



**JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY,
JAIPUR**

**Faculty of Agriculture and Veterinary Science
Department of Food and Biotechnology**

SYLLABUS

**MASTER OF SCIENCE IN
BIOTECHNOLOGY
(M. Sc. BT)**

SESSION – 2022-23

DURATION – 2 YEARS

**SYLLABUS FOR:
1-4 SEM**



PROGRAM DETAIL

Name of Program	-	Master of Science (M.Sc.)
Program Code	-	M.Sc. BT
Mode of Program	-	Semester
Duration of Program	-	2yrs/ 4Semester
Total Credits of Program	-	91
Curriculum Type and Medium Choice	-	English

Program Outcomes

This program give opportunity to understand students molecular basis for the changes occurring in living cells. It uses the methods of biochemistry, molecular biology and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact and communicate within and between cells and organs

Specific Program Outcomes

To provide facility for the students to gain sufficient practical knowledge in the subject with properly designed experiments. Explore new areas of research in all the branches of biotechnology in addition to interdisciplinary fields.



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SYLLABUS DETAIL

I SEMESTER

S. No.	Credit	Name of Course
1	3	Microbiology
2	1	Microbiology Lab
3	3	Cell Biology
4	1	Cell Biology Lab
5	3	Immunology
6	1	Immunology Lab
7	3	Statistical Methods
8	1	Statistical Methods Lab
9	3	Analytical Chemistry
10	1	Analytical Chemistry Lab
	2	Biosafety Regulatory Affairs
Total	22	

II SEMESTER

S. No.	Credit	Name of Course
1	4	Research Methodology
2	3	Metabolism and Bioenergetics
3	1	Metabolism and Bioenergetics Lab
4	3	Plant Biotechnology
5	1	Plant Biotechnology Lab
6	3	Molecular Biology
7	1	Molecular Biology Lab
8	3	Industrial Biotechnology
9	1	Industrial Biotechnology Lab
10	2	Structural and Functional Genomics
11	1	Structural and Functional Genomics lab
12	1	Industrial Visit
Total	24	



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III SEMESTER

S. No.	Credit	Name of Course
1	3	Molecular Enzymology
2	1	Molecular Enzymology Lab
3	3	Cellular and Tissue Engineering
4	3	Animal Biotechnology
5	1	Animal Biotechnology Lab
6	3	Bioinformatics
7	1	Bioinformatics Lab
8	3	Genetic Engineering
9	1	Genetic Engineering Lab
10	2	Pre Dissertation Training (60 Days) (After II Sem during summer vacation)
Total	22	

IV SEMESTER

S. No.	Credit	Name of Course
1	25	Dissertation/ New Product Development (NPD)
Total	25	



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I Semester

Course Name: Microbiology:

Total- 4 (3T+1P)

Course Outcome: This course develops the concepts of apply the knowledge of basic concepts, fundamental principles and scientific theories and processes related to the fields of life sciences with their relevance in day-to-day life.

UNIT-I (Diversity and classification of microorganisms)

Theory (1 credits)

Introduction to microbial kingdom- - An overview. Morphological details of prokaryotic and eukaryotic microbes.i.e. bacteria, fungi, yeasts, protists, streptomycetes, Microbial nutrition, physiology and life cycles.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	Preparation of culture media (i) Arrange all required compounds (ii) Calculate as per required amount of media, weighing and autoclaving	Practical

UNIT-II (Microscopy and Sterilization)

Theory (1)

Methods in microscopy and staining procedures, sterilization techniques, kinetics of sterilization, control of microbes by physical and chemical means.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	Study of different types of streaking methods. (i) preparation of media (ii) Streaking and incubation (iii) Observation of results	Practical

UNIT-III (Microbial growth and measurement)

Theory (1)

Microbial growth- Kinetics of growth, methods of growth measurement. Batch and continuous cultivation techniques, chemostat and turbidostat techniques.

Practicals (0.5 credit)

Sr. no.	Name of practical	Nature
1	Antibacterial activity by disc diffusion method (iv) preparation of media (v) Spreading and incubation (vi) Observation of results	Practical

Recommended Text Books:

1. Microbiology by Pelczar- M.J.Chan ECS & Krieg NR-Tata Mcgraw Hill,
2. Microbiology- Prescott.

Reference Books:

3. General Microbiology by Brock.
4. Microbial Physiology 4th ed. By AlberG.Moat& John W.FosterWileyLiss.
5. Foundation in Microbiology-by Talaro K, Talaro A, CassidaPelzar and Reid



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6. W.C.Brown Pub.
7. General Microbiology by R.Y.Stanier

References/Correlation with Ancient Indian Literature:

1. Rigveda1/191/9<http://www.hinduismfacts.org/hindu-scriptures-and-holy-books/rigveda/>
2. Rasa-Jala-Nidhi or Ocean of Indian chemistry and alchemy/vol.vIEd.1984/AvaniPrakashan,Ahmedabad,India;CharakSamhita<https://onlinelibrary.wiley.com/doi/abs/10.1002/jctb.5000494453>
3. AvS'5/23/5;Medicine in the Veda Ikenneth Zyskhttps://archive.org/stream/in.ernet.dli.2015.201547/2015.201547.Medicine-In_djvu.txt

Course Name: Cell Biology: Total- 4 (3T+1P)

Course Outcome:This course develops the concepts of Cell biology is about the cell, cell division and its functions. Every living species are composed of a cell. The human body comprises around a billion to trillion cells, which are mainly involved in different specialized functions.

UNIT-I(Study of cell and cell signaling)

Theory (1 credits)

Prokaryotic and eukaryotic cell organizations; intracellular compartments and transport: membrane bound organelles, secretory pathways, endocytosis pathways, phagocytosis and pinocytosis; cell communication/signaling

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	To isolate mitochondria from given plant sample	Practical

UNIT-II(Cytoskeleton)

Theory (1 credits)

Microtubule polymerization dynamics, dynamic instability and polymerization dynamics, cell crawling, contractile structures, actomyosin complex, muscle contraction, neurons, axons, dendrites, growth cone.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	To study permanent slides of mitosis	Practical

UNIT-III(Study of cell cycle and chromosome)

Theory (1 credits)

The structure of eukaryotic chromosome; Overview of the cell cycle, mitosis, meiosis, and cell cycle control: metaphase/anaphase transition, control of cell numbers in multi-cellular organisms and programmed cell death, cancer, anti-mitotic drugs; cytoskeletal diseases: microtubule dependent drugs.

Practicals (0.5 credit)

Sr. no.	Name of practical	Nature
1	To study meiosis in onion flower bud	Practical

Text Books:

Cell biology C.B. Panwar

Alberts et al., Molecular Biology of the Cell, Garland Publishing, Inc., 2002, 4th ed.



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Suggested Readings:

Lodish et al., Molecular Cell Biology, W.H. Freeman & Company, New York, 2007, 6th edition.

References/Correlation with Ancient Indian Literature:

1. Ganguli, K.M. (1883-1896) "Adi Parva" in The Mahabharata of Krishna-Dwaipayana Vyasa (12 Volumes). Calcutta https://archive.org/stream/TheMahabharataOfKrishna-dwaipayanaVyasa/MahabharataOfVyasa-EnglishTranslationByKMGanguli_djvu.txt
2. Dutt, M.N. (1895) The Mahabharata (Volume 1): Adi Parva. Calcutta: Elysium Press https://www.wikizero.com/en/Adi_Parva
3. Debroy, B. (2010) The Mahabharata, Volume 1. Gurgaon: Penguin Books India, pp xxiii – xxvi https://www.wikizero.com/en/Anushasana_Parva
4. "Book 1: Adi Parva: Jatugriha Parva". Sacred-texts.com. Retrieved 1 September 2010 <https://wikivisually.com/wiki/Mahabharata>

Course Name: Immunology:

Total- 4 (3T+1P)

Course Outcome: It is to develop concepts in role and the underlying mechanisms for the functioning of immunological cells and their interactions. The regulation of molecular synthesis, signalling, immune responses and allied activities of immune system at the molecular level.

UNIT-I (Immunity and Immune system)

Theory (1 credits)

Natural immunity, defensins, pathogen associated recognition motifs, Toll receptors, complement system, applications of complement proteins in rapid clearance of pathogens, acquired immunity: immune cells, antigens haptens, B and T cell epitopes.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	ELISA Test (i) Basic of ELISA (ii) Reagent preparation (iii) Observation after reaction time	Practical

UNIT-II (Antibody and Antigen)

Theory (1 credits)

Antibodies: structure and function, monoclonal antibodies, single chain antibodies, domain antibodies, antigen antibody reactions, genetics of immunoglobulins and antibody diversity, Major Histocompatibility Complex, structure and functions of class I and class II MHC molecules, antigen presentation by MHC and non MHC molecules.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	Radial immunodiffusion (i) Preparation of Slide (ii) Practice (iii) Observation and calculation	Practical



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UNIT-III (Hypersensitivity, Transplantation, Vaccination)

Theory (1 credits)

Cytokines, in vivo regulation of immune responses, B and T cell activations, hypersensitivity, mucosal immunity, introduction to transplantation immunology tolerance, tumor immunology and vaccines

Practicals (0.5 credit)

Sr. no.	Name of practical	Nature
1	RBC count (i) preparation of reagent (ii) Spreading on slide (iii) Observation of results	Practical

Text Books:

- 1 Janes Kuby; Immunology 2nd edition. W.H. Freeman and Company New york (1994).

Suggested Readings:

- 1 M. Roit; Essential Immunology. Blackwell Scientific publication, 1988.
- 2 Immunology by Tizard

References/Correlation with Ancient Indian Literature:

1. Suśruta 600 BC, SS. Sū chaps. 4, 15, 21 edited by Singhal et.al. ChoukhambaSurbharati 2nd edition Varanasi/Delhi, India, 2002 <https://pdfs.semanticscholar.org/68ec/5838cad4c40baf2563699c8e1d2514249fea.pdf>
2. Suśruta 600BC, SS Ci Chap. 27-30 edited by Singhal et al ChoukhambaSurbharati 2nd edition Varanasi/Delhi, India 2002 https://ayushdhara.in/review/pdf/ayush_5218193.pdf
3. Sarangdhara 1300AD, SarandharasamhitaChoukhamba publications Varanasi/Delhi, India <http://www.carakasamhitaonline.com/mediawiki-1.32.1/index.php?title=Rasayana>

Course Name: Statistical Methods

Total- 4 (3T+1P)

UNIT I (Basics of Tabulation of Data & Central Tendency)

Course Outcome: To enable the students to 1. Describe the basic concepts and principles of statistics. 2. Understand the role of statistics and computer applications to conduct research studies. 3. Apply statistical techniques to research data for analyzing. 4. Interpreting the data meaningfully and differentiate between the qualitative and quantitative methods of analysis of data. 5. Suitably apply data reduction strategies and illustrate data using various graphical methods. 6. Use appropriate parametric and non-parametric statistical tests. 7. Draw the conclusions and interpretations from the analysis of data using various statistical software.



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Theory (1 Credits)

Classification and tabulation of data, Frequency distribution, Histogram, Frequency polygon and frequency curve, cumulative frequency curves, Measures of central tendency: mean, median, mode; Measures of dispersion: range, mean deviation, variance and standard deviation.

Practicals: (1 credits)

Sr. no.	Name of practical	Nature
1	To find out Mean	Practical/Practice
2	To find out Median	Practical/Practice
3	To find out Mode	Practical/Practice

UNIT II (Probability, Correlation, Regression & Sampling)

Theory (1.0 Credits)

Elementary Probability Distribution, Correlation: Positive and negative correlation and calculation of Karl Pearson's coefficient of correlation. Regression, Sampling: concept of population and sample, Sampling distribution and standard error.

UNIT III (Vital Statistics & ANOVA)

Theory (1.0 Credits)

Hypotheses testing: null and alternative hypothesis, T-test, Chi-square test, goodness of fit test and homogeneity of samples, F-test. ANOVA: one way and two way analysis of variance, Design of experiments. Use of statistical packages for data analysis (SPSS).

Text Books:

1. Elements of Mathematical Statistics; S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi
2. Elements of Biostatistics; S. Prasad; Rastogi Publications, Meerut

Suggested Readings:

1. Basic Statistics:-B.L.Agarwal
2. Principles and Procedure of Statistics:-A Biometrical Approach:-R.G.D. Steel and J.H.torrie
3. Fundamentals of Applied Statistics, S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi.

References/Correlation with Ancient Indian Literature:

1. Sankhyā: The Indian Journal of Statistics Published by: Indian Statistical Institute <https://www.springer.com/statistics/journal/13171>
2. The Sulba Sutras http://www-history.mcs.st-and.ac.uk/Projects/Pearce/Chapters/Ch4_2.html
3. History of Hindu Mathematics, Asia Publishing House, Bombay, 1962 <https://link.springer.com/article/10.1007/BF02836134>

Course Name: Analytical Chemistry:

Total- 4 (3T+1P)

Course Outcome: It is to develop concepts in analytical chemistry we develop new technologies and methods for measuring organic and inorganic matter.

UNIT-I (Centrifugation and Chromatography)

Theory (1 credits)



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Separation Techniques in biochemistry: Centrifugation, TLC and Paper chromatography, gel permeation, ion exchange, hydrophobic, reverse-phase and affinity chromatography.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	Preparation of Polyacrylamide gel for SDS (i) Reagents preparation (ii) Gel casting	Practical

UNIT-II (Electrophoresis)

Theory (1 credits)

HPLC and FPLC, Electrophoretic techniques, Criteria of protein purity, equilibrium dialysis, ultrafiltration and various membrane techniques, API-electrospray and MALDI-TOF.

Practicals (0.25 credit)

Sr. no.	Name of practical	Nature
1	Demonstration of PCR (i) Basic of PCR (ii) Conclusion (iii) Experimental precautions	Practical

UNIT-III (Mass Spectrometry and Techniques)

Theory (1 credits)

Mass spectrometry, Radiotracer techniques for enzyme assays, receptor-ligand interactions; radioimmunoassay, ELISA.

Practicals (0.5 credit)

Sr. no.	Name of practical	Nature
1	Preparation of Calibration curve for amino acid (ii) Basic of spectrophotometer (ii) Absorption reading (i) Conclusion	Practical

Text Books:

1. Biochemical techniques- Wilson & Walker.
2. Biochemical techniques- David Freilfelder
3. D.Holem and H.Peck; Analytical Biochemistry. Longman, 1983.

Suggested Readings:

4. T.G.Cooper; The Tools of Biochemistry. Wiley Intersciences, 1997.
5. R.Scopes, Protein Purification : Principles and Practices. Springer Verlag, 1982.
6. Selected readings from Methods in Enzymology, Academic Press.
7. Statistical Methods :- G.W. Snedecor and W.G. Cochran
8. Basic Statistics :- B.L. Agarwal
9. Principles and Procedure of Statistics :- A Biometrical Approach :- R.G.D. Steel and J.H. Torrie

References/Correlation with Ancient Indian Literature:



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1. 'Ras Ratna Samuchchay' <https://www.exoticindiaart.com/book/details/rasa-ratna-samucchaya-NZI038/>
2. Rasayan Shastra <https://www.pgurus.com/chemistry-ancient-india/>

Biosafety Regulatory affairs

Unit I (Biosafety manual)

Course Outcome: This paper develops concepts a holistic and comprehensive regulatory approach to ensure biosafety would be based on the precautionary principle, covering the entire range of activities from research and development of GMOs to their commercialization, and post-release monitoring.

Theory (1)

Introduction and development of Biosafety; Practices & Principles; General lab equipments; Definitions & Biosafety levels, 1, 2, 3, 4; Biological safety cabinets, centrifuge; Shipment of biological specimens; Biological waste management; Decontaminations, Biosafety manuals; Medical surveillance, Emergency response. Quality System Regulations (QSR), Good Manufacturing Practice (GMP), Good Laboratory Practices (GLP), Good Clinical Practice (GCP)

Unit II (Bioethics in Biological Science)

Theory (0.5)

Bioethics- History & Introduction; Social, Legal & Ethical Issues in biological science, ethical concerns of biological research, Bioethics Committees Animal ethics- Norms in India-

Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Hazardous materials used in biological studies, their handling and disposal.

Unit III (Intellectual Property Rights)

Theory (0.5)

Introduction to IPR, IPR in India, IPR in abroad, Types of IPR- Patent, Copyright, Trademark, Design & Trade Secret, Biotechnology/Microbiology & IPR- Commercial potential of new biological inventions; Patenting, Protection of geographical indication

Biological Inventions-Objective, Concept of novelty, Concept of inventive step, Microorganism, Moral issues in patenting biological inventions.

Recommended Text Books:

1. Ethical Issues in Biotechnology by Richard Sherlock & John D. Morrey, Rowman & Littlefield Publishers
2. Regulatory Framework for GMOs in India, Ministry of Environment and Forest, Government of India, New Delhi. 2006
3. Cartagena Protocol on Biosafety, Ministry of Environment and Forest, Government of India, New Delhi. 2006
4. Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi. 2012

Recommended Reference Books:

1. Agarwal, K..2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.



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2. Beier, F.K., Crespi, R.S. and Straus, T.2007 Biotechnology and Patent protectionOxford and IBH Publishing Co. New Delhi.
3. Sasson A,1988 Biotechnologies and Development, UNESCO Publications.

II Semester

Course Name: Research Methodology:



Total- 4

Course Outcome: This course develops the concepts of research and covers all aspects ranging from biosafety in the laboratory, experimental protocol, presentation of data and viva voce.

UNIT - I (Introduction & Types of research)

Theory (1 Credit)

Research methodology: Introduction & meaning of research, Objectives of research, motivation in research. Types of research & research approaches. Research methods vs. methodology, Criteria for good research. Research problem: Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem.

UNIT - II (Research design)

Theory (2 Credits)

Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.

Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.

UNIT - III (Methods of data collection)

Theory (1 Credits)

Methods of data collection: collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules.

Report Writing

Recommended Text Books:

1. Kothari CR (2004). Research Methodology: Methods and Techniques, New Age International.
2. Bhattacharya DK (2009). Research Methodology, Excel Books.

Reference Text:

1. Annals of Food Science & Technology
2. Journal of Nutrition
3. Journal of Food Science & Technology

Course Name: Metabolism and Bioenergetics :

Total- 4(3T+1P)

Course Outcome: This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetic and regulation of different metabolic processes in microorganisms.

UNIT I (Carbohydrate metabolism and laws of thermodynamics)

Theory (1 credit)

Bioenergetics: First and second laws of thermodynamics and concept of free energy, high energy phosphate compounds. Carbohydrate metabolism: Glycolysis, kreb's cycle. Pentose phosphate pathway, glyoxylate cycle, glycogenolysis and glycogenesis, gluconeogenesis. Anaerobic respiration.

Practicals (0.5 credit)



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Sr. no.	Name of practical
1.	To understand the principle and operation of Spectrophotometer
2.	Determination of reducing sugars by Nelson- Somogyi's method (i) Preparation of reagents (ii) To perform the assay (iii) Observation and Calculations
3.	Determination of starch in plant Tissue (i) Preparation of reagents (ii) To perform the assay (iii) Observation and Calculations
4.	Determination of Glycogen in Liver (i) Preparation of reagents (ii) To perform the assay (iii) Observation and calculations

UNIT II (Protein metabolism)

Theory (1 credits)

Protein metabolism :metabolic fate of amino group,transamination and deamination, decarboxylation and oxidative degradation of amino acid, Nitrogen excretion and urea cycle. Biosynthesis of essential amino acids.

Practicals (0.25 credit)

Sr. no.	Name of practical
1.	Extraction and estimation of total lipid content in the given sample of oilseed (i) Preparation of reagents and extraction of total lipids (ii) Estimation of total lipids
2.	Separation and identification of various lipids by Column Chromatography (i) Preparation of reagents (ii) Separation of Lipids (iii) Identification of lipids
3.	Separation of various Components in different lipid fractions by thin layer chromatography (i) Preparation of reagents (ii) Separation of various components
4.	Estimation of Cholesterol content by Liebermann- Burchard method (i) Preparation of reagents (ii) To perform the assay (iii) Observation and Calculations



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UNIT-III (Nucleic acid and Lipid metabolism)

Theory (1 credits)

Nucleic acid metabolism: Biosynthesis and break down of purine & pyrimidine nucleotide by De novo and salvage pathway. Metabolic regulation

Lipid metabolism: Introduction to Structure of Lipids, Biosynthesis of essential and non essential fatty acids, formation of ketone bodies, biosynthesis of triacylglycerols, membrane phospholipids. Cholesterol biosynthesis.

Practicals (0.25 credit)

Sr. no.	Name of practical
1.	Estimation of protein by Lowry's method (i) Preparation of reagents (ii) To Perform the assay (iii) Observation and Calculations
2.	Determination of Protein by Barford method (i) Preparation of reagents (ii) To perform the assay and calculation for the concentration of protein

Recommended text books:

1. A.L. Lehninger, D.L. Nelson, M.M. Cox, "Principles of Biochemistry", 3rd Edn., Worth Publishers.

Reference Books

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY.
2. Biochemistry by Voet and Voet

References/Correlation with Ancient Indian Literature:

1. Atharveda <http://www.sacred-texts.com/hin/av.htm>
2. Yajurveda <http://vedicheritage.gov.in/science/>

Course Name: Plant Biotechnology:

Total- 4(3T+1P)

Course Outcome: This course deals with Plant Biology and Plant Biotechnology is a branch of biology that involves the scientific study of plant life. Plant biology is an area that concentrates the complete plant kingdom.

UNIT-I (Aseptic techniques and media)

Theory (1 credit)

Introduction and history of plant tissue culture. Cytodifferentiation and Morphogenesis. Introduction to laboratory organization, Different type of medium designing for plant tissue culture. Aseptic manipulation. Basic aspects of cellular totipotency and tissue culture :- Types of culture: Cell culture, Seed culture, Embryo culture, Organ culture, Endosperm culture, Nucellus culture, Endosperm culture and suspension culture. Synthetic seeds.

Practicals (0.5 credit)

Sr. no.	Name of practical
1.	To clean glassware and accessories used in plant tissue culture.



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2.	Preparation of MS media for plant tissue culture. (i) Preparation of stock solutions and Growth hormones. (ii) Making agarose solution and pH adjustment (iii) MS media preparation and autoclave (iv) Distribution in flasks
3.	In Vitro Multiplication of medicinal plant. (i) Preparation of media and autoclave. (ii) Inoculation of explant

UNIT-II(Different techniques of plant tissue culture)

Theory (1 credit)

Hairy root culture ,Protoplast isolation ,fusion and culture. Biotransformation, Elicitation.Cell Immobilization, Production of secondary metabolites using tissue culture. Somatic embryogenesis, somaclonal Variations and Micropropagation.

Practicals (0.25 credit)

Sr. no.	Name of practical
1	Optimization of medium and explants for callus induction. (i) Preparation of media and autoclave. (ii) Inoculation of explants
2	To regenerate callus into disease free plant. (i) Preparation of media and autoclave. (ii) Inoculation of explant
3.	Root initiation of in vitro multiplied shoots (i) Preparation of rooting media and autoclave (ii) Inoculation of explant
4	To maintain media for cell suspension culture so those to obtain disease free plants from single cells. (i) Preparation of liquid media for single cell culture. (ii) Inoculation and its incubation

UNIT-III(Applications of plant tissue culture)

Theory (1 credit)

Inbreeding depression and heterosis . Plants as bioreactor, Mutation breeding, Nitrogen fixation. Photosynthesis for crop productivity, Alien gene transfer , Robertsonian translocation, Improvement in flavor,pigmentation. Computer based chromosome analysis ,Transposons, Arabidopsis genome and Inplanta transformation.

Practicals (0.25 credit)



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Sr. no.	Name of practical
1	To acclimatize the cultured plants in growth room so that they may able to grow in field/green house (i) Sterilization of soil (ii) Preparation of soil for plant transfer (iii) Transfer of tissue cultured plant in green house for acclimatization.
2	To produce haploid plant- Anther culture (i) Preparation of Nistch media (ii) Extraction of anther and microspore (iii) Inoculation of anther in media

Recommended text Books:

1. Plant biotechnology by H. S. Chawla.

Reference books

1. Plant tissue culture by Bhojwani and Razdan.

References/Correlation with Ancient Indian Literature:

- Atharva Vedas AV. X. 3).<http://www.sacred-texts.com/hin/av/index.htm>
- Aitareya Brihmana <http://vedicheritage.gov.in/brahmanas/aitareya-brahmana/>

Course Name: Molecular Biology:

Total 4(3T+1P)

Course Outcome: This course develops concepts in molecular biology: DNA packaging, DNA damage and repair, gene structure, expression and regulation in both prokaryotes and eukaryotes.

UNIT-I(Genome packing and replication)

Theory (1credit)

Nucleic acids, DNA structure, Replication: eukaryotic and prokaryotic replication. Replication of double stranded and single stranded circular DNA, telomere replication, Nucleosomes: eukaryotic and prokaryotic genome packing, heterochromatin, euchromatin.

Practicals(0.5 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from E.coli. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate DNA from E.coli.



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2	To prepare Agarose gel for gel electrophoresis (i) Preparation of agarose solution (ii) Gel casting
3	To separate and visualize genomic DNA of E.coli. (i) Loading of DNA into agarose gel (ii) Visualization of DNA

UNIT-II(RNA synthesis and its processing, genetic code)

Theory (1 credit)

Transcription: mechanism of RNA transcription in prokaryotes and eukaryotes; model systems of transcriptional control: lac operon, lambda phage; promoters, enhancers, repressors; RNA processing: processing of heterogeneous nuclear RNA: splicing, capping, polyadenylation; Translation: universal genetic code, mechanisms of initiation, elongation and termination of translation, wobble hypothesis, genetic code in mitochondria.

Practicals (0.25 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from blood. (i) Reagent preparation. (ii) Blood collection. (iii) Isolation of DNA.
2	To isolate DNA from plant sample. (i) Grinding of plant sample (ii) Isolation of DNA
3	To determine the concentration of DNA.

UNIT-III (Mutation, DNA repair and transposons)

Theory (1 credit)

Mutation, DNA repair: Base excision, Nucleotide excision, Mismatch and SOS repair; Recombination: mechanism of homologous recombination in prokaryotes, site specific recombination, transposons, tumor suppressor genes, protein folding and degradation.

Practicals (0.25 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from cheek cells. (i) Reagent preparation. (ii) Separation and lysis of cells. (iii) Precipitation of DNA.
2	To isolate RNA from bacteria. (i) Grow colonies of E.coli.



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- (ii) Make suspension of E.coli.
- (iii) Isolate RNA from E.coli.

3 To determine the concentration of RNA.

Recommended text Books:

1. Lehninger Principles of biochemistry by Nelson and Cox.

Reference books

1. Gene VII by Benzamin Lewin.

References/Correlation with Ancient Indian Literature:

1. Rig-Veda 1-163, 1,2,3,4 Figure 7 <http://xn--j2b3a4c.com/rigveda/1/163/1>
2. The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi. <http://voiceofdharma.org/books/rig/>
3. Hindi translation of Rigveda by Ramgovind Tripath <http://literature.awgp.org/book/rigveda/v1>

Course Name: Industrial Biotechnology:

Total 4(3T+1P)

Course Outcome: This course develops concepts of management and controls on the microbial processes in industrial settings. Ability the principles of physiological understanding in improvement of industrial processes.

UNIT-I (Objectives and Scope of industrial Biotechnology)

Theory (1 credit)

Introduction, Objectives and Scope of industrial Biotechnology; Characteristic and comparison of bioprocessing with chemical processing; Substrates for bioconversion processes and design of media; Isolation, preservation and improvement of industrial microorganisms; Cell culture techniques and aseptic transfers; Cell disruption:- Physical method; osmotic shock, grinding with abrasive, solid shear, liquid shear; chemical methods: alkali reagents, enzymatic methods.

Practical- (0.5 credit)

Sr. No.	Name of practical
1.	Detection and quantification of siderophores produced by <i>Psuedomonassps.</i> <ul style="list-style-type: none">(i) Preparation of media(ii) Inoculation(iii) Observation
2	Production of red wine from grape juice. <ul style="list-style-type: none">(i) Preparation of Grapes juice(ii) Inoculation of Yeast and incubation

UNIT-II (Microbial products – classification and production)

Theory (1 credits)

Introduction, Classification of Microbial products; Process technology for the production of ethanol, acetone-butanol, citric acid, dextran and amino acids, enzymes; Antibiotics: Penicillin, Streptomycin, Tetracycline; Vitamins: Vitamin B12; Amino Acid; L- glutamic acid, Phenylalanine, L – lysine; Production of polysaccharides, lipids, pigments and Microbial Biotransformation.



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Practical- (0.25 credit)

Sr. No.	Name of practical
1.	Isolation of antibiotic producing microbes from soil. (i) Preparation of media and inoculation (ii) To isolate antibiotic producing microbes. (iii) Identification of antibiotic producing microbes.
2.	Citric acid production by <i>A. niger</i> and penicillin and its estimation. 1. Preparation of PDB media 2. Inoculation of microbes for production. 3. Estimation of citric acid by titration.
3.	Estimation of alcohol determination of total acidity and volatile acidity.

UNIT-III (Equipments and Accessories for industrial processes)

Theory (1 credit)

Equipments and Accessories for industrial processes; STR and Airlift fermenters; Bioreactors used for solid substrate fermentation; Ion chromatography, Gel filtration hydrophobic interaction chromatography, Affinity chromatography; Filtration and microfiltration.

Practical- (0.25 credit)

Sr. No.	Name of practical
1.	Production of SCP by Spirullina and yeast and Estimation of SCP protein 1. Media preparation and Autoclave 2. Inoculation of algae. 3. Incubation and observation. 4. Estimation of Protein by Lowry's method

Recommended Text Books:

1. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
2. Microbial Biotechnology: Channarayaappa, University press, Hyderabad, 2003

Reference Books:

1. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
2. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.
5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.
6. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.

References/Correlation with Ancient Indian Literature:



Atharva Vedas AV. 11.7 https://msrvvp.ac.in/vedvidya/26/27_Eng_Nimish_sharma_26.pdf

Structural and Functional Genomics

Total 3(2T+1P)

Course Outcome: This course develops concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Unit I (Organization dynamics and Overview of genomics)

Theory (0.5)

Structural Organization of Prokaryotic genome, Evolution and Structure of mitochondrial genome, DNA, RNA, protein, codon, central dogma, gene structure, Repetitive and Transposable elements in genome and their significance, Tandemly repeated DNA and interspersed genome – wide repeats, DNA and RNA transposons

Unit II (Mapping of genome)

Theory (0.5)

Linkage and Pedigree analysis, Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers – Restriction Fragment Length Polymorphism (RFLPs), Simple Sequence Length Polymorphism (SSLPs), Amplified Fragment Length Polymorphism (AFLPs), Single Nucleotide Polymorphism (SNPs)

Physical mapping - Restriction mapping, Fluorescent *in situ* hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

Practicals:

1	Analysis of mutation by Restriction Fragment Length Polymorphism	Practical	
2	Bacterial genome amplification by PCR	Practical	
3	To study about Amplified Fragment Length Polymorphism	Practical	

Unit III (Genomic database and sequencing)

Theory (1)

Genetic Databases, databanks, and genome browsers, Computer program overview for genomics: Genome Linux, NCBI blast tools

First generation sequencing: Sanger sequencing, automated sequencing, Genome investigation using “Next Generation Sequencing”. Phylogenetics and phylogenomics

Structural genomics- Assembly of contiguous DNA sequences, shotgun method and Clone Contig method and whole genome shotgun sequencing

Practicals (1)

1	Bacterial Genome Sequencing by Next Generation Sequencing	Practical	
2	Comparison of Bacterial Genome sequence by NCBI Blast	Practical	

**Recommended Text Books:**

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.
6. The Human Genome 2001, Nature Vol. 409.
7. The *Drosophila* Genome. 2000, Science Vol. 267.
8. The *Caenorhabditiselegans* genome 1998. Science Vol. 282.
9. The Arabidopsis Genome 2000 Nature vol. 408.
10. Primrose, S. B., and R. M. Twyman.2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA.

Industrial Visit

Course Outcome:It is to develop concepts in knowledge about the ongoing research in various national research institutes and functioning of microbiology- related industries and industrial processes.

III Semester

Course Name: Molecular Enzymology

Total 4(3T+1P)

Course Outcome:This course develops the concepts of methodology involved in studying the different components of microbial cell and various techniques and instruments involved and product analysis.

UNIT-I (Introduction and nomenclature of enzymes)**Theory (1 credit)**

Rate accelerations in biological systems; Catalysis and historical perspective on enzymes; Overview of applied enzymology and enzyme technology; Enzyme nomenclature; Origins of enzyme catalytic power.

Practical (0.5 credit)

Sr. no.	Name of practical	Nature
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1	To examine the effect of pH on activity of alkaline phosphatase (i) Preparation of Reagents (ii) To perform the assay (iii) Observation and calculations	Practical
2	Time course of enzymatic reaction (i) Reagent preparation (ii) To perform the assay and observe for the results	Practical

UNIT-II (Structure and kinetics of enzymes)

Theory (1 credit)

Structural basis of enzyme action and characterization of active site residues; Kinetic approaches to understand enzyme action; Michaelis-Menten kinetics; Evaluation of K_m , k_{cat} and enzyme inhibition analysis; Concept of an efficient catalyst; Elucidation of kinetic mechanism through initial velocity, product inhibition, pH and isotopic analysis.

Practical (0.5 credits)

Sr. no.	Name of practical	Nature
1.	To understand the principle and operation of Spectrophotometer	Practical
2.	Influence of substrate concentration on the rate of enzymatic reaction.	Practical

UNIT-III (Regulation of enzyme activity)

Theory (1 credit)

Role of metal ions in enzyme catalysis; Integration of kinetic, chemical and structural data to describe enzyme action; Control of enzyme activity and its role in regulating metabolism – in vivo enzymology; Frontiers in enzymology: Rational design of an enzyme catalyst, directed evolution, abzymes, non-protein catalysts.

Recommended text Books:

1. Enzymology by Palmer.

Suggested Readings:

1. Enzymatic reaction mechanisms by C. Walsh. WH Freeman, San Francisco (1979).
2. Fundamentals of Enzyme Kinetics by A. Cornish-Bowden 3rd Edition, Portland Press, London (2004).

References/Correlation with Ancient Indian Literature:

- (Mahabharatha 46) <https://sanskritdocuments.org/mirrors/mahabharata/mbhK/mahabharata-k-06-itx.html>
- Rig Veda (1-71-9) <http://xn--j2b3a4c.com/rigveda/1/71/9>

Anu.65-



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- (Charaksutrasthan 27-214) <http://www.dadf.gov.in/related-links/annex-v-ii-2-superiority-cow-milk-paper-sh-ik-narang>
- Mantra (4-21-6) of the Atharva veda <http://www.sacred-texts.com/hin/av.htm>

Course Name: Cellular and Tissue Engineering

Total 3

Course Outcome: It is to develop concepts in Cell and tissue engineering includes the study of cellular mechanics and cell signalling, mechano transduction, biosystems engineering and computational biology, nanotechnology, microfluidics, bio-MEMS and gene chips, functional tissue engineering and biomaterials, tissue structure-function and cell-matrix interactions.

Unit I: (Cell culture and Gene techniques)

Theory (1 credits)

Basic cell biology, cell-matrix interactions, receptor biology, cell culture, gene therapy and gene transfer techniques.

Unit II (Protein and Peptide Engineering)

Theory (1 credits)

Protein and peptide engineering, stem cell programming, controlled release and drug delivery, tissue ablation, engineering angiogenesis.

Unit III: (Tissue Engineering and Immunotherapy)

Theory (1 credits)

Vascularization, material based immunotherapy and case studies involving skin, bone, liver, muscle tissue engineering

Recommended text books:

1 Blitterswijk CV, Tissue Engineering, Academic Press (2008)

Suggested Readings:

- 1 Saltzman WM, Tissue Engineering, Oxford University Press (2004).
- 2 Lanza RP, Langer R, Vacanti JP, Principles of Tissue Engineering, Academic Press, 3rd Edition (2007).
- 3 Palsson B and Bhatia SN, Tissue Engineering, Pearson Prentice Hall (2003).

References/Correlation with Ancient Indian Literature:

1. Ras Ratna Samuchchay <https://www.exoticindiaart.com/book/details/rasa-ratna-samucchaya-NZI038/>
2. Rasayan Shastra <https://www.pgurus.com/chemistry-ancient-india/>

Course Name: Animal Biotechnology

Total 4 (3T+1P)

Course Outcome: It is to develop concepts in Remember and Understand the Fundamental Concepts of Animal Cell Culture techniques. Understand and envision the future Commercial aspects of Animal Cell culture.

UNIT-I (Introduction of animal biotechnology and its terminology)



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Theory (1 credit)

Animal cell culture, basic principles, serum free and serum based media, scaling-up, characterization and preservation of cell lines, cytotoxicity and viability assays. Stem cells, micromanipulation of embryos, generation of modified stem cells.

UNIT-II (Transgenic Animals and diseases)

Theory (1 credit)

Animal diseases, diagnosis, therapy, variations of diseases, modes of transmission of diseases, control and management of disease spreading. Transgenic animals, retroviruses and DNA microinjection method, transgenic mice, cattle, sheep, goat, pig, birds, knock in and knock out animals.

Practical: (0.5 credits)

Sr. no.	Name of practical	Nature
1	To determine the optimum pH of trypsin. (i) Reagent preparation (ii) Incubation and observation	Practical

UNIT-III(Applications of animal biotechnology)

Theory (1 credit)

Importance of transgenic animals in biotechnology, valuable genes for animal biotechnology.

Practical: (0.5 credits)

Sr. no.	Name of practical	Nature
1.	To disaggregate tissue by the technique of cold trypsinization (i) Isolation of tissue (ii) Chopping and washing of tissue (iii) Soaking and incubation (iv) Making suspension and seeding	Practical

Recommended Text books:

Biotechnology- U. Satyanarayn

Suggested Readings:

Culture of Animal Cells- R. Ian Freshney

References/Correlation with Ancient Indian Literature:

1. Atharva Vedas <http://www.sacred-texts.com/hin/av.htm>
2. Vishnudharmottara <https://ayushnanda.com/vishnudharmottara-purana>

Course Name: Bioinformatics

Total 4(3T+1P)

Course Outcome: This course develops the concepts of Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics; existing software effectively to extract information from large databases and to use this information in computer modelling.



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UNIT-I (Databases & Alignment)

Theory(1 Credits)

Introduction; Databases - sequence, structure, non-redundant; Sequence alignment - pairwise and multiple; phylogenetics; ORFinder;

Practical (0.5Credits)

Sr. no.	Name of practical	Nature
1	To study about the different biological databases in variable formats i) Study about the NCBI ii) Review of the variety of entities of NCBI	Practical
2	To study about the different biological databases in variable formats iii) Study of Genbank. iv) Study of Format.	Practical
3	To study about the different biological databases in variable formats v) Study of SWISS PROT. vi) Study of Format.	Practical

UNIT-II(Prediction and Structure)

Theory(1 Credits)

Structure prediction methods – high-accuracy, template based, free modeling (new folds); Secondary structure prediction;

Practical (0.5 Credits)

Sr. no.	Name of practical	Nature
1	To study about the sequence similarity in different molecules through BLAST i) Find the similarity between Protein sequences from the available protein domains ii) Learn the storage of the Protein sequence for the further proceeding work	Practical



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2	To study about the sequence similarity in different molecules through BLAST iii) Find the similarity between Gene sequences from the available resources iv) Learn the storage of the Protein sequence for the further proceeding work	Practical
3	To study about the sequence similarity in different molecules through FASTA v) Find the similarity between Protein sequences from the available protein domains vi) Learn the storage of the Protein sequence for the further proceeding work	Practical

UNIT-III(Pattern recognition)

Theory(1 Credits)

Pattern recognition – PSSMs, weight matrices; hidden Markov models

Recommended Text Books:

Bioinformatics. Keith, J. Humana Press, 2008

Computer methods for macromolecular sequence analysis. R.F.Doolittle, Academic Press, 1996.

Suggested Readings:

1 Bioinformatics. Sequence and genome analysis. D.W.Mount. Cold Spring Harbor Lab. press. 2004.

2 Bioinformatics and functional genomics. J. Pevsner. Wiley-Liss, 2003.

References/Correlation with Ancient Indian Literature:

1. Atharva Vedas <http://www.sacred-texts.com/hin/av.htm>
2. Vishnudharmottara <https://ayushnanda.com/vishnudharmottara-purana>

Course Name: Genetic Engineering

Total 4(3T+1P)

Course Outcome: This course aims to introduce the fundamental tools and techniques required for molecular cloning, with emphasis on DNA editing to protein expression in wide variety of hosts. Application of genetic engineering in agriculture, therapeutics and industry will be covered.

UNIT I (Tools of genetic engineering)

Theory (1 credits)

Concept of recombinant DNA technology and purpose, basic methodology, use of plasmids, Type I, II and III restriction modification systems, type II restriction endonucleases, nomenclature and sequence recognition, mcr and rrrr genotypes, linkers, adaptors, blunt end ligation, homopolymeric tailing, Transformation, methods in screening recombinant DNA. Radioactive and non-radioactive methods for labeling DNA: Nick translation, random priming, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase.

Practical (0.5 credit)

Sr. no.	Name of practical	Nature
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1	To isolate plasmid DNA from <i>E.coli</i>. (i) To grow colonies of <i>E.coli</i> . (ii) To make suspension of <i>E.coli</i> . (iii) Isolation of Plasmid DNA	Practical
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UNIT II (Techniques in genetic engineering)

Theory (1 credits)

Hybridization techniques, northern, Southern and colony hybridization. Restriction maps and mapping techniques. PCR technology, enzymes in PCR, hot-start, touchdown PCR, primer design, introduction of restriction sites etc. Construction of cDNA libraries in plasmids, hybrid select translation, RT-PCR and quantitative RT-PCR. Strategies for maximizing gene expression, prokaryote expression vectors; pMal, GST fusion vectors, pET vectors and their applications in expression, quantitation, purification. Inclusion bodies, approaches to solubilization, Intein based expression and purification vectors. Cloning in M13 mp vectors, application to DNA sequencing, site-directed mutagenesis;

Practical (0.5 credit)

Sr. no.	Name of practical	Nature
1	To perform electroporation for introduction of DNA into plant cell	Practical

UNIT III (Molecular markers and applications of genetic engineering)

Theory (1 credits)

PCR-based mutations. Transcription vectors. Lambda vectors; insertion and replacement vectors, selection and screening recombinant phage, in vitro packaging, genomic libraries and cDNA cloning, application of lgt10, lgt11, lZAP vectors. Cosmid vectors. Yeast transformation, yeast cloning vectors, specialized vectors such as gap and retrievers, principles and application of dihybrid systems. Cloning and expression in mammalian cells, methods of selection and screening, application of reporter genes. Basic principles of transcriptomics and proteomics.

References/Correlation with Ancient Indian Literature:

1. AsvalayanaGrhya Sutra II 7
<https://www.hinduwebsite.com/sacredscripts/hinduism/grihya/asva.asp>
2. Atharveda <http://www.sacred-texts.com/hin/av.htm>
3. Yajurveda <http://vedicheritage.gov.in/science/>

Pre-Dissertation Training (60 Days) (After II Sem during summer vacation)

Outcome: This Pre-Dissertation Training aims to introduce the Develop the skills of preparing and conducting independent research.

IV Semester

Details of Training/Visit/Dissertation/Internship: Dissertation

Outcome: This Dissertation aims to introduce ability to apply the tools and techniques of Biotechnology in conducting independent research.



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