

**RayatShikshanSanstha's**  
**KarmaveerBhauraoPatil College, Vashi**  
**(AUTONOMOUS)**



**Syllabus for Approval**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
1.	Title of the Course	F.Y.B.Sc. in Biotechnology
2.	Eligibility for Admission	H.S.C.
3.	Passing Marks	40%
4.	Ordinances/ Regulation	
5.	No. of Years/ Semester	1 Year / 2 Semesters
6.	Level	Undergraduate (UG)
7.	Pattern	Semester
8.	Status	Revised (As Per NEP2020)
9.	To be implemented from Academic Year	2023-24

Date:

Name of BOS Chairperson: \_\_\_\_\_ Signature: \_\_\_\_\_

**RAYAT SHIKSHAN SANSTHA'S  
KARMAVEER BHAURAO PATIL COLLEGE, VASHI  
(AUTONOMOUS)**



**Proposed Syllabus**

**For**

**F.Y.B.Sc. in Biotechnology**

**2023-24**

### **Preamble of the Syllabus:**

Bachelor of Science (B.Sc.) in Biotechnology is a under graduation course of Department of Biotechnology, KarmaveerBhauraoPatil College Vashi, Navi Mumbai, affiliated to University of Mumbai (MH). Biotechnology is defined as the application of technological principles for the processing or manipulating biological agents to provide goods and services. It derives its strength by harnessing biological processes that sustain life. It is a technology that is more reliable and firm. Biotechnology has the potential to transform the lives of the people by impacting hugely on agriculture, animal husbandry, health and medicines, environment, sustainable development, etc. Biotechnology has accomplished tremendous applications in just a matter of time. People have just started to recognize the endless window of opportunities it has open. Biotechnology has revolutionized the recent advancements in research and development. CBSGS: The Choice Based Semester and Grading System to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

## **Program Education Objective (PEO's):**

To prepare students to prime for-

- Higher education and research in field of biotechnology and related subjects.
- Careers related broadly to biotechnology and life sciences. Students will embark upon diverse career paths medical coding/pharmaceutical/biotechnology industries, and use their education in a variety of related endeavors.

## **Course Objective:**

- To produce students who understand fundamental principles of basic sciences and apply that understanding to analyze, solve problems and interrelate with current technological developments.
- To promote independent learning and add rationale thinking, knowledge ability by activity based learning, innovative, teaching learning and evaluation methods.

**Name of the Faculty: Science and Technology**

**Name of the Program: BSc**

**Program Outcomes (POs):**

<b>PO-1</b>	<b>Disciplinary Knowledge:</b> Understand the basic concepts, fundamental principles, theoretical formulations and experimental findings and the scientific theories related to Physics, Chemistry, Mathematics, Microbiology, Computer Science, Biotechnology, Information Technology and its other fields related to the program.
<b>PO-2</b>	<b>Communication Skills:</b> Develop various communication skills such as reading, listening and speaking skills to express ideas and views clearly and effectively.
<b>PO-3</b>	<b>Critical Thinking:</b> Propose novel ideas in explaining the scientific data, facts and figures related to science and technology.
<b>PO-4</b>	<b>Analytical Reasoning and Problem Solving:</b> Hypothesize, analyze, formulate and interpret the data systematically and solve theoretical and numerical problems in the diverse areas of science and technology.
<b>PO-5</b>	<b>Sense of Inquiry:</b> Curiously ask relevant questions for better understanding of fundamental concepts and principles, scientific theories and applications related to the study.
<b>PO-6</b>	<b>Use of Modern Tools:</b> Operate modern tools, equipments, instruments and laboratory techniques to perform the experiments and write the programs in different languages (software).
<b>PO-7</b>	<b>Research Skills:</b> Understand to design, collect, analyze, interpret and evaluate information/data that is relevant to science and technology.
<b>PO-8</b>	<b>Application of Knowledge:</b> Develop scientific outlook and apply the knowledge with respect to subject.
<b>PO-9</b>	<b>Ethical Awareness:</b> Imbibe ethical, moral and social values and exercise it in day to day life.
<b>PO-10</b>	<b>Teamwork:</b> Work collectively and participate to take initiative for various field-based situations related to science, technology and society at large.
<b>PO-11</b>	<b>Environment and Sustainability:</b> Create social awareness about environment and develop sustainability for betterment of future.
<b>PO-12</b>	<b>Lifelong Learning:</b> Ability of self-driven to explore, learn and gain knowledge and new skills to improve the quality of life and sense of self-worth by paying attention to the ideas and goals throughout the life.

**Name of the Faculty: Science and Technology**

**Name of the Program: Certificate Course in B. Sc Biotechnology**

**Program Specific Outcomes (PSOs):**

Students will be able to –

<b>PSO-1</b>	<b>Identify, understand and analyze</b> problems and propose valid solutions related to field of Biotechnology.
<b>PSO-2</b>	<b>Critically evaluate</b> biotechnological solutions on environment and societies keeping in mind the need for sustainable solutions.
<b>PSO-3</b>	<b>Develop</b> a research based ideology and technical skills to build career in Biotechnology.

# **SEMESTER-I**

**F.Y. B. Sc Biotechnology (Honors)**  
**Proposed Semester I Plan**  
**2023-24**

<b>Sem</b>	<b>Major</b>	<b>Minor</b>	<b>OE</b>	<b>VSC, SEC (VSEC)</b>	<b>AEC, VEC, IKS</b>	<b>OJT, FP, CEP, CC, RP</b>	<b>Cum Cr. / Sem</b>
<b>I</b>	<b>Fundamentals of Biotechnology (4 Credits)</b>  <b>(BT101)</b>	<b>Fundamentals of Biotechnology (4 Credits)</b>  <b>(BT101)</b>	<b>Beverage technology (4 Credits)</b>  <b>(BT102)</b>	<b>VSC- Biomolecules (BT103)</b>  <b>SEC- Green House Technology (BT104)</b>  <b>(2 Credits each)</b>	<b>AEC- 2, VEC- 2, IKS-2</b>	<b>CC-2</b>	<b>24</b>
<b>II</b>	<b>Basics of Cell Biology &amp; Genetics (4 Credits)</b>  <b>(BT151)</b>	<b>Basics of Cell Biology &amp; Genetics (4 Credits)</b>  <b>(BT151)</b>	<b>Food Adulteration &amp; Safety (4 Credits)</b>  <b>(BT152)</b>	<b>VSC-Biofuel Production (BT153)</b>  <b>SEC-Basics of Bioinformatics (BT154)</b>  <b>(2 Credits each)</b>	<b>AEC- 2, VEC- 2, IKS-2</b>	<b>CC-2</b>	<b>24</b>
<b>Cum Cr.</b>	<b>4+4</b>	<b>4+4</b>	<b>4+4</b>	<b>4+4</b>	<b>4+4+4</b>	<b>4</b>	<b>48</b>



**F.Y.B.Sc Biotechnology (Honours)**

**Proposed Semester I Syllabus**

**2023-24**

**Major / Minor**

**Paper Name: Fundamentals of Biotechnology**

**Paper Code: BT101**

**No. of credits: 4**

<b>Course Outcome</b>	<b>Student will be able to –</b>	<b>No. of lectures</b>
	<ul style="list-style-type: none"><li>• Understand fundamental vocabulary and Concepts of Biotechnology</li><li>• Differentiate between Traditional Biotechnology and Modern Biotechnology</li><li>• State various branches and applications of Biotechnology</li><li>• Understand the concept of cell culture and organization of tissue culture laboratories</li><li>• Understand the principles of plant and animal tissue culture</li></ul>	
<b>Unit 1 Introduction and Scope of Biotechnology</b>	What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology- Pharmaceutical Biotechnology, Plant, Animal Biotechnology, Marine Biotechnology, Industrial Biotechnology, Environmental Biotechnology. Biotechnology Research in India, Biotechnology in context of developing world, Public perception of Biotechnology, Ethics in Biotechnology and IPR.	15 Lectures
<b>Unit 2 Applications of Biotechnology</b>	In agriculture: Genetically modified plants and animals with examples, pros and cons, Application in crop and livestock improvements, Modifications in plant quality- Golden rice, Insect resistance- Bt crops, Molecular Farming, Plant based vaccines, Biopesticides, Biofertilizers In industry: Enzymes, Fermentation based products, Bio-fuel, Bio-energy In healthcare: Vaccines, Monoclonal antibodies, Stem cell research, Gene therapy In environment: GMO, Bioremediation and Biosensors	15 Lectures
<b>Unit-3 Basics of Animal and Plant Tissue Culture</b>	Cell theory, Definition of cell differentiation, de-differentiation, re-differentiation and regeneration PTC: Cellular totipotency, Concept of cell culture, Organization of plant tissue culture laboratory equipments and general practice, Aseptic techniques.	15 Lectures

	<p>Culture medium: Preparation and Media sterilization, Nutritional requirements of the explants, PGR's and their in vitro roles</p> <p>Callus culture technique: Introduction, Initiation and growth.</p> <p>ATC: Introduction, Properties of normal cells, Morphology of cells in culture</p> <p>Cell culture techniques, Equipment and sterilization methodology, Nutritional and physiological requirements: Growth factors and growth parameters, Serum free media</p>	
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### **Fundamentals of Biotechnology-References**

1. Advanced Biotechnology, R.C. Dubey
2. Biotechnology, B.D. Singh
3. Biotechnology, S.N. Jogdand
4. Text book of Biotechnology, R.C. Dubey
5. Text of Biotechnology, S. Chand
6. Animal cell culture, SudhaGangal
7. Plant tissue culture, M.K.Razdan

### **Laboratory Sessions**

#### **Fundamentals of Biotechnology**

1	Assignment- Study of any branch of Biotechnology and its applications
2	Assignment- Biotech company review
3	Immobilization of enzymes
4.	Study of instruments and equipment's used in ATC and PTC
5.	Trypsinisation of animal tissue.
6.	Viable count using trypan blue
7.	PTC media preparation
8.	Surface sterilization of different explants
9.	Encapsulation of germinating seeds

## Open Elective (OE)

**Paper Name: Beverage Technology**

**Paper Code: BT102**

**No. of credits: 4**

<b>Course Outcome</b>	<b>Student will be able to –</b>	<b>No. of lectures</b>
<b>Unit 1 Introduction and Overview of Beverage Technology</b>	<ul style="list-style-type: none"><li>• Understand the various concepts and principles of beverage technology.</li><li>• List the quality control steps in beverage production</li><li>• Understand the industrial production of different types of beverages</li></ul>	15 lectures
<b>Unit 2 Industrial Production of Beverages</b>	<ul style="list-style-type: none"><li>• Introduction and History of beverage technology.</li><li>• Type of beverages: fruit &amp; vegetable juices, fermented and non-fermented beverages, synthetic beverages, carbonated and non-carbonated beverages.</li><li>• Water for beverages: Types of water required for beverages, treatment of water.</li><li>• Additives for beverages: Natural and synthetic sweeteners and colours, acids, emulsifiers, preservatives, flavours and flavour enhancers.</li><li>• Quality control of beverage: Quality standards for beverages, chemical, microbial and sensory evaluation, product shelf life.</li></ul>	15 lectures
<b>Unit 3 Processing and Preservation.</b>	<ul style="list-style-type: none"><li>• Non-carbonated and carbonated synthetic beverages:-Ingredients, source of carbon dioxide, chemical and physical properties of carbon dioxide, carbonating process, packaging of carbonating beverages.</li><li>• Alcoholic Beverages: -Non-Distilled Beverages : Beer and Wine; Distilled Beverages :Vodka and Whisky.</li></ul>	15 lectures

	<p>concentration and drying Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products; FSSAI specifications and preparation and preservation of juices, squashes, syrups, sherbets. Preparation, and preservation ,machines used for manufacture of crystallized fruits and preserves, jam, jelly and candies. Preparation, preservation and machines for manufacture of chutney, pickles, sauce, puree, paste, ketchup.</p>	
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### Beverage Technology -References

1. Principles of fermentation technology- Allen WhittkarAne’s student edition.
2. Industrial Microbiology by Prescott and Dunn, fourth edition.
3. Ashurst, P.R, Chemistry and technology of Soft drink and fruit juices, 2ndedition, Blackwell Publishing Ltd. 2005.
4. Steen, D.P and Ashurst, P.R, Carbonated soft drinks – Formulation and manufacture, Blackwell Publishing Ltd. 2000.
5. ShankunthalaManay, N. and Shadakdharaswamy, M, Foods – Facts and Principles, New Age International Pvt. Ltd, 3rd revised edition 2000.
6. Handbook of food and beverage fermentation technology by Y.H. Hui 2004.

### Laboratory Sessions

#### Beverage Technology (UGBTGEP101)

1	Study of different types of fermenters and their applications.
2	Sterilization of fermenter using moist heat.
3	Study of growth characteristics (growth curve) of <i>Saccharomyces cerevisiae</i> .
4	Production of wine by traditional method and its sensory evaluation.
5	Estimation of alcohol by dichromate method.
6	Preparation of jam from selected fruits and canning of fruits like mango, guava
7	Visit to beverage plant.

## Vocational Skill Course (VSC)

**Paper Name: Biomolecules**

**Paper Code: BT103**

**No. of credits: 2**

Course Outcome	Student will be able to –	No. of lectures
<b>Unit 1 Carbohydrates and Lipids</b>	<p>Student will be able to –</p> <ul style="list-style-type: none"> <li>• Compare and contrast different Biomolecules</li> <li>• Discriminate structural and functional characteristics of various Biomolecules</li> <li>• Illustrate the structure and Characterization of Biomolecules</li> </ul> <p>Carbohydrates: Introduction, Biological importance, Definition, Classification, (Glyceraldehydes, Simple Aldoses, Simple Ketoses, D-glucose, Conformation of D-glucose) Monosaccharides other than glucose, glycosidic bond, disaccharides, polysaccharides (starch, glycogen), peptidoglycan, proteoglycan matrix.</p> <p>Lipids: Introduction, classes, fatty acids [physical and chemical properties] simple lipids, complex lipids. Steroid lipids, structural, functional storage lipids. Saturated and unsaturated fatty acids, uses as- signal, cofactor, pigment.</p>	15 Lectures
<b>Unit 2 Amino Acids &amp; Proteins</b>	<p><b>Amino Acids:</b> Classification, Structure and properties of amino acids, Titration curve, Acid- Base behavior, Zwitter ions, isoelectric pH, reactions</p> <p><b>Proteins:</b> Structure-peptide bond, -S-S (inter &amp; intra), Primary structure, Secondary structure, Tertiary structure - Interaction (Myoglobin, Hemoglobin structure as an example), Quaternary structure - Interaction in peptide Hb, Protein sequencing – Sanger’s reaction, Edman’s method, Sorenson’s titration , Denaturation of proteins, coagulation of proteins</p> <p>Different types of Proteins in the living system</p> <p><b>Enzymes:</b> Definition (zymogens, co enzymes, co factors, apoenzymes, isoenzymes) Classification, nomenclature, chemical nature, properties of enzymes, Mechanism of enzyme action, active site, enzyme specificity, Effect of pH, temperature, substrate concentration and inhibitor on enzyme activity.</p>	15 Lectures

## **Fundamentals of Biotechnology-References**

1. Biochemistry, Satyanarayana, 2<sup>nd</sup> edition, Books and Allied Pvt Ltd.
2. Lehninger, Principles of Biochemistry. 5<sup>th</sup> Edition (2008), Nelson and Cox
3. Fundamentals of Biochemistry. 3<sup>rd</sup> Edition (2008), Donald Voet & Judith Voet
4. Biochemistry, 7<sup>th</sup> Edition, (2012), Jeremy Berg, Lubert Strye

## **Laboratory Sessions**

### **Fundamentals of Biotechnology**

1	Qualitative test for carbohydrates- Molisch, Benedicts, Iodine
2	Qualitative test for lipids- Solubility test, Grease test, Saponification, Hubl's iodine test, Salkowski's test.
3	Qualitative test for proteins - Biuret, Heat coagulation, Full and half saturation test, Ninhydrin test, Xanthoproteic test
4	Estimation of glucose by DNSA method
5	Estimation of protein by Biuret method
6	Effect of Substrate, enzyme concentration, temperature, pH and inhibitors on enzyme activity

## Skill enhancement course (SEC)

**Paper Name: Green house technology**

**Paper Code: BT104**

**No. of credits: 2**

<b>Course Outcome</b>	<b>Student will be able to –</b>	<b>No. of lectures</b>
	<ul style="list-style-type: none"><li>• Understand the concept of Greenhouse, Protected Agricultural Systems, Precision Agriculture, Hydroponics and Aeroponics</li><li>• Gain the Knowledge of various types and features of Greenhouse and its importance.</li><li>• Understand the economics of Greenhouse System</li><li>• Gain the ability to design a Greenhouse System.</li></ul>	
<b>Unit 1 Introduction to Greenhouse Technology</b>	Introduction to Greenhouse Technology Introduction to agriculture and Agricultural system, History of Greenhouse, Concept of Greenhouse technology, Importance and Features of Greenhouse, Types of Greenhouse, Advantages of Greenhouse over Traditional Agriculture Systems	15 lectures
<b>Unit 2 Features of Greenhouse and Advanced Protected Agricultural System</b>	Plant Responses to Greenhouse Environment, Environmental Control inside Greenhouse, Construction of Typical Greenhouse, Covering and Construction Materials of Greenhouse, Growth media, Irrigation, Ventilation, shading, cooling, and Heating system of Greenhouse, Economics of Greenhouse Production, Computer controlled Greenhouse, Concept of Hydroponics, Aeroponics and Precision Agriculture.	15 lectures

### Reference:

1. Greenhouse Technology, 2nd Edition, K RadhaManohar, C. igathenathane.
2. Greenhouse Technology, Arupratan Ghosh

## Laboratory Sessions

### Green House Technology

1	Visit to Greenhouse facility and submission of field visit report.
2	Design a low cost Greenhouse facility
3	Design a high cost Greenhouse facility with advanced equipment
4	In-house set up of Hydroponics

# SEMESTER-II



**F.Y.B.Sc Biotechnology (Honours)**

**Proposed Semester I Syllabus**

**2023-24**

**Major / Minor**

**Paper Name: Cell Biology & Genetics**

**Paper Code: BT201**

**No. of credits: 4**

<b>Course Outcome</b>	<b>Student will be able to –</b>	<b>No. of lectures</b>
	CO-1 - Understand the difference between prokaryotic and eukaryotic cell CO-2 - Understand the principles of cellular transport & its role in different processes in body. CO-3 – Understand the structures of cell organelles and & its role. CO-4 - Understand basic foundation in field of genetics with emphasis on laws of inheritance	
<b>Unit 1 Cell &amp; Cell Organelles</b>	Ultrastructure of Prokaryotic cell: Concept of Cell Shape and Size, Detail structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cell membrane, Cytoplasm and Genetic Material Storage Bodies and Spores. Ultrastructure of Eukaryotic Cell: Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Organelles of the Biosynthetic- Secretory and Endocytic Pathways – Endoplasmic Reticulum & Golgi Apparatus, Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria and Chloroplasts, Nucleus –Nuclear Structure, Nucleolus External Cell Coverings: Cilia And Flagella, Comparison Of Prokaryotic And Eukaryotic cell	15 Lectures
<b>Unit 2 Cell Division and Study of Chromosomes</b>	Overview of cell cycle, mitosis and meiosis, Structure and shapes of metaphase chromosomes, Histone and non-histone proteins, Nucleosome and packaging of DNA into chromosome, Chromosome banding. Karyotype analysis (Normal human karyotype), Study of genetic abnormalities- Turners syndrome, Klinefelter syndrome, Down syndrome, Cri-du-chat, Philadelphia chromosome, Sex determination, Dosages compensation.	15 Lectures
<b>Unit-3 Mendelian Genetics</b>	Terminologies, Monohybrid Cross: Principle of Dominance and Segregation. Dihybrid Cross: Principle of Independent Assortment, Punnett Square, Extension of Mendelian Genetics, Incomplete Dominance and Co-	15 Lectures

	<p>dominance.  Multiple Alleles, Allelic series, Gene Interaction, Epistasis- Dominant and recessive epistasis, Environmental effect on the expression of the Human genes, Mendel's Principle in Human Genetics - Pedigree analysis, characteristics of human autosomal and sex-linked traits, Problems based on monohybrid, dihybrid cross and pedigree analysis.</p>	
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### Cell Biology & Genetics-References

1. Cell & Molecular Biology, Gerald Karp, 6<sup>th</sup> Edition
2. The Cell by Cooper and Hausman, 4<sup>th</sup> edition.
3. Genetics by Peter Russell, 5<sup>th</sup> Edition
4. iGenetics : A Molecular Approach by Russell, 3<sup>rd</sup> Edition
5. Concepts of Genetics by William S. Klug and Michael R. Cummings, 7<sup>th</sup> Edition

### Laboratory Sessions

#### Cell Biology & Genetics

1	Staining techniques: Monochrome staining, Gram staining
2	Capsule and Endospore staining
3	Endocytosis and Exocytosis
4.	Mitosis in onion root tip
5.	Meiosis in Tradescantia flower bud (permanent slides)
6.	Qualitative test for nucleic acids (DNA & RNA)
7.	Problems based on Mendelian Genetics
8.	Problems based on Pedigree analysis
9.	ABO blood grouping
10.	Karyotype analysis of normal male and female
11.	Karyotype analysis of different human syndromes
12.	Problems based on two point and three point cross

## Open Elective (OE)

**Paper Name: Food Adulteration & Safety**

**Paper Code: BT 202**

**No. of credits: 4**

<b>Course Outcome</b>	<b>Student will be able to –</b> CO1: Understand the effect of food adulteration CO2: Know commonly used adulterants CO3: Concept of sanitation and hygienic food production CO4: Different food safety law and its importance CO5: Quality control and its importance	<b>No. of lectures</b>
<b>Unit 1 Food Adulteration</b>	Commonly used adulterants and adverse effects in: Tea leaves, Coriander and cumin powder, Green vegetables, Arhar pulse, Black pepper, Rice, Wheat, Coffee powder, Jaggery, Asafoetida, Gram powder, Processed food, Parched rice, Turmeric powder, Dry red chilli, Sweet potato, Dry turmeric root, Mustard oil, Edible oil, Soda lemonade, Milk, Sweet curd, Rabdi, Ghee etc.	15 lectures
<b>Unit 2 Food safety</b>	Aspects of food safety- HACCP, GMP, role of FDA, Agmark, ISI, fssai Concept of sanitation and hygienic production of food Food Act, Food rules and Quality control	15 lectures

### References:

1. Manual for Detection of the Common Food Adulterants, Edwin M Bruce
2. Food Microbiology, Frazier and Westhoff, Tata McGraw Hill Publishers, New Delhi
3. Nutrition science, B. Srilaxmi, New age international (P) Ltd
4. Quick test for some adulterants in food, Instruction manual- Part II, FSSAI
5. Restaurant X Food Safety Training Manual

### Laboratory Sessions

**Food Adulteration & Safety-** Testing of commonly used adulterants in:

<b>Sr. No.</b>	<b>Food Groups</b>	<b>Food Items</b>
1	Beverages	Tea, coffee, soda lemonade etc
2	Pulses	Arhar pulse, moong, chick pea, matki etc
3	Grains	Rice, wheat, ragi,
4	Dairy & dairy products	Milk, curd, ghee, butter etc
5	Sweeteners	Sugar & Jaggery
6	Spices & condiments	Black pepper, asafoetida, turmeric, chilli, mustard, coriander powder etc
7	Fats	Edible oil

## Vocational Skill Course (VSC)

**Paper Name: Biofuel Production**

**Paper Code: BT 203**

**No. of credits: 2**

<b>Course Outcome</b>	<b>Student will be able to –</b>	<b>No. of lectures</b>
<b>Unit 1 Introduction to Biofuels</b>	CO1-Understand the various concepts related to bioenergy and list the need for alternative fuels and potential benefits of Biofuels. CO2-Understand the industrial production of Biodiesel and Bioethanol.	15 lectures
<b>Unit 2 Biodiesel and Bioethanol Production</b>	Introduction; fermentation of sugars to ethanol, Sucrose; Synthesis of plants; sugarcane; Bioethanol from starch; Bioethanol from wheat; Bioethanol from other grains. Second generation bio-ethanol from cellulose and other cell wall polysaccharides, plant cell wall. Bio-ethanol from algal cell wall polysaccharides. Biodiesel manufacturing. Biodiesel feed stock, soybean oil, oil seeds (canola oil, palm oil), tallow and waste oil. The potential first generation feed stock, potential second generation biodiesel feedstock.	15 lectures

### REFERENCES:

1. Luque, R., Campelo, J. and Clark, J. Handbook of biofuels production, Woodhead Publishing Limited 2011
2. Gupta, V, K. and Tuohy, M, G. Biofuel Technologies, Springer, 2013
3. Moheimani, N. R., Boer, M, P, M, K, Parisa A. and Bahri, Biofuel and Biorefinery Technologies, Volume 2, Springer, 2015
4. Eckert, C, A. and Trinh, C, T. Biotechnology for Biofuel Production and Optimization, Elsevier, 2016
5. Bernardes, M, A, D, S. Biofuel production – recent developments and prospects, InTech, 2011

## Skill enhancement course (SEC)

**Paper Name: Basics of Bioinformatics**

**Paper Code: BT 204**

**No. of credits: 2**

<b>Course Outcome</b>	<b>Student will be able to –</b> CO1-Gain an understanding of the basic concepts of Bioinformatics CO2-Understand the tools used in Bioinformatics	<b>No. of lectures</b>
<b>Unit 1 Introduction to Biological Databases.</b>	<p><b>Biological Databases:</b> Classification of Databases Raw and processed databases; Primary (NCBI), Secondary(PIR) and Tertiary or Composite (KEGG) databases; Structure and Sequence databases. Specialized Databases- Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP)</p> <p><b>Genome Information Resources</b></p> <p>DNA Sequence Databases specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns.</p> <p><b>Protein Structure Visualization Software.</b></p>	<p style="text-align: center;">.</p> <p style="text-align: center;"><b>15 Lectures</b></p>
<b>Unit 2 BLAST and Sequence Alignment</b>	<p><b>BLAST and Sequence Alignment</b></p> <p>BLAST and Sequence Alignment: BLAST and its Types; Retrieving Sequence using BLAST.</p> <p><b>Pair wise Alignment</b></p> <p>Identity and Similarity: Global and Local Alignment; Pair wise Database Searching.</p> <p><b>Multiple Sequence Alignment</b></p> <p>Goal of Multiple sequence Alignment: Computational Complexity, Manual methods,, Simultaneous methods, Progressive methods, Database of Multiple Alignment Secondary database searching, Analysis Packages:MSA and phylogenetic trees.</p>	<p style="text-align: center;"><b>15 Lectures</b></p>

## References:

1. Bioinformatics-methods and S.C. Rastogi, N Mendiratta, PHL learning Pvt. Ltd application Genomics, Proteomics, P.Rastogi 3<sup>rd</sup> edition and Drug Discovery

## Laboratory Sessions

1	Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Database
2	Use of NCBI BLAST Tool
3	Pairwise and Multiple Sequence Alignment and Phylogeny
4	Classification of Proteins using CATH/SCOP
5	Visualization of PDB Molecules using RASMOL/RASWIN