

**Curriculum for**  
**Master of Science (M. Sc.) in Biotechnology and Genetic**  
**Engineering**

**Session: 2018-19**



**Department of Biotechnology and Genetic Engineering**  
**Islamic University, Bangladesh**

**1. Program name: Master of Science (M. Sc.) in Biotechnology and Genetic Engineering**

**2. Vision:** Providing state-of-art knowledge and skills in the field of Biotechnology and Genetic Engineering for sustainable development of society and environment.

**3. Mission:**

- To provide quality education for producing competent graduates in Biotechnology and Genetic Engineering to contribute in different sectors including agriculture, healthcare, industry and environment.
- To facilitate the development of scientists, entrepreneurs and policymakers towards nation building program.
- To disseminate knowledge and skills for the betterment of the society and promote meaningful collaboration with academia, industry and research organization across the globe.

**4. Program objectives:**

To provide solution based education with cutting edge knowledge in Biotechnology and Genetic Engineering in order to harness the latest techniques, technologies and methodologies for the graduates in the field of:

1. Protein Engineering
2. Biomedical Technology
3. Industrial (bioprocess) Biotechnology
4. Agricultural (Plant & Animal) Biotechnology
5. Food Biotechnology
6. Toxicology and Pharmacology

**5. Program Outcomes:**

After graduation students will be able to:

| Program Outcomes                                                                                                                                                                                                                                                                                                                                        | Achievement              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1. Demonstrate a comprehensive understanding of the multidisciplinary as well as interdisciplinary fundamental concepts in Biotechnology and Genetic Engineering.<br>2. Analyze, synthesize and integrate knowledge and information within the context of multidisciplinary as well as interdisciplinary areas in Biotechnology and Genetic Engineering | <b>Cognitive Level</b>   |
| 1. Recognize and practice the concept of lifelong learning for continuous self improvement.<br>2. Communicate and demonstrate adequate interpersonal skills.<br>3. Appreciate social, moral and bioethical perspectives in Biotechnology and Genetic Engineering education and research.                                                                | <b>Affective Level</b>   |
| 1. Operate and maintain the basic biotechnology equipments adhering to good laboratory practices and bio-safety & security issues.<br>2. Develop practical skills for addressing the problems in biosciences.                                                                                                                                           | <b>Psychomotor Level</b> |

**6. Course structure:**

Program duration: One Year (Non-thesis group), One and half year (Thesis group)

Number of Semester: Non-thesis group (Two Semester), Thesis group (Three Semester)

Term duration: According to ordinance

Total number of credit available: Non-thesis group (36), Thesis group (42)

Minimum credit to be earned for degree requirements: Non-thesis group (36), Thesis group (42)

## 6.1 Summary of the total credits

Year-wise distribution of credits

| <b>Group A</b> | <b>Semester</b> | <b>Theory</b> | <b>Practical / Field work / Research</b> | <b>Viva voce</b> | <b>Total</b> |
|----------------|-----------------|---------------|------------------------------------------|------------------|--------------|
| Non-Thesis     | First           | 12            | 4                                        | 1                | 17           |
|                | Second          | 12            | 6                                        | 1                | 19           |
| Total          |                 |               |                                          |                  | 36           |

| <b>Group B</b> | <b>Semester</b> | <b>Theory</b> | <b>Practical / Field work / Research / Journal Article Presentation</b> | <b>Viva voce</b> | <b>Total</b> |
|----------------|-----------------|---------------|-------------------------------------------------------------------------|------------------|--------------|
| Thesis         | First           | 12            | 4                                                                       | 1                | 17           |
|                | Second          | 12            | 5                                                                       | 1                | 18           |
|                | Third           |               | 7                                                                       |                  | 6            |
| Total          |                 |               |                                                                         |                  | 42           |

## 6.2 Course outline: Semester-wise course outline for the entire program

### Compulsory Courses for General Group (Group-A)

#### FIRST SEMESTER

| Course no     | Course title                                        | Theoretical Marks | Tutorial/ Note Book Marks | Class attendance/ Performance        | Presentation          | Total marks | Credits* |
|---------------|-----------------------------------------------------|-------------------|---------------------------|--------------------------------------|-----------------------|-------------|----------|
| BT-5101       | Protein Engineering                                 | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5102       | Biomedical Engineering                              | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5103       | Advance Food Biotechnology                          | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5104       | Industrial Biotechnology                            | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5105 (Lab) | Lab in Biomedical Engineering & protein engineering | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5106 (Lab) | Lab in Food & Industrial Biotechnology              | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5107       | Viva -voce                                          |                   |                           |                                      |                       | 50          | 1.0      |
| Total         |                                                     |                   |                           |                                      |                       | 650         | 17.0     |

\*Exam duration of theoretical 3.0 credit course will be 4 hours

#### SECOND SEMESTER

| Course no     | Course title                                                                    | Theoretical Marks | Tutorial/ Note Book Marks | Class attendance/ Performance        | Presentation          | Total marks | Credits* |
|---------------|---------------------------------------------------------------------------------|-------------------|---------------------------|--------------------------------------|-----------------------|-------------|----------|
| BT-5201       | Advance Agricultural Biotechnology                                              | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5202       | Toxicology and Pharmacology                                                     | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5203       | Molecular Biology of diseases                                                   | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5204       | Business Perspectives of Biotechnology                                          | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5205 (Lab) | Lab in Agricultural Biotechnology, Toxicology and Pharmacology                  | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5206 (Lab) | Lab in Molecular Biology of diseases and Business Perspectives of Biotechnology | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5207       | Research project / Survey / Internship in Industry                              | 30 (Dissertation) | 20 (Overall performance)  | 50 (Presentation)                    |                       | 100         | 2.0      |
| BT-5208       | Viva -voce                                                                      |                   |                           |                                      |                       | 50          | 1.0      |
| Total         |                                                                                 |                   |                           |                                      |                       | 850         | 19.0     |

\*Exam duration of theoretical 3.0 credit course will be 4 hours

**COMPULSORY COURSES FOR THESIS GROUP (GROUP-B)**

**FIRST SEMESTER**

| Course no     | Course title                                        | Theoretical Marks | Tutorial/ Note Book Marks | Class attendance/ Performance        | Presentation          | Total marks | Credits* |
|---------------|-----------------------------------------------------|-------------------|---------------------------|--------------------------------------|-----------------------|-------------|----------|
| BT-5101       | Protein Engineering                                 | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5102       | Biomedical Engineering                              | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5103       | Advance Food Biotechnology                          | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5104       | Industrial Biotechnology                            | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5105 (Lab) | Lab in Biomedical Engineering & protein engineering | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5106 (Lab) | Lab in Food & Industrial Biotechnology              | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5107       | Viva -voce                                          |                   |                           |                                      |                       | 50          | 1.0      |
| Total         |                                                     |                   |                           |                                      |                       | 650         | 17.0     |

\*Exam duration of theoretical 3.0 credit course will be 4 hours

**SECOND SEMESTER**

| Course no     | Course title                                                                    | Theoretical Marks | Tutorial/ Note Book Marks | Class attendance/ Performance        | Presentation          | Total marks | Credits* |
|---------------|---------------------------------------------------------------------------------|-------------------|---------------------------|--------------------------------------|-----------------------|-------------|----------|
| BT-5201       | Advance Agricultural Biotechnology                                              | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5202       | Toxicology and Pharmacology                                                     | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5203       | Molecular Biology of diseases                                                   | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5204       | Business Perspectives of Biotechnology                                          | 70                | 15                        | 10                                   | 5                     | 100         | 3.0      |
| BT-5205 (Lab) | Lab in Agricultural Biotechnology, Toxicology and Pharmacology                  | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5206 (Lab) | Lab in Molecular Biology of diseases and Business Perspectives of Biotechnology | 70 (Examination)  | 05 (Lab Note Book)        | 10 +05 =15 (Attendance+ Performance) | Viva on experiment=10 | 100         | 2.0      |
| BT-5207       | Research project (for thesis) presentation                                      |                   |                           | 50 (Presentation)                    |                       | 50          | 1.0      |
| BT-5208       | Viva -voce                                                                      |                   |                           |                                      |                       | 50          | 1.0      |
| Total         |                                                                                 |                   |                           |                                      |                       | 700         | 18.0     |

\*Exam duration of theoretical 3.0 credit course will be 4 hours

**THIRD SEMESTER**

| Course no | Course title                 |  |  |  | Total marks | Credits |
|-----------|------------------------------|--|--|--|-------------|---------|
| BT-5301   | Journal Article presentation |  |  |  | 50          | 1.0     |
| BT-5302   | Dissertation                 |  |  |  | 200         | 4.0     |
| BT-5303   | Dissertation Presentation    |  |  |  | 100         | 2.0     |
| Total     |                              |  |  |  | 350         | 7.0     |

## 7. Teaching strategy:

Popular strategies are Lecture, Case method, Discussion, Active learning (Apply what students are learning), Cooperative learning (small groups work together for achieving a common goal), Integrating technology, Distance learning, etc.

## 8. Assessment strategy:

**Distribution of Marks:** [According to the ordinance]

- Marks distribution for theory courses: [According to the ordinance]
- Marks distribution for sessional courses: [According to the ordinance]
- Bases for class attendance marks (both for theory and sessional): [According to the ordinance]

**Continuous Assessment:** [According to the ordinance]

- **Thesis evaluation:** [According to the ordinance]
- **Grading system and grading scale:** [According to the ordinance]

**Assessment tools:**

**Theory courses:**

- Class participation (Example: attendance)
- Continuous assessment (examples: Quiz, spot test, open book exam, presentation, assignments, written exams etc.)
- Term final examination (written test)

**Practical courses:**

- Class participation (Example: attendance)
- Practical assessment (examples: field work, lab work, case study, performance, spot test, open book exam, presentation, assignments, written exams etc.)
- Viva-voce (oral)

**Thesis/project:**

- Participation (Example: Contact/Discussion/Communication with the supervisor)
- Evaluation (examples: report, project paper, monograph etc.)
- Dissertation
- Viva-voce (oral)

**Non Thesis –Group A  
(1<sup>st</sup> and 2<sup>nd</sup> Semester)**

|                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
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| <b>Course Title: Protein Engineering</b>                                                                                                                                                                                                                                                    | <b>Course No: BT-5101</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Protein Engineering                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Protein Engineering</li> <li>• Acquire general knowledge on different areas of Protein Engineering</li> <li>• Acquaint with general techniques used in Protein Engineering</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                    | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Protein Engineering</li> <li>2. Explain the history, scope and importance of Protein Engineering</li> <li>3. Describe the current trends in Protein Engineering to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                       | <p><b>Introduction</b><br/>Chemistry of amino acid and protein structure, protein sequence folding, protein-protein interaction</p> <p><b>Functional Properties of proteins</b></p> <p><b>Hydration Properties:</b> PDI (Proteins Dispersibility Index), Protein solubility curve, WHC (Water Holding Capacity), OHC (Oil Holding Capacity)</p> <p><b>Structural &amp; textural properties (Rheology):</b> Viscosity, Visco-elasticity, Gelling properties, Gel characterizing (texture map), Texture</p> <p><b>Surface properties (Emulsifying &amp; foaming):</b> Emulsifying properties, Stability of a suspension, foaming properties</p> <p><b>Methods in Protein Engineering</b><br/>Site-directed mutagenesis, Random mutagenesis, DNA shuffling, Molecular dynamics, Homology modeling, Computational methods(computational protein design), Receptor-based QSAR methods , X-ray crystallography, Peptidomimetics Phage display technology, Cell surface display technology, Flow cytometry / Cell sorting, Cell-free translation systems Stimulus-responsive peptide systems Mechanical engineering of elastomeric proteins, Engineering extracellular matrix variants, Traceless Staudinger ligation De novo enzyme engineering, mRNA display</p> <p><b>Protein design</b><br/>De novo design, Retional design, Irrational design (directed evolution)</p> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                           | <ol style="list-style-type: none"> <li>1. <b>Protein Engineering.</b> Editors: Koehrer, Caroline, RajBhandary, Uttam L. (Eds.)</li> <li>2. <b>PROTEIN ENGINEERING.</b> Edited by Pravin Kaumaya</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |

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| <b>Course Title: Biomedical Engineering</b>                                                                                                                                                                                                                                                          | <b>Course No: BT-5102</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Biomedical Engineering                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Biomedical Engineering</li> <li>• Acquire general knowledge on different areas of Biomedical Engineering</li> <li>• Acquaint with general techniques used in Biomedical Engineering</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                             | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Biomedical Engineering</li> <li>2. Explain the history, scope and importance of Biomedical Engineering</li> <li>3. Describe the current trends in Biomedical Engineering</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                | <p><b>Introduction</b><br/>Definition, Scope and Implications for Biomedical Research,</p> <p><b>Biomedical science</b></p> <p>Body cells, Gene molecule, Psychological processes and disorders, Cellular and system physiology, pharmacology, Cellular pathology and immunology, Molecular Endocrinology, Medical diagnosis, Genetic engineering, Tissue engineering</p> <p><b>Biomedical informatics</b></p> <p>Bioinformatics, Clinical informatics, Imaging informatics, Consumer health informatics, Research informatics, Public health informatics, Health information management</p> <p><b>Biomedical engineering</b></p> <p>Design and development of active and passive medical devices (Pacemakers, Defibrillators, Muscle and nerve stimulators, ultrasound therapy, infrared heating, microwave diathermy, x-ray, echocardiography, MRI, computed tomography, ECG, EMG, EEG, EOG), Development of sensor (Physical sensors, Biopotential sensors, Electrochemical sensors, Optical sensors, )orthopedic implants, Cochlear implants, medical imaging, biomedical signal processing, tissue and stem cell engineering, and clinical engineering</p> <p><b>Biomedical research</b></p> <p>Definition, Basic or pure Research, Applied Research, Clinical Research, Biological Models System</p> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                    | <ol style="list-style-type: none"> <li>1. Biomedical Engineering : W. Mark Saltzman</li> <li>2. Introduction to Biomedical Engineering 3rd Edition: John Enderle Ph.D</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |

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| <b>Course Title: Advance Food Biotechnology</b>                                                                                                                                                                                                                                                                  | <b>Course No: BT-5103</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Advance Food Biotechnology                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Advance Food Biotechnology</li> <li>• Acquire general knowledge on different areas of Advance Food Biotechnology</li> <li>• Acquaint with general techniques used in Advance Food Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                         | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Advance Food Biotechnology</li> <li>2. Explain the history, scope and importance of Advance Food Biotechnology</li> <li>3. Describe the current trends in Advance Food Biotechnology to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li><b>1. Importance of microorganisms in Food Biotechnology:</b><br/>Sources, types, incidence, and behavior of microorganisms in foods, role and significance of microorganisms, synopsis of common food-borne bacteria, synopsis of genera of molds common to foods, synopsis of genera of yeasts common to foods.</li> <li><b>2. Intrinsic and Extrinsic parameters of foods that affect microbial growth.</b></li> <li><b>3. Determination of microorganisms and their products in foods:</b><br/>Culture, microscopic and sampling methods, conventional; SPC, membrane filters, microscope colony counts, agar droplets, dry films, most probable numbers (MPN), dye-reduction, roll tubes, direct microscopic count (DMC, modern methods for rapid detection of microorganisms- impedance, DNA probes, immunochemical techniques (ELISA etc.) and fluorescence microscopy (DEFT), advantages and disadvantages of these methods, applications to detection of food poisoning bacteria.</li> <li><b>4. Microbial spoilage of food:</b><br/>Indicator and food-borne pathogens, other proven and suspected food-borne pathogens, psychrotrophs, thermophiles and radiation-resistant microorganisms, bacterial infections and intoxications, incidence of bacterial food poisoning in the U.K, salmonella food poisoning, poultry processing, <i>S. enteritidis</i>, campylobacter food poisoning, growth and physiology of <i>C. jejuni</i> and <i>C. coli</i>. <i>Vibrio parahaemolyticus</i> food poisoning.</li> <li><b>5. Food preservation and microbial physiology:</b><br/>Techniques of food preservation- heat, preservatives including acids, refrigeration and freezing, irradiation, smoking and curing, response of bacteria to pH stress, arguments for and against the use of irradiation as a method of food preservation, definition and measurement of water activity, mechanisms of osmotolerance in microorganisms, preservation by control of water activity, nitrite in foods, sources, potential hazards and role of antioxidants.</li> <li><b>6. Biosafety concerns of food:</b><br/>Potential social, economical, ethical and environmental implications of biotechnology and genetic modification of foods and plants.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"> <li>1. Food Biotechnology : Roger Angold</li> <li>2. Food Microbiology: An Introduction : Thomas J. Montville and Karl R. Matthews</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |

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| <b>Course Title: Industrial Biotechnology</b>                                                                                                                                                                                                                                                              | <b>Course No: BT-5104</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Industrial Biotechnology                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Industrial Biotechnology</li> <li>• Acquire general knowledge on different areas of Industrial Biotechnology</li> <li>• Acquaint with general techniques used in Industrial Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                   | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Industrial Biotechnology</li> <li>2. Explain the history, scope and importance of Industrial Biotechnology</li> <li>3. Describe the current trends in Industrial Biotechnology to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li><b>1. Industrial Microorganisms:</b><br/>Features of industrial microorganisms, sources of industrially important microorganisms, isolation, screening and strain improvement of industrially useful microorganisms, methods for preservation of industrial microorganisms.</li> <li><b>2. Industrial enzymes:</b><br/>Advantages and disadvantages of microbial production of industrial enzymes, microbial production of industrial enzymes, large scale enzyme applications.</li> <li><b>3. Biopolymers:</b><br/>Structure-function relationship in microbial polysaccharides, properties of xanthan, bacterial cellulose and hyaluronic acid, applications of microbially-produced hydrocolloids (gums) to food and other industries including dextran from <i>Leuconostoc mesenteroides</i>, introduction to bioplastics and PHAs.</li> <li><b>4. Biofilms:</b><br/>Microbial activity in aqueous environments occurs at solid-liquid or air-liquid interfaces. Nature and composition of biofilms, development of biofilm, beneficial applications of biofilms, detrimental effects of biofilms, role of biofilms in the natural environment.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                          | <ol style="list-style-type: none"> <li>1. M.Y. Young: Comprehensive biotechnology Vol. 1- 4</li> <li>2. T.D. Brock, Smaeur Associates: Biotechnology- A text book of industrial microbiology</li> <li>3. L.E. Casida: Industrial microbiology</li> <li>4. Prescott &amp; Dunn: Industrial microbiology</li> <li>5. S.O. Enfors &amp; L. Hagstrom: Bioprocess technology- fundamentals and applications</li> <li>6. W. Crueger and A.Crueger: Biotechnology - A hand book of industrial microbiology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |                                 |

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| <b>Course: BT-5105 (Lab)</b> | <b>Course Name: Lab in Biomedical Engineering and Protein Engineering</b> |
| <b>Full Marks: 100</b>       | <b>Unit: 1                      Credit: 2.0</b>                           |

Exp.1: Transformation of *E.coli*.with plasmid DNA.  
 Exp.2: SDS -PAGE electrophoresis using protein samples.  
 Exp.3: Amplification of DNA by polymerase chain reaction.  
 Exp.4: Restriction digestion of PCR products using genomic DNA as template  
 Exp.5: Ligation of DNA fragment (insert) to vector.  
 Exp – western blot  
 Exp – Dot blot  
 Exp – Total protein extraction from biological sample

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|------------------------------|--------------------------------------------------------------|
| <b>Course: BT-5106 (Lab)</b> | <b>Course Name: Lab in Food and Industrial Biotechnology</b> |
| <b>Full Marks: 100</b>       | <b>Unit: 1                      Credit: 2.0</b>              |

Exp.1: Production of yogurts from cow milk using starter cultures from different sources.  
 Exp.2: High throughput screening of microbes from industrial waste  
 Exp.3: Colony PCR methods for rapid identification of industrially important bacteria  
 Exp.4: Development of biofilm  
 Exp.5: Screening of industrially important bacteria  
 Exp.6: Screening industrially important fungi.  
 Exp.7: Microbial production of industrially important enzymes.  
 Exp.8: Identification of lactobacillus strains for nutritious yogurt production.  
 Exp.9: Preservation of industrially important microbes  
 Exp.10: Extraction and purification of essential oil from natural sources.  
 Exp.11: Determination of catalase enzyme activity

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|------------------------|-------------------------------------------------|
| <b>Course: BT-5107</b> | <b>Course Name: Viva-voce</b>                   |
| <b>Full Marks: 50</b>  | <b>Unit: 1                      Credit: 1.0</b> |

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| <b>Course Title: Advance Agricultural Biotechnology</b>                                                                                                                                                                                                                                                          | <b>Course No: BT-5201</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Industrial Biotechnology                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Agricultural Biotechnology</li> <li>• Acquire general knowledge on different areas of Agricultural Biotechnology</li> <li>• Acquaint with general techniques used in Agricultural Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                         | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Agricultural Biotechnology</li> <li>2. Explain the history, scope and importance of Agricultural Biotechnology</li> <li>3. Describe the current trends in Agricultural Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li><b>1. Plant growth promoting bacteria:</b><br/>Scope and prospects of Agriculture Biotechnology in Bangladesh, Nitrogen fixation; Genetic engineering of the nitrogenase gene, hydrogenase gene and nodulation gene; growth promotion by free-living bacteria, phytoremediation, biocontrol of pathogens, genetic engineering for improved biocontrol, baculoviruses as biocontrol agents.</li> <li><b>2. Applications of plant Biotechnology:</b> <ol style="list-style-type: none"> <li>i) Transgenics for improved storage, male sterility and terminator seed</li> <li>ii) Commercial transgenic crops: bt bringal, golden rice, late blight resistant potato</li> <li>iii) Transgenic plants as bioreactors</li> <li>iv) Transgenic plants as edible vaccines</li> <li>v) Metabolic engineering in plant cells</li> <li>vi) Modification of production traits: starch and oil modification, improving vitamin mineral content</li> <li>vii) Development of stress and senescence tolerant plants</li> <li>viii) Production of pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds through plant tissue culture.</li> </ol> </li> <li><b>3. Biofertilizers:</b><br/>Definition, types of biofertilizers, benefits of different types of biofertilizers.</li> <li><b>4. Biopesticides:</b><br/>Definition, integrated pest management (IPM), application, advantages and disadvantages of biopesticides.</li> <li><b>5. Regulation of use of Biotechnology:</b><br/>Regulating food and food ingredients, deliberate release of GMOs, controversy about GMOs</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"> <li>1. Gresshoff, P.M: Plant biotechnology and development, SRC series of current topics in plant molecular biology.</li> <li>2. Anderson: Plant cell culture- advances in biochemical engineering and biotechnology</li> <li>3. Watson: Recombinant DNA</li> <li>4. Portykns: Gene transfer to plants</li> <li>5. Mantell and Smith: Plant biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |                                 |

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| <b>Course Title: Toxicology and Pharmacology</b>                                                                                                                                                                                                                                                                          | <b>Course No: BT-5202</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Toxicology & Pharmacology                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Toxicology &amp; Pharmacology</li> <li>• Acquire general knowledge on different areas of Toxicology &amp; Pharmacology</li> <li>• Acquaint with general techniques used in Toxicology &amp; Pharmacology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                                  | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Toxicology &amp; Pharmacology</li> <li>2. Explain the history, scope and importance of Toxicology &amp; Pharmacology</li> <li>3. Describe the current trends in Toxicology &amp; Pharmacology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                                     | <b>A. Pharmacology</b> <ol style="list-style-type: none"> <li>1. History and Scope of pharmacology</li> <li>2. General pharmacology: Biological half-life, bioavailability, metabolism of drugs and excretion, routes of drug administration, drug absorption, distribution, elimination and factors affecting them, Pharmacodynamics-mechanisms of drugs action, receptor and non-receptor theory, signal transduction and second messengers, drug potency and efficacy, dose-response relationships, agonists and antagonisms, tolerance and tachyphylaxis, measurement of some pharmacological parameters, drug allergy, drug toxicity and drug interaction..</li> <li>3. Introduction to Pharmacogenomics and pharmacogenetics:             <ol style="list-style-type: none"> <li>a. Genes, environment and disease,</li> <li>b. Technological approaches to understanding genotype-phenotype relationships I – DNA analysis</li> <li>c. Technological approaches to understanding genotype-phenotype relationships II – RNA analysis</li> <li>d. Technological approaches to understanding genotype-phenotype relationships III – Proteomics and metabolomics analyses.</li> <li>e. Polymorphisms, Enzyme Kinetics and Pharmacokinetics/Toxicokinetics</li> <li>f. Applications of GWAS and Next Generation sequencing technologies</li> </ol> </li> </ol> <b>B. Toxicology:</b> <ol style="list-style-type: none"> <li>a. Drugs adverse effect: Determination of LD<sub>10</sub>, LD<sub>50</sub>, ED<sub>50</sub>, therapeutic index, adverse reactions, causes of adverse reaction, factors affecting side effects of drugs.</li> <li>b. Effects of poisons: Poisons, toxins of animal origin, symptoms and management of poisoning cases with pesticides, fumigants, solvents, vapor, food toxins, and cyanides.</li> <li>c. Toxicogenomics -1 ((CYPs 1A1, 1B1, 2E1, FMO3, ALDH2); Toxicogenomics - 2 (NATs, SULTs, GSTs, mEH, NQO1)</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                                         | Goodman and Gillman: Pharmacological basis of therapy.<br>R.S. Satosker: Pharmacology and Pharmacotherapeutics<br>Pharmacogenetics: An Introduction and Clinical Perspective<br>Costa, LG and Eaton DL: Gene-Environment Interactions: Fundamentals of Ecogenetics.<br>Joseph S. Bertino: Fundamentals of Ecogenetics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |                                 |

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| <b>Course Title: Molecular Biology of Diseases</b>                                                                                                                                                                                                                                                                     | <b>Course No: BT-5203</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Molecular Biology of Disease                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Molecular Biology of Disease</li> <li>• Acquire general knowledge on different areas of Molecular Biology of Disease</li> <li>• Acquaint with general techniques used in Molecular Biology of Disease</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                               | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Molecular Biology of Disease</li> <li>2. Explain the history, scope and importance of Molecular Biology of Disease</li> <li>3. Describe the current trends in Molecular Biology of Disease</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                                  | <ol style="list-style-type: none"> <li><b>1. Diabetes mellitus:</b><br/>Type I, type II and other major clinical classes; genetic basis of type I DM; HLA-DQ, HLA-DR and MHC, pattern of inheritance in type II DM; MODY (Maturity onset diabetes mellitus in young); insulin gene; biosynthesis of insulin; mechanism of insulin action; complications of DM; diagnosis and treatment (brief treatment), <i>diabetes insipidus</i></li> <li><b>2. Cardiovascular diseases:</b><br/>Dyslipidemia, atherosclerosis- molecular mechanism of atheromatous plaque formation, involvement of LDL &amp; foam cells; ischemic heart disease; myocardial infarction (MI); biochemical markers for the diagnosis of MI; coronary heart disease (CAD), heart failure; hypertension, heart attack, stroke, disorders of lipoprotein metabolism.</li> <li><b>3. Liver diseases:</b><br/>hyperbilirubinemia, Dubin-Johnson syndrome, criglar-najjar syndrome, viral hepatitis- types of hepatitis virus and their genomic organization, acute hepatocellular carcinoma, chronic hepatocellular carcinoma, liver cirrhosis, liver function tests.</li> <li><b>4. Renal disease:</b></li> <li><b>5. Neurodegenerative diseases:</b><br/>Neuropathological features and molecular mechanisms, therapeutic approaches in Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease, multiple sclerosis and prion diseases.\</li> <li><b>6. Genetic basis of some metabolic disorders:</b><br/>Phenylketonuria, alkaptonuria, maple syrup urine disease, nieman-pick disease, gaucher's disease, glycogen storage disease, gout.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. John Macloed., Davidson's principles and Practice of Medicine</li> <li>2. Gillham, B., Despo, K.P., Thomas, J.H., Will's Biochemical Basis of Medicine.</li> <li>3. R.K.Murray: Harper's Biochemistry.</li> <li>4. Devlin: Textbook of Biochemistry with clinical correlations</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |

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| <b>Course Title: Business Perspective of Biotechnology</b>                                                                                                                                                                                              | <b>Course No: BT-5204</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Business Perspective of Biotechnology                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Business Perspective of Biotechnology</li> <li>• Acquire general knowledge on different areas of Business Perspective of Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Business Perspective</li> <li>2. Explain the scope and importance of Business Perspective in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                   | <ol style="list-style-type: none"> <li><b>1. Business management:</b><br/>Company, its environment, stakeholders, corporate strategies, some basic economic principles (e.g. profit maximization, shareholder value), business planning and decision making processes and supporting tools, methods of business analysis, introduction to technology development, introduction to procurement, introduction to operations management, introduction to marketing /sales.</li> <li><b>2. Project management:</b><br/>Fundamentals of project management, life cycle of a project- Project definition; project planning; project execution and controlling; project close out, tools and methods of project management (e.g. planning methods, problem solving methods), social competence in project management ( teamwork; communication).<br/>Time and quality based controlling, auditing.</li> <li><b>3. Practical applications of business biotechnology:</b><br/>Biotechnology used for biotechnological companies, their care and nurturing, investment in<br/>Biotechnology, management needs.</li> <li><b>4. Biotechnological industry:</b><br/>Environmental release of genetically modified organisms; product labeling, technology transfer; health insurance and reimbursement; entrepreneurship, venture capital and the life cycle of a biotechnological company; public perception of biotech products; global market place for biotechnological products.</li> <li><b>5. Commercialization, marketing and management of biotechnological products:</b><br/>Fundamentals of marketing, marketing and selling of biotechnology, creating and marketing the image of the biotechnology company, power and importance of positioning of a company name and product, Art of negotiation, workable marketing and the strength of distribution, effective advertising and marketing, opportunities of international marketing and lessons to be learnt, steps involved in commercialization of a biotechnological product.</li> <li><b>6. Intellectual property rights in biotechnology:</b><br/>General introduction, patent claims, legal decision making process, ownership of intellectual property, basic requirements of patentability- patentable subject matter, novelty and public domain, special issues in biotechnology patents-disclosure requirements, collaborative research, competitive research, foreign patents, patent litigation- substantive aspects of patent litigation, procedural aspects of patent litigation, and recent developments in patent system and patentability of biotechnological invention.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                       | <ol style="list-style-type: none"> <li>1. Colin Rat ledge: Basic biotechnology</li> <li>2. Harold Koontz and heint Weihrich: Management</li> <li>3. P. Chanda: Project-Preparation, Appraisal, Budgeting and Implementatation</li> <li>4. R.J.Ruffin and P.R.Gregary: Principles of microeconomics</li> <li>5. William J. Thieman and Michael A: Introduction to biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |                                 |

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|                        | 6.                                                                                 |
| <b>Course: BT-5205</b> | <b>Course Name: Lab in Agricultural Biotechnology, Toxicology and Pharmacology</b> |
| <b>Full Marks: 100</b> | <b>Credit: 2.0</b>                                                                 |

Exp.1: Agrobacterium mediated gene transfer  
 Exp.2: Study on the effect of phytohormone on callus induction  
 Exp.3: Screening of nitrogen fixing bacteria from natural source  
 Exp.4: Production of biofertilizer by the use of nitrogen fixing bacteria

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| <b>Course: BT-5206</b> | <b>Course Name: Lab in Molecular Biology of Diseases and Business Perspective of Biotechnology</b> |
| <b>Full Marks: 100</b> | <b>Credit: 2.0</b>                                                                                 |

Exp.1: Study of biotechnological project design and development  
 Exp.2: Study of proper budgeting for the project  
 Exp.3: Study of patenting procedure  
 Exp.4: Study of the organization and workflow of a biotech company

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| <b>Course: BT-5207</b> | <b>Course Name: Mini Thesis (Research Project)/Survey/Internship in Industry</b> |
| <b>Full Marks: 100</b> | <b>Credit: 2.0</b>                                                               |

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| <b>Course: BT-5208</b> | <b>Course Name: Viva-voce</b> |
| <b>Full Marks: 50</b>  | <b>Credit: 1.0</b>            |

# **Thesis Group–Group B (1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> Semester)**

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| <b>Course Title: Protein Engineering</b>                                                                                                                                                                                                                                                    | <b>Course No: BT-5101</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Protein Engineering                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Protein Engineering</li> <li>• Acquire general knowledge on different areas of Protein Engineering</li> <li>• Acquaint with general techniques used in Protein Engineering</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                    | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Protein Engineering</li> <li>2. Explain the history, scope and importance of Protein Engineering</li> <li>3. Describe the current trends in Protein Engineering to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                       | <p><b>Introduction</b><br/>Chemistry of amino acid and protein structure, protein sequence folding, protein-protein interaction</p> <p><b>Functional Properties of proteins</b></p> <p><b>Hydration Properties:</b> PDI (Proteins Dispersibility Index), Protein solubility curve, WHC (Water Holding Capacity), OHC (Oil Holding Capacity)</p> <p><b>Structural &amp; textural properties (Rheology):</b> Viscosity, Visco-elasticity, Gelling properties, Gel characterizing (texture map), Texture</p> <p><b>Surface properties (Emulsifying &amp; foaming):</b> Emulsifying properties, Stability of a suspension, foaming properties</p> <p><b>Methods in Protein Engineering</b><br/>Site-directed mutagenesis, Random mutagenesis, DNA shuffling, Molecular dynamics, Homology modeling, Computational methods(computational protein design), Receptor-based QSAR methods , X-ray crystallography, Peptidomimetics Phage display technology, Cell surface display technology, Flow cytometry / Cell sorting, Cell-free translation systems Stimulus-responsive peptide systems Mechanical engineering of elastomeric proteins, Engineering extracellular matrix variants, Traceless Staudinger ligation De novo enzyme engineering, mRNA display</p> <p><b>Protein design</b><br/>De novo design, Rational design, Irrational design (directed evolution)</p> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                           | <ol style="list-style-type: none"> <li>1. Protein Engineering and Design : Sheldon J. Park and Jennifer R. Cochran</li> <li>2. Protein Engineering Handbook: Volume 3 : Edited by Stefan Lutz</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |                                 |

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| <b>Course Title: Biomedical Engineering</b>                                                                                                                                                                                                                                                          | <b>Course No: BT-5102</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Biomedical Engineering                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Biomedical Engineering</li> <li>• Acquire general knowledge on different areas of Biomedical Engineering</li> <li>• Acquaint with general techniques used in Biomedical Engineering</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                             | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Biomedical Engineering</li> <li>2. Explain the history, scope and importance of Biomedical Engineering</li> <li>3. Describe the current trends in Biomedical Engineering</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                | <p><b>Introduction</b><br/>Definition, Scope and Implications for Biomedical Research,</p> <p><b>Biomedical science</b></p> <p>Body cells, Gene molecule, Psychological processes and disorders, Cellular and system physiology, pharmacology, Cellular pathology and immunology, Molecular Endocrinology, Medical diagnosis, Genetic engineering, Tissue engineering</p> <p><b>Biomedical informatics</b></p> <p>Bioinformatics, Clinical informatics, Imaging informatics, Consumer health informatics, Research informatics, Public health informatics, Health information management</p> <p><b>Biomedical engineering</b></p> <p>Design and development of active and passive medical devices (Pacemakers, Defibrillators, Muscle and nerve stimulators, ultrasound therapy, infrared heating, microwave diathermy, x-ray, echocardiography, MRI, computed tomography, ECG, EMG, EEG, EOG), Development of sensor (Physical sensors, Biopotential sensors, Electrochemical sensors, Optical sensors, )orthopedic implants, Cochlear implants, medical imaging, biomedical signal processing, tissue and stem cell engineering, and clinical engineering</p> <p><b>Biomedical research</b></p> <p>Definition, Basic or pure Research, Applied Research, Clinical Research, Biological Models System</p> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                    | <ol style="list-style-type: none"> <li>1. Biomedical Engineering : W. Mark Saltzman</li> <li>2. Introduction to Biomedical Engineering 3rd Edition: John Enderle Ph.D</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                 |

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| <b>Course Title: Advance Food Biotechnology</b>                                                                                                                                                                                                                                                                  | <b>Course No: BT-5103</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Advance Food Biotechnology                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Advance Food Biotechnology</li> <li>• Acquire general knowledge on different areas of Advance Food Biotechnology</li> <li>• Acquaint with general techniques used in Advance Food Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                         | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Advance Food Biotechnology</li> <li>2. Explain the history, scope and importance of Advance Food Biotechnology</li> <li>3. Describe the current trends in Advance Food Biotechnology to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li>1. <b>Importance of microorganisms in Food Biotechnology:</b><br/>Sources, types, incidence, and behavior of microorganisms in foods, role and significance of microorganisms, synopsis of common food-borne bacteria, synopsis of genera of molds common to foods, synopsis of genera of yeasts common to foods.</li> <li>2. <b>Intrinsic and Extrinsic parameters of foods that affect microbial growth.</b></li> <li>3. <b>Determination of microorganisms and their products in foods:</b><br/>Culture, microscopic and sampling methods, conventional; SPC, membrane filters, microscope colony counts, agar droplets, dry films, most probable numbers (MPN), dye-reduction, roll tubes, direct microscopic count (DMC, modern methods for rapid detection of microorganisms- impedance, DNA probes, immunochemical techniques (ELISA etc.) and fluorescence microscopy (DEFT), advantages and disadvantages of these methods, applications to detection of food poisoning bacteria.</li> <li>4. <b>Microbial spoilage of food:</b><br/>Indicator and food-borne pathogens, other proven and suspected food-borne pathogens, psychrotrophs, thermophiles and radiation-resistant microorganisms, bacterial infections and intoxications, incidence of bacterial food poisoning in the U.K, salmonella food poisoning, poultry processing, <i>S. enteritidis</i>, campylobacter food poisoning, growth and physiology of <i>C. jejuni</i> and <i>C. coli</i>. <i>Vibrio parahaemolyticus</i> food poisoning.</li> <li>5. <b>Food preservation and microbial physiology:</b><br/>Techniques of food preservation- heat, preservatives including acids, refrigeration and freezing, irradiation, smoking and curing, response of bacteria to pH stress, arguments for and against the use of irradiation as a method of food preservation, definition and measurement of water activity, mechanisms of osmotolerance in microorganisms, preservation by control of water activity, nitrite in foods, sources, potential hazards and role of antioxidants.</li> <li>6. <b>Biosafety concerns of food:</b><br/>Potential social, economical, ethical and environmental implications of biotechnology and genetic modification of foods and plants.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"> <li>1. Food Biotechnology : Roger Angold</li> <li>2. Food Microbiology: An Introduction : Thomas J. Montville and Karl R. Matthews</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                 |

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| <b>Course Title: Industrial Biotechnology</b>                                                                                                                                                                                                                                                              | <b>Course No: BT-5104</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Credit: 3</b> | <b>Semester: 1<sup>st</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Industrial Biotechnology                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Industrial Biotechnology</li> <li>• Acquire general knowledge on different areas of Industrial Biotechnology</li> <li>• Acquaint with general techniques used in Industrial Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                   | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Industrial Biotechnology</li> <li>2. Explain the history, scope and importance of Industrial Biotechnology</li> <li>3. Describe the current trends in Industrial Biotechnology to be used in Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. <b>Industrial Microorganisms:</b><br/>Features of industrial microorganisms, sources of industrially important microorganisms, isolation, screening and strain improvement of industrially useful microorganisms, methods for preservation of industrial microorganisms.</li> <li>2. <b>Industrial enzymes:</b><br/>Advantages and disadvantages of microbial production of industrial enzymes, microbial production of industrial enzymes, large scale enzyme applications.</li> <li>3. <b>Biopolymers:</b><br/>Structure-function relationship in microbial polysaccharides, properties of xanthan, bacterial cellulose and hyaluronic acid, applications of microbially-produced hydrocolloids (gums) to food and other industries including dextran from <i>Leuconostoc mesenteroides</i>, introduction to bioplastics and PHAs.</li> <li>4. <b>Biofilms:</b><br/>Microbial activity in aqueous environments occurs at solid-liquid or air-liquid interfaces. Nature and composition of biofilms, development of biofilm, beneficial applications of biofilms, detrimental effects of biofilms, role of biofilms in the natural environment.</li> </ol> |                  |                                 |
| <b>Reference:</b>                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                 |
|                                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li>7. M.Y. Young: Comprehensive biotechnology Vol. 1- 4</li> <li>8. T.D. Brock, Smaeur Associates: Biotechnology- A text book of industrial microbiology</li> <li>9. L.E. Casida: Industrial microbiology</li> <li>10. Prescott &amp; Dunn: Industrial microbiology</li> <li>11. S.O. Enfors &amp; L. Hagstrom: Bioprocess technology- fundamentals and applications</li> <li>12. W. Crueger and A.Crueger: Biotechnology - A hand book of industrial microbiology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                 |

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| <b>Course: BT-5105</b> | <b>Course Name: Lab in Biomedical Engineering &amp; Protein Engineering</b> |                    |
| <b>Full Marks: 100</b> | <b>Unit: 1</b>                                                              | <b>Credit: 2.0</b> |

Exp.1: Transformation of *E.coli*.with plasmid DNA.  
 Exp.2: SDS -PAGE electrophoresis using protein samples.  
 Exp.3: Amplification of DNA by polymerase chain reaction.  
 Exp.4: Restriction digestion of PCR products using genomic DNA as template  
 Exp.5: Ligation of DNA fragment (insert) to vector.  
 Exp.6: Study of active and passive medical devices  
 Exp.7: Study of ultra sound therapy  
 Exp.8: Study of electrocardiogram (ECG)  
 Exp.9: Study of medical imaging (x-ray, EEG, MRI)

Exp – total proein extraction from biological Sample

Exp – dot blot

Exp – western blot

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| <b>Course: BT-5106</b> | <b>Course Name: Lab in Food &amp; Industrial Biotechnology</b> |                    |
| <b>Full Marks: 100</b> | <b>Unit: 1</b>                                                 | <b>Credit: 2.0</b> |

Exp.1: Production of yogurts from cow milk using starter cultures from different sources.  
 Exp.2: High throughput screening of microbes from industrial waste  
 Exp.3: Colony PCR methods for rapid identification of industrially important bacteria  
 Exp.4: Development of biofilm  
 Exp.5: Screening of industrially important bacteria  
 Exp.6: Screening industrially important fungi.  
 Exp.7: Microbial production of industrially important enzymes.  
 Exp.8: Identification of lactobacillus strains for nutritious yogurt production.  
 Exp.9: Preservation of industrially important microbes  
 Exp.10: Extraction and purification of essential oil from natural sources.  
 Exp.11: Determination of catalase enzyme activity

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| <b>Course: BT-5107</b> | <b>Course Name: Viva-voce</b> |                    |
| <b>Full Marks: 50</b>  | <b>Unit: 1</b>                | <b>Credit: 1.0</b> |

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| <b>Course Title: Advance Agricultural Biotechnology</b>                                                                                                                                                                                                                                                          | <b>Course No: BT-5201</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Industrial Biotechnology                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Agricultural Biotechnology</li> <li>• Acquire general knowledge on different areas of Agricultural Biotechnology</li> <li>• Acquaint with general techniques used in Agricultural Biotechnology</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                         | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Agricultural Biotechnology</li> <li>2. Explain the history, scope and importance of Agricultural Biotechnology</li> <li>3. Describe the current trends in Agricultural Biotechnology</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li><b>1. Plant growth promoting bacteria:</b><br/>Scope and prospects of Agriculture Biotechnology in Bangladesh, Nitrogen fixation; Genetic engineering of the nitrogenase gene, hydrogenase gene and nodulation gene; growth promotion by free-living bacteria, phytoremediation, biocontrol of pathogens, genetic engineering for improved biocontrol, baculoviruses as biocontrol agents.</li> <li><b>2. Applications of plant Biotechnology:</b> <ol style="list-style-type: none"> <li>i) Transgenics for improved storage, male sterility and terminator seed</li> <li>ii) Commercial transgenic crops: bt bringal, golden rice, late blight resistant potato</li> <li>iii) Transgenic plants as bioreactors</li> <li>iv) Transgenic plants as edible vaccines</li> <li>v) Metabolic engineering in plant cells</li> <li>vi) Modification of production traits: starch and oil modification, improving vitamin mineral content</li> <li>vii) Development of stress and senescence tolerant plants</li> <li>viii) Production of pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds through plant tissue culture.</li> </ol> </li> <li><b>3. Biofertilizers:</b><br/>Definition, types of biofertilizers, benefits of different types of biofertilizers.</li> <li><b>4. Biopesticides:</b><br/>Definition, integrated pest management (IPM), application, advantages and</li> </ol> |                  |                                 |

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|                   | <p>disadvantages of biopesticides.</p> <p><b>5. Regulation of use of Biotechnology:</b><br/>Regulating food and food ingredients, deliberate release of GMOs, controversy about GMOs</p>                                                                                                                                                                                                                |
| <b>Reference:</b> | <ol style="list-style-type: none"> <li>1. Gresshoff, P.M: Plant biotechnology and development, SRC series of current topics in plant molecular biology.</li> <li>2. Anderson: Plant cell culture- advances in biochemical engineering and biotechnology</li> <li>3. Watson: Recombinant DNA</li> <li>4. Portykns: Gene transfer to plants</li> <li>5. Mantell and Smith: Plant biotechnology</li> </ol> |

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| <b>Course Title: Toxicology and Pharmacology</b>                                                                                                                                                                                                                                                                          | <b>Course No: BT-5202</b>                                                                                                                                                                                                                                                                                                                    | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Toxicology & Pharmacology                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                              |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Toxicology &amp; Pharmacology</li> <li>• Acquire general knowledge on different areas of Toxicology &amp; Pharmacology</li> <li>• Acquaint with general techniques used in Toxicology &amp; Pharmacology</li> </ul> |                                                                                                                                                                                                                                                                                                                                              |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                                  | <p>At the end of the course the students will be able to-</p> <ol style="list-style-type: none"> <li>1. Describe various aspects of Toxicology &amp; Pharmacology</li> <li>2. Explain the history, scope and importance of Toxicology &amp; Pharmacology</li> <li>3. Describe the current trends in Toxicology &amp; Pharmacology</li> </ol> |                  |                                 |

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| <b>Course Content</b> | <p><b>A. Pharmacology</b></p> <p>4. History and Scope of pharmacology</p> <p>5. General pharmacology: Biological half-life, bioavailability, metabolism of drugs and excretion, routes of drug administration, drug absorption, distribution, elimination and factors affecting them, Pharmacodynamics-mechanisms of drugs action, receptor and non-receptor theory, signal transduction and second messengers, drug potency and efficacy, dose-response relationships, agonists and antagonisms, tolerance and tachyphylaxis, measurement of some pharmacological parameters, drug allergy, drug toxicity and drug interaction..</p> <p>6. Introduction to Pharmacogenomics and pharmacogenetics:</p> <p>g. Genes, environment and disease,</p> <p>h. Technological approaches to understanding genotype-phenotype relationships I – DNA analysis</p> <p>i. Technological approaches to understanding genotype-phenotype relationships II – RNA analysis</p> <p>j. Technological approaches to understanding genotype-phenotype relationships III – Proteomics and metabolomics analyses.</p> <p>k. Polymorphisms, Enzyme Kinetics and Pharmacokinetics/Toxicokinetics</p> <p>l. Applications of GWAS and Next Generation sequencing technologies</p> <p><b>B. Toxicology:</b></p> <p>d. Drugs adverse effect: Determination of LD<sub>10</sub>, LD<sub>50</sub>, ED<sub>50</sub>, therapeutic index, adverse reactions, causes of adverse reaction, factors affecting side effects of drugs.</p> <p>e. Effects of poisons: Poisons, toxins of animal origin, symptoms and management of poisoning cases with pesticides, fumigants, solvents, vapor, food toxins, and cyanides.</p> <p>f. Toxicogenomics -1 ((CYPs 1A1, 1B1, 2E1, FMO3, ALDH2); Toxicogenomics - 2 (NATs, SULTs, GSTs, mEH, NQO1)</p> |
| <b>Reference:</b>     | <p>Goodman and Gillman: Pharmacological basis of therapy.</p> <p>R.S. Satosker: Pahrmacology and Pharmacotherapeutics</p> <p>Pharmacogenetics: An Introduction and Clinical Perspective</p> <p>Costa, LG and Eaton DL: Gene-Environment Interactions: Fundamentals of Ecogenetics.</p> <p>Joseph S. Bertino: Fundamentals of Ecogenetics.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <b>Course Title: Molecular Biology of Diseases</b>                                                                                                                                                                                                                                                                     | <b>Course No: BT-5203</b>                                                                                                                                                                                                                                                                                                                 | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Molecular Biology of Disease                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Molecular Biology of Disease</li> <li>• Acquire general knowledge on different areas of Molecular Biology of Disease</li> <li>• Acquaint with general techniques used in Molecular Biology of Disease</li> </ul> |                                                                                                                                                                                                                                                                                                                                           |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                                                                               | <p>At the end of the course the students will be able to-</p> <ol style="list-style-type: none"> <li>1. Describe various aspects of Molecular Biology of Disease</li> <li>2. Explain the history, scope and importance of Molecular Biology of Disease</li> <li>3. Describe the current trends in Molecular Biology of Disease</li> </ol> |                  |                                 |

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| <b>Course Content</b> | <p><b>1. Diabetes mellitus:</b><br/>Type I, type II and other major clinical classes; genetic basis of type I DM; HLA-DQ, HLA-DR and MHC, pattern of inheritance in type II DM; MODY (Maturity onset diabetes mellitus in young); insulin gene; biosynthesis of insulin; mechanism of insulin action; complications of DM; diagnosis and treatment (brief treatment), <i>diabetes insipidus</i></p> <p><b>2. Cardiovascular diseases:</b><br/>Dyslipidemia, atherosclerosis- molecular mechanism of atheromatous plaque formation, involvement of LDL &amp; foam cells; ischemic heart disease; myocardial infarction (MI); biochemical markers for the diagnosis of MI; coronary heart disease (CAD), heart failure; hypertension, heart attack, stroke, disorders of lipoprotein metabolism.</p> <p><b>3. Liver diseases:</b><br/>hyperbilirubinemia, Dubin-Johnson syndrome, criglar-najjar syndrome, viral hepatitis- types of hepatitis virus and their genomic organization, acute hepatocellular carcinoma, chronic hepatocellular carcinoma, liver cirrhosis, liver function tests.</p> <p><b>4. Renal disease:</b></p> <p><b>5. Neurodegenerative diseases:</b><br/>Neuropathological features and molecular mechanisms, therapeutic approaches in Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease, multiple sclerosis and prion diseases.</p> <p><b>6. Genetic basis of some metabolic disorders:</b><br/>Phenylketonuria, alkaptonuria, maple syrup urine disease, nieman-pick disease, gaucher's disease, glycogen storage disease, gout.</p> |
| <b>Reference:</b>     | <p>5. John Macloed., Davidson's principles and Practice of Medicine</p> <p>6. Gillham, B., Despo, K.P., Thomas, J.H., Will's Biochemical Basis of Medicine.</p> <p>7. R.K.Murray: Harper's Biochemistry.</p> <p>8. Devlin: Textbook of Biochemistry with clinical correlations</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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| <b>Course Title: Business Perspective of Biotechnology</b>                                                                                                                                                                                              | <b>Course No: BT-5204</b>                                                                                                                                                                                                                          | <b>Credit: 3</b> | <b>Semester: 2<sup>nd</sup></b> |
| <b>Rationale:</b> This course is designed to provide general concepts of Business Perspective of Biotechnology                                                                                                                                          |                                                                                                                                                                                                                                                    |                  |                                 |
| <b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Conceptualize general knowledge of Business Perspective of Biotechnology</li> <li>• Acquire general knowledge on different areas of Business Perspective of Biotechnology</li> </ul> |                                                                                                                                                                                                                                                    |                  |                                 |
| <b>Intended Learning Outcomes (ILOs)</b>                                                                                                                                                                                                                | At the end of the course the students will be able to- <ol style="list-style-type: none"> <li>1. Describe various aspects of Business Perspective</li> <li>2. Explain the scope and importance of Business Perspective in Biotechnology</li> </ol> |                  |                                 |

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|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Content</b>  | <p><b>1. Business management:</b><br/>Company, its environment, stakeholders, corporate strategies, some basic economic principles (e.g. profit maximization, shareholder value), business planning and decision making processes and supporting tools, methods of business analysis, introduction to technology development, introduction to procurement, introduction to operations management, introduction to marketing /sales.</p> <p><b>2. Project management:</b><br/>Fundamentals of project management, life cycle of a project- Project definition; project planning; project execution and controlling; project close out, tools and methods of project management (e.g. planning methods, problem solving methods), social competence in project management ( teamwork; communication).<br/>Time and quality based controlling, auditing.</p> <p><b>3. Practical applications of business biotechnology:</b><br/>Biotechnology used for biotechnological companies, their care and nurturing, investment in<br/>Biotechnology, management needs.</p> <p><b>4. Biotechnological industry:</b><br/>Environmental release of genetically modified organisms; product labeling, technology transfer; health insurance and reimbursement; entrepreneurship, venture capital and the life cycle of a biotechnological company; public perception of biotech products; global market place for biotechnological products.</p> <p><b>5. Commercialization, marketing and management of biotechnological products:</b><br/>Fundamentals of marketing, marketing and selling of biotechnology, creating and marketing the image of the biotechnology company, power and importance of positioning of a company name and product, Art of negotiation, workable marketing and the strength of distribution, effective advertising and marketing, opportunities of international marketing and lessons to be learnt, steps involved in commercialization of a biotechnological product.</p> <p><b>6. Intellectual property rights in biotechnology:</b><br/>General introduction, patent claims, legal decision making process, ownership of intellectual property, basic requirements of patentability- patentable subject matter, novelty and public domain, special issues in biotechnology patents-disclosure requirements, collaborative research, competitive research, foreign patents, patent litigation- substantive aspects of patent litigation, procedural aspects of patent litigation, and recent developments in patent system and patentability of biotechnological invention.</p> |
| <b>Reference:</b>      | <p>5. Colin Rat ledge: Basic biotechnology<br/>6. Harold Koontz and heint Weihrich: Management<br/>7. P. Chanda: Project-Preparation, Appraisal, Budgeting and Implementatation<br/>8. R.J.Ruffin and P.R.Gregary: Principles of microeconomics<br/>9. William J. Thieman and Michael A: Introduction to biotechnology</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course: BT-5205</b> | <b>Course Name: Lab in Agricultural Biotechnology, Toxicology &amp; Pharmacology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Full Marks: 100</b> | <b>Credit: 2.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Exp.1: Agrobacterium mediated gene transfer  
Exp.2: Study on the effect of phytohormone on callus induction  
Exp.3: Screening of nitrogen fixing bacteria from natural source  
Exp.4: Production of biofertilizer by the use of nitrogen fixing bacteria

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|------------------------|----------------------------------------------------------------------------------------------------|
| <b>Course: BT-5206</b> | <b>Course Name: Lab in Molecular Biology of Diseases and Business Perspective of Biotechnology</b> |
| <b>Full Marks: 100</b> | <b>Credit: 2.0</b>                                                                                 |

Exp.1: Study of biotechnological project design and development  
Exp.2: Study of proper budgeting for the project  
Exp.3: Study of patenting procedure  
Exp.4: Study of the organization and workflow of a biotech company

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|------------------------|----------------------------------------------------------------|
| <b>Course: BT-5207</b> | <b>Course Name: Research Project (For thesis) Presentation</b> |
| <b>Full Marks: 100</b> | <b>Credit: 1.0</b>                                             |

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|------------------------|-------------------------------|
| <b>Course: BT-5208</b> | <b>Course Name: Viva-voce</b> |
| <b>Full Marks: 50</b>  | <b>Credit: 1.0</b>            |

### Third Semester

| <b>Course no</b> | <b>Course title</b>          | <b>Total marks</b> | <b>Credits</b> |
|------------------|------------------------------|--------------------|----------------|
| BT-5301          | Journal Article presentation | 50                 | 1.0            |
| BT-5302          | Dissertation                 | 200                | 4.0            |
| BT-5303          | Dissertation Presentation    | 100                | 2.0            |
| Total            |                              | 350                | 7.0.           |