant and Animal physiology	5		4	25	75	100
***	Departmental Elective I	4		3	25	75	100
**	Non Major Elective I	2		2	25	75	100
IBTS31	Skilled based studies- I: Herbal technology	2		2	25	75	100
IBTI31	Internship-1	-		1*			
IBTO31	Online course-1	-		2*			
Total Credits		**30**		**21+3***			
Semester -IV							
ITAM44	Language : Tamil-4/ other lanaguage-4	6		3	25	75	100

IENG44	Language : English-4	6		3	25	75	100
IBTT41	Core 7 : Principles of molecular biology	4		4	25	75	100
IBTP41	Core practical- II: Biochemistry and molecular biology		4	4	25	75	100
IBTA42	Allied practical –II: Plant and animal physiology	3		4	25	75	100
***	Departmental Elective –II	3		3	25	75	100
**	Non Major Elective- II	2		2	25	75	100
IBTS42	Skilled based studies- II : Medical Laboratory technology	2		2	25	75	100
Total Credits		**30**		**25**			
Semester -V							
IBTT51	Core 8 : Biostatistics	5		4	25	75	100
IBTT52	Core 9 : Immunology	5		4	25	75	100
IBTT53	Core 10 : Developmental Biology	5		4	25	75	100
IBTT54	Core 11: Basic Bioinformatics	5		4	25	75	100
IBTT55	Core 12: Recombinant DNA technology	5		4	25	75	100
***	Departmental Elective- III	3		3	25	75	100
IBTS53	Skilled based studies –III: Patent and paper/project writing	2		2	25	75	100
Total Credits		**30**		**25**			
Semester -VI							
IBTT61	Core 13: Cell and tissue culture	5		4	25	75	100
IBTT62	Core 14: Enzyme technology	5		4	25	75	100
IBTT63	Core 15: Environmental Biotechnology	5		4	25	75	100
IBTP61	Core practical –III: Immunology and Recombinant DNA technology		5	4	25	75	100
IBTP62	Core practical –IV: Environmental Biotechnology and bioinformatics		5	4	25	75	100
***	Departmental Elective- IV	3		3	25	75	100
IBTS64	Skilled based studies –IV: Effective communication and personality development	2		2	25	75	100
IBTEX	Extension activity NCC, NSS, YRC,YWF, RRC	-		3	25	75	100
Total Credits		**30**		**28**			
Semester I-VI Total Credits				**148+3***			

Course Code	COURSE TITLE	Hours/ Week		Credits	MARKS		
		L	P		CIA	ESE	Total
Semester -VII							
IBTT71	Core 16: Advanced biochemistry	6		5	25	75	100
IBTT72	Core17: Applied microbiology	6		5	25	75	100
IBTT73	Core 18: Molecular biology and genetics	6		5	25	75	100
IBTP71	Core Practical-V: Advanced biochemistry, microbiology and molecular biology		6	5	25	75	100
***	Departmental Elective V	6		5	25	75	100
IBTI72	Internship-2	-	1*				
Total Credits		**30**		**25+1***			
Semester -VIII							
IBTT81	Core 19: Immunology and Immunotechnology	6		5	25	75	100
IBTT82	Core 20:Pharmaceutical Biotechnology	6		5	25	75	100
IBTT83	Core 21: Animal biotechnology	6		5	25	75	100
IBTP81	Core Practical-VI: Immuno technology and Animal Biotechnology		6	5	25	75	100
***	Departmental Elective VI	6		5	25	75	100
Total Credits		**30**		**25**			
Semester -IX							
IBTT91	Core 22: Plant biotechnology	6		5	25	75	100
IBTT92	Core 23: Bioinstrumentation and biostatistics	6		5	25	75	100
IBTT93	Core 24: Omics and Genome Editing	6		5	25	75	100
IBTP91	Core practical-VII: Plant Biotechnology & Genome Editing		6	5	25	75	100
***	Departmental Elective VII	6		5	25	75	100
Total Credits		**30**		**25**			

Semester -X							
IBTT101	Core 25 :Bioethics, Biosafety and IPR	6		5	25	75	100
IBTT102	Core 26:Bioprocess technology	6		5	25	75	100
IBTPROJ	Dissertation/Project	18		5			
IBTO102	Online course-2	-	2*				
Total Credits		**30**		**15+ 2***			
Semester VII-X Total Credits				**90 + 3***			
Semester I-X Total Credits				**238+6***			

*Extra credits

****Non Major Elective:**

IBTNFC-Choice 1: Forest conservation

*****Departmental Elective:**

IBTNSB- Choice 1: Stem cell biology
IBTNPC- Choice 2: Phytochemistry
IBTNMM- Choice 3: Molecular Modeling and drug designing
IBTNNC- Choice 4: Nanotechnology and cancer biology
IBTNED- Choice 5: Entrepreneur Development
IBTNBB- Choice 6: Biobusiness
IBTNID- Choice 7: Industrial Fermentation and Distillation products
IBTNFP- Choice 8: Food processing Technology
IBTNWL- Option 9: Wild life conservation
IBTNIM- Choice 10: Industrial waste management
IBTNHP- Choice 11: Human pathology
IBTNPM- Choice 12: Public health and management
IBTNDM- Choice 13: Drug metabolism
IBTNSB- Choice 14: System biology

Average percentage of Courses Having Focus on Skills

S.No	Core Theory	Courses	Employability	Skill	Entrepreneurship	Knowledge
1	Core 1 (theory)	Professional English		Y		
2	Core 2 (theory)	Cell biology				Y
3	Core 3 (theory)	Biodiversity	Y			
4	Core 4 (theory)	Professional English		Y		
5	Core 5 (theory)	Basic microbiology and genetics				Y
6	Core 6 (theory)	Funtamental biochemistry				Y
7	Core 7 (theory)	Principles of molecular biology				Y
8	Core 8 (theory)	Bioinformatics				Y
9	Core 9 (theory)	Immunology	Y			
10	Core 10 (theory)	Developmental biology				Y
11	Core 11 (theory)	Basic bioinformatics				Y
12	Core 12 (theory)	Recombinant DNA technology	Y			
13	Core13 (theory)	Cell and tissue culture	Y			
14	Core 14 (theory)	Enzyme technology	Y			
15	Core 15 (theory)	Environmental biotechnology	Y			
16	Core 16 (theory)	Advanced biochemistry	Y			
17	Core 17 (theory)	Applied microbiology	Y			
18	Core 18 (theory)	Molecular biology and genetics	Y			
19	Core 19	Immunology and	Y			

	(theory)	immunotechnology				
20	Core 20 (theory)	Pharmaceutical biotechnology	Y			
21	Core 21 (theory)	Animal biotechnology			Y	
22	Core 22 (theory)	Plant biotechnology			Y	
23	Core 23 (theory)	Bioinstrumentation and biostatistics	Y			
24	Core 24 (theory)	Omics and Genome editing	Y			
	Total		**13**	**2**	**2**	**7**

S.No	**Major Practicals**	**Courses**	**Employability**	**Skill**	**Entrepreneurship**	**Knowledge**
25	Major practical I	Cell biology and microbiology			Y	
26	Major practical II	Biochemistry and molecular biology			Y	
27	Major practical III	Immunology, biostatistics and bioinformatics			Y	
28	Major practical-IV	Environmental Biotechnology and Bioinformatics		Y		
29	Major practical-V	Advanced biochemistry, Microbiology and Molecular biology			Y	
30	Major Practical-VI	Immuno technology and Animal biotechnology		Y		
31	Major Practical-VII	Plant biotechnology & Genome Editing		Y		
	Total			**3**	**4**	

S.No	**Allied Theory**	**Courses**	**Employability**	**Skill**	**Entrepreneurship**	**Knowledge**

32	Allied theory - I	Chemistry				Y
33	Allied theory- II	Plant and Animal physiology	Y			
	Total		**1**			**1**

S.No	**Allied Practicals**	**Courses**	**Employability**	**Skill**	**Entrepreneurship**	**Knowledge**
34	Allied practical - I	Chemistry		Y		
35	Allied practical - II	Plant and animal physiology		Y		
	Total			**2**		

S.No	**Skill Based Studies**	**Courses**	**Employability**	**Skill**	**Entrepreneurship**	**Knowledge**
36	Skilled based studies I	Herbal technology		Y		
37	Skilled based studies II	Medical laboratory technology		Y		
38	Skilled based studies III	Patent and paper/project writing		Y		
39	Soft skill	Effective communication and personality development		Y		
	Total			**4**		

S.No	Non Major Elective	Courses	Employability	Skill	Entrepreneurship	Knowledge
40	Elective VIII IBTNFC	Choice 1: Forest conservation	Y			
	Total		**1**			

S.No	Electives	Courses	Employability	Skill	Entrepreneurship	Knowledge
41	Elective I IBTNSB	Choice 1: stem cell biology		Y		
42	Elective II IBTNPC	Choice 2: phytochemistry	Y			
43	Elective III IBTNMM	Choice 3:Molecular Modeling and drug designing		Y		
44	Elective IV IBTNNC	Choice 4: nanotechnology and cancer biology		Y		
45	Elective V IBTNED	Choice 5: Entrepreneur Development			Y	
46	Elective VI IBTNBB	Choice 6: Biobusiness			Y	
47	Elective VII IBTNID	Choice 7: Industrial Fermentation and Distillation products	Y			
48	Elective - IBTNFP	Choice 8:food processing technology	Y			
49	Elective- IBTNWL	Choice 9 : Wild life conservation	Y			
50	Elective-	Choice 10:		Y		

	IBTNIM	Industrial waste management				
51	Elective-IBTNHP	Choice 11: Human pathology				Y
52	Elective-IBTNPM	Choice 12: Public health and management				Y
53	Elective-IBTNDM	Choice 13: Drug metabolism				Y
54	Elective-IBTNSB	Choice 14: System biology	Y			
	Total		**5**	**4**	2	3

ABSTRACT

Courses	**Employability**	**Skill**	**Entrepreneurship**	**Knowledge**
Core Theory	13	2	2	7
Major Practical		3	4	
Allied Theory	1			1
Allied Practical		2		
Skill Based Studies		4		
Non Major Elective	1			
Elective	**5**	**4**	2	3
PERCENTAGE	20	15	8	11
	37	**28**	**15**	**20**
TOTAL PERCENTAGE	**100**			

SEMESTER I

Course Title & Code	**CORE 2 (Theory) – CELL BIOLOGY – IBTT12**		
Semester	Semester-I	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K4: Analyze		
Learning Objective	• To acquaint students with the concepts in Cell Biology. • To understand structure and function of the organelles of cells • To learn the cell-cell interactions, transport mechanism and signaling pathways of cell		

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Acquire Knowledge on cell structure and function of cellular organelles and components **K1**

CO2: Analyze the behavior of cells in their microenvironment as multicellular structures **K4**

CO3: Illustrate specific processes and components involved in membrane transport. **K4**

CO4: Understand receptor subclasses and their possible uses in cell signaling **K2**

CO5: Understand the Mode of action and regulation of signaling molecules for signal transduction **K2**

CELL BIOLOGY

Unit I

Basics of Cells- Origin of life, history of cell and Cell Theory. Structure of prokaryotes and eukaryotic cell. Comparison between plant and animal cells; Cytoplasm; Chemical components

of cells. Structure and function of Cell wall; Ultra Structure of Plasma membrane; Molecular organization-lipids and membrane proteins, Molecular models of plasma membrane. Cytoskeleton.

Unit II

Structure and functions of Cell Organelles - Nucleus, nucleolus, ribosome, mitochondria, chloroplast, vacuole, endoplasmic reticulum, golgi apparatus, peroxisome, endosome and microbodies, glyoxisome, lysosome, centriole, cilia and flagella. Ultra structure of Chromosome, Specialized Chromosomes.

Unit III

Cell transport and traffic -Passive and active transport, permeases, osmosis, pumps and gated channels, co transport: symport, antiport. Vesicular transport: Endocytosis, Exocytosis, Protein glycosylation in eukaryotes and protein sorting. Transport in prokaryotic cells, entry of viruses and toxins into the cell. Cell junction, Cell adhesion, Extra Cellular Matrix,

Unit IV

Cell division and cell cycle -Cell cycle and molecules that control cell cycle, Regulation of cell cycle. Cell division: Mitosis and meiosis and their regulation, Apoptosis, Neoplasia and cell death.

Unit V

Cell Signaling molecules and their receptors-Signaling molecules: autocrine, paracrine and endocrine and its mode of action in cell signaling. Cytosolic, nuclear and membrane bound receptors: G-protein coupled receptor, protein tyrosine kinases receptor and cytokine receptors for cell signaling. Different models of signal amplifications: role of cyclic AMP, cyclic GMP and G proteins in signal transduction, phosphorylation and regulation in signaling: serine – threonine kinases in signaling. Role of Inositol triphosphate (IP3) in signal transduction, calcium ion flux and its role in cell signaling.

REFERENCES

1. Bruce Alberts *et al*., Essential Cell Biology, Taylor and Francis Group, 2014.
2. John K. Young, Introduction to Cell Biology, World Scientific, 2010.
3. George Plopper, Principles Cell Biology, Jones & Bartlett Publishers, 2016
4. Aubrey Stimola, Cell Biology, The Rosen Publishing Group, 2011.

5. G. Cooper, G. M. The Cell - A Molecular Approach.5th edition. ASM and Sinauer Press, Washington. 2009 .

6. De Robertis & De Robertis, Cell Biology, 4th Edition, 2010.

7. Lodish, H. and D. Baltimore, Cell Biology, W.H. Freeman publishers, 2012.

8. Gerald Karp, Cell and Molecular Biology, John Wiley and sons Inc, 2013.

E-book links:

1. https://www.mysciencework.com/publication/download/lecture-notes-cell-biology-1636c320/adc18b1228577d5353c56fdf7b69b6de
2. https://gurukpo.com/Content/Bsc-biotech/Cell_Biology.pdf
3. https://www.microscopemaster.com/cell-biology.html
4. https://microbenotes.com/category/cell-biology/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	M
CO5	S	S	S	S	S	S	M	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 3 (Theory) – BIODIVERSITY – IBTT13**		
Semester	Semester-I	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To understand the components of biodiversity. • To learn the tools in the study of biodiversity. • To have an insight on impacts on biodiversity. • To impart knowledge of biodiversity conservation.		

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Acquire knowledge on the concepts and values of biodiversity and its conservation **K1**

CO2: Understand the global patterns of biodiversity **K2**

CO3: Assess the impacts on biodiversity **K4**

CO4: Analyze ethics and social responsibilities **K4**

CO5: Formulate scientific intervention tools for conservation **K3**

Unit I

Introduction to Biodiversity- Biodiversity-Definition- Biodiversity and kingdom of living organisms -Types-Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity). Importance of biodiversity. Global distribution of richness, Centres of species diversity, Mega diversity centres , Hot spots and biodiversity in India.

Unit II

Studies of Biodiversity- Assessment of mapping of biodiversity; GIS/Remote sensing; Species diversity- Measurement , Hot spot analysis . Representative type (one each) studies from

Cryptogams, Phanerogams ; Sacred flora and fauna, Endemic plants and animals. Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis

Unit III

Impacts on Biodiversity- Bio-prospecting**,** Biopiracy, Hybridized plants, GM crops Bio-prospecting Botanicals for Biocontrol and Health, Threats to biodiversity predator control, exotic introductions, parasites and diseases. Overexploitation threatening living species, Animals threatened by International trade, Common patterns of over exploitation. Link between microbial diversity and ecosystem processes,

Unit IV

In situ Conservation of biodiversity- (Biosphere reserves, National parks, Sanctuaries), Botanical Gardens; Wildlife Sanctuaries, Preservation of wet lands; protection measures taken at global level. Social movement for biodiversity conservation- Chipko movement and Appiko movement. CITES, WWF, NBPGR, IUCN; ICZN rules and their role. Loss of biodiversity and restoration

Unit V

Ex situ **Conservation of biodiversity** - (Cryopreservation, Germplasm banks,Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies).

Environmental and biodiversity laws.

REFERENCE:

1. Aber, J.D.and Melillo J.M., Terrestrial Ecosystems: W.B.Saunders, 2011.
2. Ingrowille, M Diversity and Evolution of land plants Chapman and Hall, 2002.
3. Gaston KJ, Spicer JI. Biodiversity – an introduction 4th edition, Blackwell, 2014.
4. Wilson EO, The diversity of life, Harvard University Press, 2010.
5. Krishnamurthy KV, Textbook of biodiversity, Taylor and Francis, 2017
6. Richard BP, Principles of Conservation Biology, 4th edition, Sinauer Associates, Inc.. 2016.

E-book links:

1.https://www.amnh.org/research/center-for-biodiversity-conservation/about-the-cbc/what-is-biodiversity
2.https://www.researchgate.net/publication/294876262_Biodiversity_Concept_Threats_and_Conservation
3. https://ncert.nic.in/ncerts/l/lebo115.pdf
4. https://www.unesco.pl/fileadmin/user_upload/pdf/BIODIVERSITY_FACTSHEET.pdf
5. https://www.biodiversitya-z.org/content/biodiversity.pdf
6. http://www.oecd.org/env/resources/OECD-work-on-biodiversity-and-ecosystems.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	S	S	S	S	S	M	S	S	S
CO3	S	M	S	M	S	S	S	S	S	M	S	S	S
CO4	S	M	S	M	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ALLIED THEORY-I - CHEMISTRY – IBTA11**		
Semester	Semester-I	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand		

Learning Objective	• To make non-chemistry students to get exposed to day to day Chemistry related materials and science. • To learn the terms and definitions in general chemistry and use of popularly used chemicals. • To understand the basics of thermodynamics, Nuclear chemistry and electrochemistry

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Able to understand the bonding of orbitals.K1

CO2: Ability to understand the concepts in Nuclear Chemistry and Electrochemistry. K2

CO3: Ability to understand the role of fertilizers in plant growth. K2

CO4: Get exposed the chemistry related materials and science K2

CO5: Able to understand the basics of Thermodynamics K2

UNIT - I CONCEPTS OF CHEMICAL BONDING

Chemical Bonding - Molecular orbital theory - Bonding, Anti bonding and Non – bonding molecular orbitals - Energy order of MO's - Diamagnetism and Para magnetism - Bond order – Molecular orbital configuration of H2, N2, O2 and F2. Interhalogen compounds: ICl, BrF3, IF5- Preparation, properties, hybridization and structure, shape.

UNIT – II THERMODYNAMICS

Basic concepts - scope and limitations - Thermodynamic terms - intensive and extensive properties - state, equilibrium -isothermal reversible and irreversible expansion works of an ideal gas - Zeroth law of thermodynamics - Internal Energy and First law of thermodynamics – Second law of thermodynamics-Entropy and its significance-Carnot cycle- bomb calorimeter

UNIT – III ELECTROCHEMISTRY

Electrode potential – Nernst equation – derivation and problems based on single electrode potential calculation, reference electrodes – standard hydrogen electrode – calomel electrode– glass electrode – measurement of pH, electrochemical series – significance, electrolytic and electrochemical cells – reversible and irreversible cells, EMF- measurement of emf – Potentiometric Titrations (Redox – Fe2+ Vs. dichromate), Conductometric titrations (acid-base – HCl Vs. NaOH).

UNIT – IV NUCLEAR CHEMISTRY

Nuclear fission – controlled nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – light water nuclear power plant – breeder reactor**.**

UNIT – V INDUSTRIAL CHEMISTRY

Synthesis, properties and Uses of Silicones. Fuel Gases, Natural gas, Water gas, Semi water gas, Carbureted water, producer gas and oil gas. Fertilizers: Urea, Ammonium Sulphate, Ammonium nitrate, Potassium Nitrate, NPK fertilizer, Triple super phosphate.

REFERENCE

1. Dr. Veeraiyan, Chemistry –Paper I, High Mount Publishing House, Chennai, 2nd edition, 2005
2. R. D. Madan, Modern Inorganic Chemistry, Third Revised Edition, S.Chand and Co., 2011. 3. B. R. Puri, L.R. Sharma and M.S. Pathania, *Principles of Physical Chemistry*, 4th ed. New Delhi: Vishal Publishing Co., 2018.
4. P.L. Soni, O. P. Dharmarha and U.N. Dash, *Textbook of Physical Chemistry*, Revised Edition, New Delhi: S Chand & Sons, 2016.
5. P.C. Jain and Monika Jain, *Engineering Chemistry*, 16th ed. New Delhi: Dhanpat Rai Publishing Co., 2006.
6. Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, 33rd ed. Jalandhar: Vishal Publishing Co., 2017.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	S	S	S	S	S	M	S

CO2	S	M	S	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**VALUE BASED EDUCATION- IVAE11**		
Semester	Semester-I	Credits:3	Hours/weeks: 3
Cognitive Level	K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To enable the students to understand meaning and concept of values • To orient about the society, social life, integrity in personal and public life. • To learn the concepts of human values and respect for others • To provide in-depth understanding about moral awareness • To inculcate a sense of socially responsible citizens.		

COURSE OUTCOME:

Upon completion of this course, the students will be able to

CO1: develop a sense of self-respect and respect for others **K2**

CO2: occupy one's own social space and help others live peacefully **K3**

CO3: understand the need for practicing positive values **K2**

CO4: develop scientific temper and logical reasoning and to apply in day to day life **K3**

CO5: know about gender equity, ethics and human rights. **K4**

Unit I

Values – definition – value crisis – need for practicing positive values for good life – values erosion – its impact on individual, societal – cultural level – way out.

Unit II

Family, material, human values – good health – individual and intellectual freedom – human progress – production and distribution – prosperity and peace – Aesthetic values – sense of beauty – moral ethical value – conscience – integrity – fairness.

Unit III

Societal values – cooperative living – healthy behaviors – justice – social responsibility – free from bribery and corruption – good citizen – good society – pursuit of excellence – Psychological values - self-esteem and acceptance – emotional intelligence – spiritual values – devotion and self-fulfillment

Unit IV

Bioethics – definition – goals and objectives – love of life – animal use and ethics – medical ethics – negligence and wrong judgments – issues genomes on organ transplantation – donors – drugs – mortality – social ethics – child labour and bonded labor

Unit V

Women – and development – sex versus gender – women's rights – factors affecting development – violence against women – right to privacy – abortion and reproductive rights – social stigma – women empowerment – social, economic and political – government program and policies.

REFERENCE S:

1. Mani Jacob (Ed). 'Resource Book for Value Education', Institute for Value Education, New Delhi. 2002.

2. NCERT. "Value Education". Dharma Bharti National Institute of Peace and Value Education, Secunderabad, 2002.

3. Daniel and Selvamony. "Value Education Today - Madras Christian College, Tambaram and ALACHE, New Delhi, 1990.

4. Ignacimuthu S. "Values for Life". Better Yourself Books, Mumbai, 1991.

5. M.M.M.Mascaronhas. Centre for Research Education Science and Training for Family Life Promotion - Family Life Education, Bangalore, 1993.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	M	S	S	S	S	S	S	S	M	S
CO3	M	M	M	S	S	S	S	S	S	S	S	M	S
CO4	S	M	M	S	S	S	S	S	S	S	S	M	S
CO5	S	M	M	S	S	S	S	S	S	S	S	M	S

Strongly Correlating	(S)	- 3 marks
Moderately Correlating	(M)	- 2 marks
Weakly Correlating	(W)	- 1 mark
No Correlation	(N)	- 0 mark

SEMESTER II

Course Title & Code	**CORE 5 (Theory) – BASIC MICROBIOLOGY AND GENETICS – IBTT22**		
Semester	Semester-II	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• To make the students to understand the basic concepts of the biology of microorganisms and its mechanism of action in host cells. • To learn the microbiological techniques used for the classification of microorganisms • To know the important role of microbes in various field of microbiology • To understand the microbe-host interaction and their metabolic activities		

COURSE OUTCOME:

Upon completion of this course, the students will be

CO1: Able to understand the taxonomy, microbial physiology and culture methods **K1**

CO2: Able to understand the classification and nomenclature of viruses and fungi **K1**

CO3: Able to understand the concepts of genes and chromosomes **K1**

CO4: Able to understand the metabolism of the various microbes K2

CO5: Able to understand the structural aberrations of chromosomes and mutational types **K2**

Unit I

Introduction to Microbiology: An overview of microbiology including a historical perspective of microbiology-classification, and nomenclature of microorganisms-Basics of Microscopy – light, phase, fluorescent and electron microscopy (SEM and TEM)- principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining, spore staining

Unit II

Microbial Structure and Multiplication: Morphology, Structure and Functions of Prokaryotic- and Eukaryotic Cells, Multiplication of bacteria, viruses, algae, protozoa, fungi, yeast with appropriate examples, Life history of actinomycetes and bacteriophage

Unit III

Microbial Nutrition and Metabolism: Nutritional requirements of bacteria: Growth curve and Different methods to quantitative bacterial growth, Mathematics of growth generation time and growth rate constant, factors affecting growth. Aerobic and Anaerobic respiration, Microbial metabolism- Entner– Doudoroff and Phosphoketolase pathway

UNIT IV

Mendelian principles- segregation and independent assortment. Incomplete dominance. Trihybrid ratio. Epistasis. Pedegree analysis. Chromosome abnormalities, quantitative inheritance, Hardy-Weinberg equilibrium, genetic drift and speciation.

UNIT V

Sex determination and Linkage: (Drosophila, Mammals). Environmental factor and Sex determination, Sex differentiation. Sex linkage in diploids crossing over. Genetic disorders.

REFERENCES:

1. General Microbiology, Stanier, R. Y., Ingram, J.L.K., Wheelis, M.L and Painter, P.R, The Macmillan Press Ltd.,
2. Biology of Microorganisms, Brock, Madigan, M.T., Martinko, J.M. and Parker, J. Prentice-Hall.
3. Microbiology, Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R., Tata McGraw Hill
4. Microbial Genetics, Maloy, S.R., Cronan, J.E. Jr. and Freifelder, D. Jones, Bartlett Publishers.
5. Chemical Microbiology, An introduction to Microbial Physiology - AH Rose, Butterworth, London.

E-book links:

1. https://www.nature.com/subjects/microbiology#:~:text=Microbiology%20is%20the%20study%20of,host%20response%20to%20these%20agents.
2. https://www.moscmm.org/pdf/Ananthanarayan%20microbio.pdf
3. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/lecture1.pdf
4. https://samples.jblearning.com/076371075X/Wheelis_CH01_001%20copy.pdf
5. http://www.grsmu.by/files/file/university/cafedry/microbiologii-virysologii-immynologii/files/essential_microbiology.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	M	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL I- CELL BIOLOGY AND MICROBIOLOGY-IBTP21**		
Semester	Semester-II	Credits:4	Hours/weeks: 5

Cognitive Level	K1: Recall K2: Understand K3: Apply
Learning Objective	• To know about the basic techniques in cell biology and microbiology • Understand the organization and function of different cell organelles

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Perform experiment on understanding of cells

CO2: Understand the sub-cellular organelles of the cell

CO3: Perform enumeration of RBCs/WBCs for the given sample

CO4: Identify and examine bacterial cell by different staining methods

CO5: Understand the basic microbiological techniques

LAB IN CELL BIOLOGY

1. Differentiating plant cells from animal cells using a basic, acidic, and a combination stain.
2. Subjecting cells to different pH, concentrations, and analyzing the structural changes occurring due to osmosis.
3. Imaging and visualization of sub-cellular organelles using a fluorescent microscope.
4. Fractionation of nucleus and mitochondria from cauliflower cells and visualization using methyl green pyronin under a bright-field microscope of 400x magnification.
5. Enumerating and finding out whether RBCs/WBCs are in the optimal range in the sample and analyzing the results.
6. Growing root tips of different plants and comparing the chromosome number by fixing at the metaphase stage.

LAB IN MICROBIOLOGY

1. Microscopy- observation of different microscopes
2. Isolation of microorganism from samples.
3. Methods of Counting colonies in petridish cultures
4. Sterilization techniques.
5. Preparation of media.
6. Pure culture techniques – serial dilution – pour plate, spread plate, streak plate and stab culture
7. Bacterial staining methods – single, Grams and negative
8. Fungal staining methods – Lacto phenol cotton blue
9. Motility of bacteria
10. Enumeration of bacteria/Yeast cell, viable count(Plate count), Total count (Haemocytometer)

REFERENCE:

1. Dr. S. Rajan and Mrs. R. Selvi Christy, "Experimental Procedures in Life Sciences", Anjana Book House, 1st edition, 2010.
2. Molecular Cell Biology by Harvey Lodish
3. Molecular Biology of the Cell by Alberts
4. Microbiology by Pelczar Microbiology by Frobisher

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	M	S	S	S	S	S	S	S	M	S	M	S
CO2	S	M	S	S	S	S	S	S	S	M	S	M	S
CO3	S	M	S	S	S	S	S	S	S	M	S	M	S
CO4	S	M	S	S	S	S	S	S	S	M	S	M	S
CO5	S	M	S	S	S	S	S	S	S	M	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ALLIED PRACTICAL -I – CHEMISTRY – IBTA22**		
Semester	Semester-II	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To know the principles and theory of various analysis and chemical reactions		

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: To create interest in application side of chemistry K1

CO2: Ability to perform experiments, analyzes data, interpret results and observe in scientific aspects. K3

CO3: Ability to work effectively in diverse teams in laboratory. K3

CO4: Ability to understand the concepts in volumetric analysis K2

CO5: Able to know the principles of chemical reactions K2

VOLUMETRIC ANALYSIS

1. Estimation of Sodium hydroxide using Standard Carbonate.
2. Estimation of Hydrochloric acid using Standard Oxalic acid.
3. Estimation of Oxalic acid using Standard Sulphuric acid.
4. Estimation of Ferrous Sulphate using Standard Mohr's salt solution.
5. Estimation of Oxalic acid using Standard Ferrous Sulphate.
6. Estimation of Potassium permanganate using Standard Sodium Hydroxide.

REFERENCE

1. Venkateswaran. V, Veeraswamy. R, Kulandaivelu. A.R., Basic Principles of Practical Chemistry, 2nd ed. New Delhi: Chand and Sons, 2015.

2. Radha and Rekha, Chemistry Laboratory Manual, 1st ed. Chennai: Elshadai Publishers, 2011.

3. O.P. Pandey, N.Bajpai and S. Giri, Practical chemistry, 1st ed. New Delhi: Nirja Publishers and Printers Pvt. Ltd., 2014.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S

CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ENVIRONMETNAL STUDIES – IEVS21**		
Semester	Semester-II	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	▪ To understand the Scope and importance, need for public awareness ▪ To be acquainted with about Natural Resources: Renewable and non – renewable resources ▪ To comprehend the Concept and structure and function of an ecosystem and to conquer knowledge on Biodiversity and its conservation ▪ Expand knowledge about the environment and its importance for survival of living organisms		

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1 : Understand the natural resources and sustainable utilization **K1**

CO2 : Apprehend the utilization of land and water **K3**

CO3: Understand the biological resources and forests **K2**

CO4: Understand the renewable and non-renewable sources of energy **K2**

CO5: Describe the contemporary practices in resource management **K4**

Unit – I

The multidisciplinary nature of environmental studies. Definition, Scope and importance.

Need for public awareness

Unit II

Natural Resources: Renewable and non – renewable resources:

Natural resources and associated problems

a) Forest resources: Use and over – exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non – renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable of resources for sustainable lifestyles.

Unit III

- Concept of an ecosystem

- Structure and function of an ecosystem
- Producers, consumers and decomposers.
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem:
    - Forest ecosystem
    - Grassland ecosystem
    - Desert ecosystem
    - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV

Biodiversity and its conservation

- Introduction – definition: generic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega – diversity nation.
- Hot – spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wild life, man – wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Unit V

Environmental Pollution

- Causes, effects and control measures of:
    - Air pollution
    - Water pollution
    - Soil pollution
    - Marine pollution

    - Noise pollution
    - Thermal pollution
    - Nuclear hazards
- Solid waste Management: causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquakes, cyclone and landslides.

Unit VI

Social issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation. Rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit VII

Human population and the Environment

- Population growth, variation among nations.
- Population explosion – family Welfare Programme.
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS.
- Women and child welfare
- Role of Information Technology in Environment and human health.
- Case studies.

Unit VIII

Field work

- Visit to a local area to document environment assets – river / forest/ grassland/ hill/ mountain.
- Visit to a local polluted site – Urban/ Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes, etc.

REFERENCE:

1. Agarwal, K.C 2001 Environmental Biology, Nidi Publishing Ltd, Bikaner
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt Ltd. (R)
3. Brunner R.C 1989, Hazardous Waste Incineration, McGraw Hill Inc 480p
4. Clark R.S marine Pollution, Claderson Press Oxford (TB)
5. Cunningham, W.P Cooper, T.H Gorhani, E & Hepworth, M.T 2001, Environmental Encyclopedia, Jaico Publ House, Mumbai 1196p.
6. De A.K Environmental Chemistry, Wiley Eastern Ltd.,
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P 1993 Water in crisis, Pacific Institute for Studies in Dev., Environmental & Security. Stockholm Env. Institute. Oxford Univ Press 473p.
9. Hawkins R.E Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).

10. Heywood, VH & Watson R.T 1995 Global Biodiversity Assessment. Cambridge Univ Press 1140p.
11. Jadhav, H 7 Bhosale, V.M 1995 Environmental Protection and Laws. Himalaya Pub House, Delhi 248p.
12. McKinney M.L & Schoch R.M 1996 Environmental Science systems & Solutions, Web enhanced edition 639p.
13. Miller T.G Jr Environmental Science, Wadsworth Publishing Co (TB).
14. Odum, E.P 1971 Fundamentals of Ecology, W.B Saunders Co USA, 574p.
15. Rao MN & Datta A.K 1987. Waste Water treatment. Oxford & IBH Publ Co Pvt Ltd. 345p.
16. Sharma B.K 2001 Environmental Chemistry Goel Publ House, Meerut.
17. Trivedi R.K Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enciro Media (R).
18. Trivedi R.K and P.K Goel, Introduction to air pollution, Techno Science Publications (TB).

E-book links:

1.https://study.com/academy/lesson/what-is-environmental-studies-definition-topics.html
2.https://www.researchgate.net/publication/328783669_ELEMENTS_OF_ENVIRONMENTAL_STUDIES
3. http://intranet.bhu.ac.in/unit2.pdf
4.https://www.researchgate.net/publication/323944189_Environmental_Pollution_Causes_and_Consequences_A_Study
5. https://www.ugc.ac.in/oldpdf/modelcurriculum/Chapter5.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
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CO1	S	M	M	S	S	S	S	S	S	M	S	S	S
CO2	S	M	S	S	S	S	S	S	S	M	S	M	S
CO3	S	M	M	S	S	S	S	S	S	M	S	S	S

CO4	S	M	S	M	S	S	S	S	S	S	S	M	S
CO5	S	M	S	M	S	S	S	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER III

Course Title & Code	**CORE 6 (Theory) – FUNTAMENTAL BIOCHEMISTRY-IBTT31**		
Semester	Semester-III	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K5: Evaluate		
Learning Objective	• To learn biochemical principles with specific emphasis on different biomolecules. • To introduce the biomolecules which are involved in metabolic pathways • To ensure students to have strong foundation in structure, properties and function of various biomolecules.		

COURSE OUTCOMES :

Upon completion of this course, the students will be

CO1: Able to understand the fundamental aspects in biochemical phenomenon. **K1**

CO2: Apply their knowledge of biochemistry to correlate the structure and functional relationships of biomolecules in living organisms. **K3**

CO3: Acquire knowledge on structure, properties and biological functions of carbohydrates, lipids, proteins, vitamins, harmones and minerals which help them to understand the significance of biomolecules in bioprocesses and biotechnology **K2**

CO4: Able to explain the classification criteria and nomenclature of the different types of simple and complex biomolecules, according to their structural characteristics.**K5**

CO5: Able to understand the concept of chemical and regulatory interrelationship between major cellular synthetic and catabolic pathways. **K2**

Unit I

Atom, Molecules & chemical bonds properties of H2O, acid and buffer. Carbohydrates - Classification, Structure and Function, Occurrence, chemical properties, stereo and optical isomerism, Biological significance, Glycosylation of biomolecules – glycoproteins and glycolipids.

Unit II

Amino acids- structure, classification and chemical properties. Peptides – synthesis, peptide linkage- Proteins – Classification – Structure and color reactions of protein- Organization - primary (Insulin), secondary structure (alpha helix and beta structure), tertiary and quaternary structure. Significant natural and artificial peptides. Enzymes-Classification and IUB nomenclature, Holo and apo enzyme, coenzymes and cofactors.

Unit III

Lipids-Nomenclature and Classification, structure and functions: occurrence, chemical properties.; Lipoproteins: Structure and functions of lipoproteins; Role of lipids in biomembranes Fatty acids- basic structure, types, properties, functions and essential fatty acids; ketone bodies, Classes, structure, properties and functions of lipids: Simple lipid-fat and wax, Compound lipid-Phospholipid, Triglycerides, Steroids, Cholesterol, Terpenes, sphingolipid and glycolipid.

Unit IV

Nucleic acids –Structure of purine and pyrimidine bases, Structure of double stranded DNA (A, B and Z-DNA). Chargaff's rule on DNA base composition, Physical properties of double stranded DNA. Types of RNAs- r RNA, t RNA and m RNA and their biological significance. Purines and pyrimidines biosynthesis.

Unit V

Vitamins, minerals & Hormone. Introduction, Functions and deficiency -Fat - soluble vitamins - A, D, E & K –, Water - soluble vitamins, B Complex (Riboflavin, Niacin, Pyridoxine, Folic acid, Cyanocobalamine, Pantothenic acid) Vitamin C (Ascorbic acid). Daily requirement Types and Functions of hormones. Minerals - Calcium, Phosphorus, Iodine, Fluorine, Manganese, Iron, Magnesium, Potassium

REFERENCES:

1. Lehninger, A. L., "Principles of Biochemistry", 6th edition, New York., 2012
2. Stryer, L., "Biochemistry", 8th edition, New York: Freeman, 2015.
3. Voet, D., & Voet, J. G., "Biochemistry", Hoboken, NJ: J. Wiley & Sons, 5th edition, 2016.
4. Jain and Jain "Biochemistry", Chand publication, 2008.
5. Murray R.K, Granner B.K, Mayes P.A, Rodwell V.W. "Harper's Biochemistry", Prentice Hall International, 2008

E-book links:

1.http://people.uleth.ca/~steven.mosimann/bchm2000a.html
2.https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski)
3. https://www.researchgate.net/publication/200787272_Carbohydrates
4. file:///C:/Users/Thamarai/Downloads/Ch-4Protein.pdf
5. https://www.researchgate.net/publication/331701677_UNIT-II_Lipid_metabolism

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S

CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ALLIED THEORY 2 -PLANT AND ANIMAL PHYSIOLOGY-IBTA31**		
Semester	Semester-III	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K4: Analyze		
Learning Objective	• To acquire the basic knowledge needed for proper understanding of plant and animal functioning. . • Students should gain the knowledge of photo respiration • Students should identify and describe the different types of plant and animal cells and tissues, their structure and function. • Students should able to determine the role and function of specific vegetative parts of the plant and the role and function of the reproductive parts of the plant. • Students should able to know the animal physiology system		

COURSE OUTCOME:

Upon completion of this course, the students will be able to

CO1: have a brief knowledge on macro and micro nutrients and transpiration **K1**

CO2: exhibit a brief and concise knowledge on photosynthesis and electron transport system **K1**

CO3: acquire knowledge on nitrogen fixation and plant growth regulators **K2**

CO4: Able to acquire knowledge in Physiology of Cardiovascular system, Reproduction and Endrocrine Glands **K2**

CO5: gain knowledge on muscle contraction and nerves **K4**

Unit I

Plant Physiology (Importance of Plant Physiology); Plant cells -leaves, stem, roots, xylem & phloem. Water transport, water potential and transpiration through leaf, Osmosis. Photosynthesis-Structure and function of chloroplast, light and dark reactions, Cyclic and non-cyclic electron transfer, C3, C4 and CAM pathways (Crussulacean acid metabolism). Respiration & Photo respiration: Respiration types, RQ- Glycolysis, Citric acid cycle, electron transport chain and ATP synthesis. Nitrate & Ammonium assimilation. Nitrogen fixer and Nitrogen fixation.

Unit II

Plant Hormones-Types & roles- mode of action: Auxin, Gibberellins & Cytokinins, Ethylene, Abscissic Acid. Biosynthesis, Storage, breakdown & transport; Physiological effects& Mechanisms of action. Sensory Photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; Transpiration; mechanisms of loading and unloading of photo assimilates. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles

Unit III

Digestion: Physiology of digestion in the alimentary canal; Absorption of carbohydrates, lipids, Proteins, gastric ulcers, BMR. Blood Circulation - Structure & Function of Haemoglobin. Blood corpuscles, haemopoiesis, plasma function, blood volume, blood pH regulation, blood groups, haemostasis., Bohr and Haldane effect, Chloride shift. Cardiovascular System: Structure of Heart; Origin and conduction of the heart impulse, heart as a pump, Cardiac cycle, Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG-its principle and significance. Respiration: anatomy, pulmonary ventilation, Respiratory volume and capacities.

Transport of O2 and CO2 in blood. Pulmonary diseases, neural and chemical regulation of respiration

Unit IV

Physiology of excretion- Structure of Kidney & Nephron, physiology of urine formation, urea cycle, nitrogenous wastes -ammonia, urea, uric acid, creatinine. Counter current mechanism, Types of dialysis, ARF & CRF. Anatomy of the brain and spinal cord, central and peripheral nervous system. Structure and types of Neurons, Resting membrane potential, Graded potential, synaptic nerve impulse, Neuro transmitters, Orgin of graded potential and its propagation in myelinated and non myelinated nerve fibre. Molecular and chemical basis of muscle contraction.

Unit V

Sensory organs- Ultra structure and function of human eye, ear, tongue, nose and skin. Pigmentation. Sensory process (Vision, auditory, touch, taste, vestibular and kinesthesis); Perception; Cognition (Concepts, language and thought, problemsolving and decision – making); Intelligence (Characteristics, assessment, the role of creativity).Reproduction and Endrocrine Glands: Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle; Structure and function of Pituitary, Thyroid, parathyroid, adrenal and pancreas, neuroendocrine regulation.

REFERENCES:

1. Rajiv Kumar Sinha, Modern Plant Physiology, Alpha Science International Ltd, 2004.
2. Hans Mohr, Peter Schopfer, Plant Physiology, Springer, 2012.
3. P. C. Trivedi, Advances in Plant Physiology, I.K. International Publishing House Pvt. Ltd. 2006.
4. Salisbury, F.B. and Ross, C.W. 1986- Plant Physiology, CBS Publishers and Printers, New Delhi.
5. Pandey, S.N.1991 – Plant Physiology, Tata McGraw Hill Publishers, New Delhi.

6) Fundamentals of Plant Physiology- V. K.Jain
7) S. C. Rastogi, Essentials of Animal Physiology, New Age International Publishers, 2007.
8) Knut Schmidt-Nielsen, Animal Physiology: Adaptation and Environment, Fifth Edition, Cambridge University Press, 1997.
9) Lauralee Sherwood, Hillar Klandorf, Paul Yancey, Animal Physiology: From Genes to Organisms, Cengage Learning Pvt Ltd. 2012.

E-book links:

1. http://www.plantphysiol.org/
2. https://www.nature.com/subjects/plant-physiology
3. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/5%3A_Microbial_Metabolism/5.11%3A_Phototrophy/5.11C%3A_The_Two_Parts_of_Photosynthesis
4. https://www.livescience.com/51720-photosynthesis.html
5. https://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookPS.html
6. https://nptel.ac.in/courses/
7. https://www.researchgate.net/publication/286456096
8. https://www.pdfdrive.com/animal-physiology-d58162507.html
9. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2660586/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	S	S	S	M	S	M	S
CO3	S	M	M	S	S	S	S	S	S	S	S	M	S
CO4	S	M	M	S	S	S	S	S	S	S	S	M	S
CO5	S	M	M	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	SKILLED BASED STUDIES I – HERBAL TECHNOLOGY-IBTS31		
Semester	Semester-III	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• Understands the concepts of Pharmacognosy • To be able to identify, classify, collect and process medicinal plants • Acquire knowledge about the uses of various medicinal plants in the treatment of illness. • To learn the methods of processing and packaging of medicinal plants for commercial use.		

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO-1: Understand the concepts of pharmacognosy **K1**

CO-2: Know about the classification of medicinal plants. **K1**

CO-3: Able to understand the preparation and development of herbal formulations **K2**

CO-4: Understanding the basics of Herbal medicines for Human ailments **K2**

CO-5: learn the methods of processing and packaging of medicinal plants for commercial use **K3**

Unit I:

Introduction To Herbal Biotechnology And Methods For Processing Of Herbs: Introduction to herbal biotechnology: Herbal versus conventional drugs, safety in herbal medicine, importance of herbal therapy, efficacy of herbal medicinal products, validation of herbal

therapies. Methods for processing of herbs: Collection, harvesting, garbling, packing, and storage conditions. Methods of drying - natural and artificial drying methods -merits and demerits.

Unit II:

Methods For Preparation Of Extracts: Methods for preparation of extracts: Types of herbal extracts, principles of extraction and selection of suitable extraction method. Different methods of extraction - infusion, decoction, digestion, maceration, percolation, successive solvent extraction, soxhlet extraction, supercritical fluid extraction, stream distillation, microwave assisted extraction, headspace techniques, sepbox, hot continuous extraction, pilot scale extraction with example.

Unit III:

Modern Techniques In Herbal Drug Identification And Characterization : Modern technique in herbal drug identification and characterization: Ultraviolet-visible spectrometry, FTIR, TLC, capillary electrophoresis, HPLC, HPTLC, GC-MS, LC-MS, Super critical fluid chromatography, XRD, NIR, and NMR.

Unit IV:

Herbal Formulation: Herbal formulation: Types and forms, WHO Guidelines for standardization of quality herbal formulations, standardization of herbal formulations, parameter used for formulation, standardization for single drugs and compound formulations, quality assessment of herbal formulation, certification for formulations.

Unit V:

Toxicity – Regulations And Herbal Products: Toxicity and regulations: Adverse reactions in herbal medicine, toxicity in herbals and their interactions, factors affecting safety of herbal formulation, detoxification of formulation, quality control of herbal drugs, policies and regulation. Herbal products: Herbal syrups, herbal cosmetics, herbal creams, herbal lotions, herbals used in dentifrice, herbals as immunity boosters, herbal oil, colors, perfumes, preservatives.

REFERENCES:

1 S. S. Agrawal and M. Paridhavi (2013).Herbal Drug Technology, Orient Blackswan.
2 Herbal Drug Technology (English, Paperback, Mohan Lal Kori, Santram Lodhi, Tushar A Deshmukh, Rageeb Md. Usman, Vaibhav M Darvhekar).
3 Shanti bhushan Mishra (2019) Essentials of herbal drug technology: A guide of standardization quality control educreation publishing.

4 EiRi Board. Herbal Cosmetics and Beauty Products Formulations Book.Engineers India Research Instt.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://www.youtube.com/user/cecedusat
2 https://www.slideshare.net/mostafam7moud/herbal-medicine-intro
3 https://agris.fao.org/agris-search/search.do?recordID=MY2012050079
4 https://www.slideshare.net/Sindhukuberappa/phytochemical-extraction
5 https://www.slideshare.net/LavanyaSA/drlavanyasa-standardization-of-herbal-drugs
6 https://www.slideshare.net/priyankagoswami/herbal-formulations
7 https://www.slideshare.net/parth241989/who-certification-112070804014
8 https://www.slideshare.net/jatinsingla16/regulation-of-herbal-products
9 https://www.slideshare.net/binnz/herbal-regulations-92992268

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER IV

Course Title & Code	**CORE 7 (Theory)- PRINCIPLES OF MOLECULAR BIOLOGY-IBTT41**		
Semester	Semester-IV	Credits:4	Hours/weeks: 4
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To understand the basic principles of molecular biology from DNA as genetic material to protein synthesis and regulation. • To know the fundamental aspects in biological phenomenon. • To learn the basics of DNA replication		

COURSE OUTCOMES:

Upon completion of this course, the students will be able

CO1: to understand the various biological processes and molecular structure and functions of cells and molecules such as DNA, RNA and proteins **K1**

CO2: to understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems. **K2**

CO3: to understand the fundamental aspects in biological phenomenon. **K2**

CO4: to know the properties of genetic materials and storage and processing of genetic information. **K3**

CO5: to understand the Prokaryotic and Eukaryotic DNA replication **K3**

Unit I

Genome organization -Molecular Biology – An Overview – Structure of DNA - denaturation, and renaturation of DNA -Genome organization in prokaryotes and eukaryotes - DNA packaging in nucleosome – chromatin and chromosome.

Unit II

Genetic Material / Replication enzymes

DNA as genetic material. Central dogma concept. Methods of replication. Enzymes in DNA replication. Replication in prokaryotes-origin of replication, replication fork, leading and lagging strand replication. Okazaki fragments. Elongation, termination of replication. Eukaryotic DNA replication. Inhibitors of replication**.** Genetic Code. triplet code and its feature, wobble hypothesis, DNA Repair mechanism.

Unit III

RNA and Transcription - RNA structure, types of RNA, RNA polymerases, transcription in prokaryotes-initiation and elongation, promoters, termination of transcription. Eukaryotic promoters. Post Transcriptional processing and modifications. Reverse transcription.

Unit IV

Translation- Translation initiation, elongation, and termination in prokaryotes. Translation in eukaryotes. Post translational processing and modifications. Antibiotics-inhibitors of protein synthesis. Protein structure-folding of the polypeptide chain, alpha-helix and secondary beta structures.

Unit V

Gene Regulations - Principles of regulation - Cis-acting sites, and transacting molecules - feedback inhibition and allosteric regulation - The lac operon - trp operon, regulation of mRNA stability – Eukaryotic regulation.

REFERENCES:

1. Freifelder D and Malcinski GM Essential of Molecular Biology, 2nd Edition, Jones Barlett Publishers, 1993.

2. Watson JD, Molecular Biology of the Gene, 4th edition, Benjamin and Cummings Publishers, 1987.

3. Gerald Karp, Cell and Molecular Biology, John Wiley, 1996.

E-book links:

1. https://nptel.ac.in/
2. https://psychiatryonline.org/
3. http://textbookofbacteriology.net/regulation_5.html

4. https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL II - BIOCHEMISTRY AND MOLECUALR BIOLOGY- IBTP41**		
Semester	Semester-IV	Credits:4	Hours/weeks: 4
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		

Learning Objective	• To know the fundamental aspects in biological phenomenon. • To develop the skills in identifying the various biomolecules • To develop the skills of quantifying the various biomolecules

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Recall key concepts, facts, and theories relevant to biological macromolecules K1

CO2: Outline the contemporary techniques in molecular techniques K2

CO3: Know the basic units, calculations and different measurements tools used in biomolecule evaluations K3

CO4: Perform basic biochemical test K4

CO5: Apply the knowledge gained to address various technical problems K3

LIST OF EXPERIMENTS:

LAB IN BIOCHEMISTRY

1. Preparation of solutions – Molar, Normal, Percentage, Stock, Working etc.
2. Determination of pH
3. Preparation of buffers – PBS, Tris and Acetate buffer.
4. Qualitative analysis of carbohydrate, protein, and lipid
5. Estimation of protein by Lowry's method
6. Estimation of nucleic acids by absorbance at 260 nm
7. Estimation of DNA by diphenylamine
8. Estimation of RNA by orcinol method.
9. Estimation of lipids –cholestrol
10. Separation of amino acids by Paper chromatography
11. Separation of amino acids by Thin layer chromatography
12. Separation of pigments by column chromatography

13. Estimation of glucose (DNS method)

LAB IN MOLECULAR BIOLOGY

1. To measure concentration of DNA & RNA by UV spectrophotometry
2. Using a hemacytometer to count cells.
3. SDS , Electrophorosis apparatus, structure, function.
4. Bacterial Transformation.
5. PCR principles, reaction electrophoresis, observation. (Demo)
6. Separation of DNA by AGE.
7. Isolation and purification of protein (Dialysis).
8. Isolation of antibiotic resistant mutant.

REFERENCES:

1. Mathews C K, van Holde K E, Appling D R, Anthony-Cahill S J (2012) Biochemistry, 4th Edition. Prentice-Hall Bench Marked with 1.
2. Cooper G M and Hausman R E (2013) The Cell: A Molecular Approach. 6th edition. Sinauer Associates, Inc. The USA.
3. Practical Biochemistry by Wilson and Walker

Mapping of COs with POs &PSOs:

CO	PO								PSO				
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CO2	S	M	S	S	S	S	M	S	S	M	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S

CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	ALLIED PRACTICAL -II - PLANT AND ANIMAL PHYSIOLOGY-IBTA42		
Semester	Semester-IV	Credits:4	Hours/weeks: 3
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To equip the mind with the entire systems viz., digestion, cardiovascular system, excretion, nerve and muscles and endocrine glands with a view to gain a thorough input.		

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Understand the isolation of blood cells **K2**

CO2: Have knowledge on Dissection of animal body **K1**

CO3: Understand the Cardiac cycle and BMR determination **K2**

CO4: Classify relationship of complementary metabolic pathways such as photosynthesis and

respiration in energy acquisition and use during plant development **K3**

CO5: Elaborate understanding of sectioning of Dicot stem, Dicot root, Monocot Stem and Monocot root. **K2**

LIST OF EXPERIMENTS:

Lab in Plant Physiology

1. Systematic study of locally available plants belonging to the families prescribed in theory syllabus.
2. Demonstration of herbarium techniques
3. Study about Photosynthesis - Light Reactions
4. Structure of pollen grains using whole mounts
5. Demonstration of Pollen viability test using in- vitro germination
6. Study of ovule types and developmental stages of embryo sac using permanent slides /Photographs.
7. Developmental stages of onion root tip & Study of plasmolysis by using onion.
8. Section the parts of plants & Structure of endosperm (nuclear and cellular);
9. Developmental stages of dicot and monocot Embryos using permanent slides / Photographs
10. Demonstration of Hydroponics System
11. Isolation and mounting of embryo
12. Estimation of Chlorophyll from leaves

Lab in Animal Physiology

1. Blood cells isolation (centrifuge), staining, examine under microscope.
2. Blood pressure determination, blood sugar level examination.
3. Sperm structure observation, egg structure observation.
4. Dialysis process, methods, application. (Demo).
5. Skeletal muscle mechanics, and the electromyogram (EMG).
6. Cardiac cycle and the electrocardiogram (ECG).
7. BMR determination

REFERENCES:

1. Sambasivaiah, Kamalakara Rao and Augustine Chellappa, 1990. A text book of Animal Physiology and Ecology, S.Chand &Co., Ltd., New Delhi-110 055
2. Parameswaran, Anantskrishnan and Ananta Subramaniam, 1975. Outlines of Animal Physiology, S.Viswanathan (Printers & Publishers) Pvt. Ltd.,
3. Pandey, S.N.1991 – Plant Physiology,Tata McGraw Hill Publishers, New Delhi.
4. Verma,V.,1991-A Text Book of Plant Physiology, Emkay Publications, NewDelhi.
5. Malik, C.P. 1999 – Plant Physiology, Kalyani Publishers, Ludhiyana.
6. Gill, D.S.2000 –Plant Physiology, S.Chand and co., New Delhi.
7. Salisbury, F.B. and Ross, C.W. 1986- Plant Physiology, CBS Publishers and Printers, New Delhi.
8. Jayaraman, J. 1992 – Techniques in Biology. A College level Study, Higginbotham's (Private) Ltd, Chennai.
9. Winchester, A.M. (1958) : Genetics(3rd Edition) Oxford & IBH Publishing House, Calcutta, Bombay, New Delhi.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**SKILLED BASED STUDIES II - MEDICAL LABORATORY TECHNOLOGY- IBTS42**		
Semester	Semester-V	Credits:2	Hours/weeks: 2
Cognitive Level	K2:Understand K3:Apply		
Learning Objective	To understand the basic concepts and to learn the techniques essential for clinical laboratory		

COURSE OUTCOMES:

On Successful completion of the course, the students will be able to

CO1: Perform the basic haematology techniques and undertake biochemical analysis of clinical samples **K2**

CO2: Understand the tests performed in clinical microbiology lab **K2**

CO3: Undertake histological analysis of samples. **K3**

CO4: Comprehend the basic techniques performed in clinical immunology laboratory.**K3**

CO5: Know about quality control, lab accredition and automation. **K2**

Unit I

Basic Hematology - Specimen collection and handling, transportation of specimens, disposal of specimen after laboratory use. Specimen preservation. Composition of blood. Methods of estimation of Haemoglobin, PCV, total and differential count of WBC, platelet count, clotting, bleeding and prothrombin time. Blood Group - methods of grouping and Rh factor.

Unit II

Biochemical test- Tests for specific amino acids, determination of proteins in serum and plasma. Determination of glucose, glucose tolerance test, ketone bodies, glycated hemoglobin, triglycerides, cholesterol, lipoproteins. Examination of body fluids - ascitic fluid, pleural fluid, synovial fluid, pericardial fluid, CSF and amniotic fluid. Urine analysis, abnormal constituents. Faecal specimen - Macroscopic and microscopic examinations - detection of occult blood, Semen analysis. Laboratory analysis of throat swab, sputum specimens, purulent exudates – Tuberculosis

Unit III

Histopathology - Tissue reception, labeling, fixation and section cutting, Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking). Handling and care of microtome, types of microtome, sharpening of knives, and section cutting. Frozen section techniques - CO2 freezing, cryostat. Preparation of common stains. H & E, Congo red, methyl violet, Leishman stain, Giesma and staining techniques. Mounting of specimens, record keeping, indexing of slides. Molecular analysis of chromosomal aberrations in leukemias and lymphomas. Molecular diagnosis of genetic diseases.

Unit IV

Principles of Diagnosis: History, Physical Examination, Treatment, Differential Diagnosis, Tests and procedure (Clinical laboratory test, Tests using Radioisotopes, Endoscopy, Ultrasound, X-Ray, MRI, CT scan, PET scans, cytologic and Histologic examination of cells and tissue from patients).

Unit V

Molecular Diagnosis - Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, In situ PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction. Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequence analysis.Viral diagnostics: immunodiagnosis, molecular diagnosis. SNP-based diagnosis. DNA chips, automation, gene therapy; applications in diagnosis of genetic disorders, Diagnosis of Prenatal & neonatal genetic disorders.

REFERENCES:

1. Praful. B. Godkar, Darshan. P. Godkar, Text Book of Medical Laboratory Technology. Bhalani
Publishing House. 2014
2. F.J. Baker, R.E. Silverton, Butterworth - Heinemann. Introduction to Medical Laboratory Technology. Butterworth- Heinemann. 2014.
3. Mayne. Clinical Chemistry in Diagnosis and Treatment. ELBS. 6th ed. 1994
4. Harold Varley. Practical clinical biochemistry. CBS Publisher. 6th ed. 2002,
5. Todd & Stanford. Clinical Diagnosis and Management by Laboratory Methods. 16th ed.

2016

Mapping of COs with POs &PSOs:

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CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 8 (THEORY)- BIOSTATISTICS – IBTT51**		
Semester	Semester-V	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To acquire knowledge on applications of statistics in research. • To gain knowledge in experimental design and data collection techniques.		

	• To develop the technical art of writing research report and presentations. • To learn the concepts of probability, probability laws, probability distributions and apply them in solving biological problems and statistical analysis.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Understand the fundamentals of statistics and its methodology

CO2: Know the theory of statistics and their application for solving the problems in the field of life sciences.

CO3: Understand the various types of data and apply basic statistical concepts

CO4: skill development in the aspects of collection and presentation of biological data through biostatistics

CO5: learn the methods in statistics to solve the biological problems with accuracy

UNIT – I

Introduction to Basis of statistics – Definition – Statistical methods – kinds of Biological Data. Classification of Data, Meaning and definition, objectives of Classification of Data.

UNIT – II

Collection, Organization and Representation of Data.

Collection of Data, Types of Data- Primary Data and Secondary Data, methods of collecting Data. Sampling and sampling Designs – Meaning and Definition – Random and Non – Random sampling. Tabulation and representation of data – diagrammatic and graphical.

UNIT – III

Measures of central Tendency. Definition, Types of averages- Arithmetic mean, Median, Mode, Problems related to ungrouped data, simple grouped data – Continuous and discrete series.

UNIT – IV

Measures of Dispersion, Definition, Types of dispersion – Range, Mean deviation, Standard deviation and variance, problems related to measures of dispersion.

UNIT – V

Correlation analysis (Karl Pearson's and Spearman's Rank), Regression analysis – simple, linear. Tests of significance –'t'-test, Chi-square and goodness of fit, 'F' test, Analysis of variance (ANOVA): One-way & Two-way.

REFERENCES:

1. Sokal, R.R. and F.J. Rohlf. 1969. Biometry: The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, USA.
2. Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi.

E-book links:

1) https://www.pdfdrive.com/biostatistical-methods-biostatistical-methods-e15213717.html
2) https://www.pdfdrive.com/biostatistics-e42988735.html
3) https://www.pdfdrive.com/introductory-biostatistics-e15112721.html
4) https://www.pdfdrive.com/introductory-biostatistics-e176105301.html
5) https://www.pdfdrive.com/bioinstrumentation-instructional-resources-technology-austin-e15581883.html

Mapping of COs with POs &PSOs:

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CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	M	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating	(S)	- 3 marks
Moderately Correlating	(M)	- 2 marks
Weakly Correlating	(W)	- 1 mark
No Correlation	(N)	- 0 mark

Course Title & Code	CORE 9 (THEORY) – IMMUNOLOGY-IBTT52		
Semester	Semester-V	Credits:4	Hours/weeks: 5
Cognitive Level	K2: Understand K3: Apply K4: Analyze K5: Evaluate		
Learning Objective	• To gain comprehensive knowledge on cells and organs of the immune system • Understand the immune types of response • Immune mechanisms of protection and types of available • Know about the availability of new vaccines.		

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1 : Specify the lymphoid organs, cells of the immune system and their functions

CO2 : Apprehend the definition, properties and role of antigens and antibody types and comprehend the role of complement system

CO3: Understand the genetic mechanism for antibody diversity and know in detail about classical and newer vaccines

CO4: Understand the immune mechanisms, hypersensitivity and tissue transplantation

CO5: Describe the function and role of HLA protein and disease association

Unit 1

History of Immunology, Types of immunity - innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs. Cells of the immune system - lymphocytes,

mononuclear phagocytes-dendritic cells, granulocytes, NK cells and mast cells. Antigens - antigenicity, epitopes, haptens. Immunoglobulins - structure, classification and functions.

Unit II

T-cell, B-cell receptors, Antigen recognition - processing and presentation to T-cells. Immunological memory. Effector mechanisms - macrophage activation. Complement activation. Organization and expression of immunoglobulin genes. Generation of antibody diversity.

Unit III

Transplantation types. MHC antigens in transplantation. Immunodeficiency disorders - AIDS: The HIV genome and life cycle. Autoimmunity and elementary details of autoimmune disorders (systemic lupus erythematosus).

Unit IV

Immunization practices - active and passive immunization. Vaccines - killed, and attenuated. Recombinant vaccines - DNA vaccines, synthetic peptide vaccines. Production of applications of polyclonal and monoclonal antibodies.

Unit V

Agglutination and precipitation techniques. Immunoelectrophoresis, RIA, Immunoblotting, Avidinbiotin mediated immunoassay. Immunohistochemistry, immunofluorescence. ELISA - principle and applications.

REFERENCES:

1. Jenni Punt, Sharon Stranford et al. Kuby Immunology. WH Freeman & Co. 8th ed. 2018.
2. Abbas et al. Cellular and Molecular Immunology. Elsevier. 9th ed. 2018.
3. Janeway, C. (Ed), Travers. Immunobiology. Garland Publ. 9th ed. 2017.
4. Coico and Sunshine. Immunology: A short course. Wiley-Liss. 7th ed. 2015.
5. Roitt et al. Roitt's Essential Immunology. Wiley-Blackwell Sci.13th ed. 2017.

E-book links:

1. https://nptel.ac.in/
2. http://www.nptelvideos.in/2012/11/essentials-in-immunolgy.html
3. http://www.sacema.org/uploads/Introduction-to-Medical-Immunology.pdf

4. http://dl.mehrsys.ir/pdfbooks/Roitt_s%20Essential%20Immunology%20Thirteenth%20Edition(www.myuptodate.com).pdf
5. http://med-mu.com/wp-content/uploads/2018/06/Essentials-of-Clinical-Immunology-6E-Chapel-Haeney-Misbah-_-Snowden.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	M	S	S	S	S	M	S
CO2	S	M	M	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	M	S	S	M	S	S	S	S	M	S
CO4	S	M	S	M	S	S	M	S	S	S	S	M	S
CO5	S	M	S	M	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	CORE 10 Theory – DEVELOPMENTAL BIOLOGY-IBTT53		
Semester	Semester-V	Credits:4	Hours/weeks: 5
Cognitive Level	K1:Recall K2:Understand K3:Apply		

Learning Objective	• Students should able to understand the different phases of the embryo development and associated medical implications. • Students will acquire knowledge to analyze and interpret the principles of early and late embryonic development . • To compare and comprehend the development of model organisms like C. elegans, amphibians, Aves . • To demonstrate the medical implications of developmental biology.

COURSE OUTCOMES:

On Successful completion of the course, the students will be able to

CO1: Understand the basics of embryo development in vertebrates and invertebrates.**K1**

CO2: Learn the events in the early embryonic development.**K1**

CO3: Understand the development of organs and developmental pattern **K2**

CO4: Understand the events taking place during post - embryonic development.**K2**

CO5: Understand the medical implications of developmental biology.**K3**

Unit- I Basic Concepts of Development

Basic concepts of developmental biology - cell theory, mosaic and regulative development, discovery of induction. Cell division, cell differentiation, signaling, patterning.

Unit-II

Gametes structure and fertilization. Structure of the Gametes: Sperm, Egg and Recognition of egg and sperm. External Fertilization in Sea Urchins. Cleavage - From fertilization to cleavage - Patterns of embryonic cleavage-Gastrulation-Oogenesis in Mammals.

Unit-III

Early Embryonic Development: Early Development in invertebrate /vertebrate models Drosophila, C.elegans, Xenopus, Mouse. Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), body plan patterning, left right asymmetry in vertebrates. Late Development in invertebrate /vertebrate models - Organogenesis- development of central

nervous system in vertebrates, vulval formation in C.elegans

Unit-IV

Introduction: Angiosperm –Life cycle, Plant growth and development, Embryonic and post-embryonic development, Characteristics of plant development. Molecular Genetics of Plant Development: Generation and characterization of developmental mutants, studying temporal and spatial expression pattern of developmental regulators.

Unit-V

Root development: Organization and maintenance of root apical meristem, radial patterning during vascular development, Root branching; lateral root development. Shoot development: Organization and maintenance of shoot apical meristem, Organogenesis and organ polarity, Floral transition, Floral organ patterning and determinacy, Cell-to-cell communication during development.

REFERENCES:

1. Jonathan Slack. Essential Developmental Biology. Wiley-Blackwell. 3rd ed. 2012
2. Lewis Wolpert. Principles of Development. Oxford University Press.4th ed. 2012
3. Scott F. Gilbert. Developmental Biology. Sinauer Associates Inc., 10th ed. 2013
4. Lewis Wolpert & Cheryll Tickle. Principles of Development.Oxford University Press, 4th ed. 2011.
5.Klaus Kalthoff. Analysis of Biological Development. McGraw-Hill. 2nd ed. 2000

E-book links:

1. https://nptel.ac.in/
2. https://www.pdfdrive.com/developmental-biology-eighth-edition-d161981415.html
3. https://www.pdfdrive.com/embryology-e15928581.html
4. www.gutenberg.net

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	M	M	M	S	S	M	S	S	M	S	M	S
CO2	S	M	M	M	S	S	M	S	S	M	S	M	S
CO3	S	M	M	M	S	S	M	S	S	S	S	M	S
CO4	S	M	M	M	S	S	M	S	S	S	S	M	S
CO5	S	M	M	M	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 11 (Theory) – BASIC BIOINFORMATICS- IBTT54**		
Semester	Semester-V	Credits:4	Hours/weeks: 5
Cognitive Level	K1:Recall K2:Understand K3:Apply K4: Analyze K6: Create		
Learning Objective	• The objectives of this course are to provide students with the theory and practical experience of the use of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts. • Develop an understanding of the basic theory of these computational tools.		

	• Students should gain working knowledge of these computational tools and methods. • Students gain knowledge to relevance for investigating specific contemporary biological questions and critically analyse and interpret the results of their study.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Understand the basic bioinformatics information's such as data types, data storage, retrieval, sequence alignments and gene expression patterns in pro and eukaryotes.**K1**

CO2: Understand the computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts. **K2**

CO3: Apply structural bioinformatics tools to predict and elucidate protein structures and map protein interactions.**K3**

CO4: Retrieve, align, analyze and interpret sequence and structural data from databases.**K4**

CO5: Construct the phylogenetic tree of different sequences and apply database information for molecular modelling.**K6**

Unit I

Introduction- History of Bioinformatics– challenges and opportunities- applications of Bioinformatics, Biological databases- Literature databases: PubMed, Nucleic acid sequence databases: GenBank, EMBL. Protein sequence databases: UniProt, PDB. Sequence submission databases – BankIt, Structure databases -CATH, SCOP, and PDB

Unit II

Sequence analysis- Various file formats for bio-molecular sequences: genbank, FASTA, GCG, nbrf-piretc-Basic concepts of sequence similarity, identity and homology- Sequence-based Database Searches- BLAST and FASTA algorithms

Unit III

Sequence Alignment- Dot plot and Dynamic Programming - Local alignment smith waterman algorithm - and Global alignment - Needleman-Wunsch - (algorithm and example) –sequence formats and Pair wise alignment and its tools

Unit IV

Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results– Clustal W algorithm - Feng Doolittle algorithm. Definition and description of phylogenetic trees and various types of trees

Unit V

Structural Bioinformatics - 3D structure prediction – Homology modeling – folds recognition &Ab-initio methods. Visualization of structures using SPDBViewer or PyMol. Bioinformatics in the Pharmaceutical Industry- Drug discovery

REFERENCES:

1. Claverie, Jean-Michel and Cedric Notredame, Bioinformatics for Dummies, 2nd Edition, 2007.
2. Wiley (required text) Westhead, D.R., J.H. Parish and R.M. Twyman, Instant Notes: Bioinformatics, 2002.
3. BIOS Scientific Publishers Ltd. Xiong, Jin, Essential Bioinformatics, 2006, Cambridge University Press.
4. Campbell, A. Malcolm and Laurie J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd edition, 2007, Pearson Benjamin Cummings.
5. Lesk A Introduction to Bioinformatics. Oxford Univ Press. 4th ed. 2014.
6. Hodgman et al. Instant Notes in Bioinformatics. Taylor and Francis. 2nd ed. 2010.

E-book links:

1. https://www.pdfdrive.com/bioinformatics-books.html
2. http://www.ru.ac.bd/
3. https://nptel.ac.in/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	S	M	S	S	S	M	S	S	S	S	S	M
CO2	S	S	M	S	S	S	M	S	S	S	S	S	M
CO3	S	S	M	S	S	S	M	S	S	S	S	S	M
CO4	S	S	M	S	S	S	M	S	S	S	S	S	M
CO5	S	S	M	S	S	S	M	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 12 (THEORY)- RECOMBINANT DNA TECHNOLOGY- IBTT55**		
Semester	Semester-V	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To expose students to application of rDNA technology to various fields of biotechnology (medicine and research areas). • The student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms and gene therapy. • To learn about techniques employed are carved as self-study. • To get information on the latest advances in recombinant		

	DNA technology, principles, techniques for genetic engineering new organism to solve the social problems. which is a powerful tool needed for modern biotechnology research.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Study and know the tools and advanced current techniques of genetic engineering

CO2: Understand the difference between hosts and its suitable vectors for gene cloning

CO3: Learn procedure for gene transformation techniques into the cell.

CO4: Well versed in PCR techniques and primer design using bioinformatics tools and its importance to find solution and improvement in the field of plant and animal and man kind welfare

CO5: know advanced techniques identification of any organisms using DNA barcoding, DNA based nanostructure and applications

UNIT I

Restriction enzymes, DNA ligase, Klenow fragment, DNA polymerase I, T4/T7 DNA polymerase, Taq polymerase linkers, adaptors, Homopolymeric tailing, Alkaline phosphatase, Reverse transcriptase, Radioactive and non radioactive probes, hybridization, Microarray, blotting- southern, northern, western..

UNIT II

Host cells – Prokaryotic & Eukaryotic, Vectors – plasmids, Lamda phage, M13, PUC 18, Cosmids, artificial chromosomal vectors (YAC,BAC), Animal virus derived-SV40, Vaccinia, retroviral, Expression vectors-pET based yeast vectors and Shuttle vectors, Ti and R vectors.Intein – based vectors, inclusion bodies.

UNIT III

Insertion of foreign DNA into host- Transformation, Electroporation, Lipofection, Microinjection, Construction of Genomic DNA and cDNA libraries, cDNA and genomic

cloning, Expression cloning, protein-protein interactive cloning. Yeast two hybrid system, principles to maximize gene expression.

UNIT IV

Primer design, PCR- Multiplex, nested, reverse transcriptase, realtime, Touchdown, Hot start and colony. Cloning of PCR products. PCR in molecular diagnostics, Viral & Bacterial detections, mutation & polymorphism detection – RFLP, SSCP, Oligo ligation assay, Allele specific amplification, DNA fingerprinting, site directed mutagenesis.

UNIT V

DNA sequencing –chemical, enzymatic, Automated & Pyro Human genome project, DNA barcoding, DNA based nanostructure and applications. Chemical synthesis of oligonucleotides. Gene knockout and gene therapy, suicide gene therapy and transgenics.

REFERENCES:

1. Gene Cloning and DNA Analysis. An introduction (2006) by T.A Brown, Blackwell Scientific Publications.
2. Principle of Gene Manipulation and Genomics (2006) by S.B. Primrose and R.M Twyman, Blackwell Scientific Publications.
3. Molecular Biology of the Gene, 6th edition (2008) by James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings.
4. From Genes to Clones: Introduction to gene technology (1987) by Winnacker, E.L.
5. Next generation sequencing (2008) by Michael Janitz, Wiley-Blackwell Publications.

E-book links:

1) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-4th-edition-e162050162.html
2) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-e156918014.html
3) https://www.pdfdrive.com/recombinant-dna-technology-molecular-biology-and-paradigms-e11385991.html
4) https://www.pdfdrive.com/recombinant-dna-principles-and-methodologies-e185941491.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	SKILLED BASED STUDIES III -PATENT AND PAPER/PROJECT WRITING- IBTS53		
Semester	Semester-V1	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	Estimate the possibilities of IP rights and the various ways of securing national and international protection Have critical thinking and innovative skills		

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Perceive the role of IPR **K1**

CO2: Utilize IP rights in business effectively **K2**

CO3: Decide on patenting procedures, types and filing **K2**

CO4: Write the Intellectual property rights **K2**

CO5: Acquire knowledge in develop skills required in writing reports and dissertation **K2**

Unit I

Traditional Knowledge – Petty patents, Patenting of biological materials –Patentable and non patentable inventions. Patentability of living organisms and genetic material, Pharmaceutical Patent, Patentability of diagnostic methods. Priority Search, paid and free tools for priority search. Forms and Procedures for filing patent. Technology transfer, IP Policy of University.

Unit II

Choosing the problem for research, literature collection – Primary, secondary and tertiary sources – Bibliography – indexing and abstracting – Reporting the results of research in conferences – Oral and Poster presentation . Thesis writing – Research journals – SCI, National and International –monographs – reprints – proof correction – Full paper – Short Communication – Review paper. Shodhganga, inflibnet, online portals for free and paid access to journals and books.

Unit III

Proposal Writing. National and International funding agencies. Applying for research funding and their Importance, Assumptions and strategies when writing proposals, hypothesis and preliminary works, Writing review: Introduction, Literature survey, Source of literature, compilation.

Unit IV

Preparing Manuscripts**:** Main contents of a scientific paper, Procedure to submit a paper, Reviewing procedure, Advices in responding to reviewer, Examples-An example on abstract & an example on responses to reviewers, Online literature databases; Literature management tools.

Journal Metrics, Author Metrics. Referencing and citation. Plagiarism: Introduction; Tools for the detection of plagiarism; avoiding plagiarism,

Unit V

Activity: Preparation of Departmental Magazine: Collection of events including Festival celebrations, Club Activities, Departmental Activities and achievements and compilation. Monthly magazine.

REFERENCES:

1. Intellectual Property Rights (2008) Prabuddha Ganguly, Tata McGraw Hill Publishing Company, India. ISBN: 9780070077171

2.Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.

3. Ethics and Biotechnology by Anthony Oakley Dyson, John Harris. Routledge. 1994.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	M	S	S	M	S	S	S	M	M	S
CO2	S	M	M	M	S	S	M	S	S	S	M	M	S
CO3	S	M	M	M	S	S	M	S	S	S	M	M	S
CO4	S	M	M	M	S	S	M	S	S	S	M	M	S
CO5	S	M	M	M	S	S	M	S	S	S	M	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER VI

Course Title & Code	CORE 13 (Theory) – CELL AND TISSUE CULTURE –IBTT61		
Semester	Semester-V1	Credits:4	Hours/weeks: 5
Cognitive Level	K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To learn the fundamentals of cell and tissue culture, • To know about the media preparation • To understand the commercial applications of tissue culture.		

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1 : Acquire knowledge on organization of cell and tissue culture lab and methods of aseptic maintenance and nutritional requirements.**K2**

CO2 : Learn techniques for culturing animal cell line and cloning of cell lines.**K2**

CO3 : Understand the types of animal cell culture.**K2**

CO4 : Understand the techniques employed for plant tissue culture including single cell, protoplast and callus culture. **K3**

CO5 : Appreciate the commercial applications of plant and animal tissue culture in breeding and industry. **K4**

Unit I

Bacterial and Actinomycets cell culture - culture media and its types, preparation of culture media- Media optimization: pH & temperature, techniques of aseptic transfer and observation of culture. Culture methods- spread plate, streak plate, test tube culture. Pure culture- sub culture – cryopreservation Storage and Maintenance. Culture repositories.

Unit II

Fungal and viral cultures – different types of media, optimization of media, inoculation methods -fungi and mushrooms. Spore culture, maintaining of culture and specimen, identification and observation of culture, Culture repositories. Cultivation and purification of viruses, Assay of viruses. Bacteriophage – isolation and identification.

Unit III

Algal cell culture: Laboratory and Mass culture of Algae, Mass production of blue green algae. Method of production of unicellular algal food, Single Cell Protein, Sea weeds Cultivation, Algal food in the field of Aquaculture. Planktons (Phyto plankton & Zoo plantkon) - production and measurement, Methods of collection and preservation.

Unit IV

Animal cell culture: Culture media preparation, Synthetic and Artificial, Serum and glutamine in cell culture, Serum and Protein free defined media and their applications. Biology of Cultured cells: Characteristics, Measurement of growth, Cell synchronization, Senescence and Apoptosis. Primary and established cell cultures. Cell lines, Subculture: Monolayer, Suspension culture. Stem cell cultures- Organ culture and Histotypic culture. Assays for cell viability and Cytotoxicity.

Unit-V

Plant Cell Culture- Growth and development of plant cells and tissues in vitro. Laboratory requirements, aseptic techniques. Nutrient media. Plant growth regulators: mode and mechanism of action. Callus culture, cell suspension culture, organ culture, protoplast culture. In-vitro Germplasm conservation (Cryopreservation).

REFERENCES:

1. Martin BM. Tissue Culture Techniques- An Introduction. Birkhauser. 1994.
2. Smith RH. Plant tissue culture. Elsevier. 3rd ed. 2013.
3. Singh B.D. Biotechnology. Expanding horizons. Kalyani Publ. 4th ed. 2012
4. Mather JP and Barnes D. Animal Cell Culture Methods. Vol 57. Elsevier
5. Freshney RI. Culture of Animal Cells: A manual of basic technique. Wiley-Liss. 6th ed. 2010.

E-book links:

1. https://nptel.ac.in/
2. https://www.pdfdrive.com/culture-of-animal-cells-a-manual-of-basic-technique-and-specialized-applications-d157211461.html
3. https://www.pdfdrive.com/animal-cell-biotechnology-d22743665.html
4. https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-d20389188.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	M	S	S	S	S	M	S
CO4	S	M	S	S	S	S	M	S	S	S	S	M	S
CO5	S	M	S	S	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 14 (Theory) – ENZYME TECHNOLOGY-IBTT62**		
Semester	Semester-V1	Credits:4	Hours/weeks: 5

Cognitive Level	K2: Understand K3: Apply K4: Analyze
Learning Objective	• Discuss the concepts of food biotechnology • Relate the role of biotechnology in the food industry • Explain the consumer perception of food biotechnology

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1 : Understand the basic concepts and the kinetics and regulatory role of enzymes. **K2**

CO2 : Comprehend the methods for enzyme production and immobilization **K2**

CO3 : Design the strategies of enzyme engineering **K3**

CO4 : Apply the methods for large scale isolation, purification and downstream processing of Enzymes **K3**

CO5: Apprehend the applications of enzymes as tools in industry and as therapeutics in medicine. **K4**

Unit I

Brief introduction to enzymes, mechanisms of enzyme action, specificity of enzyme action, the structure–functionality relationships, concept and determination of enzyme activity, Effect of physical and chemical factors on enzyme activity, applications in food, pharmaceutical and other industries

Unit II

Kinetics of enzyme catalysed reactions. Importance and estimation of kinetic constants, Kinetics of bi substrate enzymes, Enzyme inhibition types and models- Competitive, Non-competitive and Un-competitive inhibitions. Inhibition kinetics- substrate, product and toxic compound.

Unit III

Extraction and purification of enzymes from plant, animal and microbial sources, Extraction of soluble and membrane bound enzymes. Nature of extraction medium. Purification of enzymes. Criteria of purity. Determination of molecular weight of enzymes.

Unit IV

Immobilization of enzymes: Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, Encapsulation, cross-linking, covalent binding, advantages and disadvantages of Different immobilization techniques. Design of immobilized enzyme reactors – Packed bed, Fluidized bed and Membrane bioreactors

Unit IV

Analytical and Industrial Applications of enzymes: Enzyme electrodes. Biosensors: components, types, (calorimetric, potentiometric, amperometric). Enzymes of industrial significance: use of enzymes in detergents, textiles, and leather industry, production of glucose syrup, cheese production. Therapeutic uses of enzymes: Enzymes as diagnostic aids. Therapeutic uses of enzymes: enzymes as thrombolytic agents and digestive aids.

REFERENCES:

1. Palmer T. Understanding Enzymes. Printice Hall. 2004.
2. Buchholz et al Biocatalysts and Enzyme Technology. Wiley-Blackwell. 2nd ed. 2012.
3. Pandey et al. Enzyme Technology. Springer. 2010.
4. Nelson, Cox. Lehninger Biochemistry. Freeman. 7th ed. 2017.
5. Balasubramanian et al. Concepts in Biotechnology. Univ Press. 2007.
6. Dixon and Webb. Enzymes. Elsevier. 2nd ed. 2014
7. John E. Smith. Biotechnology. Cambridge university press,5th ed. 2009

E-book links:

1. https://nptel.ac.in/
2. https://www.pdfdrive.com/enzyme-kinetics-enzymes-e5167787.html
3. http://www1.lsbu.ac.uk/water/enztech/
4. https://www.pdfdrive.com/enzymes-biochemistry-biotechnology-clinical-chemistry-e183694351.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	M	S	S	S	S	M	M
CO2	S	M	S	S	S	S	M	S	S	S	S	M	M
CO3	S	M	M	S	S	S	M	S	S	S	S	M	M
CO4	S	M	M	S	S	S	M	S	S	S	S	M	M
CO5	S	M	S	S	S	S	M	S	S	S	S	M	

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 15 (THEORY)- ENVIRONMENTAL BIOTECHNOLOGY-IBTT63**		
Semester	Semester-VI	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		

Learning Objective	• To understand the energy sources, environmental pollution and remediation using biotechnology and its control. • Students will get an idea about the hazards to our environment, solutions to protect and for sustainable development. • To learn remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development. • Student can identify the environmental problems such as global warming, ozone depletion and waste disposal and acquire skills to solve the environmental problems through biotechnological approach and become environmental conscious.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: identify and conserve the diversity both plants and animals resources. Use the resource in the natural way to avoid pollution K1

CO2: understand and identify the environmental issues due to types of pollution in current situation today country facing and problem solve mechanisms K2

CO3: learn procedure and do research in water treatment, water borne diseases, treatment of effluent from industry K3

CO4: gain knowledge about types of solid wastes generated in house and industry and solve the problems using natural process and earn income by recycling the waste K2

CO5: identify the environmental problems, find solution for chemical usage of pesticides and fertilizer and go far natural way of production technology and become good Entrepreneur K4

UNIT I

Terminology- environment, ecology, ecosystem, niche, habitat, abiotic, biotic, competition, mutualism, parasitism. Natural resource and fuels: Environment components, Role of Biotechnology in Environmental protection, Classification of natural resources – Inexhaustible, Exhaustible- resources. Conservation of natural resources – water, forest, energy and soil resources. Insitu – Exsitu conservation. Production of biogas and biofuel(alcohol), environmental act.

UNIT II

Pollution: Types of environmental pollution. Sources of environmental pollution. Bioindicators and biosensors for detection of pollution.Bioechnological methods for control of pollution. Green house effect and global warming. Ozone depletion and acid rain, Bhopal disaster, London smog. Environmental and biodiversity laws.

UNIT III

Water chemistry – physical-chemical and biological parameters – sources and efficiency of water pollution, oil pollution, super bug, water treatment, water borne diseases, Treatment of effluent from distillery and sugar industry. Bio-monitoring of water pollution using- algae, bacteria, plankton. Minamata disease, GAP, YAP, need for water management. Eutrophication, Oil disaster.

UNIT IV

Types of solid wastes, sources and its impact on environment, solid waste disposal-land filling, composting, incineration, 3R concepts, Vermicomposting, Radioactive wastes sources, Disposal - Deino coccus. Sources effects and control measures. Love canal disaster. Source of heavy metal pollution and environmental degradation. Bio-indicators of heavy metal pollution.

UNIT V

Biopesticides and Biofertilizers, Single cell protein, Biomineralisation, Mechanism of Biomineralization. Biomining. Xenobiotics – Pesticides degradation, Degradative plasmids, hydrocarbons, Biotechnology for Hazardous waste management, Persistent organic pollutants, biodegradation of organic and inorganic wastes. Bioremediation of organic spills and through plant sources. Biological detoxification of PAH, Eco – mark, Biodegradable plastics.

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1. Jordening HJ and Winter J. 2005. Environmental Biotechnology: Concepts and Applications. Wiley.
2. Dwivedi S.K, Kalita M.C, and Dwivedi P. 2007. Biodiversity and Environmental Biotechnology. 1st edition. Scientific Publishers, India, New Delhi.
3. Sharma P.D. 1994. Environmental Biology. Rastogi Publishers,New Delhi.

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E-book links:

1) https://www.pdfdrive.com/environmental-biology-the-conditions-of-life-environmental-selection-extinction-creation-e116415545.html
2) https://www.pdfdrive.com/environmental-biotechnology-biodegradation-bioremediation-and-bioconversion-of-xenobiotics-for-sustainable-development-e158141796.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL-III -IMMUNOLOGY AND RECOMBINANT DNA TECHNOLOGY - IBTP05**

Semester	Semester-VI	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To introduce students to different techniques that are commercially used in molecular diagnosis of diseases and give an account of different diseases that are routinely diagnosed using molecular testing. • To give a broad overview of molecular theory and exposure to molecular and immunology techniques, a forum to understand clinical applications of various molecular tests. • To introduce students to different techniques that are commercially used in molecular and immunology diagnosis of diseases and give an account of different diseases that are routinely diagnosed using molecular and immunology testing. • To get information on the latest advances in recombinant DNA technology, which is a powerful tool needed for modern biotechnology research.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about immunological techniques K1

CO2: understand and identify the health issues and report very easily K2

CO3: learn procedure and do research in protein, genes and gene transformation K3

CO4: gain knowledge about latest advances in recombinant DNA technology, K2

CO5: Analyze the immunological problems, find solution using immunology testing.K4

LAB IN IMMUNOLOGY AND RECOMBINANT DNA TECHNOLOGY

1. Agglutination tests: a. ABO Blood grouping. b. WIDAL test. c. ASO test. d. Pregnancy test. e. RPR test.
2. Preparation of plasma and serum, Blood cell analysis – total count, differential count.
3. ELISA, FACS, Flow cytometry
4. Blotting techniques (Southern Blotting, Western Blotting, Northern Blotting).
5. Immune diffusion methods (Radial immunodiffusion) (double immunodiffusion) , (single immunodiffusion), Rocket electrophoresis, Immuno electrophoresis
6. Vaccination- definition, production, principles, application.
7. RNA isolation from yeast
8. Western blotting
9. Restriction digestion, ligation
10. Preparation of competent *E.coli* cells & transformation of *E.Coli* using recombinant DNA
11. Primer designing and PCR

REFERENCES:

1. Roitt et al. Roitt's Essential Immunology. Wiley-Blackwell Sci. 13th ed. 2017.
2. James D. Watson et al. Recombinant DNA: Genes and Genomes- A Short Course. Freeman.3rd ed. 2006.
3. Glick and Pasternak. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press. 4th ed. 2010.
4. H.N. Thatoi , Supriya, Dash, Swagat Kumar Das. Practical Biotechnology: Principles and Protocols. 2017.
5. Thankur IS (2011) Environmental biotechnology: Basic concepts and applications. Second Edition (revised), I.K. International.

Mapping of COs with POs &PSOs:

	PO								PSO				
CO	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	M	M	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	M	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL-IV –ENVIRONMENTAL BIOTECHNOLOGY AND BIOINFORMATICS – IBTP62**		
Semester	Semester-VI	Credits:4	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To practice remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about immunological techniques

CO2: understand and identify the health issues and report very easily

CO3: learn procedure and do research in protein, genes and gene transformation

CO4: gain knowledge about analysis of water quality and solve the problem to the society

CO5: identify the environmental problems, find solution using biotechniques especially microbial techniques

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

1. Sampling techniques of water
2. Determination of colour, pH and temperature
3. Estimation of total alkalinity
5. Estimation of chloride
6. Estimation of total hardness
7. Estimation of Calcium
8. Estimation of DO, BOD and COD in drinking water
9. Estimation of DO, BOD and COD in sewage sample
10. Estimation of phosphate in drinking water
11. Estimation of nitrate in drinking water
12. Estimation of chromium and ferrous ion
13. Quick field soil test
14. Isolation of micro-organism from chrome tanning effluent
15. MPN- Water portability Test
16. Microbial treatment of industrial (sugar or dye) effluent and determination of COD

LAB IN BIOINFORMATICS

1. Database searching against a query sequence and selection of orthologous sequences using BLAST & database searching
2. Multiple Sequence Alignment using Clustal W.
3. Prediction of Open Reading Frames using ORF Finder

4. 3 Dimensional Structure of protein using Deep View, UCSC Genome Browser.

5. NCBI databases, Databases at EBI: EMBL-Bank, UniProt, ArrayExpress, InterPro Ensembl-genome browser.

Course Title & Code	**SOFT SKILL - EFFECTIVE COMMUNICATION AND PERSONALITY DEVELOPMENT-IBTS64**		
Semester	Semester-VI	Credits:2	Hours/weeks: 2
Cognitive Level			
Learning Objective	• To develop the students to understand the importance of personality development • To know about self-awareness and self-monitoring • To create an effective team and know the importance of team building		

UNIT -I

PERSONALITY - Definition – Determinants – Personality Traits –Theories of Personality – Importance of Personality Development. SELF AWARENESS – Meaning – Benefits of Self – Awareness – Developing Self – Awareness. SWOT – Meaning – Importance- Application – Components. GOAL SETTING Meaning- Importance – Effective goal setting – Principles of goal setting – Goal setting at the Right level.

UNIT – II

SELF MONITORING – Meaning – High self – monitor versus low self monitor – Advantages and Disadvantages self monitor- Self –monitoring and job performance. PERCEPTIONDefinition- Factor influencing perception- Perception process –Errors in perception – Avoiding perceptual errors. ATTITUDE – Meaning- Formation of attitude – Types of attitude - Measurement of Attitudes – Barriers to attitude change – Methods to attitude

change. ASSERTIVENESS - Meaning – Assertiveness in Communication – Assertiveness Techniques – Benefits of being Assertive – Improving Assertiveness.

UNIT – III

TEAM BUILDING – Meaning – Types of teams – Importance of Team building- Creating Effective Team. LEADERSHIP – Definition – Leadership style- Theories of leadership – Qualities of an Effect leader. NEGOTIATION SKILLS – Meaning – Principles of Negotiation – Types of Negotiation – The Negotiation Process – Common mistakes in Negotiation process. CONFLICT MANAGEMENT – Definition- Types of Conflict- Levels of Conflict – Conflict Resolution – Conflict management .

UNIT –IV

COMMUNICATION – Definition – Importance of communication – Process of communication - Communication Symbols – Communication network – Barriers in communication – Overcoming Communication Barriers. TRANSACTIONAL ANALYSIS – Meaning – EGO States – Types of Transactions – Johari Window- Life Positions. EMOTIONAL INTELLIGENCE- Meaning – Components of Emotional IntelligenceSignificance of managing Emotional intelligence – How to develop Emotional Quotient. STRESS MANAGEMENT – Meaning – Sources of Stress – Symptoms of Stress – Consequences of Stress – Managing Stress

UNIT – V

SOCIAL GRACES – Meaning – Social Grace at Work – Acquiring Social Graces. TABLE MANNERS – Meaning – Table Etiquettes in Multicultural Environment- Do's and Don'ts of Table Etiquettes. DRESS CODE – Meaning- Dress Code for selected Occasions – Dress Code for an Interview. GROUP DISCUSSION – Meaning – Personality traits required for Group Discussion- Process of Group Discussion- Group Discusson Topics. INTERVIEW – DefinitionTypes of skills – Employer Expectations –Planning for the Interview – Interview QuestionsCritical Interview Questions.

REFERENCES :

1. Stephan P.Robbins, Organisational Behaviour, Tenth Edition, Prentice Hall of India Private Limited, New Delhi, 2008

2. Jit S. Chandan, Oragnisational Behaviour, Third Edition, Vikas Publishing House

Private Limited, 2008

3. Dr.K.K. Ramachandran and Dr.K.K. Karthick, From Campus to Corporate, Macmillan Publishers India Limited, New Delhi, 2010.

SEMESTER VII

Course Title & Code	CORE 16 (THEORY)-ADVANCED BIOCHEMISTRY-IBTT71		
Semester	Semester-VII	Credits:4	Hours/weeks: 4
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• Students will get knowledge about the structure and functions of biomolecules, enzyme kinetics, bio polymers and metabolic reactions in a living system. • To introduce them to the basic structure of biomolecules which are involved in metabolic pathways • To determining how they are metabolized in organisms, and elucidating their role in the operation of the organism. • On the successful completion of the course the students will get an overall understanding of Biomolecules, their structure and classifications, enzyme kinetics and metabolic reactions in a living system. • To understand the industrial-market value and significance of these biomolecules and to apply these in the fundamentals of biotechnology		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the molecules, metabolisms of biochemical pathways **K1**

CO2: understand the lipid molecules, vitamins and hormones **K2**

CO3: know the structure, classification and properties of amino acids and proteins **K2**

CO4: know about nucleotide structure, biosynthesis, its regulation & degradation of Biomolecules **K2**

CO5: learn the basic concept of Enzymes – Nomenclature and Classification, factors influencing enzyme activity **K2**

UNIT I

Atom, Molecules & chemical bonds, properties of H_2O, acid and buffer. Properties of biomolecules in water. Introduction to metabolism – anabolism and catabolism. Carbohydrates – Occurrence, chemical properties, stereo and optical isomerism, structure and classification. Metabolism and its regulation – Glycolysis, TCA cycle, Oxidative phosphorlylation, pentose phosphate pathway and gluconeogenesis, ATP synthesis, Photosynthesis, Glygenolysis. Disorders of carbohydrate metabolism.

UNIT II

Lipids – occurrence, chemical properties and classification-biosynthesis of fatty acids triglycerides, phospholipids and cholesterol – Oxidation of fatty acids, lipid storage and membrane lipids and their organization, Lipoproteins. Disorders of lipid metabolism. Vitamins – classifications, derivatives, hormones, secondary metabolites – Types functions & disorders.

UNIT III

Amino acids and Proteins – Amino acids: structure, classification and chemical properties, structure of peptide bond – protein: classification, amino acid composition. Protein structure – Primary structure, secondary structure – alpha helia and beta pleated structure, tertiary and quaternary structure. Protein metabolism and degradation: A.A oxidation & Urea cycle. Ramachandran plot. Model proteins myoglobin, hemoglobin and chymotrypsin. Disorders of aminoacid metabolism.

UNIT IV

Nuclic acids – DNA & RNA – structure of purine and pyrimidine bases, nucleotides and nucleotide biosynthesis, its regulation & degradation of purine and pyrimidine nucleotides – Biosynthesis of deoxyribonucleotides. Sequencing of nucleotides. Disorders of nucleic acid metabolism.

UNIT V

Enzymes – Nomenclature and Classification – protein enzymes, coenzymes, prosthetic groups, cofactors, isoenzymes, ribozymes, abzymes: chemical properties of enzymes: types of specificity – absolute, group, stereochemical and geometrical; factors influencing enzyme activity – temperature, pH, concentration of enzyme, substrate and effect if ions; enzyme kinetics, types of enzyme inhibition – reversible, competitive, non-competitive, uncompetitive, irreversible inhibition; allosteric enzymes. Single substrate and multi substrate enzymes. Relevance of enzymes in metabolic regulation.

REFERENCES

1. Nelson D.L and Cox M.M. 2006. Lehninger Principles of Biochemistry, 4th edition, Macmillan worth Publishers.
2. Murray R.K, Granner D.K and Rodwell V.M. 2006. Harper's Illustrated Biochemistry, 27th Edition , The McGraw-Hill companies, Inc.
3. Berg J.M, Tymoczke J.L and Stryer W.H. 2007. Biochemistry, Freeman and Company, USA
4. Principles of Biochemistry Third Edition International Student Version Chapter 13 Biochemical Signaling Copyright © 2008 by John Wiley & Sons, Inc. Donald Voet • Judith G. Voet • Charlotte W. Pratt
5. U. Satyanarayana, Biochemistry, Books and Allied (P) Ltd., Calcutta, Latest Edition.

E-book links:

1) https://doi.org/10.1002/cbf.1216
2) https://www.pdfdrive.com/biochemistry-biochemistry-e19576202.html
3) https://www.pdfdrive.com/textbook-of-biochemistry-e14983388.html
4) https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-e18198970.html
5) https://www.pdfdrive.com/lehninger-principles-of-biochemistry-5th-edition-e164892141.html

Mapping of COs with POs &PSOs:

	PO	PSO

CO	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	M	S	S	S	M	S	S	S	M	M	S
CO3	S	M	M	S	S	S	M	S	S	S	S	M	S
CO4	S	M	M	M	S	S	M	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	CORE17 (THEORY)- APPLIED MICROBIOLOGY- IBTT72		
Semester	Semester-VII	Credits:4	Hours/weeks: 4
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	1. To learn about the basic applications of microorganisms. 2. To understand the identification of microorganisms using advanced microbiological methods 3. The knowledge about different types of microorganisms and their identification techniques in modern biology. 4. To identify the microorganisms based on the modern polyphasic approach. 5. The students will be able to identify any microorganisms,		

	predict the intermediate metabolism of any microbe used in industrial production processes, economical uses of microorganism and pathogenesis of various microbes in the environment.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the history, criteria, Classification and diversity of Bacteria **K1**

CO2: understand the culture technique for isolation and molecular identification of any microbes **K2**

CO3: well-known with the extremophiles organisms, Archaea, structure and characteristics of fungi and algae K2

CO4: know about Classification, Cultivation of virus as well as host and microbial interaction **K2**

CO5: learn the essential conception of bacteria, fungi and virus pathogencity, transmission, diagnosis and treatment with examples K2

UNIT I

Medical Microbiology: Introduction to Infectious diseases - Methods of transmission. Host parasite relationship. Causative agent, Epidemiology, Pathogenesis, Prophylaxis and Treatment - Staphylococcosis, Salmonellosis Aspergillosis, Cadidiasis, Giardiasis, Malaria, Rickettsiosis, AIDS, Influenza , Mycoplasmosis, flu (H1N1) and Covid-19.

UNIT II

Food Microbiology - Production of distilled beverage alcohol, wine, brandy and beer. Single cell protein and Baker's yeast. Food industry enzymes -source and application. Contamination and spoilage of meat, fish, milk, vegetables and fruits. - Principle of food preservation methods, Food quality and control. Determination of microorganisms in food -culture, microscopy and sampling methods

UNIT III

Agriculture Microbiology: Microbial flora of soil – bacteria, fungi, algae and protozoa.

Microbial interactions among soil microorganisms. Plant growth promoting bacteria.

Introduction to Nitrogen fixing bacteria-Rhizobium. Phosphorus solubilizing bacteria –VAM,

Anabaena –importance in agriculture. Disease causing microbes- *Xanthomonas oryzae, Puccinia spp,* Banana bunchy top virus

UNIT IV

Environmental Microbiology: Bioremediation, Microbial degradation of xenobiotics (DDT, PCB). Sewage and wastewater treatment. Microbial insecticides: NPV, *Bacillus thuringiensis, B. sphaericus, Baculovirus.* Microbial removal of heavy metals: precipitation of metal sulphides by SRB. Bioleaching-recovery of metals from ores. Solid Waste Management-composting and Biogas.

UNIT V

Industrial microbiology- Production of alcohol (ethanol), acids (citric acid, lactic acid), solvents (ethanol, butanol), antibiotics (penicillin, cephalosporine), amino acids (lysine, aspartate). Commercial production of fructose. Enzymes used for commercial purposes and their industrial production. Whole cell immobilization and industrial applications

REFERENCES

1. Atlas R. M and Bartha R. 2000. Microbial Ecology-Fundamentals and Applications
2. Prescott L.M, Harley J.P. and Klein D.A. 2005. Microbiology, Sixth edition
3. McGraw Hill, Boston.
4. Maier R.M., Pepper I.L. and Gerba C.P. 2006. Environmental Microbiology, Elseiver Publication, New Delhi, India.
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9. Microbiology: An Introduction (2014), Twelth edition. Gerard J. Tortora, Berdell R. Funke, Christine L. Case.

10. Alcamo's Fundamentals of Microbiology (2011), Fifteenth edition. Jeffery C. Pommerville and I. Edward Alcoma. Chicago, Sudburg, Mass: Jones and Bartlette Publishers.
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E-book links:

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2) https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html
3) https://www.pdfdrive.com/prescotts-microbiology-e166597880.html
4) https://www.pdfdrive.com/food-microbiology-fundamentals-and-frontiers-e175273799.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	M	S	S	S	S	S	S	M	M	S
CO3	S	M	M	S	S	S	S	S	S	S	S	M	S
CO4	S	M	M	S	S	S	S	S	S	S	S	S	M
CO5	S	M	S	S	S	S	S	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	CORE 18 (THEORY) - MOLECULAR BIOLOGY AND GENETICS-IBTT73		
Semester	Semester-VII	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• Outline the regulation of gene expression • Explain the importance of mutations • Illustrate chromosome inheritance pattern • To Understanding the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Recall key concepts about the organization of genes and the process of replication K1

CO2: Gain knowledge in genome organization of organisms. K2

CO3: Understanding the structural and functional aspects of the genes provides the student with a strong foundation in the molecular mechanisms K2

CO4: Understand the basis of mutations and gene arrangements K2

CO5: Compare different methods of gene transfer and their related mechanisms K2

Unit: I Genetic Material / Replication enzymes

DNA as genetic material. Central dogma concept. Semi-conservative replication. Enzymes in DNA replication -prokaryotic and eukaryotic DNA polymerases, fidelity, and processivity of polymerases. Genetic code: commaless, non-ambiguous, degenerate, triplet code and its feature, wobble hypothesis, universality of genetic code.

Unit: II DNA Replication

Replication in prokaryotes-origin of replication, replication fork, leading and lagging strand

replication. Okazaki fragments. Elongation, termination of replication. Eukaryotic DNA replication. Inhibitors of replication**.**

Unit: III RNA and Transcriptional process

RNA structure, types of RNA, RNA polymerases, transcription in prokaryotes-initiation and elongation, promoters, termination of transcription. Eukaryotic promoters. Post transcriptional processing and modifications of RNA

Unit: IV Gene Transfer Mechanism

Lateral and Horizontal gene transfer. Conjugation, Transformation, and Transduction (Generalized transduction and specialized transduction) Transformation and & its mechanism. Griffith experiment. **DNA repair -** DNA damage and causative agents. The mechanism that reverse, excise, or tolerate DNA repair.

Unit: V Mutation and Gene arrangement

Classes of mutations, spontaneous and induced mutation, mutagens, Reversion and suppression mutations, Ames test. Genetic characterization of mutants. **Transposition-** Transposons, structure, types and mechanism. **Genetic Recombination -** Homologous Recombination, enzymes, and models (Double-stranded invasion model and Meselson and Radding model). Site-specific recombination (Bacteriophage lambda). Short sequence recombination

REFERENCES:

1. Chaudhuri K (2012) Microbial Genetics The Energy and Resources Institute, TERI
2. Snyder L, Peters JE, Henkin TM, Champness W (2013) Molecular Genetics of bacteria,4th Edition ASM press
3. Krebs JE Lewin B, Goldstein ES and Kilpatrick ST (2014) Lewin's GENES XI Jones & Bartlett Publishers
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6. Molecular Biology of the Cell (2014), 6th Edition, B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P Walter, Garland Publishing (Taylor & Francis Group), New York & London (ISBN: 9780815344322).

7. Molecular Cell Biology (2014), Harvey Lodish, 7th Edition, W.H.Freeman and Company, New York.
8. Primrose S.B, Twyman R.M., Old R.W. 2002. Principles of Gene Manipulation and genomics. 7th Edition. Blackwell Science.

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6) https://www.pdfdrive.com/karps-cell-and-molecular-biology-e176035175.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	S	M
CO2	S	M	M	S	S	S	S	S	S	S	S	S	M
CO3	S	M	M	M	S	S	S	S	S	S	S	S	M
CO4	S	M	S	M	S	S	S	S	S	S	S	S	M
CO5	S	M	S	M	S	S	S	S	S	S	S	S	M

Strongly Correlating	(S)	- 3 marks
Moderately Correlating	(M)	- 2 marks
Weakly Correlating	(W)	- 1 mark
No Correlation	(N)	- 0 mark

Course Title & Code	CORE PRACTICAL-V - LAB IN ADVANCED BIOCHEMISTRY, MICROBIOLOGY AND MOLECULAR BIOLOGY- IBTP71		
Semester	Semester-VII	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To learn the technique about identification of microorganism from biological samples. • To know the isolation and purification of actinomycetes and fungi and biochemical characterization of selected bacteria. • To know the technique about spontaneous mutation by gradient plate technique, induced mutagenesis (UV, NTG) and replica plate technique. • To learn technique about molecular mechanisms underlying cellular function, isolation of plasmid DNA and genomic DNA and DNA repair mechanism.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about biomolecules K1

CO2: develop skill and do different chromatography techniques K2

CO3: gain hands on isolation and identification of microbes in the laboratory K3

CO4: gain knowledge about analysis of mutation studies K2

CO5: train on isolation of nucleic acids K2

LAB IN BIOCHEMISTRY

1. Preparation of solutions – Molar, Normal, Percentage, Stock, Working etc.
2. Preparation of buffers – PBS, Tris and Acetate buffer.
3. Qualitative analysis of carbohydrate, protein, and lipid
4. Estimation of sugars- reducing and non-reducing.
5. Estimation of mono saccharide
6. Extraction and Estimation of starch from potato/ tapioca
7. Estimation of protein
8. Estimation of nucleic acids by absorbance at 260 nm
9. Enzyme assay: Estimation of salivary amylase from saliva & phosphatase from potato
10. Estimation of DNA by diphenylamine
11. Estimation of RNA by orcinol method.
12. Estimation of lipids –cholestrol
13. Estimation of vitamins – ascorbic acid, α-tocopherol & β – carotenoids.
14. Separation of amino acids by Paper chromatography
15. Separation of amino acids by and Thin layer chromatography
16. Separation of pigments by column chromatography
17. Estimation of glucose (DNS method)

LAB IN MICROBIOLOGY AND MOLECULARBIOLOGY

18. Microscopy- observation of different microscopes
19. Isolation of microorganism from samples.
20. Methods of Counting colonies in petridish cultures
21. Sterilization techniques.
22. Preparation of media.
23. Pure culture techniques – serial dilution – pour plate, spread plate, streak plate and stab culture
24. Bacterial staining methods – single, Grams and negative
25. Fungal staining methods – Lacto phenol cotton blue
26. Motility of bacteria

27. Enumeration of bacteria/Yeast cell, viable count(Plate count), Total count (Haemocytometer)
28. Isolation and purification of actinomycetes, fungi
29. Biochemical characterization of selected bacteria.
30. Spontaneous mutation by gradient plate technique.
31. Induced mutagenesis (UV, NTG)
32. Detection of mutants by replica plate technique.
33. Study of mutation by Ames test.
34. Antibiotic sensitivity
35. Bacteriophage titration – plaque forming cells.
36. Isolation of Plasmid DNA
37. Isolation of Genomic DNA
38. Quantification of nucleic acids- UV method
39. DNA repair mechanism.

REFERENCES:

1. Molecular Cell Biology by Harvey Lodish
2. Molecular Biology of the Cell by Alberts
3. Practical Biochemistry by Wilson and Walker
4. Microbiology by Pelczar Microbiology by Frobisher

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	M	S	S	S	S	S	M

CO4	S	S	S	M	S	S	S	S	S	S	S	S	M
CO5	S	S	S	M	S	S	M	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER VIII

Course Title & Code	**CORE 19 (THEORY)- IMMUNOLOGY AND IMMUNOTECHNOLOGY- IBTT81**		
Semester	Semester-VIII	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To understand the definition of immunity, how it discriminates self and non-self and its regulation • To understand the concepts of immune system and the structure, functions and properties of different cell types and organs that comprise the immune system. • To comprehend the range of immunological agents and the strategies that may be used to prevent and combat infectious diseases		

COURSE OUTCOMES:

Upon completion of this course the students will be

CO1: Able to acquire the knowledge about immune system and its components K1
CO2: Able to understand the complement system, MHC and the mechanism of immunity K2
CO3: Able to classify the immune response related to immunodeficiency, allergy and hypersensitivity K2
CO4: Able to know about organ transplantation and immunological anomalies related to autoimmune disorders K2
CO5: Analyze the production of monoclonal antibodies, different types of vaccines and antibodies K3

Unit- I

Introduction - Overview of the immune system, Milestones of Immunology. Structure, classification, functions, Isotypes, allotypes and idiotypes. Complement systemcomponents, nomenclature, pathways of complement activation, classical pathway and alternate pathway. Biological functions of complement. Types of immunity.

Unit-II

Innate and adaptive immunity - Lymphoid organs and cells of immune system. Complement classical and alternate pathways. T-cells and B-cell receptors. Maturation of T and B-cells. Antigen recognition, Antigen presentation, Immunological memory, Immuno tolerance.
- phagocytosis, cell mediated immunity- antibody-dependent cellular cytotoxicity (ADCC), MHC proteins – Antigen processing and presentation. Inflammatory response to infection. Transplantaion types. Graft vs host reaction.

Unit-III

Major Histocompatibility Complex, Hypersensitivity and Transplantation: Major histocompatibility complex- gene organisation - HLA genes class I and II antigens. Structure and function histocompatibility testing, cross matching. MHC & disease association. Hypersensitivity- definition and classification - type I to type V (brief account only). Transplantation-types: autograft, syngraft, allograft, xenograft.

Unit-IV

Immunization practices and Immune Disorders: Immunization practices - active and passive immunization. Vaccines - killed, attenuated- toxoids. Recombinant vector vaccines - DNA vaccines, synthetic peptide vaccines. Production and applications of polyclonal and monoclonal antibodies. Genetically engineered antibodies. AIDS - pathogenesis. Tumor immunology - tumor antigens, cancer immunotherapy. Elementary details of anti-immunodisorder-SLE

Unit-V

Immunotechniques: Agglutination and precipitation techniques. Immunodiffusion techniques, mmunoelectrophoresis, RIA, Immunoblotting, Avidin - biotin mediated immunoassay. Immunohistochemistry, immunofluorescence. Complement fixation test. HLA typing. Hybridoma technology, ELISA - principle and applications. Western blotting and Flow cytometry.

REFERENCES:

1. Kuby J. *et al*., Immunology, 6th Edition. W.H. Freeman and Company, New York. 2006.
2. Chakravarthy A, Immunology and Immunotechnology, Oxford University Press, India. 2009.
3. C. V. Rao, An introduction to Immunology, Narosa Publishing House, Chennai. 2002.
4. Khan, Fahim Halim. The elements of Immunology, Pearson Education (India) Pvt. Ltd. 2009.
5. R. Tizard, Immunology: An Introduction. 4th Edition. Saunder's College Publishing, NY. 1995.
6. Roitt, Essential Immunology. Blackwell Science, Singapore. 1994.

E-book links:

1) https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html
2) https://www.pdfdrive.com/cellular-molecular-immunology-7th-edition-e157242744.html
3) https://www.pdfdrive.com/basic-immunology-e21670961.html
4) https://www.pdfdrive.com/medical-microbiology-virology-immunology-e43491517.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	M	M	S
CO2	S	M	S	S	S	S	M	S	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S	S	S	S
CO4	S	M	M	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating	(S)	- 3 marks
Moderately Correlating	(M)	- 2 marks
Weakly Correlating	(W)	- 1 mark
No Correlation	(N)	- 0 mark

Course Title & Code	CORE 20 (THEORY) - PHARMACEUTICAL BIOTECHNOLOGY – IBTT82		
Semester	Semester-VIII	Credits:5	Hours/weeks: 6
Cognitive Level	K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To know the basic concepts in pharmaceutical industry • To understand drug development, approval process and manufacturing of biopharmaceuticals. • To know the steps involved in drug discovery process		

At the end of the course, the student will be able to

CO1 : Understand the scope of pharmaceutical biotechnology. K2

CO2 : Understand pharmacokinetics, metabolism, dynamics of drugs and steps involved in drug discovery process K2

CO3 Apply the manufacturing principles in formulation of drugs and biopharmaceuticals.K3

CO4 : Comprehend the production of recombinant proteins, enzymes and carbohydrate and nucleic acid based biopharmaceuticals. K4

CO5: Explain the regulatory aspects in drug development and drug approval K2

Unit -1 Introduction

Pharmacetuical Biotechnology and biopharmaceuticals. Sources of biopharmaceuticals - yeast, animal cell cultures, bacteria, fungi, plants, animals, transgenic plants. Drug isolation and evaluation. Formulation of biopharmaceutical products. Shelf life of protein based pharmaceuticals. Site specific delivery of protein drugs.

Unit-II Pharmacokinetics and Dynamics

Routes of drug administration. Absorption of drugs. Bioavailability - factors influencing absorption and bioavailability. Drug distribution - plasma protein binding, placental transfer, blood-brain barrier. Mechanism of drug action, receptor theory, adverse effects of drugs, drug interactions.

Unit-III Drug Metabolism and Manufacturing

Chemical reactions (proteolysis, deamidation, oxidation, disulfide exchange), reduction, hydrogenation, dehydrogenation. Excretion Manufacturing principles - compressed tablets, controlled and sustained release dosage formsenteric coated tablets and capsules.

Unit-IV Biopharmaceuticals

Vaccines, modern vaccine technologies, pharmaceutical aspects. Recombinant proteins as pharmaceutical drugs. Protein engineering, peptide chemistry and peptidomimetics. Catalytic antibodies. Monoclonal antibody based pharmaceuticals. Hematopoietic growth factors. Nucleic acid therapy in development. Pharmaceutical enzymes. Development of adhesion molecules. Glycoprotein and carbohydrate based pharmaceuticals (Elementary details only).

Unit-V Drug development and approval.

Strategies for new drug discovery, lead compound, combinatorial approaches to drug discovery,

pre-clinical and clinical trials. Phase I, II and III. Regulatory authorities - Food and Drug Administration (USA), European regulations- National security authorities, European medicine agency and new EU drug approval system. Current Streams of Thought The faculty will impart knowledge on the current developments in the subject of study to the students and this component will not be covered in the examinations.

REFERENCES:

1. Gilman et al. Goodman and Gilman's The Pharmacological Basis of Therapeutics. McGraw Hill.12th ed. 2011.

2. Satoskar, Bhardarkar and Rege. Pharmacology and Pharmacotherapeutics.
Poular Prakashan. 24th ed. 2015

3. Kayser O, Muller RH. Pharmaceutical Biotechnology- Drug Discovery and Clinical Applications. Wiley-VCH. 2004.

4. Klefenz H. Industrial Pharmaceutical Biotechnology. Wiley-VCH. 2002.

5. Shargel L, Yu ABC, Wu-Pong S. Applied Biopharmaceuticals and Pharmacokinetics. McGraw-Hill. 6th ed. 2012.

6. Spada S, Walsh G. Directory of Approved Biopharmaceuticals CRC Press. 2004

E-book Links:

1. https://www.pdfdrive.com/pharmaceutical-biotechnology-fundamentals-and-applications-e164753639.html
2. https://www.kobo.com/us/en/ebook/pharmaceutical-biotechnology-2
3. https://www.pdfdrive.com/pharmaceutical-biotechnology-concepts-and-applications-d38535075.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	S	S

CO2	S	M	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 21 (THEORY)- ANIMAL BIOTECHNOLOGY- IBTT83**		
Semester	Semester-VIII	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To gain knowledge on animal cell culture, gene manipulation, principles of cloning and transgenic animal technology and safety. • To know the ethical principles underlying biotechnology research and develop entrepreneurship skills.		

COURSE OUTCOMES:

Upon completion of this course , the students will be able to

CO1 : Understand the fundamental principles that underlie cell culture and carryout cell based

assays. K1

CO2 : Comprehend the steps in manipulation of reproduction and acquire knowledge in animal cloning. K2

CO3 : Understand the methods of gene transfer in animals. K2

CO4 : Comprehend the methods of producing transgenic animals and benefits of transgenesis and related issues. K2

CO5: Recognize the importance of biosafety practices, ethical guidelines for research and entrepreneurship skill development. K3

UNIT- I

Structure and organization of animal cell. History of animal cell culture technique. Constituents of culture medium; serum and supplements; Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification. Animal cell culture-merits and demerits.

UNIT-II

Primary cell culture techniques - aggregation, Cell growth & viability determination. Measuremnet of cell death, Transformation and Cytotoxicity assays. chromosome analysis and antigenic markers, selectable markers for animal cells. Mass culture of cells - manipulation of cell line selection - types of cell lines - maintenance of cell lines - immobilization of cells and its application - synchronization of cell - cryopreservation - germplasm conservation and establishment of gene banks. Hazards and safety aspects of cell culture techniques.

UNIT -III

Sources of contamination, Monitoring and eradication – suspension, monolayer, organ culture. Knock out and Knock in, Suicide gene therapy Gene silencing. Transgenic animals and Molecular pharming: Animal Biotechnology for the production of regulatory proteins, blood products, cell culture based vaccines and hormones and other therapeutic proteins. Embryonic preservation and its uses in endangered animals.

UNIT-IV

Gene therapy – IVF & Embryo transfer, Gene transfer techniques, Tissue engineering, Organ transplant. Synthetic viral vectors in gene transfer. Biotechnological applications for HIV. diagnostics and therapy. DNA based diagnosis of genetic diseases, DNA barcoding. Oncogenes

and anti oncogenes. Genetic engineering approaches for genetic disorder correction. Transgenic animals as models for human disease.

UNIT-V

Stem cells: types – Hematopoietic stem cells, Mesenchymal stem cells, embryonic stem cells, fetal stem cells, Adult stem cells- characterization, isolation, cultures. Stem cells as vector for cancer therapthy. Collection, processing, preservation and banking of Umbical cord blood stem cells. 3D culture, human cloning, ethical limits and mapping of human genome. Commercial application of animal cell culture

REFERENCES:

1. Ralf Pörtner. 2007. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). 2nd Edition. Humana Press. USA.
2. R.Spier and J.Griffiths. 1994. Animal Cell Biotechnology. Academic Press. London.
3. D.C. Darling and S.J. Morgan. 1994. Animal Cells Culture and media, BIOS Scientific Publishers Limited. Oxford. UK.
4. Jennie P. Mather and David Barnes. 1998. Methods in Cell Biology. Volume 57: Animal Cell Culture Methods. Academic Press. New York.
5. Ann Harris. 1996. Epithelial Cell Culture, Cambridge University Press. USA.
6. M .M. Ranga. 2000.Animal Biotechnology, Agrobios, India.
7. R Ian Freshney.2005. Culture of Animal Cells: A Manual of Basic Techniques (5th Edition): Wiley-Liss, New York.
8. John R W Masters. 2000. Animal Cell Culture – Practical Approach, Ed. Oxford Univ Press.
9. JD Watson, M. Gilamn, J. Witkowski. 1992. Recombinant DNA technology. Scientific American books, New York.
10. Bhernard R Glick and Jack J. Pasterna, 2009, Molecular Biotechnology II edition, 4th edition, ASM press. USA.

E-book links:

1) https://www.pdfdrive.com/animal-cell-biotechnology-e22743665.html
2) https://www.pdfdrive.com/animal-biotechnology-1-reproductive-biotechnologies-e187110512.html

3) https://www.pdfdrive.com/animal-cell-biotechnology-e177857548.html
4) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-4th-edition-e162050162.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL-VI –IMMUNO TECHNOLOGY & ANIMAL BIOTECHNOLOGY- IBTP06**		
Semester	Semester-VIII	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		

Learning Objective	• To know the basic principles and techniques involved in plant cell culture and to understand the concepts of transformation and achievements of biotechnology in Plant systems. • To know practical knowledge about the basics of animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about plant cell culture techniques requirements

CO2: know and skill in transformation techniques in plant cells

CO3: learn culture media preparation and cell culture procedure

CO4: gain knowledge about Virus inoculation methods

CO5: check Cell viability test – MTT and storage of cells

LAB IN IMMUNO TECHNOLOGY

1. Agglutination tests: a. ABO Blood grouping. b. WIDAL test. c. ASO test. d. Pregnancy test. e. RPR test.

2. Preparation of plasma and serum, Blood cell analysis – total count, differential count.

3. ELISA, FACS, Flow cytometry

4. Blotting techniques (Southern Blotting, Western Blotting, Northern Blotting).

5. Immune diffusion methods (Radial immunodiffusion) (double immunodiffusion) , (single immunodiffusion), Rocket electrophoresis, Immuno electrophoresis

6. Vaccination- definition, production, principles, application.

LAB IN ANIMAL BIOTECHNOLOGY

1. Introduction to the laboratory and general safety practices for animal cell culture.
2. Balanced salt solutions
3. Animal cell culture media preparation

4. Filter sterilization of cultural media
5. Cell disaggregation
6. Handling of animals
7. Isolation of fibroblast from chick embryo
8. Virus inoculation methods
9. Isolation of genomic DNA from Animal cells
10. Quantification of DNA by spectroscopic method
11. Cell growth analysis
12. Cell viability test – MTT
13. Resuscitation of frozen cell lines
14. Sub culture of Adherence cell lines

REFERENCES:

1. Andreas Hofmann and Samuel Clokie. Wilson and Walker's Principles and techniques of Biochemistry and Molecular Biology. Cambridge University Press. 8th ed. 2018.
2. Smith RH. Plant Tissue Culture. Elsevier. 3rd ed. 2013.
3. Sandy B. Primrose, Richard Twyman and Bob Old. Principles of Gene Manipulation and Genomics. Blackwell Sci. 8th ed. 2016.

SEMESTER IX

Course Title & Code	**CORE 22 (THEORY)- PLANT BIOTECHNOLOGY- IBTT91**		
Semester	Semester-IX	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply K5: Evaluate K6: Create		

Learning Objective	• Explain the developmental processes operating in plants • Demonstrate plant tissue culture methods • Analyze biotechnological tools for engineering plants in agriculture and industry

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Understand and learn the techniques for culturing tissues, single cell, protoplast and anther culture and adopt methods of sterilization and cryopreservation **K1**

CO2 : Learn gene transfer methods and molecular marker assisted selection. K2

CO3 : Evaluate the production and benefits of genetically modified plants.K5

CO4 : Apply rDNA technology for crop improvement.K3

CO5 : Recognize the importance of protection of new knowledge and patenting of innovations in research K6

UNIT I

Laboratory setup- Plant cell and tissue culture-culture media; composition and preparation, plant hormones, sterilization, Callus culture, Micropropagation, suspension culture, root tip culture, anther culture pollen culture, ovary culture, embryo culture, embryo rescue, large scale culture of plant cells

UNIT II

Somoclonal variation, Somatic hybridization – protoplast isolation fusion and culture, synthetic seeds, germplasm conservation hardening and green house technology. Use of haploids in plant breeding. Selection of hybrid seeds and regeneration of hybrid plants.

UNIT III

Transgenesis in plants: Gene transfer – Agrobacterium mediated, viral vector and their application , Caulio virus, Baculo virus mediated, Direct nuclear transformation methods, Promoters, reporter genes and marker genes, terminator, marker free gene targetting. Gene silencing.

UNIT IV

Terminator seed technology – delayed fruit ripening, transgenic plants-plantibodies, golden ride, edible vaccine, insect resistant-Bt, *cry* genes of Bt and their gene expression, heribicide resistance-glyphospate, Disease resistant-antifungal proteins, Virus resistance-coat protein & nucleo capsid, Nemotode resistant, Abiotic stress tolerant.

UNIT V

Plant as bioreactor: Green & red fluorescent protein, starch and fructans. Nitrogen fixation and genes. Application of RFLP, RADP and DNA finger printing in plant biotechnology. Biosafety guidelines for research involving GMO's benefits and risks.IPR related to plants, IPP.

REFERENCES:

1. Smith RH. Plant Tissue Culture. Elsevier. 3rd ed. 2013.

2. Sandy B. Primrose, Richard Twyman and Bob Old. Principles of Gene Manipulation and Genomics. Blackwell Sci. 8th ed. 2016.

3. Glick and Pasternak. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press. 4th ed. 2010.

5. James D. Watson et al. Recombinant DNA: Genes and Genomes-A Short Course. Freeman. 3rd ed. 2006.

6.Slater A. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford Univ Press. 2nd ed. 2008.

E-book links:

1) https://www.pdfdrive.com/plant-biotechnology-and-genetics-principles-techniques-e15853574.html
2) https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-e20389188.html
3) https://www.pdfdrive.com/principles-of-plant-biotechnology-e33514134.html
4) https://www.pdfdrive.com/plant-genomics-e28703875.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 22 (THEORY)- BIOINSTRUMENTATION AND BIOSTATISTICS – IBTT92**		
Semester	Semester-IX	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To develop knowledge handle the instruments for biological research and interrupt the data. • To acquire knowledge on applications of statistics in research. • To gain knowledge in experimental design and data collection techniques. • To develop the technical art of writing research report and presentations.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know about types of microscopy and its principles, working procedure and sample preparation techniques

CO2: understand the importance of centrifuge and chromatography techniques in research aspects

CO3: know the advanced methods to detect and study any biomolecules using XRD,NMR, MADI-TOF, thermocycler, microarray. Principles and handling procedure of Electrophoresis techniques

CO4: skill development in the aspects of collection and presentation of biological data through biostatistics

CO5: learn the methods in statistics to solve the biological problems with accuracy

UNIT -I

Microscopy-Principle and applications of light, phase contrast, fluorescence, inverted, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, field emission scanning electron microscope, cytophotometry and flow cytometry. Micrometry, lyophilizer, Preparation of microbial, animal and plant samples for microscopy. Principles of colorimetry and spectroscopy.

UNIT - II

Centrifugation: Basic principle and applications: Differential, density and Ultracentrifugation-velocity and buoyant density , Principle methodology and applications of gel – filtration, ion – exchange and affinity chromatography; Thin layer, liquid and gas chromatography; High performance liquid chromatography, ultra sonicator, pH meter, FT-IR.

UNIT -III

Principle of biophysical method and used for analysis of biopolymer structure; X ray diffraction, fluorescence, UV, visible, IR. Atomic absorption and plasma emission spectroscopy, NMR, MS, ELISA reader, Electrophoresis: Principle and applications of Native, SDS,2D, Agarose gel, isoelectric focusing, isotachophoresis, MADI-TOF, thermocycler, microarray.

UNIT-IV

Collection and presentation of experimental data. Brief description and tabulation of data and its graphical representation. Measures of central tendency: arthimetic mean, median, mode, geometric mean, Harmonic mean. Uncertainities in estimation of mean. Measures of dispersion: range, interquartile range, standard deviation.

UNIT-V

Hypothesis testing - Idea of two types of errors and level of significance. Tests of significance: Parametric (F & t test); Non parametric: Chi square tests. Simple linear regression and correlation. Analysis of variance. Statistical treatment to proportion data and count data. Poisson distribution, standard error, confidence limits of count.

REFERENCES:

3. John G Webster. 2004. Bioinstrumentation .Student edition, John Wiley & sons, Ltd. New York.
4. Edward Batschelet. 1992. *Introduction to Mathematics for Life Scientists,* 3rd ed., Springer. New York.
5. M Becker, G A Caldwell and E A Zachgo. 1996. Biotechnology: A laboratory course (Second Edition) Academic Press, USA.
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E-book links:

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7) https://www.pdfdrive.com/biostatistics-e42988735.html
8) https://www.pdfdrive.com/introductory-biostatistics-e15112721.html
9) https://www.pdfdrive.com/introductory-biostatistics-e176105301.html
10) https://www.pdfdrive.com/bioinstrumentation-instructional-resources-technology-austin-e15581883.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	M	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 24 (THEORY)-**OMICS AND GENOME EDITING – IBTT93		
Semester	Semester-IX	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To study prokaryotic and eukaryotic genomes , general methods of genome sequencing techniques, genome analysis and annotations, genome mapping techniques and applications of genomics. • To understand the proteins enclosed by the genes with respect to structure, function, protein – protein interactions,		

	techniques for separation and analysis, database and applications.

COURSE OUTCOMES:

After completion of this course, student would be able to

CO1: Know the current genomic and proteomic perspective of model organisms. K1
CO2: Gain the knowledge on the computational methods for gene expression analysis. K1
CO3: Understand the constraint-based metabolic modelling and metabolic simulation. K2
CO4: Use the proteome tools for protein identification from experimental data and Interaction databases.K3
CO5: Use the knowledge on comparative genomics and its applications and also know the transcriptome analysis and its applications. K3

UNIT –I

Genome and Genome sequencing: Genome structure and organization – Eukaryotic genome - Organelle genome- Genomics of Microbes and Microbiomes – Genome sequencing technologies –Comparative genomics and its applications

UNIT- II

Functional genomics - Large scale gene expression analysis –Experimental methods - Computational tools for expression analysis-Hierarchical clustering – Gene expression analysis– STS-EST-GSS-Assessing levels of gene expression using ESTs - cDNA databases – Transcriptome analysis and applications

UNIT –III

Molecular systems biology – Introduction – methodologies – constraint and kinetic modeling – Biomass objective function - metabolic simulation - biotechnological applications – Molecular network biology – Medical and clinical genomics - Pharmacogenomics and drug discovery – Agriculture genomics and its applications

UNIT –IV

Proteome – structural and functional features – Qualitative proteome technology (Gel-based and Gel-free) – Quantitative proteome technology – Functional proteome technology – Methods, algorithms and tools in computational proteomics - Proteome databases – Protein engineering resources

UNIT –V

Interactomics - Techniques to study protein-protein interactions - Modelling of proteomic networks – Interactome databases - Label-free nanotechnologies in proteomics – Modificomics – Proteomics applications in clinical and biomedicine - Application of proteomics in agricultural biotechnology – Industrial proteomics and its applications

REFERENCES:

1. Baxevanis D and Ouellette BFF, *Bioinformatics: A practical guide to the analysis of genes and proteins* (3rd Ed), John Wiley & Sons,Inc. 2005.

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7. Sándor Suhai, *Genomics and Proteomics: Functional and Computational Aspects*, Kluwer AcademicPublishers, 2002.

E-book Links:

1. www.genomic.org.uk/

2. https://www.britannica.com/science/genomics
3. https://www.sciencedirect.com/journal/genomics

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	M	S	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	M
CO3	S	M	S	S	S	S	M	S	S	S	M	S	S
CO4	S	M	S	S	S	S	S	S	S	S	M	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE PRACTICAL-VII -PLANT BIOTECHNOLOGY & GENOME EDITING- IBTP91**		
Semester	Semester-IX	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply		

Learning Objective	• To know the basic principles and techniques involved in plant cell culture and to understand the concepts of transformation and achievements of biotechnology in Plant systems. • To know practical knowledge about the basics of animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about plant cell culture techniques requirements

CO2: know and skill in transformation techniques in plant cells

CO3: learn culture media preparation and cell culture procedure

CO4: gain knowledge about Virus inoculation methods

CO5: check Cell viability test – MTT and storage of cells

LAB IN PLANT BIOTECHNOLOGY

1. Introduction to the laboratory and general safety practices for plant cell culture.
2. Preparation of media, stock preparation and sterilization techniques.
3. Plant genomic DNA extraction.
4. Micropropagation using shoot tip.
5. Callus culture.
6. Synthetic seed preparation
7. Protoplast isolation
8. Transformation using *Agrobacterium tumefaciens*.
9. Size analysis of DNA by agorose gel electrophoresis.
10. Haploid culture Root induction.
11. Root induction
12. Embryo culture

13. Nodal culture
14. Single cell culture
15. Suspension culture

LAB IN GENOME EDITING

1. Retrival of whole genome sequencing
2. Genome assembly using online tools
3. Genome annotation by RAST
4. Gene function prediction
5. Comparison of gene using metabolic pathway

REFERENCES:

4. Andreas Hofmann and Samuel Clokie. Wilson and Walker's Principles and techniques of Biochemistry and Molecular Biology. Cambridge University Press. 8th ed. 2018.
5. Smith RH. Plant Tissue Culture. Elsevier. 3rd ed. 2013.
6. Sandy B. Primrose, Richard Twyman and Bob Old. Principles of Gene Manipulation and Genomics. Blackwell Sci. 8th ed. 2016.

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S

CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER X

Course Title & Code	**CORE 25 (THEORY)- BIOETHICS, BIOSAFETY AND IPR – IBTT101**		
Semester	Semester-X	Credits:5	Hours/weeks: 6
Cognitive Level	K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To get knowledge on Bioethics, Biosafety and IPR. • To learn about procedures on IPR filings • To improve knowledge towards ethical clearances and and Biosafety regulations • Student will acquire knowledge in bioethics, biohazard and bio-safety level and Intellectual property rights.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Become aware on bioethical issues and Analyze it **K4**

CO2: Understand the various biosafety regulations in biotechnology **K2**

CO3: Gain knowledge to handle living organisms **K3**

CO4: Get familiarized with IPR and patent procedures **K3**

CO5: Gain knowledge about various committees, regulations on bioethics, biosafety and IPR **K2**

UNIT I

Introduction to bioethics, concepts, ethical terms, issues on genetic modification and recombinant DNA technologies, ethics in agriculture and Environment benefits, risks, transhumanism and bioweapons. GM crops, Release of GMO to the environment. Special procedures for r-DNA based product production. Risk of genetic engineering, Ecocide-Eco terrorism. Emerging issues of biotechnology's impact on society.

UNIT II

Animal rights, ethics of human cloning, Reproductive cloning, Ethical legal and Socio economic aspects of Gene therapy, Somatic, Embryonic and Adult stem cell research, ELSI of human genome project. Transgenic plants and animals. Challenges to public policy and regulations. CCAC Guidelines on Transgenic Animals (1997), CCAC Guidelines on Animal Welfare, Laboratory Animal Management, The Need for Ethical Review

UNIT III

Primary containments for biohazards, Biosafety levels, recommended biosafety levels for specific microorganism, infectious agents and Infected animals. Enivironmental release of GMO and risk assessment. Biosafety regulations, r-DNA guidelines- National and international, levels of containment., Role of Intuitional biosafety committee, GEAC, RCGM, Cartagena protocol. CPCSEA Guidelines. Hazardous Materials Used in Biotechnology—Handling and Disposal, Good Manufacturing Practices, Good Laboratory Practices.

UNIT IV

Introduction to IPR – types; copy rights, patents, trade marks, trade secret design rights, geographical indication, PVPR, patentable and non-patentable – PCT, importance of IPR, Types of Patent applications, PCT cost, procedure and requirements for international patenting- patent infringement – scope, litigation, meaning, case studies & examples. TKDL, Biopiracy. Patenting of biological material. Precautions to be taken before patenting.

UNIT V

Introduction to WTO, GATT,WIPO,TRIPS, Patenting in India, Indian patent act, WIPO treaty budaspest treaty, publication of patents-Gazette of India, Patenting by research students, lectures and scientist University/Organizational rules in India and aboard. Global scenario of patents and Indian position. IP as a determining factor in biotechnology.

REFERENCES:

1.Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.

2.Bioethics and Biosafety in Biotechnology (2007), V.Sree Krishna, New Age International (P) Limited Publishers. ISBN (13): 978-81-224-2248-1

3.Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010), 4th Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC.

4.Introduction to Plant Biotechnology (2001), 3rd Edition, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.

5.Bioethics and Biosafety (2008) M. K. Sateesh, I. K. International Pvt. Ltd, New Delhi, India.

6.Intellectual Property Rights (2008) Prabuddha Ganguly, Tata McGraw Hill Publishing Company, India. ISBN: 9780070077171 9. http://www.patentoffice.com/index.php

7. Recombinant DNA Safety Guidelines, Department of Biotechnology, Ministry of Science and Technology. Government of India.

8. Revised Guidelines for research in Transgenic Plants, Department of Biotechnology, Ministry of Science and Technology. Government of India.

9. Ethics and Biotechnology by Anthony Oakley Dyson, John Harris. Routledge. 1994.

10. Barry R. Schaller "Understanding Bioethics and the Law: The Promises and Perils of the Brave New World of Biotechnology" Praeger Publishers Inc, 2007

11. Sateesh MK, Bioethics and Biosafety, IK International, 2012

12. Sree Krishna. Bioethics and Biosafety in Biotechnology. New Age International Publishers, New Delhi, 2007

E-book links:

1) https://www.pdfdrive.com/bioethics-and-biosafety-in-biotechnology-e52867075.html
2) https://www.pdfdrive.com/bioethics-medicine-and-the-criminal-law-volume-1-the-criminal-law-and-bioethical-conflict-walking-the-tightrope-e176230762.html
3) https://www.pdfdrive.com/patents-and-standards-a-modern-framework-for-ipr-based-standardisation-e45986739.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5

CO1	S	S	M	M	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S	S	M	S
CO3	S	S	M	M	S	S	S	S	S	S	S	M	S
CO4	S	S	M	S	S	S	M	S	S	S	S	S	S
CO5	S	S	M	M	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE 26 (THEORY)- BIOPROCESS TECHNOLOGY- IBTT102**		
Semester	Semester-X	Credits:5	Hours/weeks: 6
Cognitive Level	K1: Recall K2: Understand K3: Apply K6 : Create		
Learning Objective	• To understanding the knowledge about food production, pest control, and the development of new drug and for other related biotechnological applications. • To exploiting knowledge about microbes and to study the downstream processes for product recovery in fermentation. • To learn about commercially valuable biochemical and genetic resources in plants, animals and microorganisms. • Student will understand basics of industrial Biotechnology and		

	requirements for large scale productions.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Identify the industrially important organisms and create new designs on application **K6**

CO2: Know about principles and techniques in Designing and types of fermentor **K1**

CO3: Gain knowledge and aware bioreactor usage and fermentation process **K2**

CO4: Understand and apply knowledge on the fermentation product purification and characterization **K3**

CO5: know about Industrial production of bioproducts **K2**

UNIT I

Milestones of fermentation technology. Identification of industrially important microorganism, primary and secondary screening, strain development and improvement for increase yield, product assays. Microbial growth and death kinetics, mathematical expression of bacterial growth.

UNIT II

Designing and types of fermentor – liquid, solid state and immobilized, Media and ingredients for industrial fermentation, industrial sterilization of fermentor media and air. Types of heat exchangers, immobilization techniques, Bioreactor for cell cultures. Diauxic growth and factors affecting microbial growth.

UNIT III

Instrumentation for monitoring bioreactor and fermentation process – PH, temperature pressure dissolved O2, air flow rate, shaft speed, foaming, viscosity and controlling. Batch, fed and continuous fermentation, large scale cultivation of plant and animal cells. Up-streaming process in product production.

UNIT IV

Downstream processing – recovery and purification of fermentation products – filtration, flocculation, centrifugation, cell disruption, liquid- liquid extraction, Solvent and super critical

extraction, precipitation, chromatography, ultra filtration, drying, crystallization, lyophilization. Storage and packing of products.

UNIT V

The production of primary metabolites such as organic acids like citric acid, glucamic acid, Lysine. Protease, Alcohols: Beer and Wine production. Production of Bioethanol. Secondary metabolites - Antibiotics: Penicillin V, Streptomycin and Ampicillin sodium salt. flavoring and colour production.

REFERENCES:

1. Stanbury, RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
2. Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts" Prentice Hall of India Pvt. Ltd.,2nd edition, 2005.
3. Kalaichelvan and Arulpandi, Bioprocess Technology. MJP. Publishers 2008.
4. Biotechnology: The Biological Principles (1990) Edited by M D Trevan, S Boffey, K H Goulding, and P Stanbury, Tata McGraw-Hill Publishing company Ltd, New Delhi, India.
5. Peter F. Stanbury, Stephen J. Hall & Whitaker. A, "Principles of Fermentation Technology", Butterworth – Heinemann an Imprint of Elsevier India Pvt.Ltd., 2nd edition, 2005.
6. Pauline M. Doran, Bioprocess Engineering Principles, Elsevier Science & Technology Books, 2nd edition, May 1995

E-book links:

1) https://www.pdfdrive.com/bioprocess-technology-d27110100.html
2) https://www.pdfdrive.com/advances-in-bioprocess-technology-d186651074.html
3) https://www.pdfdrive.com/biotechnology-bioprocessing-d158764194.html

Mapping of COs with POs &PSOs:

	PO	PSO

CO	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	M	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	M	S	S	S	S	M	S
CO5	S	M	S	M	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

NON MAJOR ELECTIVE

Course Title & Code	**ELECTIVE - FOREST CONSERVATION - IBTNFC**		
	CHOICE 8	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• Acquire knowledge on composition and structure of forest. • To know the techniques in establishment, growth and quality of forest vegetation. • Understand the role of forests in environmental sustenance. • Learn about the manipulations in management and establishment of forest vegetation.		
Course Outcomes	At the end of the course, the student will be able to		
	CO1 :	Understand the objectives and scope of forest conservation **K2**	
	CO2 :	Understand the composition and structure of forest **K1**	
	CO3 :	Understand the role of forests in environmental sustenance **K2**	
	CO4 :	Understand the concepts of Injuries to forest **K2**	
	CO5:	Understand the fundamentals of Forest Management and its	

	Management Systems **K2**
Unit I	Definition, objectives and scope of Silviculture. Status of forests in India and their role. General Silvicultural Principles : methods of propagation, grafting techniques; site factors; nursery and planting techniques-nursery beds, polybags and maintenance, water budgeting, grading and hardening of seedlings; special approaches; establishment and tending.
Unit II	Introduction to trees and their general classification under different forest types. Important tree families and their peculiar characters. Types of trees and canopy structure. Coniferous and broad leaved tree species. Trees in tropical, sub-tropica, temperate and alpine regions.
Unit III	Forests Soils, classification, factors affecting soil formation; physical, chemical and biological properties. Soil conservation - definition, causes for erosion; types - wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; Role of forests in conserving soils.
Unit IV	Forest Management and Management Systems : Objective and principles; techniques; stand structure and dynamics, sustained yield relation; rotation, normal forest, growing stock; regulation of yield; management of forest plantations, commercial forests, forest cover monitoring. Approaches viz., (i) site-specific planning, (ii) strategic planning, (iii) Approval, sanction and expenditure, (iv) Monitoring (v) Reporting and governance.
Unit V	Injuries to forest - abiotic and biotic, destructive agencies, insect-pests and disease. Role of afforestation and forest regeneration in absorption of CO2. effect of wild animals on forest regeneration, human impacts; encroachment, poaching, grazing, live fencing, shifting cultivation and control.
References	1. Dwivedi, A. P. 1992. Principles and Practice of Indian Silviculture, Surya Publication, 420p. 2. Shiva, M.P. A Handbook of Systematic Botany, 1986.IBD Publisher, Dehradun. 3. Sagreiya, K.P. Forests and Forestry, 1997. National Book Trust India. 4. Khanna, L. S. 1984.Principles and Practice of Silviculture, Khanna Bhandu, Dehra Dun. P. 476. 5. Ram Prakash and L.S. Khanna. 1991. Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun. 298p. 6. Dwivedi, A.P. 1993. A Text Book of Silviculture, International Book Distributors, Dehradun.
E-Reference book links	1. https://www.pdfdrive.com/forestryagro-forestry-indian-council-of-agricultural-research-e10418465.html 2. https://www.pdfdrive.com/tropical-forest-ecology-the-basis-for-conservation-and-management-tropical-forestry-e168566994.html 3. https://www.pdfdrive.com/forest-ecology-and-conservation-a-handbook-of-techniques-techniques-in-ecology-conservation-e185085454.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	M	S	S	S	S	S	S	M	S
CO2	S	M	S	M	S	S	M	S	S	S	S	M	S
CO3	S	M	S	M	S	S	M	S	S	S	S	M	S
CO4	S	M	S	M	S	S	M	S	S	S	S	M	S
CO5	S	M	S	M	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

DEPARTMENTAL ELECTIVES

Course Title & Code	**ELECTIVE - STEM CELL BIOLOGY- IBTNSB**		
	CHOICE 1	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• Recall the fundamental concepts of stem cells • Dissect mechanistic details about stem cells and regeneration (horizontal and vertical integration) • Extend these concepts in the industrial and academic sectors		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1:	Relate the fundamental aspects of stem cell technology **K1**	
	CO2:	Illustrate the principles and methodologies about the mechanistic aspects **K2**	
	CO3:	Apply the knowledge gained in regenerative aspects and therapeutic potential **K3**	
	CO4:		
	CO5:		

		Having a clear understanding of professional and ethical responsibility **K2** Determine the commonalities and distinguish between embryonic and adult stem cells **K2**
Unit I	Introduction- Embryonic stem cells, Blastula, Inner cell mass, Totipotent, pluripotent, multipotent and Induced pluripotent stem cells characterization, potency, self-renewal, cell division, and differentiation	
Unit II	Pathways involved in stem cell proliferation, differentiation, and dedifferentiation - Signal transduction pathways and signaling molecules involved cellular proliferation, differentiation, and dedifferentiation. Relationship between cellular proliferation and differentiation concerning stem cells	
Unit III	Embryonic stem cells - How embryonic stem cells are obtained, in vitro multiplication: embryonic stem cells gene manipulation and nuclear transfer technology. Adult stem cells - Methods to obtain stem cells from adults (Amniotic fluid, cord blood cells, Mesenchymal stem cells, etc). Induced pluripotent technology (IPS), genes, and their mode of action in inducing stemness in adult cells. Advantages and disadvantages of IPS technology	
Unit IV	Organ regeneration using Stem cells - Heart regeneration, angiogenesis, kidney regeneration, a neurodegenerative disorder, spinal cord injury, tissue engineering. Ethics in using Embryonic stem cells - Human stem cell research: Ethical consideration; Stem cell religion consideration; Stem cell-based theories: Preclinical regulatory consideration, and Patient advocacy.	
Unit V	Application of stem Cells- Overview of embryonic and adult stem cells for therapy in Neurodegenerative diseases; Parkinson's, Alzheimer's, Spinal Code Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia, etc.	
References	1. Cherian E (2011) Stem cells JP brothers medical publishers 2. Atala A (2012) Progenitor and Stem Cell Technologies and Therapies Woodhead publishing 3. Phinney DG (2011) Adult stem cells: Biology and methods of analysis Humana press	
E-Reference links:	1. https://www.law.berkeley.edu/files/stem_cell_day1_part2_shelanski.pdf 2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/stem_cell_handbook.pdf 3. https://go.openathens.net/redirector/tulane.edu?url=http://www.sciencedirect.com/science/book/9780123815354	

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	M
CO3	S	M	S	S	S	S	M	S	S	S	S	S	M
CO4	S	M	S	S	S	S	S	S	S	S	S	S	M

CO5	S	M	S	S	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE - PHYTOCHEMISTRY- IBTNPC**		
	CHOICE 2	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K4: Apply		
Learning Objective	• Learn to extract and purify the bioactive compounds • Understand the structural analysis of bioactive compounds • Gain a knowledge on herbal medicine and phytopharmaceuticals		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1: Understand the extraction and purification of the bioactive compounds **K2** Able to perform various chromatographic techniques **K2** **CO2:** Understand the structural analysis of bioactive compounds using **CO3:** spectroscopy **K2** Apply the knowledge on purifying bioactive compounds **K4** **CO4:** Know the basics of phytopharmaceuticals **K1** **CO5:**		
Unit 1	Polar and Non-polar solvents for extraction. Extraction – purification of bio-active compounds from plants - cold & hot extract. Soxhlet extraction - crude extracts purification by various solvents.		
Unit II	Isolation of bioactive compounds- chromatographic techniques - thin layer chromatography- liquid chromatography - HPLC and UPLC.		
Unit III	Structural analysis of bioactive compounds - IR spectroscopy - Mass spectroscopy – NMR spectroscopy.		
Unit IV	Herbal medicine - History of herbal medicine - different types of herbal medicine - Ayurveda, Siddha and Unani - Pharmacological action - clinical research and traditional uses of Indian medicinal plants - *Eclipta alba*, *Gymnema sylvestre*, *Ocimum sanctum*, *Curcuma longa*.		
Unit V	Phytopharmaceuticals and their health benefits - anthocyanins, carotenoids, lycopene, isoflavones, polyphenols, omega 3 - fatty acids, biological effects of resveratrol.		
References	1. Harbone, J.B. Phytochemical Methods: A guide to modern techniques of plant analysis, 3rd ed. Springer (India) Private Limited, New Delhi. 1998. 2. R. M. Silverstein, F. X. Wester- Spectroscopic identification of organic compounds. John-Wiley. 1998.		

	3. H.H. Willard, L. L. Merrit, J. A. Dean. Instrumental Methods of Analysis, 1987. 4. V. M. Godte. Ayurvedic pharmacology and therapeutic uses of medicinal plants. Bharathiya Vidya Bhavan, Mumbai. 2000. 5. R.C. Grewal. Medicinal Plants. Campus Books International, New Delhi. 2000.
E-Reference links	1. https://www.pdfdrive.com/textbook-of-pharmacognosy-and-phytochemistry-d184620437.html 2. https://books.google.co.in/books?id=satDwAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0 3. https://www.pdfdrive.com/trease-and-evans-pharmacognosy-e58233029.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	S	S	S	M	S	S	S	S	M	M
CO2	S	M	S	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	M	S	S	S	S	S	M
CO4	S	M	M	S	S	S	S	S	S	S	S	S	M
CO5	S	M	S	M	S	S	M	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE - MOLECULAR MODELLING AND DRUG DESIGNING – IBTNMM**		
	CHOICE 3	Credits:2	Hours/weeks: 2
Cognitive Level	K2: Understand K3: Apply K4: Analyze		
Learning Objective	• Outline preliminary concepts in molecular modeling using molecular dynamics • Utilize basic modeling techniques to explore biological phenomena at the molecular level • Perceive knowledge in protein-ligand interaction study by docking and visualization tools for molecular dynamics.		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1: Illustrate the concepts of Molecular modeling using Molecular Dynamics **K2** **CO2**: Experiment with protein-ligand interaction study by docking.**K3** **CO3**: Translate the understanding of visualization tools for molecular dynamics **K3**		

	CO4: **CO5**:	Apply the information gained in various chemistry and biochemistry courses toward solving problems pertinent to drug designing **K3** Demonstrate the relative importance of molecular modeling and drug designing **K4**
Unit I	**Quantum mechanics & concepts in molecular modeling:** Coordinate systems, potential energy surfaces. Introduction to quantum mechanics. Force Fields - Bond stretching; angle bending. torsional terms; non-bonded interactions; electrostatic interactions; Vander Waals interactions	
Unit II	**Molecular Dynamics and Monte Carlo simulation:** Design constraints, Potentials in MD simulation, Molecular dynamics algorithms.	
Unit III	**Analysis and Properties** - Geometry optimization, Vibrational frequencies: potential energy surface, harmonic vs. fundamental frequencies, zero-point vibrational energies.	
Unit IV	**Modeling :**Homology modeling, Ab initio, Protein Threading. **Drug design** - Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design.	
Unit V	**Molecular Docking :** Docking - molecular modeling in drug design – structure-based drug design – pharmacophores -QSAR.	
References	1. Leach AR (2010) Molecular Modeling, Principles & Applications, (Dorling Kindersley(India) (P)Ltd with Pearson education Ltd, UK. 2. Arjun S (2103) Drug Discovery, Design & Development Lambert Academic publishing. 3. Clark T, Thurston DE, and Banting L (2012) Drug Design Strategies: Computational Techniques & Applications Royal society of chemistry	
E-Reference links	1. https://www.mdpi.com/books/pdfview/book/1187 2. https://www.kobo.com/us/en/ebook/molecular-modelling-and-drug-design 3. https://faculty.psau.edu.sa/filedownload/doc-3-pdfe1490523b8cd2c130b29656613850cf8-original.pdf	

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	M	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE - NANOTECHNOLOGY AND CANCER BIOLOGY- IBTNNC**		
	CHOICE 4	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• To provide the students with knowledge and the basic understanding of nanotechnology and cancer. • The properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials. • To give an idea about Synthesis of nanomaterials, charecterisation and their application • To give students an historical perspective on the most commonly studied topics in cancer biology. • To link specific cancer biology subjects with clinical aspects of the disease. • **S**tudents can understand the nanomaterials, its synthesis and application for almost all the field to the benefit of humankind. Students will also acquire knowledge on cancer biology.		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1:	Know basic about nanomaterial and Nanoparticles **K1**	
	CO2:	Learn the Application of nanotechnology in different field and problem solving solution **K2**	
	CO3:	Learn update research in Nanotechnology for cancer research & therapy **K2**	
	CO4:	Gain knowledge about Epidemiology of cancer, cancer types, characteristics of cancer cells in molecular aspects **K2**	
	CO5:	Find out and acquire knowledge about chemotherapy and chemoprevention in Tumor immunology **K2**	
Unit I	Nanotechnology – definition – Quantum dots, Nanowires & properties, 2D films. Nano scale materials. Nanopores . Characterization of Nanoparticles and Nanomaterials.		
Unit II	Application of nanotechnology; Nano sensors-types & its applications, Nano carriers for drug delivery-polymeric NP, Micelles, Micro emulsions, Lipoproteins as pharmaceutical carriers. Solid lipid NP as drug carriers. Nanocapsules-Preparation, Characterization & therapeutic applications. Nano medicine-Biopharmaceuticals. Implantable materials, Devices, Surgical aids, diagnostic tools, Genetic testing, Imaging.		
Unit III	Nanotechnology for cancer research & therapy. Environmental nano remediation technology. Thermal, physico-chemical and Biological methods. Nano filtration for the treatment wastes, removal of organics, Inorganics and pathogens. Nanotechnology for water purification.		
Unit IV	Epidemiology of cancer, cancer types, characteristics of cancer cells, carcinogenesis: Cancer initiation, promotion and progression, termination. Factors responsible for Carcinogenesis; Physical, Chemical and Biological.		

Unit V	Tumor immunology – tumor antigens, cytokines, vaccine development, immunotherapy and its limitations, Tumor cell evasions of immune defenses. Principles of chemotherapy and chemoprevention.
References	1. Maloy S.R., Cronan Jr. J. E., and Freifelder D. 2006. Microbial Genetics, Jones and Bartlett Publishers, Sudbury, Massachusetts. 2. Chichester and Dale JW, 1994. Molecular genetics of Bacteria. John Wiley & sons. New York. 3. Hartl D.A and Jones E.W. 2000. Genetics: Analysis of genes and genomes, Jones & Bartlett Publishers, Sudbury, Massachusetts. 4. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 1994. Molecular Biology of the Cell, Fourth Edition, Academic Press. New York. 5. Lodish, Berk, Baltimore et al . 2000. Molecular Cell Biology, 6th Eds, W.H. Freeman & Co. 6. Cooper G. 2000. The Cell: A molecular approach. 2nd Eds, Sinauer Associates Inc. 7. Kleinsmith L. J. and Kish V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York. 8. De Robertis and De Robertis. 2005. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins. 9. Brown T.A, 2002. Genomes. 2nd Edition. Wiley-Liss, New York. 10. Primrose S.B, Twyman R.M., Old R.W. 2002. Principles of Gene Manipulation and genomics. 7th Edition. Blackwell Science. 11. The Cell: A Molecular Approach (2016) 7th Edition, ASM Press, Washington D.C. & Sinauer Associates, Inc, Sunderland, Massachusetts. Geoffrey M.Cooper and Robert E.Hausman 12. Cell and Molecular Biology – Concepts and Experiments (2016), (ed), John Wiley & Sons Inc, New York. Gerald Karp, Harris, D 13. Genes IX (2007), 9th Edition, Jones and Barlett Publishers. ISBN: 0763740632. Benjamin Lewin
E-Reference links	1. https://books.google.co.in/books?id=81vBBwAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0 2. https://www.pdfdrive.com/cancer-nanotechnology-methods-and-protocols-d158801917.html 3. https://www.pdfdrive.com/introduction-to-cancer-biology-d58366931.html 4. https://www.pdfdrive.com/nanotechnology-and-nanosensors-introduction-to-nanotechnology-d187619895.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	M	M	S	S	M	S	S	S	S	S	M
CO2	S	S	S	S	S	S	M	S	S	S	S	S	S

CO3	S	S	M	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	M	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE -ENTREPRENEUR DEVELOPMENT- IBTNED**		
	CHOICE 5	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply K6: Create		
Learning Objective	• To train students in different aspects of management pertaining to biotechnology industry in addition to principles of economics and accountancy. • To know the ethical principles underlying biotechnology research and develop entrepreneurship skills.		
Course Outcome	On Successful completion of the course, the students will be able to		
	CO1: Develop an understanding of the fundamental topics on management. **K1** **CO2:** Gain knowledge on business economics and project management. **K2** **CO3:** Get a strong foundation on commercialization of biotechnology products. **K3** **CO4:** Get the required knowledge to lead and administer biotechnology companies. **K2** **CO5:** Undertake entrepreneurship ventures.**K6**		
Unit I	Entrepreneurship - definition, needs and importance. Factors necessary for entrepreneurship. Promoting bio-entrepreneurship. Bio-entrepreneurship in India. Entrepreneurial traits, self appraisals, sources of funds. Business planning in Biotech.		
Unit II	Principles of management, management process, functions of organization. Functions of mangers - delegation, decentralization and leadership. Motivation - management control, MIS process of design and management. Use of flow sheets in the design of a process.		
Unit III	Entrepreneurship development - theory of entrepreneurship. Process techniques, raw material preparation, product recovery and purification, formulation packaging and quality control. Economic considerations - cost estimation, total product cost, capital investment and profitability. Manufacturing cost estimates, capital investment and resources, cost benefit analysis.		
Unit IV	Legal and ethical issues, biosafety legal issues concerning genetic engineering, biological containment, ethical and professional problems, risk assessment and		

	prevention. Patents and exploitation of inventions.Intellectual Property Rights (IPR), Farmer's/ breeder's rights, geographic appalletation.
Unit V	Bio industry and prospects - recent trends in the development of bioindustry, selection, transfer and adaptation of technologies. Training of qualified personnel, new relationship between industries and universities. International cooperation. Scope and status of biotechnology industry in India.
References	1. Harpum P. Portfolio, Program and Project Management in the pharmaceutical and biotechnology industries. 2010. 2. M.J. Roy. Biotechnology operations: Principles & Practices. CRC Press. 2011. 3. Biren N Shah, Bhavesh S Nayak, Vineet C Jain; Textbook Of Pharmaceutical Industrial Management; 2010; 1st edition; Elsevier India

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	M	S	S	S	S	M	S	S	M	S
CO2	M	M	S	S	S	S	S	S	M	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	M	S	S	S	S	S	M	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE - BIOBUSINESS- IBTNBB**		
	CHOICE 6	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Evaluate		
Learning Objective	• To introduce students in different aspects of biobusiness. •		
Course outcomes	On Successful completion of the course, the students will be able to		
	CO1: Identify the origin of bio business and the current scenario **K1** **CO2**: Evaluate the various sectors of bio business **K4** **CO3**: Determine different types of business models viz. product, subscription and integrated **K2** **CO4**: Adopt international standards and certifications for cGMP and Cglp K3		

	CO5:	Perceive the role of IPR in bio business **K2** Analyse the prons and cons of biobusiness **K4**
Unit I	**Fundamentals of Bio business :** History of evolution of Bio Business, Importance of Finance for Bio business –Sectorial support by Government of India - policies, and frameworks.	
Unit II	**Overview of Bio business in various sectors :** Healthcare, Industrial life-Sciences, Agriculture and Agri-biotechnology, Environment and Environmental Biotechnology.	
Unit III	**Business Models in Bio business:** Product Based-Service Based-Subscription Based-Integrated Models.	
Unit IV	**Best Practices:** Current Good Manufacturing Practices (cGMP), Current Good Laboratory Practices (cGLP).	
Unit V	**IPR:** Determining "patentability"; Industry-wise implications; use of patents – relevant case studies highlighting its importance. Importance of IPR in the Pharmaceutical Industry- Drug development-Product/Process Patenting-Marketing. Technology transfer, Licensing	
References	1. Shahi, G. BioBusiness in Asia: How Asian Countries Can Capitalize on the Life Science Revolution. Pearson Prentice Hall. 2004. 2. Hirsch RD & Peters MP, "Entrepreneurship," Tata McGraw Hill Publishers, New Delhi, 2002. **3.** Holt DH, "Entrepreneurship – New Venture Creation," Prentice Hall of India, 1999.	

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	M	S	S	S	S	M	S	S	M	S
CO2	M	M	S	M	S	S	S	S	M	S	S	M	S
CO3	M	M	S	M	S	S	S	S	M	S	S	M	S
CO4	M	M	S	M	S	S	S	S	S	S	S	M	S
CO5	M	M	S	M	S	S	S	S	S	S	S	M	S

Strongly Correlating (S)- 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation(N) - 0 mark

Course Title & Code	**ELECTIVE - INDUSTRIAL FERMENTATION PRODUCTS-IBTNID**		
	CHOICE 7	Credits:2	Hours/weeks: 2
Cognitive Level	K3: Apply K4: Analyze K5: Evaluate K6: Create		

Learning Objective	• To equip the mind with the modern techniques such as fermentation technology and manufacture of various bioproducts • To design appropriate bioreactor configurations and operation modes based upon the nature of bioproducts	
Course Outcomes	Upon completion of this course, the students will be able to	
	CO1:	Evaluate model required for the microbial growth and can design own batch thermal Sterilization **K5**
	CO2:	Formulate medium using various kinetics for maximum production of metabolites and biocatalyst for commercial applications **K6**
	CO3:	Model the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes **K6**
	CO4:	Choose better yield using gene manipulation of microorganisms and integrate research lab and industry **K3**
	CO5:	Identify problems and seek practical solutions for large scale implementation of biotechnology **K4**
Unit I	Definition and importance of fermented products; Organisms used for production of fermented products; Fermented beverages- types, methods of manufacture for vinegar, sauerkraut, tempeh, miso , soya sauce ,beer,wine and traditional indian foods ; Dairy Fermentations - Buttermilk, Yogurt, cheese, Milk- Characteristics, Processing, Starter culture, Growth and Genetics -Properties and beneficial effects of probiotic and prebiotic. Fermented meat and fish products, Indian fermented foods.	
Unit II	Distillation, Types of Distillation - Simple distillation, Fractional distillation, Steam distillation, Vacuum distillation, Air-sensitive vacuum distillation, Short path distillation and Zone distillation. Alcohol distillation: basic principles, equipment, performance relationships, and safety. Mechanism of Distillation. : Hydrodiffusion, Hydrolysis, Decomposition by heat, Advantage and Disadvantage of different distillation methods. Application of distillation methods. Heat exchangers.	
Unit III	Practical in fermentation • Isolation of industrially important microorganisms • Production of Industrially important Enzyme by solid state fermentation • Production of Organic acids • Production of Antibiotics • Wine preparation • Production of alcohol by microbes. •Production of biofuel by microorganism	
Unit IV	Practical in food 1. Food Fermentation Technologies. 2. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery. 3. Starter cultures. 4. Production of Baker's Yeast 5. Development of a fermented food/drink utilizing plant products /animal products or byproducts as substrate	
Unit V	Extraction methods of natural essential oils- water and steam distillation; and direct steam distillation.	

References	4. Stanbury P.F., Whitaker A, Hall S.J (2016) Principles of Fermentation Technology,Butterworth Heinemann, 3rd edition. UK 5. Shuler M.L and Kargi F (2017) Bioprocess Engineering: Basic concepts Prentice Hall, 2ndedition. 6. Doran PM (2013) Bioprocess Engineering Principles Elsevier, 2nd edition. 7. Cornish-Bowden A, (2012) Fundamentals of Enzyme Kinetics, Butterworth group, 4th edition. 8. Okafor N (2016) Modern Industrial Microbiology and Biotechnology, SP publishers
E-Reference book links	1. https://nptel.ac.in/ 2. https://www.wakenbtech.co.jp/wp/wpcontent/uploads/2015/11/nbs_fermentation_basics.pdf 3. https://biokamikazi.files.wordpress.com/2013/09/principles_of_fermentation_technology-stanburry_whittaker.pdf 4. https://mmbr.asm.org/content/mmbr/62/3/646.full.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	ELECTIVE - FOOD PROCESSING TECHNOLOGY- IBTNFP		
	CHOICE 8	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To gain knowledge and understanding about food systems in the production, processing and consumption of food and an appreciation of their impact on society. • To have a knowledge and understanding about the nature of		

	food and human nutrition and an appreciation of the importance of food to health. • To understand the sources and processing techniques of meat , dairy products, edible fats and Oils • To know about principles of food preservation, packaging and its ethics.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Recall the influence of food on human health **K1**

CO2: Understand the microbes play a vital role in food and industrial production of products **K2**

CO3: Know about principles of food preservation, packaging and its ethics **K1**

CO4: Understand the sources and processing techniques of meat, dairy products, edible fats and Oils **K2**

CO5: Know about the Food Safety and Risks Hazards **K3**

UNIT – I

Basic principles of Food Processing – Properties of foods and processing-Properties of liquids, solids and gases-Viscosity-Surface activity-Rheology and texture. Effects of processing on nutritional properties, Food safety, good manufacturing practice and quality assurance.

UNIT – II

Food Processing- Process control: Automatic control, Computer-based systems. ambient-temperature processing: Raw material preparation- Cleaning, Sorting, Grading, Peeling. Size reduction - Size reduction of solid foods, liquid foods. Mixing and forming

UNIT – III

Processing and Effect on foods: Heat processing using steam or water- Blanching, Steam Hot-water blanchers. Effect on foods – Nutrients, flavor,Texture. Pasteurization: packaged foods, unpackaged liquids. Heat sterilization-Ultra high-temperature (UHT)/aseptic processes, Evaporation and distillation. Heat processing using hot air : Dehydration, Baking and roasting. Heat processing by direct and radiated energy - Dielectric, ohmic and infrared heating.

UNIT – IV

Processing by the removal of Heat: Chilling - Mechanical refrigerators, Cryogenic chilling. Controlled- or modified-atmosphere storage and packaging: MAP for fresh foods, processed foods, Packaging materials for MAP. Freezing: Cooled-air freezers, Cooled-liquid, Cryogenic freezers. Effect of freezing, Effects of frozen storage, Thawing.

UNIT – V

Post-processing operations: Coating or enrobing, Coating materials- Batters, powders and breadcrumbs, Chocolate and compound coatings, Enrobers, Dusting or breading, Pan coating. Packaging : Types of packaging materials, Printing, Interactions between packaging and foods, Interactions between packaging and foods. Filling and sealing of containers: Rigid and semi-rigid containers, Flexible containers, Types of sealer, Labelling. Materials handling, storage and distribution.

REFERENCES:

1. Food science – Fifth Edition – Normal N.Potter, Joseph H. Hotchkiss.
2. Outlines of Dairy technology – Sukumar De.
3. Modern technology of milk processin & Dairy products – NIIR Board of dairy technology
4. Nutrition & Dietetics – Shubhangini A.Joshi.
5. Frazier, W. C. and D. C. Westhoff, Food Microbiology. 4th Edition. Tata McGraw-Hill Publishing Co. Pvt. Ltd., New York. 2003.

E-book links:

1. https://nptel.ac.in/
2. https://ncert.nic.in/textbook/pdf/lehe105.pdf
3. https://mastermilk.com/uploads/biblio/food_process_engineering_and_technology.pdf
4. https://www.webpal.org/SAFE/aaarecovery/2_food_storage/Food%20Processing%20Technology.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	M	M	S	S	S	S	S	M	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	M	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	M	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE - WILD LIFE CONSERVATION - IBTNWL**		
	CHOICE 9	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand		
Learning Objective	• To understand about habitat analysis, human-wildlife interactions • To know about the concepts of management and sustainable wildlife management		
Course	At the end of the course, the student will be able to		

Outcomes	**CO1** : **CO2** : **CO3** : **CO4** : **CO5**:	Understand the ethics of wildlife conservation **K2** Understand the salient features of habitat analysis **K2** Describe the basics of human-wildlife interactions **K1** Understand the concepts of management **K2** Understand the fundamentals of sustainable wildlife management **K2**
Unit I	**Introduction:** Values and ethics of wildlife conservation; importance of conservation. Conservation Vs protection Concept of Buffer zones, Wildlife corridors Strategies to reduce human-wildlife interactions	
Unit II	**Habitat analysis:** Types of Habitats & their major ecological factors Ecological Succession & climax ecosystems (e.g. Sholas) Maximizing usage of Habitat resources by populations Insular habitats & insular flora & fauna Extreme Habitats and their flora & fauna (Dark Caves, deep sea etc.) Evaluation and management of wild life - Physical parameters and Biological Parameters; Standard evaluation procedures: Faecal analysis of ungulates and carnivores. Geographical Information System (GIS), Global Positioning System (GPS), and Remote Sensing (RS).	
Unit III	**Human-wildlife interactions:** Poaching, illegal trading, conflict management and shifting from extraction to preservation; effect of extinction of a species on ecosystem; Forest landscape restoration. Conservation Vs protection Concept of Buffer zones, Wildlife corridors Strategies to reduce human-wildlife interactions Role of Government and NGOs in controlling human-wildlife interactions Socio-economic issues related to human-wildlife interaction	
Unit IV	**Concepts of management:** Protected Area Network (PAN), WWFN, IUCN, and CITES. Wild life Legislation – Wild life Protection act (1972), its amendments and implementation. IUCN Red data book and red list categories (only names), Protected areas National parks & sanctuaries, Community reserve; Important features of protected areas in India; Project Tiger and Project Elephant.	
Unit V	**Sustainable wildlife management:** Natural resource management. Eco tourism / wild life tourism in forests; various Environmental movements in India: Bishnoi movement, Chipko movement, Narmada bachao andolan, Silent valley movement, Baliyapal movement.	
References	1. Caughley, G., and A.R.E. Sinclair Wildlife Ecology and Management, Blackwell Science. 2004 2. Woodroffe R., S. Thirgood and A. Rabinowitz. People and Wildlife, Conflict or Coexistence? Cambridge University Press, 2011 3. Bookhout, T.A. Research and Management Techniques for Wildlife and Habitats, 5th edition.The Wildlife Society, Allen Press. 2006 4. Sutherland, W.J. The Conservation Handbook: Research, Management and Policy. Blackwell Sciences 2010 5. Hunter M.L., J.B. Gibbs and E.J. Sterling. Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing. 2009	
E-Reference book links	1. https://www.pdfdrive.com/wildlife-ecology-conservation-and-management-2nd-edition-d184311905.html	

	2. https://www.pdfdrive.com/comprehensive-wildlife-conservation-strategy-e38430632.html 3. https://www.pdfdrive.com/wildlife-ecology-and-management-wildlife-producers-association-e9899184.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	M	S	S	S	S	S	S	M	S
CO2	S	M	S	M	S	S	M	S	S	S	S	M	S
CO3	S	M	S	M	S	S	M	S	S	S	S	M	S
CO4	S	M	S	M	S	S	M	S	S	S	S	M	S
CO5	S	M	S	M	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE – INDUSTRIAL WASTE MANAGEMENT - IBTNIM**		
	CHOICE 10	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3-Apply K4: Analyze		

Learning Objective	• To impart knowledge on effluent characteristics and effects on environment • To understand the importance of industries for development • To develop skill for designing ETP for industries
Course Outcomes	Upon completion of this course, the students will be able to
	CO1: Acquire Knowledge on effect of industrie**s** waste on environment and environmental legislation **K1** **CO2:** Understand the basic of common waste water treatment **K2** **CO3**: Gain the knowledge effluent characteristic and treatment process of various industrial effluent **K1** **CO4:** Analyse the characteristics of effluent and student can able to design treatment process for industries **K4** **CO5:** Apply biotechniques to control the hazards waste pollution **K3**
Unit I	Types of industries and Importance of industries – Industrial pollution –characteristics of industrial effluents –effects of industrial effluents on streams and land. Environmental laws related to prevention and control of industrial effluents. Waste audit. .
Unit II	Wastewater Treatment - Primary, Secondary and advanced treatment: Classification and application of physical unit processes with principles and process analysis, biological waste water treatment - UASB, Wastewater disposal and Reuse. Sludge disposal:
Unit III	Sugar mills and Distilleries, Tanneries, Fertilizer industries and pharmaceutical industries : Sources, characteristics of wastes, effects on receiving water bodies and Treatment of their wastes and disposal.
Unit IV	Cement industries - sources of pollution and wastes. Effect of wastes. Control technique of pollution. thermal power plants, Sources of pollution, characteristics of pollutants and their effects. Pollution control techniques.
Unit V	Biotechnological application of hazardous waste management and management of Resources: bioremediation, phytoremediation,1. Use of microbial systems. 2. Waste water treatment using root zone treatment by plants. 3. Reclamation of wasteland: biomass production for Biogas.
References	• 1. Rao M. N. & Dutta A. K. , "Wastewater Treatment", Oxford – IBH Publication, 1995. • Eckenfelder W.W. Jr., "Industrial Water Pollution Control", McGraw Hill Book Company, New Delhi, 2000. • Patwardhan. A.D., Industrial Wastewater Treatment", Prentice Hall of India, New Delhi 2010. • Bishop, P.L., "Pollution Prevention: Fundamental & Practice", McGraw Hill, 2000. • Pandey, "Environmental Management" Vikas Publications, 2010. • Industrial Wastewater Management, Treatment and Disposal",(WEF – MOP –

	FD3) McGraw Hill, 2008.
E-reference links:	**1.** https://www.mysciencework.com/publication/download/lecture-notes-cell- biology-1636c320/adc18b1228577d5353c56fdf7b69b6de **2.** https://gurukpo.com/Content/Bsc-biotech/Cell_Biology.pdf **3.** https://www.microscopemaster.com/cell-biology.html 4. https://microbenotes.com/category/cell-biology/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE – HUMAN PATHOLOGY- IBTNHP**		
	CHOICE 11	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3-Apply K4: Analyze		
Learning Objective	• The student should acquire a theoretical knowledge in General pathology. • To gain knowledge about systemic pathology Gastrointestinal system, Respiratory tract and Breast Tumours • To understand and skill on Transfusion Medicine, Clinical pathology		
Course Outcomes	Upon completion of this course, the students will be able to		
	CO1: Understand the basics of pathological disorders **K2** **CO2:** Gain knowledge on morphology and reproduction of fungi **K1** **CO3**: Acquire knowledge on Systemic Pathology **K2** **CO4:** Apply their skill in the clinical laboratory **K3** **CO5:** Analyze the Blood grouping and blood transfusion **K4**		

Unit I	General Pathology – Introduction, History of pathology, Cell injury and cell death, Cellular accumulations, Inflammation and repair, Circulatory disturbances, Immunological disorders, Infections, Neoplasia
Unit II	Mycology - Human Fungi - morphology and reproduction. Classification of fungi . Opportunistic fungi. Superficial mycotic infection. Fungi causing subcutaneous mycoses. Fungi causing systemic infections. Laboratory diagnosis of fungal infections.
Unit III	Systemic Pathology - Gastrointestinal system. Disorders of mouth, salivary glands , esophagus, stomach , intestines, rectum and anal canal. Respiratory tract – infections, inflammations, environmental, immunological and neoplastic disorders and their identification. Breast - Tumors and tumor like conditions. Pathogenesis pathology and diagnosis.
Unit IV	Haematology - Development and morphology of blood cells, bone marrow, general alterations in diseases. Anaemia – deficiency, hemolysis and other causes. Disorders of hemostasis and coagulation. Disorders of leucocytes and platelets – quantitative, qualitative and in neoplastic proliferations. Paraproteinemia and plasma cell disorders.
Unit V	Transfusion Medicine. Essentials of blood bank serology and transfusion medicine. Clinical Pathology - Basic principles and methods employed in tissue processing, paraffin and frozen sections and staining procedures including tissue microarrays.
References	1.Husain A. Sattar,2017.Fundamentals of Pathology. Published by PathomaLLC. 2.Balaram Jana.2005. Human Pathology.B.Jain Publishers 3. David T. Rowlands.1986. Human Pathology: An Introduction to the Study of Disease. Macmillan Pub Co publisher 4. Harsh Mohan. 2014.Textbook of Pathology, 7th Edition. Jaypee Brothers,Medical Publishers Pvt. Limited 5. Vinay Kumar Abul Abbas Jon Aster. 2014.Pathologic Basis of Disease 9th Edition. Elsevier.
E-reference links:	1. https://www.pdfdrive.com/pathology-handbook-capital-pathology-e36414786.html 2. https://www.pdfdrive.com/genitourinary-pathology-a-volume-in-foundations-in-diagnostic-pathology-series-high-yield-e176374227.html 3. https://www.pdfdrive.com/harsh-mohan-textbook-of-pathology-e52206258.html 4. https://www.pdfdrive.com/fundamentals-of-pathology-pathoma-2018-e185838619.html 5. https://www.pdfdrive.com/pathology-usmle-step-1-volume-1-basic-

	pathology-e187109588.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**ELECTIVE – PUBLIC HEALTH AND MANAGEMENT- IBTNPM**		
	CHOICE 12	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3-Apply K4: Analyze		
Learning Objective	To gain a knowledge on pollution, types of pollutants and gobal warming To understand the waste management and its hazards To understand the risk factors, symptoms and treatment of communicable and non-communicable diseases.		
Course Outcomes	Upon completion of this course, the students will be able to		
	CO1: Discuss the sources and causes of environmental hazards **K1** **CO2:** Know the types, causes, sources and prevention of pollution K1 **CO3**: Describe the types and characteristics of wastes and disposal K2 **CO4:** Understand the social and economic factors of communicable diseases K2 **CO5:** Understand the risk factors, symptoms and treatment of non-communicable Diseases K2		
Unit I	Introduction: Sources and causes of Environmental hazards, identification and accounting of hazards, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure assessment and tests.		

Unit II	Pollution: Air pollution: definitions, types of pollutants, causes, sources, effects and prevention. Water pollution: , definitions, types of pollutants, causes, sources, effects and prevention, noise pollution sources and effects. Global warming.
Unit III	Waste Management and hazards: Types and characteristics of wastes, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants. Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.
Unit IV	Communicable Diseases: Social and economic factors of disease including role of health services and other organizations: Infectious (Bacterial-Tuberculosis, Typhoid; Viral- AIDS, Poliomyelitis, Protozoan- Leishmaniasis, Malaria)
Unit V	Non-communicable Diseases: Lifestyle and Inherited/genetic diseases, brief account of immunological diseases; Risk factors, symptoms, diagnosis and treatment of cancer, diabetes and cardiovascular diseases
References	1. Cutter, S.L. (2009). Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi. 2. Kolluru R., Bartell S., Pitblado R. and Stricoff, S. (2006). Risk Assessment and Management Handbook. McGraw Hill Inc., New York. 3. Kofi, A.D. (2012). Risk Assessment in Environmental management, John Wiley and sons, Singapore. 4. Joseph, F. L. and Louver, B.D. (2007). Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey
E-reference links:	1. https://www.pdfdrive.com/environmental-policy-and-public-health-air-pollution-global-climate-change-and-wilderness-public-health-environmental-health-d157201871.html 2. https://www.pdfdrive.com/environmental-epidemiology-volume-1-public-health-and-hazardous-wastes-environmental-epidemiology-d184299151.html 3. https://www.pdfdrive.com/principles-of-epidemiology-in-public-health-practice-d23834453.html 4. https://www.pdfdrive.com/risk-management-handbook-for-health-care-organizations-student-edition-j-b-public-health-health-services-text-d185548651.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

ourse Title & Code	**ELECTIVE – DRUG METABOLISM- IBTNDM**		
	CHOICE 13	Credits:2	Hours/weeks: 2
Cognitive Level	K1: Recall K2: Understand K3-Apply K4: Analyze		
Learning Objective	• To understand the classification and mechanism of action of drugs • To gain knowledge on Pharmacokinetics • To know about the Drugs for metabolic disorders and its toxicity		
Course Outcomes	Upon completion of this course, the students will be able to		
	CO1: Know the identity, distribution and regulation of major drug-metabolizing enzymes and transporters K1 **CO2:** Evaluate the appropriate application of experimental models and protocols to drug metabolism K3 **CO3**: Interpret the relative importance of various metabolic pathways K4 **CO4:** Acquire knowledge on clinical toxicology K2 **CO5:** Understand the biochemical mode of action of antibiotics K2		
Unit I	General Pharmacology: Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs.Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50.		
Unit II	Pharmacokinetics: Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney		
Unit III	Therapeutics: Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer.		
Unit IV	Screening for pharmacological activity: Analgesic, anti-inflammatory and antipyretic agents, gastrointestinal drugs, antiulcer and laxatives, antioxidants, anticancer and anti-fertility agents. Drugs for metabolic disorders like antidiabetic, anti-hyperlipidemic, anti-obesity and hepatoprotective agents		
Unit V	Clinical Toxicology: Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy,		

	hypersensitivity, antagonism and synergism. Methods of detection. Drug abuses and their biological effects. Rational prescription of drugs. Toxicity of anticancer drugs. Clinical symptoms of toxicity and marker parameters.
References	1. Introduction to Drug Metabolism, by G. Gordon Gibson and Paul Skett 2. Drug Metabolism Handbook Concepts and Applications Edited by Ala F. Nassar, Wiley 3. F S K Barar, Essentials of Pharmacotherapeutics, S. Chand Limited, 2000. 4. Bertram Katzung, Anthony Trevor, Basic and Clinical Pharmacology, McGraw Hill Professional, 2014. 5. Golan, David E., Armen H. Tashjian, and Ehrin J. Armstrong, eds. Principles of pharmacology: the pathophysiologic basis of drug therapy. Lippincott Williams & Wilkins, 2011.
E-reference links:	1. https://www.pdfdrive.com/drug-metabolism-e-library-fakultas-kedokteran-uwks-d3133731.html 2. https://www.pdfdrive.com/principles-of-pharmacology-the-pathophysiologic-basis-of-drug-therapy-d157890965.html 3. https://www.pdfdrive.com/pharmacology-d33542642.html 4. https://www.pdfdrive.com/basic-clinical-pharmacology-e34443843.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	ELECTIVE: SYSTEM BIOLOGY - IBTNSB		
	CHOICE 14	Credits:2	Hours/weeks: 2

Cognitive Level	K1: Recall K2: Understand K3: Apply
Learning Objective	• To know the basic concepts in pharmaceutical industry • To understand drug development, approval process and manufacturing of biopharmaceuticals. • To know the steps involved in drug discovery process

COURSE OUTCOMES:

After completion of this course, student would be able to

CO1: Understand the comprehensive (or high throughput) measurements of biological systems. K2
CO2: Know the details on the factors involved in Biological System Design. K1
CO3: Understand the details about the systems biology tools: E-Cell and V-Cell. K2
CO4: Know the networking of genes and protein interaction networks. K1
CO5: Relate the engineering principles in Synthetic Biology and its applications. K3

UNIT -I INTRODUCTION AND BIOLOGICAL NETWORKS

Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems - Introduction to Biological Networks and Basic Concepts – Metabolic, Signaling and Regulatory networks - Why build and study models? - Characterizing dynamic states - Formulating and studying dynamic network models - Properties of dynamic states - Network structure versus dynamics

UNIT- II STANDARD MODELS AND APPROACHES IN SYSTEMS BIOLOGY

Metabolism- enzyme kinetics and thermodynamics- Michaelis-Menten Kinetics - metabolic networks- metabolic control analysis - Signal transduction- introduction- function and structures-

interactions- structural components - signaling selected biological processes - mathematical models - prediction of biological systems.

UNIT -III E-CELL PROJECT

E-CELL: Organization - History - Research group - modeling methods – formalism - techniques numerical simulation algorithm-mathematical analysis methods-software environment-projects models-applications chemotaxis - molecular clock-circadian rhythms-oxidation stress-multi-enzyme systems.

UNIT- IV SYSTEMS BIOLOGY SOFTWARE

Systems biology software project: About the project-model inter change-code use-bio-models-online services-SBML Layout viewer-SBML validation-simulation translator-model repository-SBW broker - Jurnac-J-designer- BioSpice – BioUMC - CellDesigner – Cytoscape - Dizzy-Oscillator- Virtual cell - virtual rice project.

UNIT -V INTRODUCTION TO SYNTHETIC BIOLOGY

Introduction – Definition – Synthetic Biology versus Systems Biology - Synthesis and Engineering Tools - DNA Synthesis - Protein Engineering - Pathway Engineering - Genome Engineering - Computational and Theoretical Tools – Genomics, Proteomics and Metabolomics Tools - Applications in Synthetic Biology – Molecular, Pathway and Whole Cell Levels - Challenges and Future Perspectives.

REFERENCES:

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press,2001.
2. Bernhard Ø. Palsson, Systems Biology – Simulation of Dynamic Network States, Cambridge Univ. Press, UK,2011.
3. E.Klipp, et al. Systems Biology in Practice, Wiley-VCH, Weinheim,2005.
4. Huimin Zhao (Ed.), Synthetic Biology: Tools and Applications, Academic Press, Elsevier, USA,2013.
5. Arthur M. Lesk, Introduction to Bioinformatics 2nd Edition, Oxford University Press, New Delhi,2005.

6. Jing Liang, Yunzi Luo, and Huimin Zhao, Synthetic biology:

E-book Links:

1. www.systems-biology.org/
2. https://www.sysbiol.cam.ac.uk/
3. https://www.systemsbiology.org/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	M	S	S	S	M	S	S	S	M	S	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	M
CO3	S	M	S	S	S	S	M	S	S	S	M	S	M
CO4	M	M	S	S	S	S	S	S	S	S	M	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark