Department of BIOTECHNOLOGY

School of Biological Sciences

Curriculum Framework

M.Sc. Biotechnology

Based on National Education Policy- 2020

Date of BoS:…….

Doctor Harisingh Gour Vishwavidyalaya
(A Central University)
Sagar-Madhya Pradesh-470003

About the Department:

The Department of Biotechnology was established in 2001-02 with UGC approval. The Department acquired an independent status in 2009 upon the up gradation of the University to Central University. The Department took a new shape in the year 2013 when the appointed faculty established fully functional research laboratories and sophisticated instruments were installed. The Department is a full-fledged independent unit under the School of Biological Sciences. Currently, the department has two faculty members specialized in Genetic Engineering and Plant Biotechnology, Nanotechnology, Molecular Virology, Bacteriology, Proteomics and Genomics. The Department is well equipped to impart Master and PhD advanced education and training. The Department faculty adopts advance pedagogy techniques such as flip learning and laboratory based teaching.

The Department has published significant number of publications in the leading national and international peer reviewed scientific journals. The Department regularly organizes several hands-on workshops, national and international conferences and special lectures. At the Department of Biotechnology research is being pursued in both basic and applied areas of Biotechnology. The Departmental is inclined towards inter disciplinary research; faculty members in the Department have forged active national & international collaborations. The Departmental faculties have secured funding various funding agencies of UGC, DST, DBT, etc.

During the COVID-19 pandemic the Department quickly adapted to the online teaching mode using various ICT tools, online classroom platforms and other resources to continue the teaching and learning process. This ensured that students did not suffer any academic loss.

Vision:

The Department of Biotechnology foresees itself to emerge as a Department of national and international repute through its education and research. The Department aspires to make seminal contribution to health and food security of the society. We aim to become the center of innovative and cutting edge research. One of the important objectives of the Department is to cultivate distinguished future academicians and scientists. It is our endeavor to become a model of public private partnership.

Mission:

The Department is developing robust research environment in the areas of plant genetic engineering and physiology; and infectious disease biology. We are striving to secure intramural and extramural funding to foster research in the Department. We pursue to enhance pedagogy to achieve higher objectives of teaching and learning. The focus is to cater to the need of efficient human resource of the country by producing skilled biotechnology professions.

Curriculum Framework based on National Education Policy-2020

NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader. In the same spirit, we at Department of

Biotechnology have developed a curriculum framework to encompass the goals of NEP 2020. To this end, we have incorporated choice of subject/disciplines of study, creating academic pathways having constructive combinations of disciplines for study with multiple entry and exit points as well as focus on **experiential learning** for students by introducing **multidisciplinary and skill enhancement courses** and actual Hand's on training in the recent and trending aspects of Biotechnology.

M.Sc. Biotechnology: 04 Semester Course as per NEP 2020
Curriculum: 2022 Onwards

A) General:

1. Name of the Program: **M. Sc. Biotechnology**

2. Duration of the Program:

a) Minimum duration: 2 years
b) Maximum duration: 4 years

3. Structure of the Program:

a) Number of Major courses: 09 (54 credits)

b) Skill Enhancement courses: 03 (26 credits)

c) Compulsory Skill enhancement course in IV semester (14 Credit)

4. Scheme of Examination:

a) Mid Sem I Examination: 20 marks (As per University Norms)

b) Mid Sem II examination- Internal Assessment: 20 marks (As per University Norms)

* To appear in the End Semester Examination the student must appear in all the Mid Semester Examinations.

End semester Examination for Laboratory courses is of 60 Marks.

Mode of Examination for all Skill Enhancement Courses (SEC) is Internal.

a) Assessment of performance in the experiment : 40 marks

b) Viva-voce of experiment : 10 marks

c) Maintenance of lab records and attendance : 10 Marks

Biotechnology: M. Sc. Program Structure and Scheme (NEP 2020)

Semester		Paper Code	Title of the Paper	Credits			
				L	T	P	C
I	Discipline Specific: Major-1	BIT-DSM-121	Cell Biology	4	0	0	4
		BIT-DSM-122	Laboratory -1	0	0	2	2
	Discipline Specific: Major-2	BIT-DSM-123	Bioinstrumentation & Bioinformatics	4	0	0	4
		BIT-DSM-124	Laboratory-2	0	0	2	2
	Multi-Disciplinary: Major-3	BIT-MDM-121	Biochemistry and metabolic regulation	4	0	0	4
		BIT-MDM-122	Laboratory-3	0	0	2	2
	Skill Enhancement: Course (SEC)	BIT-SEC-121	Basics of Research Methodology	2	0	0	2
		BIT-SEC-122	Tools for Scientific Communication and presentation	0	0	2	2
				Total Credit = **22**			
II	Discipline Specific: Major-1	BIT-DSM 221	Genetics & Molecular Biology	4	0	0	4
		BIT-DSM 222	Laboratory-4	0	0	2	2
	Discipline Specific: Major-2	BIT-DSM 223	Animal & Plant Biotechnology	4	0	0	4
		BIT-DSM 224	Laboratory-5	0	0	2	2
	Multi-Disciplinary: Major-3	BIT-MDM 221	Microbial Technology	4	0	0	4
		BIT-MDM 222	Laboratory-6	0	0	2	2
	Skill Enhancement: Course (SEC)	BIT-SEC 221	Lab based Project Work	0	0	4	4
				=22			
				Exit with PG Diploma			
III	Discipline Specific: Major-1	BIT-DSM 321		4	0	0	4
		BIT-DSM 322		0	0	2	2
	Discipline Specific: Major-2	BIT-DSM 323		4	0	0	4
		BIT-DSM 324		0	0	2	2

	Multi-Disciplinary: Major-3	BIT-MDM 321		**0**	**0**	**4**	**4**
		BIT-MDM 322		**0**	**0**	**2**	**2**
	Skill Enhancement: Course (SEC)	BIT-SEC 321		**2**	**0**	**0**	**2**
		BIT-SEC 322		**0**	**0**	**2**	**2**
				Total Credit= 22			
IV	Skill Enhancement Course (SEC)	BIT-SEC 421		**14 Credits**			

Total Credits

I +II+III+IV

22+22+22+14= 80 Credit

L: Lecture **P:** Practical **T:** Tutorial **C:** Credits

Semester-I

Discipline Specific: Major-1

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-DSM -121	Cell Biology	Mid Sem 40 End Sem 60	04

Objectives: The objectives of this course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes.

Outcome: Students will learn fundamental aspects in biological phenomenon and basic of cell structure and functions along with basic techniques.

UNIT	Content	Contact Hours
I	Structure of Prokaryotic and Eukaryotic cell, Plasma membrane, Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Peroxisomes, Vacuoles Endoplasmic Reticulum, Plastids and Chloroplast. Cell motility- cilia and flagella.	12
II	Structure and organization of cell skeleton; Microfilaments and Microtubule-structure and assembly, actins, myosin muscle contraction, Cell matrix interactions, Adhesion junction, Tight junctions, Gap junctions	12
III	Membrane transport; Ways to move molecules across membranes; carrier proteins, Ion channels; Nuclear transport (export and import), transport across mitochondria and chloroplasts; exocytosis & endocytosis, protein modification in the secretory pathway.	12
IV	Molecular mechanism of signal transduction, Integration of signals, second messengers; G Protein Signaling	12
V	Cell cycle- steps and control of cell cycle; Cell cycle and cancer; Details of mitosis and meiosis cell division, Cellular death and regulation: different modes of cell death and their regulation (apoptosis, necrosis, autophagy, senescence etc.).	12

Essential Readings:

1) B. Alberts *et. al*., Molecular Biology of Cell, Garland Science, 2014, 6th edition
2) H. Lodish *et al*., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
3) E. D. P De Robertis, Cell and Molecular biology, Wolter Kluwer, 2011.
4) G. Karp, Cell Biology, Wiley, 2013, 7th edition
5) Bakers, The world of the Cell, Jeff Hardin, Pearson Education, 8th

Suggested Reading:

1) S. F. Gillbert, Developmental Biology, Sinauer, 2016, 11th edition
2) B. Lewin, Cells, Jones & Bartlett Pub, 2006, 1st edition

Semester-I
Discipline Specific: Major-1

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-DSM -122	Laboratory-1	Mid Sem 40 End Sem 60	02

Objectives: To provide hands on training and laboratory practice on various aspects of Cell biology techniques.

Outcome: Students would be able to analyse and understand various techniques to observe the cell structure and function at laboratory level.

List of Practical

1. Cell disruption using grinding/ homogenizing and microscopic observation.
2. Sub cellular fractionation of tissues and microscopic visualization
3. Microscopic examination of cell division and stages (Slide visualization).
4. Qualitative estimation of cell/ components by histo-chemical staining.
5. Isolation and separation of cell organelles and their assay.
6. Squash preparation for chromosome staining for mitosis (onion root tip).

Essential Readings:

1) J. Davey and J.M. Lord, Essential Cell Biology Vol 1: Cell Structure (A practical approach), Oxford University Press, 2003
2) J. Davey and J.M. Lord, Essential Cell Biology Vol 2: Cell Function (A practical approach), Oxford University Press, 2003

Suggested Readings:

1) J. E. Celis, Cell Biology: A laboratory handbook (Vol 1-4), Elsevier Academic Press, 2008, 3rd edition
2) E. Goldman and L. H. Green, Practical Handbook of Microbiology, CRC press, 2015, 3rd edition

Semester-I
Discipline Specific: Major-2

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DSM-123	Bioinstrumentation & Bioinformatics	Mid Sem 40 End Sem 60	04

Objectives: To provide students with the theory and practical experience of various instruments used in the Biotechnology and also the use of common computational tools and databases which facilitate investigation of molecular biology.

Outcomes: The student would be able to operate the sophisticated instruments and use online bioinformatic tools.

UNIT	Content	Contact Hours
I	Microscopy: Light and compound microscopy, confocal microscopy, electron microscopy; Principles of colorimetry and UV-Vis spectrophotometry, Mass spectrometry	12
II	Principle of centrifugation, preparative and analytical centrifugation, Principle of Chromatography, planar and column chromatography, paper chromatography, Thin layer chromatography, High performance liquid chromatography and Gas Chromatography, Electrophoresis techniques: Principle and application	12
III	Molecular biology techniques: Southern, Northern and Western blotting-principle and applications; Principle of DNA sequencing: Gilbert chemical degradation method, Sanger's dideoxy chain termination method	12
IV	Introduction of biostatistics. Types of data, types of variables, tabulation of data and its graphical representation. Measures of central tendency and dispersion: Mean median, model range, standard deviation and variance, various methods of mean comparison (T-test, ANNOVA)	12
V	Tools for sequence alignment using NCBI database; Alignment of pairs of sequence; Alignment of multiple sequences; Primer designing tools and characteristics of primers; Accessing and retrieving genome project information for microbes, plants and animals from database, molecular docking	12

Essential Reading:

1) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013.
2) B Sivasankar, Instrumental Methods of Analysis, Oxford University Press, 2012
3) Sharma, Munjal and Shanker, Text book of Bioinformatics: Rastogi publisher, India 2017
4) Attood, Parry-Smith and Phukan, Introduction to Bioinformatics, Fourth edition, Pearson Publisher

Suggested Reading:

1) B. Williams and S. Sawyer, using information technology: a practical introduction to computers & communications, McGraw Hill Education, 2005, 6th edition

Semester-I
Discipline Specific: Major-2

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DSM-124	Laboratory-2	Mid Sem 40 End Sem 60	02

Objectives: To provide students with practical experience of various instruments used in the Biotechnology and also the use of common computational tools and databases which facilitate investigation of molecular biology.
Outcomes: The student would be able to operate the sophisticated instruments and use online bioinformatic tools.

List of Practical:

1. Operating system commands of computer.
2. Sequence analysis, BLAST, NCBI search methods
3. Separation by Chromatography (TLC/ paper Chromatography).
4. Spectrophotometric analysis of bacterial culture and growth analysis.
5. Hands on training on DNA sequencing method
6. Experimental demonstration of TEM, SEM and Confocal Microscopy

Essential Reading:

1) K. M. Mooring, Computer Fundamentals: A Practical Guide, Kendall Hunt Pub Co, 2009
2) J. J. Parsons and D. Oja, Practical Microsoft Office 2013, South-Western College Publishing, 2013
3) M. Agostino, Practical Bioinformatics, Garland Sciences, 2012, 1st edition
4) M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition

Suggested Reading:

1) J. Pevsner, Bioinformatics and Functional Genomics, Wiley-Backwell, 2015, 3rd edition
2) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013, 7th edition

Semester-I
Multi-disciplinary Major-3

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-MDM -121	Biochemistry & and metabolic regulation	Mid Sem 40 End Sem 60	04

Objectives: To build upon undergraduate level knowledge of biochemical principles with specific emphasis on different metabolic pathways.
Outcome: Students would be able to analyse and interpret various biomolecules, pathways of the cell and their significance in metabolism.

UNIT	Content	Contact Hours
I	Chemical basis of life: Water – properties of water, essential role of water for life on earth pH, buffer, Basic concept of thermodynamics of living system, Enthalpy, Entropy, Free energy, Thermodynamic rules,	12
II	Carbohydrates-classification and reactions. Carbohydrates metabolism, Lipids- classification, structure and functions. Glycolipids and phospholipids, structure and function plasma membrane	12
III	Amino acids and peptides- classification, Proteins structure and classification: Primary, secondary, tertiary and quaternary structures of protein. Concept of protein folding & denaturation; Structural details of Nucleic acids (DNA and RNA),	12
IV	Enzymes: Structure and classification. Enzymes as biological catalysts: Isozymes, Vitamins and cofactors; Ribozymes: structure and function; Mechanism of enzyme action, Enzyme inhibition: competitive, non-competitive, allosteric inhibition.	12
V	Glycolysis & Citric acid cycle, entry to citric acid cycle, Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F1-F0 ATP Synthase; Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane, Z scheme of light reaction	12

Essential Readings:
1) D. Voet and J. G. Voet, Biochemistry, J. Wiley & Sons, 2011, 4th edition
2) L. Pauling, General Chemistry, www.bnpublishing.com, 2011
3) D. L. Nelson and M. Cox, Lehninger Principles of Biochemistry, WH Freeman, 2017, 7th edition
4) J. M. Berg, et. al., Biochemistry, WH Freeman, 2015, 8th edition
Suggested Readings:
1) H. Lodish, et.al., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
2) E. D. P De Robertis, Cell and Molecular biology, Wolter Kluwer, 2011.

Semester-I

Multi-disciplinary Major-3

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-MDM - 122	Laboratory-3	Mid Sem 40 End Sem 60	02

Objective: To introduce and train students in various techniques used for biochemical analysis of biomolecules.

Outcomes: The students would be able to analyze biomolecules qualitatively and quantitatively.

List of Practical:

1. Preparation of different buffers used in biochemical reactions and its pH measurement
2. Isolation and quantification of protein by spectrophotometric method.
3. Qualitative reactions of various amino acids including diagnostic tests
4. Qualitative reactions of various carbohydrates including diagnostic tests
5. Method of isolation of plant/animal genomic DNA & quantification.
6. Method of isolation of RNA & quantification

Essential Reading:

1) H. Miller, et al., Molecular Biology Techniques, Elsevier Academic Press, 2011, 3rd edition
2) W. Ream and K. G. Field, Molecular Biology Techniques: An Intensive Laboratory Course, Elsevirer Academic Press, 1998, 1st edition
3) David Plummer, An Introduction to Practical Biochemistry, Tata McGraw Hill Education; 3rd edition (2006)

Suggested Reading:

1) M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cols Spring Harbor Laboratory Press, 2012, 4th edition

Semester-I
Skill Enhancement: Course (SEC)

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-SEC -121	Basics of Research Methodology	Mid Sem 40 End Sem 60	02

Objectives: Students will be able to understand the techniques for scientific literature searching and scientific writing and presentation as well as develop scientific communication skills.
Outcomes: The students should be able to read, interpret and present scientific data.

UNIT	Content	Contact Hours
I	Empirical science, scientific methods and best laboratory practices; Choosing a mentor, lab and research question; maintaining a lab notebook; Computing skills for scientific research: search engines and their mechanism of searching; types and importance of search engines in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness	6
II	Scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism: software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts	6
III	Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating, barriers to effective communication, PowerPoint Presentation skills – formal presentation skills; defending interrogation of science	6
IV	Publishing scientific papers - peer review process and problems, recent developments such as open access and blind review; characteristics of effective technical communication; ethical issues, scientific misconduct.	6
V	Dissertation/ Thesis writing skill. Article writing, Scientific poster preparation & presentation; participating in group discussions; Fellowship/scholarship application writing.	6

Mode of End semester examination: Internal only
Essential Reading:
1. Valiela, I. (2001). *Doing Science: Design, Analysis, and Communication of Scientific Research.* Oxford: Oxford University Press.
2. *On Being a Scientist: a Guide to Responsible Conduct in Research.* (2009). Washington, D.C.: National Academies Press.
3. Gopen, G. D., & Smith, J. A. *The Science of Scientific Writing*. American Scientist, 78 (Nov-Dec 1990), 550-558.
4. J. Giba and R. Ribes, Preparing and Delivering Scientific Presentations: A Complete Guide for International Medical Scientists, Springer, 2011
Suggested Readings:
Gopen, G. D., & Smith, J. A. *The Science of Scientific Writing*. American Scientist, 78 (Nov-Dec 1990), 550-558.
Mohan, K., & Singh, N. P. (2010). *Speaking English Effectively*. Delhi: Macmillan India

Semester-I
Skill Enhancement: Course (SEC)

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-SEC -122	Tools for Scientific Communication and presentation	Mid Sem 40 End Sem 60	02

Objectives: Students will be able to understand the techniques for scientific literature searching and scientific writing and presentation as well as develop scientific communication skills.

Outcomes: The students should be able to read, interpret and present scientific data.

List of Practical

1. PowerPoint preparation based on research paper
2. Learning effective PPT presentation
3. Plagiarism analysis of write-up using available software
4. Making of poster and presentation
5. Training on scientific writing based upon give topics
6. Communication while group discussion/ interview

Mode of End semester examination: Internal only

Essential Reading:

1. Valiela, I. (2001). *Doing Science: Design, Analysis, and Communication of Scientific Research.* Oxford: Oxford University Press.
2. *On Being a Scientist: a Guide to Responsible Conduct in Research.* (2009). Washington, D.C.: National Academies Press.
3. Gopen, G. D., & Smith, J. A. *The Science of Scientific Writing*. American Scientist, Nov-Dec 1990), 550-558
4. J. Giba and R. Ribes, Preparing and Delivering Scientific Presentations: A Complete Guide for International Medical Scientists, Springer, 2011

Suggested Readings:

Gopen, G. D., & Smith, J. A. *The Science of Scientific Writing*. American Scientist, Nov-Dec 1990), 550-558.
Mohan, K., & Singh, N. P. (2010). *Speaking English Effectively*. Delhi: Macmillan India
M. Davis, et al., Scientific Papers and Presentations, Elsevier Academic Press, 2012, 3rd edition

Semester-II
Discipline Specific: Major 1

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DCM-221	Genetics & Molecular Biology	Mid Sem 40 End Sem 60	04

Objectives: To teach students the fundamentals of genetics, central dogma, gene expression and regulation.
Outcomes: The students would be able to understand each step of gene expression and regulation.

UNIT	Content	Contact Hours
I	History of genetics, Mendelian principles, dominance, codominance and incomplete dominance, concept of gene and genome, monohybrid and dihybrid crosses, Concept of alleles and gene	12
II	Molecular structure of DNA, Chromosome organization, DNA Replication: Prokaryotic and Eukaryotic DNA replication, enzymes and accessory proteins involved in DNA replication. DNA damage and repair	12
III	Transcription: Prokaryotic and Eukaryotic transcription, RNA polymerase. Transcription factors, regulatory elements and mechanisms of transcriptional regulation, transcription termination; Posttranscriptional modification, Operon concept in prokaryotes with examples	12
IV	Universal genetic codes, degeneracy of codons, Wobble Hypothesis; Translation: Prokaryotic and Eukaryotic translation, translation machinery, mechanisms of initiation, elongation and termination, regulation of translation.	12
V	Gene silencing approaches: co-suppression, antisense RNA techniques, transpositions- transposable genetic elements in prokaryotes and eukaryotes, role of transposons in gene expression	12

Essential Reading:
1) J. E. Kerb's, Lewin's Gene XII , Jones and Barlett.
2) H. Lodish, et.al., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
3) G. Karp, Cell Biology, Wiley, 2013, 7th edition
4) D. Voet and J. G. Voet, Biochemistry, J. Wiley & Sons, 2011, 4th edition
5) P. J. Russel, Genetics: A Molecular Approach, Pearson Education, 3rd Edition.
6) D. P. Snustad and M. J. Simmons, Principles of Genetics, John Wiley, 5th Ed.
Suggested Reading:
1) J. M. Berg, et. al., Biochemistry, WH Freeman, 2015, 8th edition
2) B. Alberts and A, Johnson, Molecular Biology of Cell, Garland Sciences, 2014, 2014.

Semester-II
Discipline Specific: Major 1

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DCM-222	Laboratory-4	Mid Sem 40 End Sem 60	02

Objective: To train students in various basic techniques of molecular biology.

Outcome: The student should be able to isolate, manipulate, visualize and quantify nucleic acids and proteins.

List of Practical:

1. Plasmid DNA isolation and separation on gel.
2. Isolation of genomic DNA from plants/ insect/ animal cell.
3. Electrophoresis of DNA- linear, circular and super coiled plasmid.
4. Restriction digestion of genomic DNA.
5. Isolation of RNA and separation on denaturing gel
6. Amplification of DNA using PCR technique

Essential Reading:

1) T. Brown, Essential Molecular Biology: Volume I: (Practical Approach Series), Oxford University Press, 2000, 2nd edition
2) T. Brown, Essential Molecular Biology: Volume II: (Practical Approach Series), Oxford University Press, 2000, 2nd edition

Suggested Reading:

1) M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cols Spring Harbor Laboratory Press, 2012, 4th edition

Semester-II
Discipline Specific: Major 2

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DSM-223	Animal & Plant Biotechnology	Mid Sem 40 End Sem 60	04

Objective: To teach students the fundamentals of animal & plant biotechnology and their applications with various approaches to understand animal biotechnology, plant and animal genomics, genetic transformation and molecular breeding of plants and animals.
Outcomes: The students should be able to analyze and comprehend the requirement and principles of plant and animal cell and culture techniques.

UNIT	Content	Contact Hours
I	Plant Tissue Culture historical perspective; media preparation – nutrients and plant hormones; Principle of tissue Culture; Major instruments requirement of plant tissue culture, Factors affecting tissue culture, micropropagation and callus culture, Organogenesis, Somatic embryogenesis; protoplast isolation and culture, Applications of tissue culture in germplasm conservation and cryopreservation	12
II	Transgenic plants: Mechanism of genetic transformation Agrobacterium-mediated gene delivery; direct gene transfer in plant- electroporation, particle bombardment and alternative methods. Importance of transgenic plants, Pros and cons of transgenic plants, Regulation of GE plants	12
III	Animal cell culture: brief history of animal cell culture; cell culture media, reagents & instruments; Balanced Salt Solutions (BSS), Culture medium. Chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide, serum and supplements in cell culture. Culture of mammalian tissues, primary culture, secondary culture, cell lines maintenance	12
IV	Organ culture, Whole embryo culture, *In-vitro* fertilization and embryo transfer, Animal cloning: Methods and applications. Transgenic animals: methods and their commercial applications	12
V	Production of monoclonal antibodies, Bioreactors for large scale culture of animal cells, DNA based molecular markers for genetic mapping, Intellectual property management, trademark and patent	12

Essential Reading:
R. I. Freshney, Culture of Animal Cells A Manual of Basic Technique and Specialized Applications, Wiley-Blackwell, 2016, 7th edition
Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
An Introduction to Plant Tissue Culture, M.K. Razdan, Oxford and IBH Publishing
J. Hammond, Plant Biotechnology: New products and applications, Springer, 2000
Suggested Reading:

M. M. Ranga, Animal Biotechnology, Agrobios India, 2007, 3rd edition
Plant Tissue Culture: Theory & Practice, S.S. Bhojwani and M.K. Razdan, Elsevier Health Sciences
M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition

Semester-II
Discipline Specific: Major 2

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-DSM-224	Laboratory-5	Mid Sem 40 End Sem 60	02

Objective: To introduce and provide hands on training to the students in various plant and animal cell culture techniques used for genetic engineering.
Outcomes: The students would be able to analyze perform culture of plant and animal cells.

Practical:

1. Preparation, sterilization and pouring of MS nutrient media for plant tissue culture
2. Induction of callus using the leaf explants
3. Demonstration of *Agrobacterium* mediated transformation
4. Preparation of media & Surface sterilization for animal cell culture
5. Culture and maintenance of animal cell lines
6. Experimental demonstration of available molecular marker technique

Essential Reading:
1) K. Lindsey, Plant tissue culture manual, Springer, 2007
2) J. S. Vennison, Laboratory manual for Genetic Engineering, PHI Learning, 2010, 1st edition

Suggested Reading:
1) M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition
2) R. H. Smith, Plant Tissue Culture: Techniques and Experiments, Elsevier Academic Press, 2012, 3rd edition

Semester-II
Multi Disciplinary: Major 3

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	II	BIT-MDM -221	Microbial Technology	Mid Sem 40 End Sem 60	04

Objectives: The students will understand the significance and importance of microorganisms. The course is designed to introduce students to the basics of microbial growth, nutrition, structure and classification and importance of microbes in human life.
Outcomes: The student would be able to: articulate the importance of microbes in various aspects of life and environment.

UNIT	Contents	Contact Hours
I	The history and development of Microbiology, contribution of Leeuwenhoek, Pasture, Jenner, Koch; Morphology and structure of bacteria, Berger's manual classification of microorganisms, three domain system, Scientific nomenclature, phylogenic and taxonomic hierarchy.	12
II	Principles of microbial growth: Liebig's Law and Shelfords law; Microbial nutrition and Microbial growth: Culture media (Synthetic and complex), batch and continuous culture, Growth curve of bacteria. Factors affecting microbial growth; Staining: Gram's staining, Acid fast staining.	12
III	Bacteriology: Classification, Characteristic features and importance. Characteristics of methanobacteria, halophiles, thermoacidophiles. Microbial diversity of Eubacteria: Structure-function, properties and economic importance of Gram Positive (Actinomycetes) and Gram negative bacteria Spirochetes, Chlamydia, Rickettsia and Mycoplasma.	12
IV	Virology: General characteristics structure of and classification of virus ultra structure TMV Lytic and Lysogenic cycle in bacteriophoges; Life cycle of HIV and Herpes simplex virus. Antimicrobial agents, Antibiotics.	12
V	Development and scope of industrial microbiology, microorganisms used in industrial microbiology, Screening for economically important cultures (Primary and Secondary screening); Microbiology of fermented food, probiotics, major products of industrial microbiology.	12

Essential Readings:
1) J. Willey, et. al., Prescott's Microbiology, McGraw Hill Education, 2011, 8th edition
2) M. J. Pelczar, et. al., Microbiology, McGraw Hill Education, 2001, 5th edition
3) R. Ananthanarayan, A & P Textbook of Microbiology, Orient Blackswan, 2013, 9th edition
4) G. J. Tortora, et. al., Microbiology, Pearson Education India, 2016, 11th edition
Suggested Readings:
D. Anderson, Nester's Microbiology: A Human Prespective, McGraw Hill Education, 2016, 8th edition

Semester-II

Multi Disciplinary: Major 3

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	I	BIT-MDM - 124	Laboratory-6	Mid Sem 40 End Sem 60	02

Objectives: To provide hands on training and laboratory practice on various aspects of microbial techniques.
Outcome: Students would be able to demonstrate the technique of bacterial chandelling, growth and application at laboratory level.

List of Practical

1. Sterilization of media and instruments.
2. Isolation of bacteria from soil and its qualitative characterization.
3. Gram's staining of bacteria.
4. Bacterial growth curve and its analysis.
5. Demonstration of bacterial fermentation and visualization of bacterial strains
6. Antibiotic sensitivity test

Essential Readings:

1. J. P. Harley, Laboratory exercises in Microbiology, McGraw-Hill Higher Education, 2004, 6th edition
2. Industrial Microbiology by Casida, L.E. McGraw-Hill Higher Education, 2008
3. Industrial Microbiology by Patel, A.H. Elsevier Academic Press, 2003

Suggested Readings:

1) J. E. Celis, Cell Biology: A laboratory handbook (Vol 1-4), Elsevier Academic Press, 2008, 3rd edition
2) E. Goldman and L. H. Green, Practical Handbook of Microbiology, CRC press, 2015, 3rd edition

Semester-II
Skill Enhancement Course

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
M.Sc	Biotechnology	III	BIT-SEC-321	Lab Based project work	Periodic assessment: 40 Evaluation of project report/presentation: 60	04

The purpose of the course is to improve the student's ability to apply basic concepts and knowledge through laboratory based project work. The course will comprise of a mini project to solve or address a simple question or to improve/develop expertise of a particular technique through hands on experiments and generate data. The data will be interpreted and submitted as a project report and also be presented.

Evaluation:

a) First periodic assessment of the progress after 08 weeks : 20 marks
b) Second periodic assessment of the progress after 12 weeks : 20 marks
c) End semester examination will consist of
    i) Evaluation of project report/presentation : 50 marks
    ii) Viva-Voce of the project : 10 marks

Mode of end semester examination: Internal only