॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun.ac.in

E-mail: bos@srtmun.ac.in

प्रस्तुत विद्यापीठाच्या जैवतंत्रज्ञान सकुंलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील **M. Sc. Biotechnology II year** पदव्यूत्तर स्तरावरील **CBCS Pattern** नुसारचा **Revised** अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या ५६ व्या मा. विद्यापरिषद बैठकीतील ऐनवेळी चर्चासाठी उपस्थित विषयातील ठराव क्रमांक १ अन्वये मान्यता देण्यात आलेला, प्रस्तुत विद्यापीठाच्या जैवतंत्रज्ञान संकुलातील **विज्ञान व तंत्रज्ञान विद्याशाखेतील M. Sc. Biotechnology II year या पदव्यूत्तर स्तरावरील C.B.C.S. (Choice Based Credit System) Pattern** नुसारचा **Revised** अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/
न्यू मॉडल डिग्री कालेज/ २०२३–२४/135
दिनांक : १०.०७.२०२३.

आपली विश्वासू

सहा.कुलसचिव

शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) संचालक, जैवतंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) अधीक्षक, परिक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.
७) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. यानां देवून कळविण्यात येते की, सदरील परिपत्रक विद्यापीठाच्या संकेतस्थळावर प्रसिध्द करण्यात यावे.

SEMESTER PATTERN CURRICULUM UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

for
Post Graduate Program
Faculty of Science and Technology

SUBJECT: BIOTECHNOLOGY

Program Code: SLS-S-BTT-PG

M. Sc. Second Year

SCHOOL OF LIFE SCIENCES

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

With Effect From June 2023

Preamble:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in the curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

Swami Ramanand Teerth Marathwada University has several initiatives towards academic excellence, quality improvement and administrative reforms.

Biotechnology is often considered as the technology of hope for meeting future challenges like feeding our increasing population, cleaning dangerously polluted environments and potentiating healthcare sector etc. Establishment of new IISERs, Central Universities and IITs indicate that we are already on the track of developing infrastructure and human resource. Our dream of becoming future 'superpower' will not be possible without Biotechnology and inclusive efforts. Therefore, it is necessary to attract young and bright students and train them in the field of Biotechnology.

Keeping in mind, BOS in Biotechnology and Bioinformatics revised this curriculum to ensure up-to-date level of understanding of Biotechnology. Studying Biotechnology prepares the students for their career working either in educational institutions or industries in which they can be directly involved in the teaching, research and development. Also, to ensure uniform curriculum and its quality at UG/PG level, curriculum of different Indian Universities, syllabus of NET, SET, MPSC and UPSC and the UGC model curriculum are referred to serve as a base in updating the same.

The comments or suggestions from all teachers, students and other stakeholders are welcome for upbringing this curriculum.

Salient Features:

The syllabus of M Sc Biotechnology has been framed to meet the requirement of Choice Based Credit System. The courses offered here in will train and orient the students in the specific fields of Biotechnology.

The Core Courses deal with Biochemistry, Cell Biology, Immunology, Genetics and Molecular Biology, Bioprocess Engineering and Technology, r-DNA Technology, Bioinformatics, Enzyme Technology, Plant Biotechnology, Pharmaceutical Biotechnology and Genomics and Proteomics.

Apart from the core courses, the Discipline Specific Elective Courses deal with Bioinstrumentation and Biochemical Techniques, Biostatistics and Basic Computer, Medical Biotechnology, Environmental Biotechnology, Food Biotechnology, Animal Biotechnology and Microbial Technology. These courses offered during this program are designed with the aim of imparting specific skills to the students which will lead to the employability of the students.

This would help students to lay a strong foundation in the field of Biotechnology.

Overall after completion of this program, students will also acquire fundamental knowledge of applications of Biotechnology.

Program Educational Objectives:

The Objectives of this program are:

PEO1: To offer postgraduate program in Biotechnology based on the needs of industries, academic and research institutions worldwide.

PEO2: To promote and popularize Biotechnology at grass root level and attract young and budding talents.

PEO3: To expose the students to the different emerging fields of Biotechnology.

PEO4: To update curriculum by introducing recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PEO5: To train and orient the students so as to develop human resource for the educational institutes and other organizations.

PEO6: To inculcate analytical and application oriented abilities to create active and frontline researchers and human resource for the industries.

PEO7: To develop specific skills amongst students for self-employability and also for the development of their own enterprises.

Program Outcomes:

The Outcomes of this program are:

PO1: This Biotechnology program shall promote and popularize Biotechnology at grass root level and attract young and budding talents.

PO2: This program will expose the students to the different emerging fields of Biotechnology.

PO3: This will provide updated curriculum with recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop human resource for the educational institutes and other organizations.

PO5: This program shall train and orient the students so as to develop active and frontline researchers and human resource for the industries.

PO6: This will also develop specific skills amongst students for self-employability and also for the development of their own enterprises.

Prerequisite:

Basic knowledge of Science at B.Sc. level. The optional courses of this program are offered to the students registered for post-graduate programs. Such students should have the basic knowledge of Biotechnology and willing to gain additional knowledge in the field of Biotechnology.

Dr. Sunita D. Lohare

Chairman, BOS in Biotechnology and Bioinformatics

Swami Ramanand Teerth Marathwada University,

Nanded 431606.

Swami Ramanand Teerth Marathwada University, Nanded.

School of Life Sciences

Name of Programme: M.Sc. Biotechnology

III[rd] and IV[th] Semester Syllabus w.e.f. 2023-2024

Semester	Course Code	Title of theory/ Practical	No. of instructional hrs/week	Type of Course	Total Credits	Marks		Total Marks
						MSA	ESA	
Semester III	**Theory**							
	BTT-C-301	r DNA Technology	04	CC	04	50	50	100
	BTT-C-302	Bioprocess Engineering and Technology	04	CC	04	50	50	100
	BTT-C-303	Enzyme Technology	04	CC	04	50	50	100
	BTT-C-304	Research Methodology	02	CC	02	25	25	50
	***BTT-E-301 **OR** ***BTT-E-302 **OR** ***BTT-E-303 **OR** ***BTT-E-304	Advanced Instrumentation Communication Skills in English Foreign Language-French Foreign Language-Spanish	02	SDC	02	25	25	50
		**Open Elective	02	OE	02	25	25	50
	Practical							
	BTL-C-301	Lab Course in r DNA Technology	04	CC	02	25	25	50
	BTL-C-302	Lab Course in Bioprocess Engineering and Technology	04	CC	02	25	25	50
	BTL-C-303	Lab Course in Enzyme Technology	04	CC	02	25	25	50
		Total	**30**	**4-CC, 1-SDC, 1-OE**	**24**	**300**	**300**	**600**
Semester IV	**Theory**							
	BTT-C-401	Plant Biotechnology	04	CC	04	50	50	100
	BTT-C-402	Pharmaceutical Biotechnology	04	CC	04	50	50	100
	BTT-C-403	Genomics and Proteomics	04	CC	04	50	50	100
	*BTT-E-401 **OR** *BTT-E-402 **OR** *BTT-E-403	Microbial Technology Food Biotechnology Animal Biotechnology	04	DSE	04	50	50	100
		**Open Elective	02	OE	02	25	25	50
	Practical							
	BTL-C-401	Lab Course in Plant Biotechnology and Pharmaceutical Biotechnology	04	CC	02	25	25	50

	BTL-C-402	Lab Course in Genomics and Proteomics and Microbial Technology/ Food Biotechnology/Animal Biotechnology	04	CC	02	25	25	50
	BTL-C-403	**Project/ Research Review Writing**	04	CC	04	50	50	100
		Total	**30**	**3-CC, 1-DSE, 1-OE**	**26**	**325**	**325**	**650**

CC: Core course, OE: Open Elective Course, DSE: Discipline Specific Elective Course, SDC: Skill Development Course, MSA-Mid Semester Assessment, ESA: End Semester Assessment.

*Discipline Specific Elective	**Open Elective/***Skill Development Elective Course
* indicates an Elective Course. Biotechnology student in particular semester, can opt for any one of these Courses **OR** a Course offered by other Programs of the School	**indicates an Open Elective Course. Biotechnology student must opt for any Open Elective Course **OR** Skill Development Course offered by Other Schools of the Campus OR MOOC-SWAYAM-NPTEL Course.

Total Credits/year = 50; Total Credits of All Four Semesters = 100, Total Marks of All Four Semester = 2500; MSA: For each 4 Credit Course-Two Internal Exams of 15 Marks each (Based on MCQ), Home assignment of 10 Marks, Seminar of 10 Marks. For each 2 Credit Course-One Internal exam of 15 marks (MCQ), Home Assignment-05 Marks; Seminar -05 Marks.

List of Open Electives in Biotechnology for Other Schools

School of Life Sciences- Subject: Biotechnology				
Sr. No.	**Course Code**	**Title of Open Elective Course**	**Number of Credits**	**Semester in which Open Elective is offered**
1.	BTT-OE-101	Infectious Diseases and Vaccine Technology	02	I/III
2.	BTT-OE-201	Computer Aided Drug Design	02	II/IV
3.	BTT-OE-301	Food Biotechnology	02	I/III
4.	BTT-OE-401	Fundamentals of Intellectual Property Rights	02	II/IV

SEMESTER III

r-DNA TECHNOLOGY
COURSE CODE: BTT-C- 301

CREDITS: 4

Course objectives:

The objective of this course is to familiarize the students with concept of r-DNA, clone and gene cloning, cloning strategies, tools and techniques, applications and advantages and alternatives to transgenics etc.

COURSE CONTENT:

UNIT –I Fundamentals of Genetic Engineering

Introduction to concept of r-DNA, clone and gene cloning. Scope and Milestones in Genetic Engineering.

Molecular Tools: Restriction and modifying enzymes. DNA and RNA markers. Vectors: Cloning and expression vectors; vector components: Promoters, selectable markers, reporter genes, ori, URRs, codon optimization, Properties and Applications. Commonly used vectors: Plasmids, bacteriophages, Phagemids and Cosmids and Artificial chromosomes.

UNIT –II Gene Cloning Strategies and Tools

Isolation and purification of chromosomal and plasmid DNA, Yield analysis, Nucleic acid amplification and its applications. Genomic and c-DNA library preparation and application.

Cloning Methods: Blunt end cloning, Sticky end and sticky end PCR cloning, TA cloning, PCR recombination, Integration PCR, In-Fusion™ Cloning, TOPO Cloning, Gateway cloning etc.

Methods of screening: Selection by complementation, antibiotic resistance, colony PCR etc. Expression analysis: Phenotype, RNA and Protein level. Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays, RT-PCR and Real time q-PCR, Nucleic acid microarray, Transcriptome sequencing, Western blotting.

UNIT –III Applications of r-DNA Technology

Heterologous expression of proteins. Vector engineering and codon optimization, host engineering, Expression in bacteria, expression in mammalian and plant cells, Processing of Recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Process and applications of Phage Display.

GMO (Microorganisms, Plants and Animals) with traits having applications in different sectors: A. Health, B. Agriculture, C. Environment and D. Industrial

UNIT- IV

Gene silencing: Strategies, applications and advantages. Genome editing: Strategies, applications and advantages.

Gene therapy: Principles of Gene therapy: Vector engineering. Strategies of gene delivery. Gene replacement/augmentation therapy, success and limitations of gene therapy. Genetic engineering guidelines, Regulatory bodies: GEAC, RCGM and IBSC.

BTL-C-301 Laboratory Course in r-DNA technology

1) Genetic recombination (conjugation, transformation, transduction) in bacteria.

2) Gene cloning: Restriction digestion and ligation, DNA. Cloning in plasmid vectors and analysis of gene products.
3) Preparation of competent cells by CaCl2 method and transformation.
4) DNA amplification.
5) DNA fingerprinting: RFLP, RAPD and AFLP
6) Blotting and hybridization techniques: Western, Southern & Northern hybridization.
7) Gene expression in *E. coli*
8) Agarose gel electrophoresis by using DNA markers for molecular weight determination

Learning Outcomes (LO):

Students will be GM literate i.e. aware about r DNA technology, its advantages and disadvantages in addition to tools and techniques. It will help in avoiding spread of misconception about GMOs in society.

References:

1. Sambrook, J., Fritisch,E. F. and Maniatis,T. (2000) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.
2. Glover, D. M. and Hames,B. D. (1995) DNA Cloning: a Practical Approach, IRL, Press, Oxford.
3. Kaufman, P. B., Wu, W., Kim,D. and Cseke,L. J. (1995) Molecular and Cellular Methods in Biology and Medicine, CRC Press, Florida.
4. Berger, S. L. and Kimmel,A. R. (1998) Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, Academic Press, Inc. San Diego.
5. Goeddel,D. V. (1990) Methods in Enzymology Vol. 185, Gene Expression Technology, Academic Press, Inc., San Diegoo.
6. Mickloss,D. A. and Freyer, G. A. (1990) DNA Science. A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
7. Primrose,S. B. (1994) Molecular Biotechnology (2nd edition), Blackwell Scientific Publishers, Oxford.
8. Davies, J. A. and Raznikoff, W. S. (1992) Milestones in Biotechnology, Classic papers on Genetic Engineering, Butterworth-Heinemann, Boston.
9. Walker, M. R. and Rapley, R.(1997) Route Maps in Gene Technology, Blackwell Science Ltd., Oxford.
10. Kingsman, S. M. andKingsman, A. J. (1998) Genetic Engineering: An Introduction to gene analysis and exploitation in eukaryotes, Blackwell Scientific Publications, Oxford.
11. Glick - Molecular Biotechnology .

BIOPROCESS ENGINEERING AND TECHNOLOGY
COURSE CODE: BTT-C- 302

CREDITS: 4

Course Objectives:

The objective of this course is to apply fundamental principles and concepts of chemical engineering to biological systems.

To provide a comprehensive understanding of media formulations, microbial growth kinetics, bioreactor selection, upstream & fermentation processes, and its role in manufacturing bio-products.

COURSE CONTENT:

UNIT-I

Introduction: Interaction of two disciplines: biology and bio-chemical engineering, historical advancement in fermentation processes, current status of biochemical engineering in fermentation industry, range of microbial diversity in fermentative processes.

Microbial Growth Kinetics: Growth, growth measurement, media formulation, stoichiometry of cell growth and product formation, factors influencing product formation, varying carbon & nitrogen source, batch culture, Monod's kinetics, modelling of batch growth kinetics, environmental factors affecting microbial growth, continuous culture, an ideal Chemostat, advantages and limitations of continuous over batch culture, fed-batch culture and its applications.

UNIT-II

Aeration and Agitation: Fick's law, theories of mass transfer, mass transfer between two phases, role of aeration and agitation in a bioprocess, oxygen transfer methodology in a fermentation process, significance of volumetric transfer coefficient (KLa) and its determination, factors affecting KLa values in a bioreactor, power requirements in gassed and ungassed bioreactors, rheological characteristics of fermentation fluids.

UNIT-III

Bioreactor Selection and Design: Selection criteria for bioreactor, body construction of fermenter and its components *i.e.*, impellers, stirred glands and bearings, seal assemblies, baffles, sparger and valves, solid state and submerged fermentation, design aspects of bubble column bioreactor, air-lift fermenter, plug-flow and packed bed bioreactor, scaling up of bioreactor.

UNIT-IV

Sterilization, Instrumentation and Process Control: Need of sterilization, media sterilization, Del factor, design of batch and continuous sterilization, air sterilization, log penetration theory, scale up of sterilization process, filter design, control systems in a bioprocess, methods of measuring process variables i.e., temperature, pressure, flow, dissolved oxygen, pH, role of computer in fermentation process analysis

BTL-C-302 Laboratory Course in Bioprocess Engineering and Technology

1 Bacterial growth kinetics

2 Effect of varying Carbon/ Nitrogen substrate on specific growth rate

3 Production of citric acid and lactic acid

4 Production of Alcohol (Ethanol)

5 Comparative study on rate of product formation using immobilized and suspension cells

6 KLa determination using non-fermentative and fermentative methods

7 Effect of mixing and agitation rate on KLa

Learning Outcomes (LO):

Students will be able to

1 Explain how microorganisms and biochemical processes can be applied in engineered systems.

2 Distinguish among batch, continuous and fed-batch culture systems for the production of Biochemical products.

3 Describe microbial growth & cultivation, various bioreactor components, and types of Bioreactor used in biotechnology industries.

4 Design media sterilization and design of air filter in a bioprocess.

5 Apply various concepts to improve bioreactor performance and evaluate process variables to analyse a bioprocess.

Reference Books

1 P.F. Stanbury and A. Whitaker-Principle of Fermentation Technology; Pergamon Press (1988).

2 M. L. Shuler and F. Kargi- Bioprocess Engineering: Basic Concepts" by, 2nd Edition, PearsonEducation (2001).

3 P. M. Doran-Bioprocess Engineering Principles Academic Press (2012).

4 J. E. Bailey and D.F. Ollis-Biochemical Engineering Fundamentals, McGraw-Hill Book Co., New York (1986)

5 S. Aiba, A. E. Humphrey, N. F. Millis-Biochemical Engineering, Academic Press, New York 2nd Edition (1973)

ENZYME TECHNOLOGY
COURSE CODE: BTT-C-303

CREDITS: 4

Course Objectives:

To provide basic knowledge of enzyme technology and use of enzymes as tools in industry, agriculture and medicine.

COURSE CONTENT:

UNIT-I:

General characteristics of enzymes, activation energy, active site & its importance, nomenclature and classification of enzymes, enzyme activity units, specific activity, coenzymes and cofactors. Sources of enzyme, isolation & purification of enzymes, enzymes catalysis: Michaelis-Menten equation and forms of Michaelis-Menten equation, significance of Vmax & Km. Effect of physiochemical parameters on enzyme activity

UNIT-II:

Types of enzyme inhibition, kinetics of competitive, non-competitive & uncompetitive inhibition, Allosteric inhibition- Positive and negative cooperativity, sigmoidal kinetics and allosteric enzymes. Models accounting cooperativity – Hill, Adair, MWC and KNF models. Cooperative binding of oxygen to haemoglobin – significance of sigmoidal behaviour. Aspartate transcarbamoylase as allosteric enzyme. Importance of enzyme regulation, enzyme induction & repression, covalent modification & feedback inhibition. Abzymes, synzymes & ribozymes.

UNIT-III:

Techniques of enzyme Immobilization, stability of immobilize enzymes. Analytical, therapeutic, environmental and industrial applications of immobilized enzyme. Enzyme engineering- Objectives of Protein Engineering, basic strategy of enzyme engineering. Techniques of Enzyme Engineering, Chemical modification and Site directed mutagenesis to study the structure- function relationship of industrially important enzymes. Properties of enzymes modified by enzyme engineering and their examples.

UNIT-IV:

Enzymes in food & leather industry, enzymes in disease diagnosis(enzymes as thrombolytic & anti-inflammatory agents), enzymes in cancer therapy. biosensors & their applications, enzyme probe.

BTL-C-303 Laboratory Course in Enzyme Technology

1. Isolation of microbial strains for the production of commercially important enzymes.
2. Production of commercially important enzymes from microbial source.
3. Standardization of medium, composition for the optimum production of enzymes
4. Partial purification of isolated enzymes
5. Determination of enzyme activity and specific activity
6. Study of Maltose calibration curve
7. Characterization of enzymes, effect of pH, temperature and inhibitors on enzyme activity.
8. Study of kinetic parameters Km, Vmax and Kcat
9. Molecular weight determination of enzyme by gel filtration method
10. Method of checking the purity of the enzymes SDS PAGE
11. Immobilization of enzymes

Learning Outcomes (LO):

Students will be able to

1. Learn kinetics of enzyme catalyzed reactions & enzyme inhibitory and regulatory process.
2. Perform immobilization of enzymes
3. Get exposure of wide applications of enzymes and their future potential

Reference Books:

1. Dixon, M. and E.C Webb. "Enzyme inhibition and activation" Enzymes 3 (1979)
2. Palmer, T. Understanding enzymes, 4th ed. Prentice Halls/Ellis Horwood, London (1995)
3.Price, Nicholas C., and lewis Stevens. Fundamentals of Enzymology. Oxford science publications. 2nd ed. New York, 2001
4. Buchholz, Klaus, Volker Kasche and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology, John Wiley & Sons, 2012
5. Copeland, Robert A. Enzymes: a practical introduction to structure, mechanism and data analysis, John Wiley & Sons, 2004
6. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, and Jayaraman R, Concepts in Biotechnology, Universities Press (2007).
8. Satyanarayana, U, Biotechnology, Books and Allied (P) Ltd. (2005).
9. Smith JE, Biotechnology, Cambridge University Press (2006).
10. Berg JM, Tymoczko JL and Stryer L, Biochemistry, W H Freeman and Company (2002).
11. Creighton TE, Protein-Structure and Molecular Properties, W.H. Freeman and Co. (1997).
12. Primrose SB and Twyman RM, Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006) 7th ed.
14. Sambrook J, Fritsch EF, Maniatis T, Molecular Cloning: A Laboratory Manual, Cold Spring HarboLaboratory (1999)

RESEARCH METHODOLOGY
COURSE CODE: BTT-C-304

CREDITS: 2

Course Objectives: To familiarize the students how to access new facts using systematic thinking, analysing phenomena, problems and seeking solutions to them based on reliable facts. To familiarize the students with analysis of a phenomenon and trace its basics and refute its cause.

To familiarize the students with the prediction based on scientific evidence, documented methodology and consecutive logical steps.

To provide logical solution to the problem.

To reach new and innovative results based on the latest facts and research.

COURSE CONTENT:

Unit I: Introduction and scope

Science, Scientific Field and Biological research. Role of a researcher in different stages of a project, Routes to research funding (academic and commercial)

Research, Definition, Importance of research, Characteristics of research, Types and steps in research, Identification, Selection and formulation of research problem, Research questions, Research design – Formulation of Hypothesis, Review of Literature.

Unit II: Types of research articles

Type of Articles (review, letters etc). Scientific paper format (Abstract, Introduction, Materials and Methods, Results, Discussion). Writing (ethical Vs unethical), evaluating, presenting and publishing the results of scientific research in the academic press (journals, conferences etc). Choosing the appropriate journal (Sources, Information, Instructions to authors, peer review system, journal evaluation), Case studies of areas of current research. Formulating a research plan and its presentation.

Learning Outcomes (LO):

Students will be able to

1. Understand basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Present a research report and paper
5. Write a research proposal for grant

Text book & References:

1. Kothari CR, Garg G (2004) Research Methodology Methods and Techniques, New Age International Publishers Ltd. Hyderabad.

2. Gupta S (2010) Research Methodology Methods and statistical Techniques, Deep and Deep Publication Pvt. Limited, New Delhi.

ADVANCED INSTRUMENTATION
COURSE CODE: BTT-E-301

CREDITS: 2

Course Objectives: To familiarize students with the basic principle, working of advanced microscopic techniques. Ability to extract important biomolecules from organisms and analyze their structure and to measure thermostability of polymeric molecules.

COURSE CONTENT:

UNIT I:

Principle, working and applications of scanning and transmission electron microscopy, confocal microscopy, atomic force microscopy and fluorescence microscopy. General principle & procedure involved in solid phase extraction and liquid-liquid extraction, LC-MS/MS and GC-MS/MS techniques, MALDI-TOF.

UNIT II:

Principle, instrumentation and applications of Thermogravinometric analysis (TGA), Differential thermal analysis (DTA) & Differential scanning colorimetry. X-ray crystallography- single crystal diffraction & powder diffraction.

Learning Outcomes (LO):

Students will be able to

1. Understand the advanced instruments used and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs
3. Understand the calibration of various analytical instruments
4. Know analysis of drugs using various analytical instruments.

References:

1. Sharma B K (2005) Instrumental methods of chemical analysis, Krishna Prakashan (P), Ltd. Meerut.
2. Sharma Y R (2010) Elementary Organic spectroscopy, S.Chand Publication, New Delhi.
3. Connors K A (2007) Text book of pharmaceutical analysis. Wiley Publishing Company, Hoboken, New Jersey.
4. Vogel A I, Mendham J (2010) Vogle's text book of quantitative chemical analysis, Prentice Hall Publishing Company, Hoboken, New Jersey, U.S.
5. Beckett A H, Stenlake JV (2005) Practical pharmaceutical chemistry, CBS Publishers.
6. Finar I L (2002) Organic Chemistry, Pearson Education India.
7. Kemp W (2019) Organic Spectroscopy, Macmillan publishers U.K.
8. Garrett D C (1976) Quantitative analysis of drugs, Springer Science & Business Media, Berlin/Heidelberg, Germany.
9. Sethi P D (2019) Quantitative analysis of drugs in pharmaceutical formulations, CBS Publications.
10. Silverstein R M, Webster FX, Kiemle D J, Bryce D L (2014) Spectrophotometric identification of organic compounds, John Wiley & Sons Inc, Hobeken, New Jersey, USA.

COMMUNICATION SKILLS IN ENGLISH
COURSE CODE: BTT-E- 302

CREDITS: 2

Course Objectives: To provide the students with the essential skills required for effective communication and to provide a comprehensive view of business communication and its role in the corporate environment.

COURSE CONTENT:

UNIT-I

Essentials of Communication: Meaning, Definition, process, feedback, emergence of communication as a key concept in the corporate and global world, impact of technological advancements in communication.

Channels of Communication: Formal and Informal: Vertical, horizontal, diagonal, and grapevine.

UNIT-II

Methods and Modes of Communication: Verbal and nonverbal, Verbal Communication: Characteristics of verbal communication, Non-verbal Communication: Characteristics of non-verbal communication, kinesics, proxemics and chronemics.

Barriers to Communication: Physical, semantic, language, socio-cultural, psychological barriers, Ways to overcome these barriers.

UNIT-III

Listening: Importance of listening skills, cultivating good listening skills.

Written Communication: Business letters, memos, minutes of meeting, notices, e-mails, agendas and circulars.

Technical Report Writing: Types of Reports, contents of reports. Formatting, writing styles and documentation.

UNIT-IV

Presentations: Principles of effective presentation, power-point presentation, video and satellite conferencing.

Interviews and Group Activities Personal interviews, group discussion and panel discussion

Creative writing: Paragraph and Essay writing, Book reviews, Movie Reviews, Editorials and articles.

Self-Learning: Paper writing: Styles of paper writing: Short Communication, Review papers and Research papers, referencing styles: MLA, Chicago Style and APA.

Learning Outcomes (LO):

Students will be able to:

1. Understand and demonstrate the use proper writing techniques relevant to the present day technological demands, including anticipating audience reaction.
2. Write effective and concise letters and memos, prepare informal and formal reports, proofread and edit copies of business correspondence.
3. Develop interpersonal skills that contribute to effective personal social and professional relationships.

Text & Reference Books:

1. Lehman CM, DuFrene DD, Walker R (2019) BCOM - An Innovative Approach to Learning and Teaching Business Communication, Cengage Learning New Delhi.

2. McMurrey AM, Buckley J (2012) Handbook for Technical Writing, Cengage Learning, New Delhi.

3. Lesikar RV, Flately ME (2008) Basic Business Communication-Skills for Empowering the Internet Generation, Tata McGraw-Hill Publishing Company Limited, New Delhi.

FOREIGN LANGUAGE- FRENCH
COURSE CODE: BTT-E-303

CREDITS: 2

Course objectives:

1. To acquire the phonology of French language.
2. To present and talk about one self and others.
3. Introduction to Grammar.
4. To learn about France.

COURSE CONTENT:

UNIT- I Communicative and linguistic components

Communicative: Formal and informal greetings- To Introduce oneself and to introduce others- Ask and give details of personal information: age, profession, nationality, address, e-mail etc.- To give and ask for time and date – to describe persons and things.

Grammar and Structure: Alphabet and pronunciation- Subject personal pronouns- Indicative Simple Present: Conjugation of -er, - ir, -re ending verbs (Regular verbs, selected irregular verbs)- Basic Negative and interrogative constructions- Gender and number- Question Words -Definite, Indefinite Articles–-Qu'est-cequec'est?, C'est/cesont, Il y a.

Vocabulary: Classroom communication - Nationalities, countries and languages- Parts of the day, days of the week and months- Numbers- Adjectives of Quality -Professions –Internet.

UNIT -II Cultural components

Introduction to France - institutions, symbols, history, culture, physical features, polity.

Learning Outcomes (LO): Students should be able:

1. To master the sounds of French language and its alphabet.
2. To talk about oneself and others briefly.
3. To have a notion of basic grammatical structures of French.
4. To communicate effectively in oral and written format in simple personal and professional situations in French using the linguistic and extra-linguistic skills gained during the course.

References:

1. Régine M, Loiseau Y (2004) Connexions Niveau 1 (Text book and Work book), Didier, Paris.
2. Other select print, illustrated, audio and video material from books, CDs, DVDs and online sources.
3. CLE Grammaire 450 nouveaux Exercices –Débutant (Livre + corriges).
4. DELF/DALF practice books available in the University Library.
5. Haine SW (2000) The History of France, Greenwood Publishing, Westport, Connecticut.
6. Northcutt W (1996) The Regions of France: A Reference Guide to History and Culture, Greenwood Press.
7. Dictionaries and reference books available in the University Library.

FOREIGN LANGUAGE- SPANISH
COURSE CODE: BTT-E- 304

CREDITS: 2

Course objectives:

1. To develop the skills of listening, speaking, reading & writing.
2. To read and understand simple texts.
3. To be able to write brief texts.
4. To be able to listen to simple texts and answering questions on them.
5. To have conversations based on visual texts.

COURSE CONTENT:

UNIT –I: Communicative functions & cultural components

Formal and informal greetings. To introduce oneself and to introduce others. To ask and give details of personal information: name, age, profession, nationality, address, email etc. To give and ask for time and date. To describe every day activities and habits with frequency. To talk of relations with other persons. To talk about one's family. Life and culture of the people where the language is spoken. Diversity of the countries where the language is used. Spanish speaking countries. Spanish songs, music and dance.

UNIT –II: Functional grammar and vocabulary

Alphabet and pronunciation.Subject personal pronouns.Indicative simple present: conjugation of *-ar, - er, -ir*ending verbs (regular verbs, reflexive verbs and selected irregular verbs). Negative and interrogative constructions.Gender and number. Articles and contractions. Interrogative pronouns: *qué, cuál, quién, cómo, dónde, cuándo, cuánto, etc.* Classroom communication. Greetings. Parts of the day. Days of the week. Months of the year. Seasons. Colours. Numbers (0 to 100). Family relations. Languages.

Learning Outcomes (LO):

Learners should be able to -

1. Participate in simple conversations in various day to day situations.
2. Organize ideas and communicate both in the written as well as oral form.
3. Know different aspects of life and culture of the people who speak the language.
4. Know basic concepts of grammar as well as functional and notional questions of language use/registers.

References:

1. J. Corpas, AulaInternacional- I, Inicial. (Libro de alumno, cuaderno de ejercicios, CD). Madrid, 2010.
2. Virgilio Borobio, Nuevo eleinicial 1 (Libro del alumno, cuaderno de ejercicios, casete), Ediciones SM, Madrid, 2005.
3. 450 Ejercicios Gramaticales, Aquilino Sánchez, SGEL, Spain, 2007.
4. Cuadernos de Gramática Española, Emilia Conejo, CIPD, Barcelona, 2008.

5. Dictionaries available in the university library.

6. Other print, audio and video material from various books, CDs, DVDs and the internet.

.

SEMESTER IV

PLANT BIOTECHNOLOGY
COURSE CODE: BTT-C-401

CREDITS: 4

Course objectives:

1. To acquaint the students with basic principles and various methods of Plant Tissue Culture.
2. To impart knowledge about varied methods of gene transfer and transgenic plant development.
3. To understand basics of secondary metabolites and their engineering.
4. To acquire knowledge about molecular markers and their use in plant breeding.

COURSE CONTENT:

UNIT- I

History: Important events in the history of plant tissue culture ; Laboratory Requirements and General Techniques; Cellular Totipotency ; Tissue Culture Media: Introduction, media constituents, media selection, media preparation; Callus Culture; Micropropagation: Introduction, techniques, applications, production of pathogen free plants; Somatic Embryogenesis; Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny of androgenic haploids, plant regeneration from pollen embryos, homozygous diploids, applications, limitations; Triploid production.

UNIT- II

Somaclonal & gametoclonal variations; Protoplast Culture: Protoplast isolation, fusion and regeneration, Cybrids; Embryo Culture and embryo rescue: Introduction, techniques ; Synthetic Seeds; Cell and Suspension Culture: Introduction, isolation of single cells, suspension cultures, culture of single cells, plant cell reactors, applications of cell culture; Production of secondary metabolites: Introduction, strategies used to optimize product yield, commercial aspects.

UNIT- III

Introduction to transgenic technology: Conventional breeding versus Transgenesis; Introduction to *Agrobacterium tumefaciens* and *A. rhizogenes,* Features of Ti and Ri Plasmids and their use as vectors, Binary and co-integrate vectors, *Agrobacterium* mediated transformation*,* Direct DNA transfer to plants, Detection, characterization and expression of Transformants

Applications of plant transformation for productivity and performance: GM technology for : Conferring resistance to biotic stresses (pests, viruses and fungi) and abiotic stresses (draught and salt), Herbicide resistance**,** Increasing shelf life of fruits and flowers**,** Enhancing the nutritional quality (pro-vitamin A), Chloroplast Transformation.

UNIT- IV

Metabolic engineering and industrial products: Plant secondary metabolites: alkaloids, industrial enzymes, biodegradable plastic: polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, oleosin partitioning technology etc, Aspects related to commercial release of transgenic crops.

Molecular marker aided breeding**:** RFLP, RAPD, Microsatelites, AFLP etc.

BTL-C-401 Laboratory Course in Plant Biotechnology

1. Preparation of MS medium
2. Surface sterilization of explants
3. Micro propagation of plant through multiplication of pre-existing meristems.
4. Hardening of *in vitro* raised plants
5. Encapsulation of somatic embryos / Artificial seed preparation
6. Embryo culture and embryo rescue.
7. Protoplast isolation, fusion and culture.
8. *In vitro* production of fast growing normal root culture for production of secondary metabolites
9. Elicitation of plant cells for secondary metabolites
10. *Agrobacterium* Ti plasmid based vector mediated transformation, selection of transformants, reporter gene assay.
11. Transformation of plant tissues using *Agrobacterium rhizogenes*for hairy root production
12. Transformation and expression of GFP gene in suitable host.
13. Developing RFLP maps, Developing RAPD maps

Learning Outcomes (LO):

On completion of this course, the students shall:

1. Demonstrate the knowledge about the techniques of Plant Tissue Culture and acquire comprehensive knowledge on GM technology for quality characteristics and their role in crop improvement.
2. Acquire knowledge in metabolic engineering and industrial products.
3. Develop skills in molecular markers studies and their use in plant breeding.
4. Shall develop scientific skills to work in Plant tissue culture, Pharmaceutical and Research laboratories.

References:

1. Razdan M. K. (2002) Introduction to Plant Tissue Culture; Oxford and IHB Publishing Co. Pvt. Ltd.
2. Kumar U, (1999): Methods in Plant Tissue Culture, Bikaner, Agro Botanica.
3. Misawa Masanaru (1994) Plant tissue culture; an alternative for production of useful metabolites, Daya Publishing House, New Delhi.
4. Bhojwani S. S. and Razdan M. K. (1996) Plant tissue culture, theory and practice a revised edition, Elsevier India Ltd.
5. Ignacimuthu SJ (1997) Applied Plant Biotechnology, Tata McGrew Publishing Company, New Delhi.
6. Flower M. W. and Wasven E. S. (1992). Plant Biotechnology comprehensive Biotechnology supplement, Oxford Pergaman press.

7. Hammand J; McGarvey P and Yusibov V (2000): Plant B:iotechnology, New Products and applications; Springer, New Delhi.

8. Mantell S. H; Matthews J. A.: Makee R A (1985) Principles of Plant Biotechnology; an introduction to genetic Engineering in plants; Oxford, Blackwell- Scientific publication.

9. Chawla Harvinder Singh (1998): Biotechnology in crop improvement: International Book distribution company, Lucknow.

10. Gupta P. K. (1996) Elements of Biotechnology: Rastogi and Company Meerut.

11. Pareek LK. (1997): Trends in Plant tissue culture and Biotechnology; Agro Botanica publishers.

12. Galum E, Breiman A (1997) Transgenic plants: Imperial College Press.

13. Singh BD (1998) Biotechnology, Kalyani Publishers.

14. Narayanswami S (1992) Plant tissue culture, McGraw Hill Education, New York, USA.

15. J. Hammond, P. McGarvey and V. Yusibov (Eds.): Plant Biotechnology, Springer Veriag, 2000.

16. Fu TJ, Singh G, Curist WR (1999) Plant Cell and Tissue Culture for the production of Food Ingredients. Kluwer Academic/Plenum press.

17. Chawla HS (1998) Biotechnology in Crop Improvement. International Book Distribution Company.

PHARMACEUTICAL BIOTECHNOLOGY
COURSE CODE: BTT-C-402

CREDITS: 4

Course objectives:

The objective of this course is to apply the basic Biotechnological concepts in the specific field of pharmaceutical sciences.

To acquaint the students with insights into identification and design of drugs that could be potentially useful in the identification of candidate drugs which have efficacy in cell culture or animal models

COURSE CONTENT:

UNIT –I: Pharmacology of drugs

Physicochemical properties of drugs in relation to biological action, Effects and routes of administration, Drug Targets, Validation techniques of Pharmaceutical targets, Pharmacokinetics and Pharmacodynamics of drugs, Drug Toxicity. Basic terminologies in drug delivery and drug targeting, Doses forms, Strategies for enhanced therapeutic efficacies. DNA vaccines, Vaccines & Monoclonal antibody-based pharmaceuticals and other pharmaceutical products: Streptokinase, streptodornase

UNIT- II: **Antibiotics and Synthetic antimicrobial agents**

Concept of bioassay, therapeutic index, MIC and LD_{50} Mechanism of action, microbial resistance, therapeutic, prophylactic usage and adverse reactions of antibiotic and synthetic antimicrobial agents: β-lactam, aminoglycosides, tetracyclines, ansamycins, macrolides, peptide antibiotics, synthetic antibiotics: Sulphonamides, Chloramphenicol, Quinolone. Antifungal antibiotics: Amphotericin B, Griseofulvin and Fluconazole. Antiviral drugs: Acyclovir, Zidovudine, Amantadine. Antitumor drugs: Bleomycin, Dactinomycin

UNIT- III: Drug discovery methods

Drug Discovery Process, biological activity directed and other types of screening, natural products, combinatorial chemistry; General overview of validation techniques, Methods of Drug Discovery and development, QSAR and SAR. Concepts of Bioavailability, Process of drug absorption, Pharmacokinetic processes, Timing for optimal therapy, Drug delivery considerations for the new biotherapeutics.

UNIT- IV: Formulations and Regulations of drugs

Formulation of Biotechnological Products, Drug Delivery, Examples of some Biotechnological products in clinical development. Role of FDA, ICH Guidelines, The Regulation of Pharmaceutical Biotechnological Products and Ethical Issues. Indian Pharmacopeia and British Pharmacopeia.

BTL-C 401 Laboratory Course in Pharmaceutical Biotechnology

1.Quality control of antibiotic and non-antibiotic formulations using titrimetric, spectrophotometric, chromatographic methods as per IP/US Pharmacopoeia.
2. Microbiological assays of antibiotics.
3. Sterility testing and stability testing of parenteral formulations.
4. Sterility testing of pharmaceutical products (intra-venous injections, antibiotics and vitamins),
5. Assays for screening antimicrobial/antifungal agents from plants and other natural sources.
6. Test for disinfectants (phenol coefficient) / Rideal Walker Coefficient method.
7. Determination of antibacterial spectrum for drugs/antibiotics.
8. Testing for antibiotic / drug sensitivity /resistance.
10. Determination of MIC value for antimicrobial chemicals / LC_{50}

Learning Outcomes (LO):

Students will be able to

1 Explain the strategies and various steps of new drug discovery process.

2 Explain the concept of pharmacodynamics and pharmacokinetics

3 Apply the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals like antibiotics, vaccines, proteins and hormones

4 Carry out the quality control procedures in the production of various biopharmaceuticals

5 Explain the regulatory aspects in the development of pharmaceuticals.

Reference Books

1. Hugo WB, Russel AR (2004) Pharmaceutical Microbiology, 6th Edition. Blackwell Scientific Publications.

2. Kadam SS, Mahadik KR, Bothra KG (2008) Principles of Medicinal Chemistry Vol. 1, 18th Edition, Nirali Publication.

3. Kokate CK, Gokhale SD, Surana SJ, Kalaskar MG (2021) Pharmacognosy, 18th Edition, Nirali Publication.

4. Singh BD (2004) Biotechnology – Expanding Horizon 1st Edition, Kalyani Publication, New Delhi.

5. Vyas SP, Dixit VK (2018) Pharmaceutical Biotechnology, CBS Publishers & Distributors, New Delhi.

6. Hooper DC, Wolfson JS (1989) Fluoro-Quniolinone antimicrobial agents, ASM Washington DC.

7. Cooper MS (1973) Quality control in the Pharmaceutical industry, Vol. 2, Academic Press New York.

8. Rehm HJ, Reed G (1987) Biotechnology, Vol 4 VCH publications, Federal Republic of Germany.

9. Gregoriadis G (1979) Drug carriers in Biology & Medicine, Academic Press New York.

10. Hillery AM, Lloyd AW, Swarbrick J (2001) Drug Delivery and Targeting, Harwood Academic Publisher.

11. Ansel HC, Allen LV, Popovich NG (2005) Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams and Wilkins Publisher.

12. Mohapatra S, Ranjan S, Dasgupta N, Mishra R, Thomas S (2019) Applications of Targeted Nano Drugs and Delivery Systems, Elsevier.

GENOMICS AND PROTEOMICS
COURSE CODE: BTT-C-403

CREDITS: 4

Course objectives: To understand the concept of genomics proteomics and their applications.

To asquint the students with the basic concepts of sequences, structural alignment, database searching, protein structure prediction and computer-based drug designing.

COURSE CONTENT:

UNIT I: Genomics

Introduction, Methods of preparing DNA (isolation and *in-vitro* chemical synthesis), DNA isolation techniques and DNA sequence analysis, Sanger dideoxy method, NGS-Automated sequencing, fluorescence method, Genome mapping: Introduction, methods, construction, use of online tools for genome map construction.

UNIT- II: Genome Engineering

Microarray technology: Introduction, methods and application, Combinational genomics: Introduction and application, synthetic chromosome/ synthetic life pharmacogenomics and proteomics.

UNIT III: Proteomics

Introduction and scope, polyacrylamide gel electrophoresis, Isoelectric focusing, Two dimensional PAGE for proteome analysis and image analysis of 2D gel, Mass spectrometry for protein identification.

UNIT IV: Protein structure prediction

Introduction, principle, tools, application for structure prediction of primary to quaternary structure of proteins, Protein engineering: Introduction, protein chips and functional proteomics, protein modelling, introduction, methods and tools, assigning secondary structure.

BTL-C-402 Laboratory course in Genomics and Proteomics

1 Proteomics tools,

2 Structural and functional predictions of proteins

3 Phylogenetic Analysis/ Phylogenetic tree construction

4 DNA and protein sequence -retrieval and submission

5 Local and global sequence alignment of protein and DNA sequences,

6 Needleman Wunsch and Smith-Waterman algorithm,

7 BLAST, Multiple sequence alignment

Learning Outcomes (LO):

Students will be able to

1 Perform alignment of sequences and construct the matrix for alignment based on dynamic programming and analyse sequence and structure of bio-macromolecule data

2 Construct the phylogenetics of different organisms

3 Edit the three dimensional structure of protein using structural bioinformatics tools

4 Explain the properties of genetic materials and storage and processing of genetic information and analyse genomic data.

5 Explain biological phenomena based on comparative genomics

6 Design transcriptomics and proteomics experiments for studying differential gene expression and related analysis and metagenomics approach for studying phenomena associated with microbial communities.

Reference Books

1 Primrose, S.B. and Twyman, R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006) 7th ed. ISBN 1-4051-3544-1

2 Lesk, A. M., Introduction to Genomics, Oxford University Press (2008), ISBN 978-0-19-955748-6

3 Lesk, A. M., Introduction to Bioinformatics (3rd Edition), Oxford University Press (2011), ISBN 978-0- 19-958079-8

4 Ghosh, Z. and Mallick, B., Bioinformatics Principles and Applications(2008) Oxford University Press ISBN 9780195692303

5 Lewin, B., Genes VIII, International Edition, Pearson Education International (2004), ISBN0131238264

MICROBIAL TECHNOLOGY
COURSE CODE: BTT-E-401

CREDITS: 4

Course objectives: The aim of this course is to impart knowledge about biological & biochemical technologies with focus on biological products, design & operation of industrial practices.

COURSE CONTENT:

UNIT I: Microbial production of therapeutic agents

• Antibiotics: Griseofulvin, Rifamycin
• Antiviral & anticancer agents
• Vaccines, insulin and siderophores.
• Biotransformation of steroids and antibiotics.

UNIT II: Microbial production of solvents, beverages and biofuels

• Solvents: Ethanol, acetone-butanol.
• Beverages: Wine and beer.
• Biofuels- H_2 gas and biodiesel.

UNIT III: Modern trends in Microbial Production

• Biopolymers & Bioplastics: Dextran, Alginate, Xanthan, Pullulan, PHA & PHB.
• Bioferilizers: Nitrogen fixers, Phosphate solubilizers.
• Biomass: Mushroom and probiotics.
• Biosurfactants & Biopigments: Glycolipids, beta-carotene.
• Bio – insecticides & Bioweedicides.

UNIT IV: IPR and IPR Practices

• Introduction to IPR & patents: Composition of patents, patent practices and problems, patent, Trademarks and copyrights.
• Patenting of biological materials: Microbial products, transgenic organisms and isolated genes
• Patent regulation bodies at national and international level.

BTL-C-402 Laboratory Course in Microbial Technology

1. Production, extraction & recovery of amylase using *A. niger / A. oryzae.*
2. Production, extraction & recovery of citric acid using *A. niger.*
3. Production of Glutamic acid using *C. glutamium*
4. Production of penicillin using *Pencillium notatum.*
5. Production of ethanol using *S. cerevisiae.*
6. Microbial production of biosurfactants.
7. Production of biofertilizers & testing of efficacy.
8. Production of siderophore using *Pseudomonas aeruginosa.*

Learning Outcomes (LO):

Students will be able to

1. Demonstrate production of antibiotics, solvents, biopolymer by using microorganisms at lab scale level.
2. Acquire knowledge of biofertilizer, mushroom, biosurfectant and bioinsecticide production as per society need.
3. Familiarize students about patents of microbiological products

Reference books

1. Biotechnology by Open Learning (BITOL) (1997) Biotechnological innovations in Chemical Synthesis, Butterworth-Heinemann, Linacre House, Jordan Hill, Oxford.

2. Reed G (2020) Industrial Microbiology, CBS Publishers and Distributors, Mumbai.

3. Baltz R H, Demain AL, Davies J E (Eds.) (2010) Manual of industrial microbiology and Biotechnology, 3rd Edition. ASM Press.

4. Hershnergy C I, Queener SW, Hageman Q (1998) Genetics and Biotechnology of Industrial Microorganism, Publisher, ASM

5. Ewis C (1998) Bioremediation Principles, McGraw Hill.

6. Crueger W, Crueger A, Aneja K R (2017) Crueger's Biotechnology, A textbook of industrial Microbiology, Medtech Publication.

7. Demain AL, Davies JE, Atlas RM, Cohen G, Hershberger CL, Hu WS, Sherman DH, Willson RC, Wu JHD (1999) Manual of industrial microbiology and Biotechnology 2nd Edition, ASM Publications.

8. Mukhopadhayay S N (2004) Process Biotechnology Fundamentals, 2nd Edition., Viva Books Pvt. Ltd, Mumbai.

9. Rehm H J, Reed G (1983) Biotechnology, Vol. 3 Dellweg, H. (ed.), Verlag Chemie, Basel.

8. Martin A M (1998) Bioconversion of Waste Materials to industrial products, 2nd Edition, Blackie Academic and professional, London.

9. Chincholkar S B, Mukherji KG (2007) Biological Control of Plant Diseases, Hawarth Food and Agricultural Products Press, Oxford.

FOOD BIOTECHNOLOGY
COURSE CODE: BTT-E-402

CREDITS: 4

Course objectives: To provide basic knowledge about food biotechnology and preliminary preparation of food before actual processing steps.

To know the effect of microorganisms on food and to make the clear understanding about chemical and microbiological properties of food etc.

To understand the concept of food born infections and to aware the students about laws and standards in food biotechnology.

COURSE CONTENT:

UNIT-I

Microorganisms in Food: Types of microorganisms associated with food, Factors affecting the growth of micro-organisms in food, Microbial Food Spoilage, Sources of Microorganisms in foods, Some important food spoilage microorganisms, Spoilage of specific food groups- Milk and dairy products, Meat, poultry and sea foods, Cereal and cereal products, Fruits, vegetables and Canned food products.

UNIT-II

Food Fermentations – Definition and types of fermented food, Microorganisms used in food fermentations, Dairy Fermentations- starter cultures and their types, concept of probiotics, biotechnological process for food fortification, prebiotics and oligosaccharides, fermented foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso, soya sauce, beer, wine and traditional Indian fermented foods.

UNIT-III

Foodborne Disease infections and infections, food borne intoxications and toxins with common and recent examples. Control of microorganisms in foods: Principles and methods of preservation, Physical Methods of Food Preservation- Dehydration, Freezing, Cold storage, Heat Treatment, Irradiation, Bio-preservatives i.e Bacteriocins and other natural products, Role of lactic acid bacteria in preservation of food items.

UNIT-IV

Food safety Laws and Standards: Food quality & analysis; Food adulterations, Pre and Post-harvest factors in food quality, Physical, Chemical and Microbiological factors of quality, proximate analysis of foods, sample and sample preparation in foods. food laws: voluntary and mandatory food laws in India. Food certification agencies.

BTL-C-402 Laboratory course in Food Biotechnology

1. Isolation of microorganism from spoiled food (Dairy products, Meat products, Vegetables & Fruits)
2. Isolation of microorganism from traditional Indian fermented foods
3. Production and characterization of bacteriocin from probiotic microorganisms.
4. Antimicrobial activity of spices and oils against food spoilage causing microorganism
5. Microbiological Analysis of Milk: Raw and Pasteurized Milk - MBRT, SPC, Coliform, Sterilized Milk / LHT Milk - Spore Count.
6. Microbiological analysis of Milk Products: Analysis of butter, ice cream, Paneer, Standard plate count, coliform count, yeast and mold count.
7. Proximate analysis of dairy & fermented foods

Learning Outcomes (LO): Students will be able to

1 Comprehend the different microorganisms involved in food Biotechnology with different food items.

2 Define and explain different preliminary steps before and after food fermentation.

3 Comprehend phenomenon of food degradation and spoilage by microorganisms with change in the properties of food.

4 To create awareness about different laws and standards in food biotechnology.

Reference Books

1. Norman NP, Hotchkiss JH (2007) Food Science, 5th Edition , Springer Science & Business Media, Berlin/Heidelberg, Germany.

2. Rahman MS (2007) Handbook of Food Processing, 2nd Edition, CRC Press, Taylor and Francis Group.

3. Frazier WC, Westhoff DC (2004) Food Microbiology, TMH, New Delhi.

4. Sivasankar B (2002) Food Preservation, PHI Learning.

5. Sharma A (2006) Textbook of Food Science & Technology (Vol-I & II), International Book Distributing Company.

6. Cheung P, Mehta CK, Bhavbhuti M (2015) Handbook of Food Chemistry, Springer-Verlag Berlin Heidelberg.

7. Jay JM (2000) Modern Food Microbiology, CBS Publication, New Delhi.

8. Garbutt J (1997) Essentials of Food Microbiology, Arnold, London.

9. Pelczar MJ, Chan ECS, Krieg NR (1993) Microbiology, 5th Edition., TMH, New Delhi

10. Lawley R, Curtis L, Davis,J (2004) The Food Safety Hazard Guidebook , RSC publishing.

ANIMAL BIOTECHNOLOGY
COURSE CODE: BTT-E-403

CREDITS: 4

Course objectives: The objective of this course is to enable students to develop basic skills for vertebrate cell culture, maintenance of cell lines and *in vitro* application of cell and molecular techniques and also to understand the principles of animal cloning and its applications.

COURSE CONTENT:

UNIT -I

Structure and organization of animal cell, Equipments and materials for animal cell culture technology. Primary and established cell line cultures. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum and protein free defined media and their applications. Application of animal cell culture.

UNIT- II

Primary and secondary culture of animal cells: types of primary cell cultures, isolation of tissue and primary culture.

Subcultured propagation, criteria for subculture and propagation, split ratio, subculture in suspension. Basic techniques of mammalian cell culture *in vitro*, disaggregation of tissue and primary culture; maintenance of cell culture; cell separation.

Scaling- up of animal cell culture.

UNIT -III

Culture and maintenance of cell lines, Biology and characterization of the cultured cells, Measurement of viability of cell lines. Model animals in animal biotechnology

DNA transfer techniques into mammalian cells, Microinjection, electroporation, Stem cell etc. Artificial insemination, IVF, somatic cell nuclear transfer and stem cell technology.

UNIT -IV

Principle, Concept and applications of animal cloning, embryonic stem cells and their applications

Cell culture based vaccines, viral vectors, Gene therapy, animal ethics and bio safety, Principle of tissue engineering

BTL-C-402 Laboratory course in Animal Biotechnology

1. Enumeration of Red Blood cells (RBCs) from sheep and human blood
2. Isolation of Cells from Liver tissue and its Quantification
3. Cell Viability assay using dye-exclusion method
4. Micronucleus Assay
5. Hemolytic test for *Staphylococcus aureus*
6. Con-A induced Hemagglutination Assay
7. Anchorage independent cell culture (Lymphocyte culture)
8. Anchorage dependent cell culture (Chick embryo cell culture)
9. Epithelial cell culture
10. Anti-angiogenic activity using chick chorio-allantoic membrane (CAM) assay
11. Preparation of culture media.

Learning Outcomes (LO):

Students will be able to

1 Explain the fundamental scientific principles that underlie cell culture

2 Acquire knowledge for isolation, maintenance and growth of cells.

3 Develop proficiency in establishing and maintaining of cell lines.

4 Acquire knowledge in animal cloning and its applications

Reference Books

1 R. Ian Freshney Culture of Animal Cells: A Manual of Basic Technique, 4th Edition" 2000.
2 Ranga, M.M., Animal Biotechnology, Agrobios (2007) 2nd ed.
3 Masters, J. R.W., Animal Cell Culture, Oxford (2000) 3rd ed.
4 Marshak L, Stem Cell Biology, Cold Spring Harbor Publication, (2001).

INFECTIOUS DISEASES AND VACCINE TECHNOLOGY
COURSE CODE: BTT-OE-101

Credit: 02

Course Objectives

The objective of this course is to provide detailed knowledge of important infectious diseases of human caused by viruses, bacteria, fungi and protozoa and their mode of infection, symptoms, detection, epidemiology and treatment.

The familiarize the students with conventional and modern vaccines for prevention of diseases

COURSE CONTENTS:

UNIT-I

Microbial Diseases of Humans: mode of infection, symptoms, detection, epidemiology and control measures of disease caused by Viruses (AIDS, Hepatitis- B, Rabies, HSV-1), Bacteria (Typhoid, STD, TB, Plague), Fungi (Aspergillosis, Histoplasmosis, Cryptococcosis) and Protozoa (Malaria, Amoebiasis).

UNIT-II

History of vaccines, Conventional vaccines; Bacterial vaccines; Viral Vaccines; Vaccines based on routes of administration: parenteral, oral, mucosal; Live attenuated and inactivated vaccine; Subunit Vaccines and Toxoids; Peptide Vaccine.

New Vaccine Technologies: Rationally designed Vaccines; DNA Vaccination; Mucosal vaccination; New approaches for vaccine delivery; Engineering virus vectors for vaccination; Vaccines for targeted delivery (Vaccine Delivery systems); Disease specific vaccine design: Tuberculosis Vaccine; Malaria Vaccine; HIV/AIDS vaccine; New emerging diseases and vaccine needs (Ebola, Zika & COVID-19).

Student Learning Outcomes (LO):

After successful completion of the course student will be able to understand

1. Mode of infection, symptoms, detection, and control of human diseases
2. Understands merit and demerits of conventional vaccines
3. How modern vaccine are designed rationally to enhances efficacy

Recommended Textbooks and References:

1. Judit Pongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier publications, 2008
2. S N Jogdand Medical Biotechnology 2nd Edition Himalaya publishers 2008
3. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2005). Immuno Biology: The Immune System in Health and Disease. USA: Garland Science Pub.
4. Kindt, T. J., Osborne, B. A., Goldsby, R. A., &Kuby, J. (2013). Kuby Immunology. New York: W.H. Freeman.
5. Kaufmann, S. H. (2004). Novel Vaccination Strategies. Weinheim: Wiley-VCH.
6. Journal Articles (relevant issues) from: Annual Review of Immunology, Annual Review of Microbiology, Current Opinion in Immunology, Nature Immunology, Expert review of vaccines.

COMPUTER AIDED DRUG DESIGN
COURSE CODE: BTT-OE-201

Credit: 02

Course Objectives: The objectives of this course is to provide theory and practical experience common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts.

COURSE CONTENT

UNIT-I

Introduction to Drug Discovery and Development: Stages of drug discovery and development, Lead discovery and Analog Based Drug Design. Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Quantitative Structure Activity Relationship (QSAR). SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-II

Molecular Modelling and virtual screening techniques. Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping andpharmacophore-based Screening, Molecular docking: Rigid docking, flexible docking, manualdocking, Docking based screening. De novo drug design.

Informatics & Methods in drug design: Introduction to Bioinformatics, cheminformatics. ADME databases, chemical, biochemical and pharmaceutical databases. Molecular Modelling: Energy minimization methods and Conformational Analysis

Student Learning Outcomes (LO):

Student should be able to:

Develop an understanding of basic theory of these computational tools; Gain working knowledge of these computational tools and methods; Appreciate their relevance for investigating specific contemporary biological questions; Critically analyse and interpret results of their study.

Recommended Textbooks and References:

1. Suryawanshi CP, Usman MR, Wagh RD, Sathe BS, Khan GJ (2019) Computer aided drug design, S Vikas and Company (PV), India.

2. Coumar MS Molecular Docking for Computer-Aided Drug Design: Fundamentals, Techniques, Resources and Applications, Academic Press Inc.

3.Regalla SP (2020) Computer Aided Analysis and Design, Dreamtech Press, New Delhi

4. Chhajed S, Bastikar V, Mohapatra DK, Bastikar A (2019) Computer Aided Drug Design, Everest Publishing House, Pune

5.Chittipolu AK, Sreepada D (2021) Computer Aided Drug Design and Tools Directory, AkiNik Publications, New Delhi.

FOOD BIOTECHNOLOGY
COURSE CODE: BTT-OE-301

Credit: 02

Course Objectives: The objective of this course is to provide basic knowledge of food biotechnology. This elective course is designed for those students who have no Life Science background and wish to study microbial spoilage of food and their control as well as to understand importance of prebiotics and probiotics in human diet.

COURSE CONTENTS:

Unit I

Microbes in Food Spoilage & Control: Types of micro-organisms normally associated with food, mold, yeast, and bacteria, Microbial growth pattern, physical and chemical factors influencing destruction of microorganisms.

Micro-organisms in natural food products and their control. Biochemical changes caused by micro-organisms, deterioration and spoilage of various types of food products. Food poisoning and microbial toxins, standards for different foods. Food borne intoxicants and mycotoxins.

Unit II

Prebiotic sand Probiotics: Food Sources- Prebiotics Dietary fibre, Oligosaccharides (Galacto-oligosaccharides, Fructooligosaccharides), Resistant Starch, Sugar alcohols, Traditional Fermented Foods as sources of Probiotics. Strains of microorganisms used as probiotics and Role in Health and Disease, Mechanism of Action, Levels of Probiotics required for therapeutic efficacy. Genetically modified foods (GM foods): Crops Fruits and vegetables Genetically modified livestock and fish (GM fish).

Student Learning Outcomes (LO): After successful completion of the course student will be able to understand

1. Scope of microbial food spoilage & control by using different methods
2. Food poisoning associated with microbial toxins and food borne intoxicants and mycotoxins
3. Role of prebiotics and probiotics in health and disease control
4.Significance of genetically modified foods

Recommended Textbooks and References:

1. Anthony Pometto (2005). Food Biotechnology, 2nd Edition. CRC Press
2. Byong H Lee (2014). Fundamentals of Food Biotechnology, 2nd Edition, Wiley Blackwell
3. Goldberg, I 1994. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall
4. Gibson, GR and William, CM. (2000). Functional foods - Concept to Product. Wood head publishing.
5. Aluko, R.E. (2012). Functional Foods and Nutraceuticals. Springer
6. Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, New York.
7. Jay J.M. 1986. Modern Food Microbiology. 3rd Edition. VNR, New York.
8. Robinson, R.K. Ed. 1983. Dairy Microbiology. Applied Science, London.

FUNDAMENTALS OF INTELLECTUAL PROPERTY RIGHTS
COURSE CODE: BTT-OE-401

Credit: 02

Course Objectives: To make the students familiar with basics of IPR and their implications in research, development and commercialization.

To facilitate the students toexplore career options in IPR.

COURSE CONTENTS

UNIT-I

Concept of Intellectual Property Rights: Protection of innovations by IPR such as Patents, Trademarks, Copyright, Industrial Designs Registrations, Geographical Indications, Trade Secrets etc. Territoriality of IPR; Role of WTO and WIPO; Balancing Rights and Responsibilities.

Patents: Benchmarks for patentability of inventions; Understanding the Patent system in India; Filing patents outside of India. Searching patents databases for designing research objectives; online patents search patent search strategy; Debates surrounding patent protection in fields like Biotechnology, Computer sciences, etc.

UNIT-II

Industrial Designs Registrations and copyright: Classification, Protection and Enforcement of Industrial Designs in India. Registration and protection of design in India and abroad.

Trade secretes : Trade secretes and its maintenance, Types of trade secretes, applications, enforcement of trade secrete rights in Biotechnology.

Student Learning Outcomes (LO):

1. The students will be able to get an adequate knowledge on patent and copyright for their innovative research work.
2. During their research career, information on patent documents provide useful insight on novelty of their idea from state-of-the art search. This provides further way for developing their ideas or innovations

Recommended Textbooks and References:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management .India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. Ganguli Prabuddha “Intellectual Property Rights--Unleashing the Knowledge Economy”, Tata McGraw Hill (2001).

****