

# **Program Structure**

**Program: M.Sc. (Biotechnology)**

**Program Code: SBR0413**

**Batch: 2018-20**

**Department of Life Sciences**

**School of Basic Science & Research**

# **Vision, Mission and Core Values of the University**

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## **Vision of the University**

**To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.**

## **Mission of the University**

- 1. Transformative educational experience**
- 2. Enrichment by educational initiatives that encourage global outlook**
- 3. Develop research, support disruptive innovations and accelerate entrepreneurship**

## **Core Values**

- Integrity**
- Leadership**
- Diversity**
- Community**

## **Vision and Mission of the School**

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### **Vision of the School**

**Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society**

### **Mission of the School**

- 1. To equip the students with knowledge and skills in basic and applied sciences**
- 2. Capacity building through advanced training and academic flexibility.**
- 3. To establish centre of excellence for ecologically and socially innovative research.**
- 4. To strengthen interinstitutional and industrial collaboration for skill development and global employability.**

## **Vision and Mission of Department of Life Sciences**

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### **Vision of Life Sciences Department**

**Strive to achieve excellence in teaching and research in the field of Microbiology and Biotechnology and to build human resource for solving contemporary problems.**

### **Mission of Life Sciences Department**

- **Providing distinctive and relevant education in Life Sciences to students.**
- **Motivating young minds through innovative teaching methods, to acquire theoretical knowledge and practical skills in different disciplines of chemistry and empowering them with problem solving skills.**
- **Nurturing innovation by carrying out world class research and scholarly work**
- **Promoting interdisciplinary research in collaboration with national/international laboratories/Institutions.**

## Program Educational Objectives (PEO)

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PEO1: To create a foundation of various biological concepts and phenomena in the minds of students through theoretical and practical knowledge.

PEO2: To keep students upgraded with new discoveries in biological world and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.

PEO3: To teach the students various bio-techniques and application of these techniques for betterment of society and environment.

PEO4: To make students industry- or academia-ready by developing independent thinking, good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.

PEO5: To make students understand interdisciplinary nature of research in biotechnology by assigning them different research projects/ case studies/ presentations.

### Map PEOs with Mission Statements:

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| PEO Statements | School Mission 1 | School Mission 2 | School Mission 3 | School Mission 4 |
|----------------|------------------|------------------|------------------|------------------|
| PEO1           | 3                | 2                | -                | -                |
| PEO2           | 3                | 2                | 2                | -                |
| PEO3           | 3                | 3                | 2                | 1                |
| PEO4           | 2                | 3                | 2                | 2                |
| PEO5           | 3                | 2                | 2                | 2                |

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

### Map PEOs with Department Mission Statements:

| PEO Statements | Departmental Mission 1 | Departmental Mission 2 | Departmental Mission 3 | Departmental Mission 4 |
|----------------|------------------------|------------------------|------------------------|------------------------|
| PEO1           | 3                      | 1                      | 1                      | 1                      |
| PEO2           | 3                      | 3                      | 2                      | 2                      |
| PEO3           | 2                      | 2                      | 2                      | 2                      |
| PEO4           | 3                      | -                      | 2                      | 3                      |
| PEO5           | 3                      | 2                      | 3                      | 2                      |

## Program Outcomes (PO's)

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**PO1: Knowledge:** Students will develop a sound understanding the biological systems and processes.

**PO2: Skill Set Development:**The student will be skilled in various biological techniques that will enhance the employability of the students.

**PO3: Oral Communication and Scientific Writing:** The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report and reviews) content.

**PO4: Environment and Sustainable Development:** Student will be able to realize the effect of human malpractices on environment and the need and importance of sustainable development.

**PO5: Ethics, Independent Thinking and Team Work:** The students will develop professional ethics and also gain knowledge about various ethical issues associated with biotechnology.

Students will learn to think and analyze a problem independently while at the same time realizing the importance of team work in carrying out successful research/ projects/ presentations.

## Mapping of Program Outcome Vs Program Educational Objectives

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|     | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|-----|------|------|------|------|------|
| PO1 | 3    | 2    | 2    | 2    | 2    |
| PO2 | 3    | 2    | 2    | 3    | 2    |
| PO3 | 1    | 1    | -    | 3    | 2    |
| PO4 | 1    | 2    | 3    | -    | 2    |
| PO5 | 1    | 2    | -    | 3    | 2    |

*1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)*

**M.Sc.**  
**in**  
**Biotechnology**

**COURSE STRUCTURE & SYLLABI**

(For Batch 2018-19 onwards)



**Department of Life Science**  
**School of Basics Sciences and Research**  
**SHARDA UNIVERSITY**

**SUMMARY SHEET**

|                                |   |                                       |
|--------------------------------|---|---------------------------------------|
| <b>Teaching Department</b>     | : | Life Science                          |
| <b>School</b>                  | : | School of Basic Sciences and Research |
| <b>Name of Course</b>          | : | M.Sc. in Biotechnology                |
| <b>Duration</b>                | : | Two Years                             |
| <b>Total number of Credits</b> | : | 86                                    |



## Term I

| Sr. No   | Course Code* | Course Name                                     | Category **<br>Note:***         | L | T | P | Credits |
|--|--------------|---|---------------------------------|---|---|---|---------|
| <b>Semester I</b>                                    |              |   |                                 |   |   |   |         |
| 1  | MSB114       | Advanced Biochemistry                           | Core course                     | 4 | 0 | 0 | 4       |
| 2  | MSB122       | Advanced Molecular Biology                      | Core course                     | 4 | 0 | 0 | 4       |
| 3  | MSB119       | Animal Cell Technology                          | Core course                     | 4 | 0 | 0 | 4       |
| 4  | MSB123       | Advanced Genetic Engineering                    | Core course                     | 4 | 0 | 0 | 4       |
| 5  | MST111       | Biostatistics                                   | Generic Elective                | 0 | 0 | 3 | 2       |
| 6  | MSB159       | Genetic Engineering Lab                         | Practical                       | 0 | 0 | 3 | 2       |
| 7  | MSB155       | Biochemistry Lab                                | Practical                       | 0 | 0 | 3 | 2       |
| 8  | MSB156       | Molecular Biology Lab                           | Practical                       | 0 | 0 | 3 | 2       |
| <b>Semester I Total Minimum Credits: 24</b>          |              |   |                                 |   |   |   |         |
| <b>Semester II</b>                                   |              |   |                                 |   |   |   |         |
| 1  | MSB116       | Bio instruments                                 | Core course                     | 4 | 0 | 0 | 4       |
| 2  | MSB118       | Advances in Plant Biotechnology                 | Core course                     | 4 | 0 | 0 | 4       |
| 3  | MSB117       | Immunology and Immunotechnology                 | Core course                     | 4 | 0 | 0 | 4       |
| 4  | MSB121       | Fermentation Technology                         | Core course                     | 4 | 0 | 0 | 4       |
| 5  | MSB120       | Bioinformatics                                  | (AEC/SEC)                       | 2 | 0 | 0 | 2       |
| 6  | MSB157       | Immunotechnology Lab                            | Practical                       | 0 | 0 | 3 | 2       |
| 7  | MSB158       | Plant Biotechnology Lab                         | Practical                       | 0 | 0 | 3 | 2       |
| 8  | MSB160       | Bioinstrumentation Lab                          | Practical                       | 0 | 0 | 3 | 2       |
| <b>Semester II Total Minimum Credits:24</b>          |              |   |                                 |   |   |   |         |
| <b>Semester III</b>                                  |              |   |                                 |   |   |   |         |
| 1  | MMB201       | Environmental Microbiology and waste management | 'Discipline Specific' Electives | 4 | 0 | 0 | 4       |
| 2  | MSB204       | Genomics  | Core course                     | 4 | 0 | 0 | 4       |
| 3  | MSB206       | Enzyme Technology                               | Core course                     | 4 | 0 | 0 | 4       |
| 4  | MSB203       | Intellectual Property rights and ethical issues | Core course                     | 4 | 0 | 0 | 4       |
| 5  | MSP206       | Enzyme Technology Lab                           | Practical                       | 0 | 0 | 3 | 2       |
| 6  | MSB256       | Genomics & Bacterial Genetics Lab               | Practical                       | 0 | 0 | 3 | 2       |
| 7  | MSB258       | Dissertation Part I                             | 'Discipline Specific' Electives | 0 | 0 | 4 | 4       |
| <b>Semester III Total Minimum Credits:24</b>         |              |   |                                 |   |   |   |         |
| <b>Semester IV</b>                                   |              |   |                                 |   |   |   |         |
| 1  | MSB259       | Dissertation Part II                            | 'Discipline Specific' Electives | 0 | 0 | 6 | 6       |
| 2  | MMB204       | Food Microbiology                               | Core course                     | 4 | 0 | 0 | 4       |
| 3  | MSB205       | Cancer Biology                                  | Core course                     | 4 | 0 | 0 | 4       |
| <b>Semester IV Total Minimum Credits:14</b>          |              |   |                                 |   |   |   |         |
| <b>Grand Total Minimum Credits for Programme: 86</b> |              |   |                                 |   |   |   |         |

**MSB114: Advanced Biochemistry**  
**L-T-P: 4-0-0**

**Credits 4**

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School : SBSR</b>         |                       | <b>Batch : 2018-20</b>   |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 1</b>   |            |
| 1                            | Course Code           | <b>MSB114</b>  |            |
| 2                            | Course Title          | <b>Advanced Biochemistry</b>   |            |
| 3                            | Credits               | 4  |            |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |            |
| 6                            | Course Objective      | <ol style="list-style-type: none"> <li>1. Structure of polysaccharides</li> <li>2. Classification and structure of lipids</li> <li>3. Protein-ligand interaction and modulation of protein activity</li> <li>4. Assimilation of inorganic phosphorus, sulfur and nitrogen, Nitrogen fixation</li> </ol>  |            |
| 7                            | Course Outcomes       | <p>After studying this course, students will be able to</p> <p>CO1: Determine Classification and structure of carbohydrates</p> <p>CO2: Evaluate Nucleic acid structure, nucleic acid chemistry, Functions of Nucleotides</p> <p>CO3: Interpret the Protein-ligand interaction and modulation of protein activity</p> <p>CO4: Analyse the Biosynthesis of polysaccharides and interconversion of sugars</p> <p>CO5: Determine Synthesis of purines, pyrimidines and nucleotides</p> <p>CO6 : Analyze and study Photosynthesis and photophosphorylation</p> |            |
| 8                            | Course Description    | This course contains various advanced biochemistry concepts ranging from structure and classification of carbohydrates, proteins, nucleic acids and nucleotides. After studying course, students will be able to learn chemistry of biomolecules, and their metabolic pathways.  |            |
| 9                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Carbohydrates</b>   | <b>CO1</b> |
|                              | A                     | Classification and structure of carbohydrates, Structure of polysaccharides  |            |
|                              | B                     | glycoproteins and peptidoglycans, Functions of polysaccharides   |            |
|                              | C                     | glycoproteins and peptidoglycans.  |            |
|                              | <b>Unit 2</b>         | <b>Lipids Amino acids, Nucleic acids and Nucleotides</b>   | <b>CO2</b> |
|                              | A                     | Classification and structure of lipids, Saturated and unsaturated fatty acids, rancidity   |            |
|                              | B                     | Classification, structure and functions of amino acids, Peptide Bond, Ramachandran Plot, Primary, secondary and Tertiary structure of Proteins   |            |
|                              | C                     | Nucleic acid structure, nucleic acid chemistry, Functions of Nucleotides   |            |
|                              | <b>Unit 3</b>         | <b>Chemistry of Biomolecules, Biological Membranes and Transport</b>   | <b>CO3</b> |

|  |                        |  |     |     |            |
|--|------------------------|--|-----|-----|------------|
|  | A                      | Protein-ligand interaction and modulation of protein activity, protein sequencing  |     |     |            |
|  | B                      | Composition and architecture of membranes  |     |     |            |
|  | C                      | membrane dynamics, solute transport across membranes   |     |     |            |
|  | <b>Unit 4</b>          | <b>Metabolic Pathways</b>  |     |     | <b>CO4</b> |
|  | A                      | Glycolysis, Entner-Doudoroff, HMP and oxidative pentose phosphate; Glyoxylate cycle, TCA cycle, and oxidative phosphorylation,   |     |     |            |
|  | B                      | Biosynthesis of polysaccharides and interconversion of sugars <b>Catabolism:</b> Bioenergetics of $\beta$ -oxidation of fatty acids,   |     |     |            |
|  | C                      | long chain fatty acids, Anabolism: <b>Biosynthesis of fatty acids:</b> saturated, unsaturated  |     |     |            |
|  | <b>Unit 5</b>          | <b>Nucleotide Biosynthesis and Use of Energy in Biosynthesis</b>   |     |     | <b>CO5</b> |
|  | A                      | Synthesis of purines, pyrimidines and nucleotides  |     |     |            |
|  | B                      | Photosynthesis and photophosphorylation, Photorespiration  |     |     |            |
|  | C                      | Assimilation of inorganic phosphorus, sulfur and nitrogen, Nitrogen fixation   |     |     |            |
|  | Mode of examination    | Theory   |     |     |            |
|  | Weightage Distribution | CA   | MTE | ETE |            |
|  |                        | 30%  | 20% | 50% |            |
|  | Text book/s*           | Nelson D.L. and Cox M.M., "Lehninger Principles of Biochemistry", W.H. Freeman, 2009   |     |     |            |
|  | Other References       | Stryer L., "Biochemistry", W. H. Freeman, 2010.<br>Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2005. |     |     |            |

### Course Outcome

| No  | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| CO1 | 3   | 1   | 1   | 1   | 1   |
| CO2 | 1   | 3   | 1   | 1   | 1   |
| CO3 | 1   | 1   | 3   | 1   | 1   |
| CO4 | 1   | 1   | 1   | 3   | 1   |
| CO5 | 1   | 1   | 1   | 1   | 3   |
| CO6 | 1   | 1   | 1   | 1   | 1   |

## MSB122: Advanced Molecular Biology

L-T-P:4-0-0

Credits 4

|                              |                    |   |            |
|------------------------------|--------------------|---|------------|
| <b>School: SBSR</b>          |                    | <b>Batch: 2018-20</b>   |            |
| <b>Program: M.Sc.</b>        |                    | <b>Current Academic Year: 2018-19</b>   |            |
| <b>Branch: Biotechnology</b> |                    | <b>Semester: 01</b>   |            |
| 1                            | Course Code        | <b>MSB122</b>   |            |
| 2                            | Course Title       | <b>Advanced Molecular Biology</b>   |            |
| 3                            | Credits            | 4   |            |
| 4                            | Contact H (L-T-P)  | 4-0-0   |            |
|                              | Course Status      | <b>Compulsory</b> /Elective/Open Elective   |            |
| 5                            | Course Objective   | <ol style="list-style-type: none"><li>1. Understand the structure and function of nucleic acids and genome organization.</li><li>2. Understand the process of DNA replication and Transcription in prokaryote and eukaryote.</li><li>3. Understand the process of Translation and regulation of gene expression.</li></ol>  |            |
| 6                            | Course Outcomes    | CO1: To understand the structure and function of Nucleic acid, Chromatin and Chromosome.<br>CO2: To understand the process of DNA replication in prokaryotes and eukaryotes.<br>CO3: To understand the process of transcription in prokaryotes.<br>CO4: To understand the process of transcription in eukaryotes.<br>CO5: To understand the process of Translation and regulation of gene expression<br>CO6: Observe different life processes happening at molecular level inside cell and perspectives on gene regulation. |            |
| 7                            | Course Description | The course covers the gene organization in prokaryotic and eukaryotic cells. Course will familiarise students with the process of replication, transcription, post-transcriptional modifications and translation in both prokaryotes and eukaryotes.  |            |
| 8                            | Outline syllabus   |   | CO Mapping |
|                              | <b>Unit 1</b>      | <b>Genome Organization</b>  |            |
|                              | A                  | Structure of DNA and RNA, Nucleoside and nucleotide, complementary base pairing   | CO1        |
|                              | B                  | DNA melting and reassociation kinetics  | CO1        |
|                              | C                  | Structure of eukaryotic chromosomes, Euchromatin and heterochromatin.   | CO1        |
|                              | <b>Unit 2</b>      | <b>DNA Replication</b>  |            |
|                              | A                  | Replication process in prokaryotes  | CO2        |
|                              | B                  | Replication process in eukaryotes   | CO2        |

|  |                        |   |            |            |
|--|------------------------|---|------------|------------|
|  | C                      | Enzymes and accessory proteins in replication, Replication of ss-circular DNA   |            | CO2        |
|  | <b>Unit 3</b>          | <b>Prokaryotic Transcription</b>  |            |            |
|  | A                      | Process of prokaryotic transcription  |            | CO3        |
|  | B                      | Inducible and constitutive promoters  |            | CO3        |
|  | C                      | Operators and regulators in prokaryotic transcription   |            | CO3        |
|  | <b>Unit 4</b>          | <b>Eukaryotic Transcription</b>   |            |            |
|  | A                      | Process of eukaryotic transcription   |            | CO4        |
|  | B                      | Eukaryotic promoters and enhancers, TATA binding proteins and associated factors, activators and repressors   |            | CO4        |
|  | C                      | Post-transcriptional modifications  |            | CO4        |
|  | <b>Unit 5</b>          | <b>Translation and Regulation of gene expression</b>  |            |            |
|  | A                      | Translation machinery, Ribosome, degeneracy of codons and termination codons  |            | CO5        |
|  | B                      | Mechanism of initiation, elongation and termination   |            | CO5        |
|  | C                      | Operon system, Lac operon, Trp operon and Ara operon.   |            | CO5        |
|  | Mode of examination    | Theory/Jury/Practical/Viva  |            |            |
|  | Weightage Distribution | CA<br>30%   | MTE<br>20% | ETE<br>50% |
|  | Textbook/s*            | Lewin B., "Gene IX", Jones and Barlett Publishers, 2007   |            |            |
|  | Other References       | <ol style="list-style-type: none"> <li>1. Alberts B., Johnson A., Lewis J. and Raff M., "Molecular Biology of the Cell", Garland Science, 2002.</li> <li>2. Watson J.D., Hopkins N.H., Roberts J.W., Seitz J.A. and Weiner A.M., "Molecular Biology of the Gene", Benjamin Cummings Publishing Company Inc, 2007</li> </ol> |            |            |

| Course Outcome No | PO1 | PO2 | PO3 | PO4 | PO5 |
|-------------------|-----|-----|-----|-----|-----|
| CO1               | 3   | 1   | 1   | 1   | 1   |
| CO2               | 1   | 3   | 1   | 1   | 1   |
| CO3               | 1   | 1   | 3   | 1   | 1   |
| CO4               | 1   | 1   | 1   | 3   | 1   |
| CO5               | 1   | 1   | 1   | 1   | 3   |
| CO6               | 3   | 3   | 3   | 3   | 3   |

# MSB123: ADVANCED GENETIC ENGINEERING

L-T-P: 4-0-0

Credit: 4

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School: SBSR</b>          |                       | <b>Batch : 2018-20</b>   |            |
| <b>Program: M.Sc</b>         |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 1</b>   |            |
| 1                            | Course Code           | <b>MSB123</b>  |            |
| 2                            | Course Title          | <b>Advanced Genetic Engineering</b>  |            |
| 3                            | Credits               | 4  |            |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |            |
|                              | Course Status         | Compulsory   |            |
| 5                            | Course Objective      | 1. To acquire knowledge of principle and techniques involved in genetic engineering.<br>2. To comprehend the basic strategies of cloning and how it can be applied for human benefit.<br>3. To learn the use of expression vectors and their role in recombinant protein production.<br>4. To learn the production of transgenic plants and animals and their benefits to human beings.  |            |
| 6                            | Course Outcomes       | After the successful completion of this course students will be able to:<br>CO1: Recognize the molecular tools for genetic manipulation.<br>CO2: Analyze different vector types and their application in construction of libraries.<br>CO3: Describe PCR process and its applications and hybridization techniques.<br>CO4: Explain the different types of expression vectors and their use along with methods of gene delivery.<br>CO5: Analyze different applications of genetic engineering in various fields such as gene therapy and transgenic organisms.<br>CO6: Describe gene transfer technologies and tools used for these methods, creation of gene libraries and various application of genetic engineering. |            |
| 7                            | Course Description    | The 'Applied Genetic Engineering' course involves study of molecular tools in genetic engineering. It encompasses detailed procedure of genetic engineering including selection of host cells, vectors, expression vectors etc. It also involves the use of genetic engineering for mankind, creation of transgenic plants and animals.  |            |
| 8                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Genetic engineering tools and methods</b>   |            |
|                              | A                     | Restriction Enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase  | CO1, CO6   |

|  |                        |   |     |     |          |
|--|------------------------|---|-----|-----|----------|
|  | B                      | Modifying Enzymes, Reverse transcriptase, Other important Nucleases   |     |     |          |
|  | C                      | Cohesive and blunt end ligation; Linkers, Adaptors; Homopolymeric tailing   |     |     |          |
|  | <b>Unit 2</b>          | <b>Cloning</b>  |     |     |          |
|  | A                      | Cloning vectors: Plasmids; PUC19 and Bluescript vectors   |     |     | CO2, CO6 |
|  | B                      | Bacteriophages; M13 mp vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40 & retroviral vectors  |     |     |          |
|  | C                      | Cloning methodology and selection: Insertion of foreign DNA into vectors; Transformation; Selection, Construction of libraries, cDNA and genomic libraries  |     |     |          |
|  | <b>Unit 3</b>          | <b><i>In vitro</i> DNA Amplification</b>  |     |     |          |
|  | A                      | Nucleic acid extraction   |     |     | CO3, CO6 |
|  | B                      | PCR, Types of PCR – multiplex, nested, reverse transcriptase, real time PCR   |     |     |          |
|  | C                      | Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Southern and Colony hybridization  |     |     |          |
|  | <b>Unit 4</b>          | <b>Expression</b>   |     |     |          |
|  | A                      | Expression vectors: His-tag and GST-tag based vectors   |     |     | CO4, CO6 |
|  | B                      | Plant based vectors, Ti plasmid based Co-integrated and binary vectors; Yeast vectors, Shuttle vectors, Expression cloning  |     |     |          |
|  | C                      | Methods gene delivery, Screening and analysis of gene expression and Diagnosis of gene expression   |     |     |          |
|  | <b>Unit 5</b>          | <b>Application</b>  |     |     |          |
|  | A                      | Gene therapy  |     |     | CO5, CO6 |
|  | B                      | Mutagenesis   |     |     |          |
|  | C                      | Transgenic organisms  |     |     |          |
|  | Mode of examination    | Theory  |     |     |          |
|  | Weightage Distribution | CA  | MTE | ETE |          |
|  |                        | 30%   | 20% | 50% |          |
|  | Text book/s*           | Brown T.A, “Gene Cloning and DNA Analysis: An Introduction”, John Wiley & Sons, 2010  |     |     |          |
|  | Other References       | <b>1. Molecular Biotechnology. Principles and Applications.</b> 3 <sup>rd</sup> Edition. Glick BR and Pasternak JJ. ASM Press @2003. ISBN 1-55581-224-4.<br><b>2. Gene cloning and DNA Analysis- An Introduction.</b> 6 <sup>th</sup> Edition. Wiley-Blackwell. Brown TA @2010. |     |     |          |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 2          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 2          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |



## MSB119: Animal Cell Technology

L-T-P: 4-0-0

Credit: 4

|                              |                       |  |
|------------------------------|-----------------------|--|
| <b>School: SBSR</b>          |                       | <b>Batch : 2018-20</b>   |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 1</b>   |
| 1                            | Course Code           | <b>MSB 119</b>   |
| 2                            | Course Title          | <b>Animal Cell Technology</b>  |
| 3                            | Credits               | 4  |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |
|                              | Course Status         | Compulsory   |
| 5                            | Course Objective      | 1. To acquire a fundamental knowledge of animal cell biology<br>2. To Study cell, tissue culture, media component<br>3. To Study Cell Cell Kinetics and Characteristic<br>4. To Study Animal cloning, cell genetics<br>5. To Study large scale industrial and medical applications of cell engineering.  |
| 6                            | Course Outcomes       | After successfully completion of this course students will be able to:<br>CO1 Understand basics of Animal Cell and Tissue culture. Evaluate media and aseptic techniques of establishing primary and Secondary cell cultures.<br>CO2 Establish a continuous cell line from cells of different origin and determine their nutrient and environment requirements<br>CO3 Differentiate between adherent and non-adherent cell culture techniques, calculate growth kinetics parameters and apply cryopreservation technique for long-term storing of cells.<br>CO4 Understanding Somatic and Germ Cell Genetics, Cell to Cell communication<br>CO5 Scaling up of Cell cultures for industrial and medical applications. Understanding Cell cloning, Three-dimensional culture and Tissue Engineering<br>CO6 Applications of Cell Culture, Hybridoma Technology and Antibody production, Stem cell technology<br>CO6 Review the future perspectives, importance and ethical issues related with stem cell technology and transgenic animals. |
| 7                            | Course Description    | To acquire a fundamental and advanced knowledge of Animal Cell Culture Technology by studying cell, tissue culture, media component, Animal cloning, cell genetics and large scale industrial and medical applications of cell engineering.  |

|   |                         |  |     |                   |
|---|-------------------------|--|-----|-------------------|
| 8 | <b>Outline syllabus</b> |  |     | <b>CO Mapping</b> |
|   | <b>Unit 1</b>           | <b>Cell Culture</b>  |     | CO1,2,3           |
|   | A                       | Cell, Tissue and organ culture, Culture procedures   |     | CO1               |
|   | B                       | Culture media and growth conditions, primary cultures  |     | CO1,2             |
|   | C                       | Establishment and maintenance of cell lines and Risks in a tissue culture laboratory and safety.   |     | CO2,3             |
|   | <b>Unit 2</b>           | <b>Cell Kinetics and Viability</b>   |     | CO3,4             |
|   | A                       | Cell Killing, Characterization of cultured cells-morphology of cells   |     | CO3               |
|   | B                       | cell adhesion, proliferation, differentiation, Kinetics involved in growth of cultured cells,  |     | CO4               |
|   | C                       | Cell viability, Methods for testing cell viability, Cytotoxicity assays  |     | CO4               |
|   | <b>Unit 3</b>           | <b>Cell Characteristics</b>  |     | CO5               |
|   | A                       | Cell Adhesion and Signalling   |     | CO5               |
|   | B                       | cell-cell communication, Cell senescence   |     | CO5               |
|   | C                       | Somatic and Germ cell genetics   |     | CO5               |
|   | <b>Unit 4</b>           | <b>Scaling-up of cell cultures</b>   |     | CO6,7             |
|   | A                       | Animal cell culture scale up, Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture  |     | CO6               |
|   | B                       | Scale up in monolayer-Roller bottle culture, multisurface culture, multiarray disks, spirals and tubes monitoring of cell growth   |     | CO 6              |
|   | C                       | Cell cloning and micromanipulation, Cell culture in industrial methods, Three dimensional culture and Tissue Engineering   |     | CO7               |
|   | <b>Unit 5</b>           | <b>Application of Animal Cell Culture Technology and Ethics</b>  |     | CO8,9             |
|   | A                       | Hybridoma technology, Antibody production  |     | CO8               |
|   | B                       | Transgenic animals, Applications of transgenic animals,  |     | CO8,9             |
|   | C                       | Stem cells, Stem cell therapy, Ethical issues in cell culture  |     | CO9               |
|   | Mode of examination     | Theory   |     |                   |
|   | Weightage Distribution  | CA   | MTE | ETE               |
|   |                         | 30%  | 20% | 50%               |
|   | Text book/s*            | Butler M., "Animal Cell Culture and Technology", Garland Science, 2008.  |     |                   |
|   | Other References        | 1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006.<br>2. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.<br>3. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007. |     |                   |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

**MST111: BIO-STATISTICS****L-T-P: 2-0-0****Credits 2**

|                              |   |  |
|------------------------------|---|--|
| <b>School: SBSR</b>          |   | <b>Batch: 2018-20</b>  |
| <b>Program: M.Sc.</b>        |   | <b>Current Academic Year: 2018-19</b>  |
| <b>Branch: Biotechnology</b> |   | <b>Semester: 1</b>   |
| 1                            | Course Code.  | MST111   |
| 2                            | Course Title  | BIO-STATISTICS   |
| 3                            | Credits   | 2  |
| 4                            | Contact Hours<br>(L-T-P)  | 2-0-0  |
|                              | Course status   | Compulsory   |
| 5                            | Course Objectives   | To make students familiar with the concept of Probability and Statistics with emphasis on some standard probability distributions and sampling distributions.  |
| 6                            | Course Outcomes   | CO1: Describe the concept of Statistics and statistical inference and calculate find the measures of central tendency and dispersion of a data. (K1,K2,K3)<br>CO2: Explain the concept of probability and evaluate the probability of various events in a random experiment, theorem on probability, conditional probability. (K2,K4,K5)<br>CO3: Discuss the concept of random variable and its distributions for evaluate relevant probabilities. (K1,K2,K5)<br>CO4: Discuss about confidence interval and evaluate population parameters from the statistics of samples.(K1,K2,K5)<br>CO5: Explain and evaluate statistical hypothesis using large and small samples. (K2,K4,K5) |
| 7                            | Course Description  | In this introductory statistics course we will explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations. We will cover descriptive statistics, probability, and hypothesis testing and statistical inference.  |
| 8                            | Outline syllabus:   |  |
| <b>UNIT 1</b>                | <b>Introduction and descriptive statistics.</b>   | CO Mapping   |
| A                            | Representation of data: Frequency distribution, Measures of central tendency, mean, median, mode and mean of combined data. | CO1  |
| B                            | Dispersion: mean deviation, standard deviation  | CO1  |
| C                            | Moments, Skewness and Kurtosis.   | CO1  |

|               |  |   |     |     |
|---------------|--|---|-----|-----|
| <b>UNIT 2</b> | <b>Probability.</b>  |   |     |     |
| A             | Random experiment, sample space, events.   |   | CO2 |     |
| B             | Mutually exclusive events, independent events, conditional probability.                                |   | CO2 |     |
| C             | Baye's theorem.  |   | CO2 |     |
| <b>UNIT 3</b> | <b>Random variables and its Distribution.</b>  |   |     |     |
| A             | Random variables, expectation and variance of a random variable.                                       |   | CO3 |     |
| B             | Binomial Distribution.   |   | CO3 |     |
| C             | Normal Distribution  |   | CO3 |     |
| <b>UNIT 4</b> | <b>Sampling Distribution</b>   |   |     |     |
| A             | Sampling distribution of sample mean (Small Sample).   |   | CO4 |     |
| B             | Sampling distribution of difference of two sample means (Small Sample).                                |   | CO4 |     |
| C             | Sampling distribution of sample means and difference of two sample means. (large samples.).            |   | CO4 |     |
| <b>UNIT 5</b> | <b>Testing of hypothesis.</b>  |   |     |     |
| A             | Testing of hypothesis: single population mean for small sample.  |   | CO5 |     |
| B             | Testing of hypothesis: difference of two population means for small sample.                            |   | CO5 |     |
| C             | Testing of hypothesis: single population mean and difference of two population means for large sample. |   | CO5 |     |
|               | Mode of Examination  | Theory  |     |     |
|               | Weightage distribution   | CA  | MTE | ETE |
|               |  | 30%   | 20% | 50% |
|               | Text books   | 1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics".  |     |     |
|               | Other references   | 1. Daniel,Wayne W.,"Biostatistics": Basic concept and Methodology for Health Science.<br>2. Grewal,B.S, "Higher Engineering Mathematics".<br>3. Probability and Statistics for Engineers and Scientists, Walpole R. E., Mayers R. H., S. I., Ye. K. 7 <sup>th</sup> Edition, Pearson, 2002. |     |     |

|  |   |
|--|---|
|  | <p>4. Statistics for Biologists, Campbell R. C., Cambridge University Press 1988.</p> <p>5. The Principles of Scientific Research, Freedman P., Pergamon Press, New York.</p> |
|--|---|

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 2          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 1          | 1          | 1          | 1          | 1          |

**MSB159 Genetic Engineering Lab****L-T-P: 0-0-3****Credits 2**

|                              |                        |   |     |            |
|------------------------------|------------------------|---|-----|------------|
| <b>School: SBSR</b>          |                        | <b>Batch: 2018-20</b>   |     |            |
| <b>Program: M.Sc.</b>        |                        | <b>Current Academic Year: 2018-19</b>   |     |            |
| <b>Branch: Biotechnology</b> |                        | <b>Semester: 01</b>   |     |            |
| 1                            | Course Code            | <b>MSB159</b>   |     |            |
| 2                            | Course Title           | <b>Genetic Engineering</b>  |     |            |
| 3                            | Credits                | 1   |     |            |
| 4                            | Contact Hours (L-T-P)  | 0-0-2   |     |            |
|                              | Course Status          | <b>Compulsory/Elective</b>  |     |            |
| 5                            | Course Objective       | To give students a introduction and hands on basic experiments of genetic engineering technique   |     |            |
| 6                            | Course Outcomes        | CO1: Perform experiments on DNA isolation from biological resource and understanding different methods for DNA isolation<br>CO2: Perform experiments on RNA isolation.<br>CO3: Validation of isolated DNA and RNA content.<br>CO4: Amplification of particular gene of interest by PCR method.<br>CO5: Validation of amplified gene by electrophoresis method.<br>CO6: Performing basic experiments of Genetic engineering technique. |     |            |
| 7                            | Course Description     | This course is designed to make students a thorough understanding of Database usage, tools and software for each bioinformatics applications  |     |            |
| 8                            | Outline syllabus       |   |     | CO Mapping |
|                              | <b>Unit 1</b>          | <b>DNA isolation</b>  |     | CO1        |
|                              |                        | Sub unit - a, b and c detailed in Instructional Plan  |     | CO1        |
|                              | <b>Unit 2</b>          | <b>RNA isolation</b>  |     | CO2        |
|                              |                        | Sub unit - a, b and c detailed in Instructional Plan  |     | CO2        |
|                              | <b>Unit 3</b>          | <b>Validation of isolated DNA and RNA</b>   |     | CO3        |
|                              |                        | Sub unit - a, b and c detailed in Instructional Plan  |     | CO3        |
|                              | <b>Unit 4</b>          | <b>Amplification of specific gene of interest by PCR method</b>   |     | CO4        |
|                              |                        | Sub unit - a, b and c detailed in Instructional Plan  |     | CO4        |
|                              | <b>Unit 5</b>          | <b>Validation of amplified gene by electrophoresis method</b>   |     | CO5        |
|                              |                        | Sub unit - a, b and c detailed in Instructional Plan  |     | CO5        |
|                              | Mode of exam           | Jury/Practical/Viva   |     |            |
|                              | Weightage Distribution | CA  | MTE | ETE        |
|                              |                        | 60%   | 0%  | 40%        |
|                              | Text book/s*           | Brown T.A, "Gene Cloning and DNA Analysis:An Introduction", John Wiley & Sons, 2010.  |     |            |
|                              | Other References       | 1. Old R.W and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication, 2002.<br>2. Dale W., von Schantz M. and Plant N., "From Genes to Genomes: Concepts and Applications of DNA Technology", John Wiley, 2011.  |     |            |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 2          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |



## MSB156: Molecular Biology Lab

L-T-P: 0-0-3

Credits 2

|                          |                       |  |            |
|--------------------------|-----------------------|--|------------|
| School : SBSR            |                       | Batch : 2018-20  |            |
| Program: M.Sc.           |                       | Current Academic Year: 2018-19   |            |
| Branch:<br>Biotechnology |                       | Semester: 01   |            |
| 1                        | Course Code           | MSB156   |            |
| 2                        | Course Title          | Molecular Biology Lab  |            |
| 3                        | Credits               | 2  |            |
| 4                        | Contact Hours (L-T-P) | 0-0-3  |            |
| Course Status            |                       | Compulsory   |            |
| 5                        | Course Objective      | 1. To familiarize students with sterilization techniques and solution/media preparations etc.<br>2. To motivate students towards molecular techniques for better genome understanding.<br>3. To acquaint with principles, technical requirement, scientific and commercial applications in molecular biology.<br>4. Design and manage techniques for understanding interplay amongst macromolecules.   |            |
| 6                        | Course Outcomes       | CO1: Demonstrate safe laboratory practices and handle the equipment safely.<br>CO2: Estimate the quality and quantity of nucleic acids.<br>CO3: Amalgamation of tools for plasmid vectors and DNA uptake.<br>CO4: Perform <i>in silico</i> analysis for studying genome.<br>CO5: To design primers and carry out amplification of DNA by PCR.<br>CO6: Complete acquaintance with principles, technical requirement, scientific and commercial applications in molecular biology. |            |
| 7                        | Course Description    | The aim of this course is to acquaint the students about the versatile tools and techniques employed in molecular biotechnology. The course will also provide students with a hands-on understanding of how modern DNA-sequencing technology, along with bioinformatics tools, can be used to discover genetic differences and understand molecular function.  |            |
| 8                        | Outline syllabus      |  | CO Mapping |
|                          | <b>Unit 1</b>         | <b>Practical based on introduction to molecular biology lab</b>  | <b>CO1</b> |
|                          | A                     | Good lab practices in molecular biology laboratory.  |            |
|                          | B & C                 | Preparation of standard solutions for molecular biology experiments  |            |
|                          | <b>Unit 2</b>         | <b>Isolation of Nucleic acids and quantification</b>   | <b>CO2</b> |

|  |                        |   |    |     |            |
|--|------------------------|---|----|-----|------------|
|  | A                      | Isolation of DNA from bacteria  |    |     |            |
|  | B                      | Isolation of RNA from bacteria  |    |     |            |
|  | C                      | Gel electrophoresis   |    |     |            |
|  | <b>Unit 3</b>          | <b>Practical related to preparation of plasmids and transformations</b>   |    |     | <b>CO3</b> |
|  | A                      | Plasmid isolation   |    |     |            |
|  | B                      | Preparation of competent cells  |    |     |            |
|  | C                      | Transformation of plasmid into competent cells  |    |     |            |
|  | <b>Unit 4</b>          | <b>Practical related to in silico analysis of genome</b>  |    |     | <b>CO4</b> |
|  | A                      | Sequence similarity search with freely available tools  |    |     |            |
|  | B                      | Construction of phylogenetic tree   |    |     |            |
|  | C                      | Identification of motifs and domain in sequences  |    |     |            |
|  | <b>Unit 5</b>          | <b>Practical related to gene amplification</b>  |    |     | <b>CO5</b> |
|  | A & B                  | Designing of primers for CDs and partial sequences  |    |     |            |
|  | C                      | Performing PCR reactions  |    |     |            |
|  | Mode of examination    | Practical and/or Viva   |    |     |            |
|  | Weightage Distribution | CA  | MT | ETE |            |
|  |                        | 60%   | 0% | 40% |            |
|  | Textbook/s             | Michael, R. G., Sambrook. J., "Molecular Cloning-A Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.  |    |     |            |
|  | Other References       | 1. Davis, L. (2012). Basic methods in molecular biology. Elsevier.<br>2. Chard, T., Work, T. S., & Work, E. (1987). Laboratory techniques in biochemistry and molecular biology. Elsevier, Amsterdam. |    |     |            |

**Course Outcome**

**No**

|     | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|-----|------------|------------|------------|------------|------------|
| CO1 | 3          | 1          | 1          | 1          | 1          |
| CO2 | 1          | 3          | 1          | 1          | 1          |
| CO3 | 1          | 1          | 3          | 1          | 1          |
| CO4 | 1          | 1          | 1          | 3          | 1          |
| CO5 | 1          | 1          | 1          | 1          | 3          |
| CO6 | 3          | 3          | 3          | 3          | 3          |

## MSB155: Biochemistry Lab

L-T-P: 0-0-3

Credits 2

|                              |                       |   |            |
|------------------------------|-----------------------|---|------------|
| <b>School: SBSR</b>          |                       | <b>Batch: 2018-20</b>   |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>   |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 01</b>   |            |
| 1                            | Course Code           | <b>MSB155</b>   |            |
| 2                            | Course Title          | <b>Biochemistry Lab</b>   |            |
| 3                            | Credits               | 2   |            |
| 4                            | Contact Hours (L-T-P) | 0-0-3   |            |
| Course Status                |                       | Compulsory  |            |
| 5                            | Course Objective      | <ol style="list-style-type: none"><li>1. To understand difference between types of biomolecules</li><li>2. To learn qualitative estimation of biomolecules</li><li>3. To learn the separation techniques for various biomolecules</li><li>4. To understand the enzymatic parameters that indicate proper functioning of living systems</li></ol>  |            |
| 6                            | Course Outcomes       | After finishing the course, the students will be able to<br>CO1: identify and distinguish between mono-, di-, and oligosaccharides present in different samples<br>CO2: analyze individual compounds present in a particular mixture/ extract and explain different chromatographic techniques<br>CO3: illustrate presence of starch and other plant secondary metabolites in leaf<br>CO4: isolation and quantitation of DNA<br>CO5: illustrate metabolite/ enzymatic markers for particular organs<br>CO6: use biotechniques for identification, separation and or analysis of biomolecules and enzymatic markers in different samples |            |
| 7                            | Course Description    | Biochemistry lab course is designed to make students learn the estimation of carbohydrates, lipids, proteins and nucleic acids. The students also learn various techniques such as various types of chromatography used for separation of amino acids and plant secondary metabolites, estimation of various plant secondary metabolites, estimation of biomarkers for hepatic and renal function etc.  |            |
| 8                            | Outline syllabus      |   | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Practical based on estimation of carbohydrates</b>   |            |
|                              |                       | Subunit – a and b   | CO1, CO6   |
|                              | <b>Unit 2</b>         | <b>Practical related to estimation and separation of amino acids</b>  |            |
|                              |                       | Subunit – a and b   | CO2, CO6   |
|                              | <b>Unit 3</b>         | <b>Practical related to estimation of starch</b>  |            |

|  |                        |   |          |     |
|--|------------------------|---|----------|-----|
|  |                        | Subunit - b and c   | CO3, CO6 |     |
|  | <b>Unit 4</b>          | <b>Practical related to isolation and estimation of nucleic acids</b> |          |     |
|  |                        | Subunit - c   | CO4, CO6 |     |
|  | <b>Unit 5</b>          | <b>Practical related to Practical related to study of enzymes</b>     |          |     |
|  |                        | Subunit - b   | CO5, CO6 |     |
|  | Mode of examination    | Practical/Viva  |          |     |
|  | Weightage Distribution | CA  | MTE      | ETE |
|  |                        | 60%   | 0%       | 40% |
|  | Textbook/s*            | Sawhney S.K. and Singh R. <b>Introductory Practical Biochemistry.</b> |          |     |
|  | Other References       | NA  |          |     |

**Course Outcome**

**No**

|     | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|-----|------------|------------|------------|------------|------------|
| CO1 | 3          | 1          | 1          | 1          | 1          |
| CO2 | 1          | 3          | 1          | 1          | 1          |
| CO3 | 1          | 1          | 3          | 1          | 1          |
| CO4 | 1          | 1          | 1          | 3          | 1          |
| CO5 | 1          | 1          | 1          | 1          | 3          |
| CO6 | 3          | 3          | 3          | 3          | 3          |

**MSB116: Bioinstruments****L-T-P: 4-0-0****Credit - 4**

|                              |                       |  |     |
|------------------------------|-----------------------|--|-----|
| <b>School : SBSR</b>         |                       | <b>Batch : 2018-20</b>   |     |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |     |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 02</b>  |     |
| 1                            | Course Code           | <b>MSB116</b>  |     |
| 2                            | Course Title          | <b>Bioinstruments</b>  |     |
| 3                            | Credits               | 4  |     |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |     |
| 5                            | Course Objective      | Allow students to familiarize themselves with the specific requirements of biomedical instrumentation and biotechnology tools for enabling their intended use for research and industrial application.   |     |
| 6                            | Course Outcomes       | <ol style="list-style-type: none"> <li>1. Perform experiments based on electrophoresis for separating proteins and nucleic acids.</li> <li>2. Purify compounds from a mixture using column, ion-exchange, affinity chromatography, HPLC, affinity and gas chromatography.</li> <li>3. Illustrate organelle and protein localization by microscopy.</li> <li>4. Isolate cells by using fluorescence activated cell sorting (FACS) or magnetic activated cell sorting (MACS) and compare cell disruption techniques.</li> <li>5. Conduct enzymatic and end-point assays using spectrophotometer, apply spectroscopy techniques to understand the structure of biological material.</li> <li>6. familiarize with the specific requirements of biomedical instrumentation and biotechnology tools</li> </ol> |     |
| 7                            | Outline syllabus:     |  |     |
| 7.01                         | <b>Unit 1</b>         | <b>Electrophoresis</b>   | CO1 |
| 7.02                         | Unit 1a               | Principle of electrophoresis   |     |
| 7.03                         | Unit 1b               | Agarose gel and 2D-gel electrophoresis: Principle and applications,  |     |
| 7.04                         | Unit 1c               | Capillary and Immunoelectrophoresis: Principle and applications  |     |
| 7.05                         | <b>Unit 2</b>         | <b>Chromatography</b>  | CO2 |
| 7.06                         | Unit 2a               | Paper Chromatography, TLC  |     |
| 7.07                         | Unit 2b               | Column chromatography. Ion-exchange and Affinity chromatography  |     |
| 7.08                         | Unit 2c               | Instrumentation and applications HPLC: Instrument setup and working  | CO3 |
| 7.09                         | <b>Unit 3</b>         | <b>Microscopy</b>  |     |
| 7.10                         | Unit 3a               | Principle of microscope, Optical microscopy  |     |
| 7.11                         | Unit 3b               | AFM and Fluorescence Microscopy,   |     |

|      |                                  |  |     |
|------|----------------------------------|--|-----|
| 7.12 | Unit 3c                          | Electron Microscopy  | CO4 |
| 7.13 | <b>Unit 4</b>                    | <b>Cell Separation Techniques and Centrifugation</b>   |     |
| 7.14 | Unit 4a                          | Cell isolation and cell disruption techniques  |     |
| 7.15 | Unit 4b                          | FACS and MACS- Principle and applications; Preparative centrifugation  |     |
| 7.16 | Unit 4c                          | Differential and density gradient centrifugation, Ultracentrifugation  |     |
| 7.17 | <b>Unit 5</b>                    | <b>Spectrometry and Spectroscopy</b>   | CO5 |
| 7.18 | Unit 5a                          | Spectroscopy- Absorption and fluorescence, Atomic and Raman spectroscopy   |     |
| 7.19 | Unit 5b                          | Mass spectrometry and NMR: Instrumentation and working   |     |
| 7.20 | Unit 5c                          | X-ray crystallography: crystal preparation, working and uses.  |     |
| 8    | Course Evaluation                |  |     |
| 8.1  | Course work: 30 marks            |  |     |
| 8.2  | Attendance                       | None   |     |
| 8.3  | Quizzes                          | Three best quizzes out of Five 30-minutes quizzes in lecture hours; 10 percent   |     |
| 8.4  | Presentations                    | One: 10 percent  |     |
| 8.5  | Assignments                      | Three best out of five; 10 percent   |     |
| 8.6  | MST                              | One; 20 percent  |     |
| 8.7  | End-term examination: 50 percent |  |     |
| 9    | References                       |  |     |
| 9.1  | Textbook                         | 1. Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2010.   |     |
| 9.2  | Other references                 | 1. Ninfa A.J., Ballou D.P. and Benore M., "Fundamental Laboratory Approaches for Biochemistry and Biotechnology", Wiley, 2009.<br>2. Sheehan D., "Physical Biochemistry: Principles and Applications", Wiley, 2009 |     |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 2          | 1          | 1          | 1          |
| CO2                          | 2          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

## MSB118: Advances in Plant Biotechnology

L-T-P: 4-0-0

Credit: 4

|                              |                   |  |
|------------------------------|-------------------|--|
| <b>School : SBSR</b>         |                   | <b>Batch : 2018-20</b>   |
| <b>Program: M.Sc.</b>        |                   | <b>Current Academic Year: 2018-19</b>  |
| <b>Branch: Biotechnology</b> |                   | <b>Semester: 02</b>  |
| 1                            | Course Code       | <b>MSB 118</b>   |
| 2                            | Course Title      | <b>Advances in Plant Biotechnology</b>   |
| 3                            | Credits           | 4  |
| 4                            | Contact H (L-T-P) | 4-0-0  |
| 5                            | Course Objective  |  |
| 6                            | Course Outcomes   | After successfully completion of this course students will be able to:<br><ol style="list-style-type: none"><li>1. Will learn about tissue culture techniques applied in plant science</li><li>2. Will comprehend genetically modified plants and Transgenic plants and their economic significance</li><li>3. Will learn about the techniques for transferring gene by direct or indirect methods</li><li>4. Will be able to classify different types of molecular markers, vectors, etc</li><li>5. Will learn to apply the techniques in different field of science like ecology, environments, etc.</li><li>6. Will comprehend recent advances in the field of plant biotechnology and their applications</li></ol> |
| 7                            | Outline syllabus: |  |
| 7.01                         | <b>Unit 1</b>     | <b>Techniques in Plant Tissue Culture</b>  |
| 7.02                         | Unit 1a           | Concept of totipotency , Production of Secondary metabolite  |
| 7.03                         | Unit 1b           | Haploid plant culture; Soma clonal variation, protoplast fusion and Hairy root culture   |
| 7.04                         | Unit 1c           | Elicitors , development of High yielding varieties   |
| 7.05                         | <b>Unit 2</b>     | <b>Genetic Engineering of Plants</b>   |
| 7.06                         | Unit 2a           | Biotic and abiotic stress, how to develop stress resistant plant like disease resistant plants   |
| 7.07                         | Unit 2b           | Herbicide, pesticide resistant plant production, concept of vectors  |
| 7.08                         | Unit 2c           | Concept of vectors and their role in genetic Engineering, role of Agrobacterium tumefaciens  |
| 7.09                         | <b>Unit 3</b>     | <b>Methods of Gene Transfer</b>  |
| 7.10                         | Unit 3a           | General characteristics of gene transferring; Ti and Ri Plasmids their role.;  |
| 7.11                         | Unit 3b           | Physical & Chemical Method of gene transfer  |
| 7.12                         | Unit 3c           | Gene transfer technology; Advantage and disadvantage   |
| 7.13                         | <b>Unit 4</b>     | <b>Molecular Markers</b>   |



|      |                                  |  |
|------|----------------------------------|--|
| 7.14 | Unit 4a                          | Concept of molecular markers, Examples of molecular markers                                      |
| 7.15 | Unit 4b                          | Application of molecular markers   |
| 7.16 | Unit 4c                          | Importance of molecular markers in crop improvements   |
| 7.17 | <b>Unit 5</b>                    | <b>Application of Plant Biotechnology</b>  |
| 7.18 | Unit 5a                          | Edible Vaccine; Concept of molecular and non-molecular farming                                   |
| 7.19 | Unit 5b                          | Production of antibiotics  |
| 7.20 | Unit 5c                          | Bioplastics  |
| 7.17 | Course Evaluation                |  |
| 8    | Course work: 30 marks            |  |
| 8.1  | Attendance                       | None   |
| 8.11 | Quizzes                          | Three best quizzes out of Five 30-minutes quizzes in lecture hours; 10 percent                   |
| 8.12 | Presentations                    | One: 10 percent  |
| 8.13 | Assignments                      | Three best out of five; 10 percent   |
| 8.14 | MST                              | One; 20 percent  |
| 8.15 | End-term examination: 50 percent |  |
| 9    | <b>References</b>                |  |
| 9.1  | Textbook                         | 1. Bhojwan S S Dantu Pk , Plant tissue culture: An Introductory Text Springer 2013               |
| 9.2  | Other references                 | CB Nirmala G. Rajalakshmi Chandra Kartik: Plant Biotechnology. MJP publisher 2009                |
| 9.3  |                                  | Stewart CN Plant Biotechnology and Genetics: Techniques and Applications Wiley Interscience 2008 |

### Course Outcome

| No  | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| CO1 | 3   | 1   | 1   | 1   | 1   |
| CO2 | 1   | 3   | 1   | 1   | 1   |
| CO3 | 1   | 1   | 3   | 1   | 1   |
| CO4 | 1   | 1   | 1   | 3   | 1   |
| CO5 | 1   | 1   | 1   | 1   | 3   |
| CO6 | 3   | 3   | 3   | 3   | 3   |

## MSB125: Bioinformatics

L T P: 4-0-0

Credit: 4

|                              |                   |  |
|------------------------------|-------------------|--|
| <b>School: SBSR</b>          |                   | <b>Batch: 2018-20</b>  |
| <b>Program: M.Sc.</b>        |                   | <b>Current Academic Year: 2018-19</b>  |
| <b>Branch: Biotechnology</b> |                   | <b>Semester: 02</b>  |
| 1                            | Course Code       | <b>MSB125</b>  |
| 2                            | Course Title      | <b>Bioinformatics</b>  |
| 3                            | Credits           | 4  |
| 4                            | Contact H (L-T-P) | 4-0-0  |
| 5                            | Course Objective  | To acquire an advanced knowledge of bioinformatics tools used for designing and analyzing <i>in silico</i> experiments and different techniques used for molecular modeling.   |
| 6                            | Course Outcomes   | <p>After successfully completion of this course students will be able to:</p> <p><b>CO1:</b> Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology.</p> <p><b>CO2:</b> Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases.</p> <p><b>CO3:</b> To attain knowledge about data storage model/format, retrieval of information and integration.</p> <p><b>CO4:</b> Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/software with algorithm.</p> <p><b>CO5:</b> To apply different techniques for gene prediction, motif search and genome sequencing analysis.</p> <p><b>CO6:</b> Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms.</p> |
| 7                            | Outline syllabus: | CO Mapping   |
| 7.01                         | <b>Unit A</b>     | <b>Introduction to Bioinformatics</b>  |
| 7.02                         | Unit A Topic 1    | Scope and importance   |
| 7.03                         | Unit A Topic 2    | Large scale generation of molecular biology data   |
| 7.04                         | Unit A Topic 3    | Different fields in bioinformatics   |
| 7.05                         | <b>Unit B</b>     | <b>Biological Databases</b>  |
| 7.06                         | Unit B Topic 1    | Introduction of Biological Databases   |
| 7.07                         | Unit B Topic 2    | Structural and Sequence database   |
| 7.08                         | Unit B Topic 3    | Specialized Genome databases and Structure databases   |
| 7.09                         | <b>Unit C</b>     | <b>Data Storage and retrieval</b>  |
| 7.10                         | Unit C Topic 1    | Controlled vocabulary  |

|      |                                  |  |          |
|------|----------------------------------|--|----------|
| 7.11 | Unit C Topic 2                   | Introduction to Metadata; File Storage, File Format (FASTA, GenBank, Swiss-Prot, DDBJ and PDB)   | CO4, CO6 |
| 7.12 | Unit C Topic 3                   | Boolean Search and Fuzzy Search  |          |
| 7.13 | <b>Unit D</b>                    | <b>Sequence-alignment Related Problems</b>   |          |
| 7.14 | Unit D Topic 1                   | Sequence databases, Similarity matrices, pairwise alignment and BLAST  |          |
| 7.15 | Unit D Topic 2                   | Sequence assembly and multiple sequence alignment  |          |
| 7.16 | Unit D Topic 3                   | Clustal and phylogenetics, distance based approaches, parsimony  |          |
| 7.17 | <b>Unit E</b>                    | <b>Sequence pattern analysis &amp; System-wide Analysis</b>  | CO5, CO6 |
| 7.18 | Unit E Topic 1                   | Structure of Prokaryotic and Eukaryotic gene, Basic and advanced sequencing (Maxam–Gilbert sequencing, Sanger sequencing, NGS, Pyrosequencing)   |          |
| 7.19 | Unit E Topic 2                   | Gene finding, composition-based finding, sequence motif-based finding  |          |
| 7.20 | Unit E Topic 3                   | Pattern Matching, Regular expression, Transcriptomics, Microarray technology and expression profiles   |          |
| 8    | Course Evaluation                |  |          |
| 8.1  | Course work: 30%marks            |  |          |
| 8.11 | Attendance                       | None   |          |
| 8.12 | Homework                         | Three best out of 4 assignments: 20 marks  |          |
| 8.13 | Quizzes                          | Two 30-minutes surprise quizzes in lecture hours: 10 marks   |          |
| 8.14 | Projects                         | None   |          |
| 8.15 | Presentations                    | None   |          |
| 8.16 | Any other                        | None   |          |
| 8.2  | MTE                              | One, 20 percent  |          |
| 8.3  | End-term examination: 50 percent |  |          |
| 9    | References                       |  |          |
| 9.1  | Text book                        | Jin X., “Essential Bioinformatics”, Cambridge University Press, 2006.  |          |
| 9.2  | Other References                 | 1. Mount D.W., “Bioinformatics: Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press, 2004.<br>2. Baxevanis A., Ouellette F.B.F., “Bioinformatics: A practical guide to the analysis of genes and proteins”, Wiley-Interscience, 2004.<br>3. Bourne P.E., Gu J., “Structural Bioinformatics”, Wiley-Blackwell, 2009. |          |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

## MSB121: Fermentation Technology

**L T P: 4-0-0**

**Credit: 4**

|                                 |                      |   |            |
|---------------------------------|----------------------|---|------------|
| <b>School: SBSR</b>             |                      | <b>Batch: 2018-20</b>   |            |
| <b>Program: MSc</b>             |                      | <b>Current Academic Year: 2018-19</b>   |            |
| <b>Branch:</b><br>Biotechnology |                      | <b>Semester: 2</b>  |            |
| 1                               | Course Code          | <b>MSB121</b>   |            |
| 2                               | Course Title         | <b>Fermentation Technology</b>  |            |
| 3                               | Credits              | 4   |            |
| 4                               | Contact H<br>(L-T-P) | 4-0-0   |            |
| Course Status                   |                      | Compulsory  |            |
| 5                               | Course Objective     | <p>1. To enable students bridge the gap between theoretical concepts and practical aspects in fermentation technology.</p> <p>2. To provide knowledge about the different processes being used to prepare various industrially important substances</p> <p>3. To enable students to understand the bioreactor designs.</p> <p>4. To provide insight of various industrial fermentation process.</p>   |            |
| 6                               | Course Outcomes      | <p>After successfully completion of this course students will be able to:</p> <p>CO1: Understand the history of fermentation technology and growth kinetics of microorganisms.</p> <p>CO2: Design bioreactors to achieve desired results (i.e. specified cell concentration, production rates, etc).</p> <p>CO3: Examine the mass transfer operation of various biochemical processes.</p> <p>CO4: Apply scale-up methods for increasing yield. Justify the use of different biochemical strategies for the production of biologicals.</p> <p>CO5: To learn the basics of downstream processing</p> <p>CO6: Cradle to grave knowledge of microbial process engineering.</p> |            |
| 7                               | Course Description   |   |            |
| 8                               | Outline syllabus     | CO Mapping  |            |
|                                 | <b>Unit 1</b>        | <b>Introduction to Fermentation Process</b>   | <b>CO1</b> |
|                                 | A                    | Microbial growth kinetics; Media for Industrial fermentation;   |            |
|                                 | B                    | Sterilization: Batch and continuous;  |            |
|                                 | C                    | Heat sterilization of liquid media; Filter sterilization of liquid media and air.   |            |
|                                 | <b>Unit 2</b>        | <b>Bioreactors</b>  | <b>CO2</b> |
|                                 | A                    | Packed bed bioreactors; Fluidized-bed bioreactors;  |            |
|                                 | B                    | Air lift bioreactors; Bubble column bioreactors;  |            |
|                                 | C                    | Immobilized enzymes bioreactors.  |            |

|  |                        |  |     |     |                     |
|--|------------------------|--|-----|-----|---------------------|
|  | <b>Unit 3</b>          | <b>Bioreactor Instrumentation</b>  |     |     | <b>CO2,CO3</b>      |
|  | A                      | Measurement of physical and chemical parameters in bioreactors;  |     |     |                     |
|  | B                      | Measurement of biological parameters in bioreactors;   |     |     |                     |
|  | C                      | Transport phenomenon in bioreactor   |     |     |                     |
|  | <b>Unit 4</b>          | <b>Bioreactor Control</b>  |     |     | <b>CO2, CO3</b>     |
|  | A                      | Agitation and mixing; Effect of stirring and sparging  |     |     |                     |
|  | B                      | Monitoring and control of dissolved oxygen, pH,  |     |     |                     |
|  | C                      | Impeller speed and temperature in stirred tank fermenter.  |     |     |                     |
|  | <b>Unit 5</b>          | <b>Downstream Processing</b>   |     |     | <b>CO2, CO3,CO4</b> |
|  | A                      | Isolation-physical and chemical techniques for cell separation and cell disruption.  |     |     |                     |
|  | B                      | Chromatographic and electrophoretic separation   |     |     |                     |
|  | C                      | evaporation, drying and crystallization techniques.  |     |     |                     |
|  | Mode of examination    | Theory/Jury/Practical/Viva   |     |     | Theory              |
|  | Weightage Distribution | CA   | MTE | ETE |                     |
|  |                        | 30%  | 20% | 50% |                     |
|  | Text book/s*           | 1. Doran P.M., “Bioprocess Engineering Principles”, Academic Press, 2012.  |     |     |                     |
|  | Other References       | 1. Katoh S. and Yoshida F., “Biochemical Engineering”, Wiley-VCH, 2009.<br>2. McNeil B. and Harvey L., “Practical Fermentation Technology”, Wiley, 2008. |     |     |                     |

**Course Outcome**

**No**

|     | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|-----|------------|------------|------------|------------|------------|
| CO1 | 3          | 1          | 1          | 1          | 1          |
| CO2 | 1          | 3          | 1          | 1          | 1          |
| CO3 | 1          | 1          | 3          | 1          | 1          |
| CO4 | 1          | 1          | 1          | 3          | 1          |
| CO5 | 1          | 1          | 1          | 1          | 3          |
| CO6 | 3          | 3          | 3          | 3          | 3          |

## MSB117 Immunology and Immunotechnology

|                       |                      |  |            |
|-----------------------|----------------------|--|------------|
| <b>School: SBSR</b>   |                      | <b>Batch: 2018-20</b>  |            |
| <b>Program: M.Sc.</b> |                      | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: BT</b>     |                      | <b>Semester: 02</b>  |            |
| 1                     | Course Code          | <b>MSB117</b>  |            |
| 2                     | Course Title         | <b>Immunology and Immunotechnology</b>   |            |
| 3                     | Credits              | 4  |            |
| 4                     | Contact H<br>(L-T-P) | 4-0-0  |            |
|                       | Course Status        | <b>Compulsory</b> /Elective/Open Elective  |            |
| 5                     | Course Objective     | <ol style="list-style-type: none"> <li>1. Understand immune system, immunity and various immune responses.</li> <li>2. Discuss about the structure and function of antigen and antibodies; Hypersensitivity and Autoimmunity.</li> <li>3. Understand the principle behind Immunization and Vaccines; Ag-Ab reactions and immune-techniques.</li> </ol>   |            |
| 6                     | Course Outcomes      | CO1: To understand Immune system, immunity and immune responses<br>CO2: Discuss about the structure and function of antigen and antibodies.<br>CO3: Discuss about Hypersensitivity and Autoimmunity.<br>CO4: Understand the principle behind Immunization and Vaccines<br>CO5: To understand the Antigen-antibody reactions and Immuno-techniques<br>CO6: To acquire a fundamental working knowledge of the basic principles of immunology |            |
| 7                     | Course Description   | The course will help students to acquire a fundamental working knowledge of the basic principles of immunology; to begin to understand how these principles apply to the process of immune function; and to develop the ability to solve problems in clinical immunology by making use of existing tools and techniques  |            |
| 8                     | Outline syllabus     |  | CO Mapping |
|                       | <b>Unit 1</b>        | <b>Immune System and Immune responses</b>  |            |
|                       | A                    | Immune system: cells and organs of the immune system; Hematopoiesis; Immunity and its types; Innate immunity: barriers of innate immunity; Complement system, inflammatory responses and phagocytosis  | CO1        |
|                       | B                    | Acquired immunity; Cell-mediated and humoral immunity; Activation of T-lymphocytes and B-lymphocytes   | CO1        |
|                       | C                    | Antibody-mediated and macrophage-mediated cytotoxicity; Cytokine release and their role in immune regulation;  | CO1        |
|                       | <b>Unit 2</b>        | <b>Antigen and Antibody</b>  |            |

|  |                        |   |            |
|--|------------------------|---|------------|
|  | A                      | Antigen and Immunogen; Properties of an antigen; Hapten, Superantigen, Antigenicity and Immunogenicity, Adjuvants, Epitopes.                    | CO2        |
|  | B                      | Structure and function of immunoglobulin and its types  | CO2        |
|  | C                      | Major Histocompatibility Complex, BCR and TCR   | CO2        |
|  | <b>Unit 3</b>          | <b>Hypersensitivity and Autoimmunity</b>  |            |
|  | A                      | Hypersensitivity and its types, Immunodeficiencies: Severe combined immunodeficiency syndrome (SCID), Acquired immunodeficiency syndrome (AIDS) | CO3        |
|  | B                      | Autoimmunity; Organ-Specific Autoimmune Diseases: Hashimoto's Thyroiditis Graves' Disease, Myasthenia Gravis                                    | CO3        |
|  | C                      | Systemic Autoimmune Diseases: Systemic Lupus Erythematosus, Multiple Sclerosis, Rheumatoid Arthritis  | CO3        |
|  | <b>Unit 4</b>          | <b>Immunization and Vaccines</b>  |            |
|  | A                      | Active and passive immunization   | CO4        |
|  | B                      | Vaccine and its properties  | CO4        |
|  | C                      | Types of Vaccines   | CO4        |
|  | <b>Unit 5</b>          | <b>Antigen-antibody reactions and Immuno-techniques</b>   |            |
|  | A                      | Antigen-antibody reactions: Agglutination and precipitation reactions   | CO5        |
|  | B                      | Immunodiffusion, Immunofluorescence; RIA and types of ELISA   | CO5        |
|  | C                      | Hybridoma technology and monoclonal antibodies; Polyclonal vs. monoclonal antibodies  | CO5        |
|  | Mode of examination    | <b>Theory/Jury/Practical/Viva</b>   |            |
|  | Weightage Distribution | CA<br>30%   | MTE<br>20% |
|  |                        |   | ETE<br>50% |
|  | Text book/s*           | Kindt T.J., Osborne B.A. and Goldsby R.A. (2006) Kuby Immunology, W. H. Freeman   |            |
|  | Other References       | 3. Delves P.J, Martin S.J., Burton D.R. and Roitt I.M., (2011) Roitt's Essential Immunology, Wiley  |            |



| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 1          | 1          | 1          | 1          | 1          |

## MSB157: Immunotechnology Lab

L-T-P 0-0-3

Credit 2

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School : SBSR</b>         |                       | <b>Batch : 2018-20</b>   |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 2</b>   |            |
| 1                            | Course Code           | <b>MSB157</b>  |            |
| 2                            | Course Title          | <b>Immunotechnology Lab</b>  |            |
| 3                            | Credits               | 2  |            |
| 4                            | Contact Hours (L-T-P) | 0-0-3  |            |
| 5                            | Course Status         | Compulsory   |            |
| 6                            | Course Objective      | <p>1) This course understanding provides a strong foundation and can prompt a greater enthusiasm for and an improved understanding of the complete immune response.</p> <p>2) The Work involving human samples is enticing to students with clinical interests, and further detailed protocols, and analysis guidance may be appropriate for introductory immune response.</p>   |            |
| 7                            | Course Outcomes       | <p>After successfully completion of this course students will be able to:</p> <p>CO1: understand basic laboratory techniques of blood groups<br/>           CO2: estimate the haemoglobin of its own blood<br/>           CO3: practical knowledge of antigen antibody interactions<br/>           CO4: isolate lymphocytes for further deep analysis<br/>           CO5: prepare suspension solutions of spleen and bone marrow<br/>           CO6: understanding provides a strong foundation and can prompt a greater enthusiasm for and an improved understanding of the complete immune response.</p> |            |
| 8                            | Course Description    | <p>The aim of this course is to acquaint the students about the versatile tools and techniques employed in immunology. The course will also provide students with a hands-on understanding of how immunology can be used to discover various processes used by animals and humans for their self defence mechanism.</p>  |            |
| 9                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         |  | <b>CO1</b> |
|                              | A                     | To study permanent slides of immune tissues and organs   |            |
|                              | B                     | To find the blood group of own blood   |            |
|                              | C                     | To find the Rh factor of own blood group   |            |
|                              | <b>Unit 2</b>         |  | <b>CO2</b> |
|                              | A                     | To estimate the amount of Hb present in human blood  |            |
|                              | B                     | To perform Rocket immunoelectrophoresis  |            |
|                              | C                     | To perform Separation of lymphocytes   |            |
|                              | <b>Unit 3</b>         |  | <b>CO3</b> |
|                              | A                     | To perform Sandwich enzyme linked immunosorbant assay  |            |
|                              | B                     | To perform DoT ELISA   |            |
|                              | C                     | To perform Haemagglutination test  |            |
|                              | <b>Unit 4</b>         |  | <b>CO4</b> |
|                              | A                     | To perform Ouchlerlony's double immunodiffusion method.  |            |

|  |                        |   |     |     |            |
|--|------------------------|---|-----|-----|------------|
|  | B                      | To perform Radial Immunodiffusion   |     |     |            |
|  | C                      | To perform RIA  |     |     |            |
|  | <b>Unit 5</b>          |   |     |     | <b>CO5</b> |
|  | A                      | Preparation of single cell suspension of spleen.  |     |     |            |
|  | B                      | Preparation of single cell suspension of bone marrow.   |     |     |            |
|  | C                      |   |     |     |            |
|  | Mode of examination    | Practical/or Viva   |     |     |            |
|  | Weightage Distribution | CA  | MTE | ETE |            |
|  |                        | 60%   | 0%  | 40% |            |
|  | Text book/s*           | Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.                |     |     |            |
|  | Other References       | Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing |     |     |            |

| <b>Course Outcome No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|--------------------------|------------|------------|------------|------------|------------|
| CO1                      | 3          | 2          | 1          | 1          | 1          |
| CO2                      | 1          | 3          | 1          | 1          | 1          |
| CO3                      | 1          | 1          | 3          | 1          | 1          |
| CO4                      | 1          | 1          | 1          | 3          | 2          |
| CO5                      | 1          | 1          | 1          | 1          | 3          |
| CO6                      | 3          | 3          | 3          | 3          | 3          |

## MSB158 Plant Biotechnology Lab

**L-T-P: 0-0-3**

|                              |                    |   |            |
|------------------------------|--------------------|---|------------|
| <b>School: SBSR</b>          |                    | <b>Batch : 2018-20</b>  |            |
| <b>Program: M.Sc.</b>        |                    | <b>Current Academic Year: 2018-19</b>   |            |
| <b>Branch: Biotechnology</b> |                    | <b>Semester: 2</b>  |            |
| 1                            | Course Code        | MSB158  |            |
| 2                            | Course Title       | Plant Biotechnology Lab   |            |
| 3                            | Credits            | 3   |            |
| 4                            | Contact H (L-T-P)  | 0-0-3   |            |
|                              | Course Status      | Compulsory  |            |
| 5                            | Course Objective   | <p>1. To familiarize students with sterilization techniques and media preparations etc.</p> <p>2. To motivate students towards plant cell and tissue culture for mass propagation.</p> <p>3. To acquaint with principles, technical requirement, scientific and commercial applications in Plant Biotechnology.</p> <p>4. Develop and manage plant tissue culture techniques for crop improvement.</p>  |            |
| 6                            | Course Outcomes    | <p>CO1: Development of ability to design and conduct experiments under controlled conditions.</p> <p>CO2: Development of skills for application of tissue culture techniques in plant.</p> <p>CO3: To Amalgamation tools for artificial germination of seeds.</p> <p>CO4: Perform regeneration of plant under artificial conditions.</p> <p>CO5: Develop transgenics and differentiate between transgenics from wild cultivars.</p> <p>CO6: To familiarize students with sterilization techniques and media preparations etc.</p> |            |
| 7                            | Course Description | <p>The aim of this course is to acquaint the students about the versatile tools and techniques employed in plant biotechnology. Cell and tissue culture of plants offers avenues for enhancing crop production and utilization of molecular tools in plant genome modification helps in creation of transgenic plants for combating food problems.</p>  |            |
| 8                            | Outline syllabus   |   | CO Mapping |
|                              | <b>Unit 1</b>      | <b>Practical based on introduction to plant biotechnology lab</b>   | <b>CO1</b> |
|                              | A                  | Aspetic conditions maintenance in laboratory  |            |

|  |                        |  |           |            |
|--|------------------------|--|-----------|------------|
|  | B & C                  | Conditions optimization for growth of plant cell/tissue under conditions   |           |            |
|  | <b>Unit 2</b>          | <b>Isolation of Nucleic acids from plants and quantification</b>   |           | <b>CO2</b> |
|  | A& B                   | Isolation of DNA and RNA from plants   |           |            |
|  | C                      | Agarose gel electrophoresis  |           |            |
|  | <b>Unit 3</b>          | <b>Seed germination on stratified media</b>  |           | <b>CO3</b> |
|  | A & B                  | Preparation of MS medium, Water Agar medium, Gamborg medium  |           |            |
|  | C                      | Sterilization of seeds and germination on stratified medium  |           |            |
|  | <b>Unit 4</b>          | <b>Plant regeneration</b>  |           | <b>CO4</b> |
|  | A                      | Callus culture   |           |            |
|  | B                      | Shoot regeneration   |           |            |
|  | C                      | Rooting of <i>in vitro</i> raised plants   |           |            |
|  | <b>Unit 5</b>          | <b>Construct preparation and transgenics</b>   |           | <b>CO5</b> |
|  | A                      | Restriction of vector and gene for construct   |           |            |
|  | B                      | <i>Agrobacterium</i> construct for transformation  |           |            |
|  | C                      | PCR for confirmation of transgene  |           |            |
|  | Mode of examination    | Practical and/or Viva  |           |            |
|  | Weightage Distribution | CA<br>60%  | MTE<br>0% | ETE<br>40% |
|  | Text book/s            | Michael, R. G., Sambrook. J., "Molecular Cloning-A Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.   |           |            |
|  | Other References       | 1. Giri, C. C., and Archana Giri. Plant biotechnology: Practical Manual. IK International Pvt Ltd, 2013.<br>2. Aneja, K. R. Experiments in microbiology, plant pathology and biotechnology. New Age International, 2007. |           |            |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 2          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

## MSB160: Bio-instrumentation Lab

L T P: 0-0-3

Credits- 02

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School: SBSR</b>          |                       | <b>Batch: 2018-20</b>  |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 02</b>  |            |
| 1                            | Course Code           | <b>MSB160</b>  |            |
| 2                            | Course Title          | <b>Bio-Instrumentation Lab</b>   |            |
| 3                            | Credits               | 2  |            |
| 4                            | Contact Hours (L-T-P) | 0-0-3  |            |
|                              | Course Status         | <b>Compulsory/Elective</b>   |            |
| 5                            | Course Objective      | To give students a thorough understanding of tools and techniques in Biomedical and Biotechnology Laboratories. To make students learn the working and operation of various biotechnological instruments   |            |
| 6                            | Course Outcomes       | CO1: Operate autoclave, Laminar Air flow and Hot air oven and sterilize glass and plasticwares.<br>CO2: Operate centrifuge and refrigerated centrifuge and separate cell components.<br>CO3: Separate and visualize nucleic acids and proteins using gel electrophoresis.<br>CO4: Operate spectrophotometer and perform absorbance assays.<br>CO5: Separation of pigments, drugs, amino acids and hormones using chromatographic techniques.<br>CO6: Operation and working of different instruments and bioanalytical techniques |            |
| 7                            | Course Description    | This course is designed to make students learn about various instruments and techniques of biomedical and biotechnology laboratory and will also enable them to use and apply these techniques and equipments to solve experimental problems.  |            |
| 8                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Practical based on Sterilization</b>  | CO1        |
|                              |                       |  | CO1        |
|                              |                       | To learn the working of an autoclave.  |            |
|                              |                       | To learn the working of a laminar air flow.  |            |
|                              |                       | To sterilize glasswares using hot air oven.  |            |
|                              | <b>Unit 2</b>         | <b>Practical related to centrifuge</b>   | CO2        |
|                              |                       |  | CO2        |
|                              |                       | Using pH meter   |            |
|                              |                       | Working and principle of incubator shaker  |            |
|                              |                       | Working of refrigerated centrifuges  |            |
|                              | <b>Unit 3</b>         | <b>Practical related to gel electrophoresis</b>  | CO3        |

|  |                  |  |     |     |
|--|------------------|--|-----|-----|
|  |                  | Separation of DNA using AGE  | CO3 |     |
|  |                  | Separation of proteins using PAGE  |     |     |
|  | <b>Unit 4</b>    | <b>Practical related to spectrophotometer</b>  | CO4 |     |
|  |                  | Principle and working of a spectrophotometer   | CO4 |     |
|  |                  | Measuring concentration of protein using spectrophotometer   |     |     |
|  | <b>Unit 5</b>    | <b>Practical related to chromatography</b>   | CO5 |     |
|  |                  | Use of paper chromatography for separation of plant pigments   | CO5 |     |
|  | Mode of exam     | Jury/Practical/Viva  |     |     |
|  | Weightage        | CA   | MTE | ETE |
|  | Distribution     | 60%  | 0%  | 40% |
|  | Textbook/s*      | Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge Press, 2010.   |     |     |
|  | Other References | 1. Cottenil R.M.S., "Biophysics: An Introduction", John Wiley and Sons, 2002.<br>2. Gupta A., "Instrumentation and Bioanalytical Techniques", Pragati Prakashan, 2009. |     |     |

### Course Outcome

| Course Outcome No | PO1 | PO2 | PO3 | PO4 | PO5 |
|-------------------|-----|-----|-----|-----|-----|
| CO1               | 3   | 1   | 1   | 1   | 1   |
| CO2               | 1   | 3   | 1   | 1   | 1   |
| CO3               | 1   | 1   | 3   | 1   | 1   |
| CO4               | 1   | 1   | 1   | 3   | 1   |
| CO5               | 1   | 1   | 1   | 1   | 3   |
| CO6               | 3   | 3   | 3   | 3   | 3   |



## MMB201: Environmental Microbiology and Waste Management

**L-T-P: 4-0-0**

**Credit: 4**

|                              |                       |  |
|------------------------------|-----------------------|--|
| <b>School : SBSR</b>         |                       | <b>Batch : 2018-20</b>   |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 3</b>   |
| 1                            | Course Code           | MMB201   |
| 2                            | Course Title          | Environmental Microbiology & Waste Management  |
| 3                            | Credits               | 4  |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |
|                              | Course Status         | Compulsory   |
| 5                            | Course Objective      | <p>1. This course provides a comprehensive introduction to microbial ecology and fundamentals of microbial diversity.</p> <p>2. The course is designed to give students an up-to-date understanding of a wide array of applications of microorganisms in maintaining biogeochemical factors.</p> <p>3. This course also focuses on concepts of applied environmental microbiology and how microbes can be used for various industrial/ research applications.</p> <p>4. The course also highlights the modern methods of waste management and significant role of microorganisms in waste and resources management.</p>  |
| 6                            | Course Outcomes       | <p>After the successful completion of this course students will be able to:</p> <p>CO1: Comprehend ecological interactions and role of microorganisms played in there and discuss microbial ecology concepts including methods of assessing microbial diversity and studying microbial populations.</p> <p>CO2: Analyze the role of microorganisms in biogeochemical cycles.</p> <p>CO3: Classify different methods of bioremediation and use of microorganisms and plasmids in bioremediation</p> <p>CO4: Explain the commercial application of microorganisms in extraction of metals, oil and in production of biogas.</p> <p>CO5: Identify different methods of waste management and how different microbial metabolic processes can assist in waste management.</p> <p>CO6: To provide a comprehensive introduction to microbial ecology and fundamentals of microbial diversity.</p> |
| 7                            | Course Description    | <p>The 'Environmental Microbiology and Waste Management' is a course designed to give students knowledge about basic concepts of environment/ ecosystem and the role microorganisms play in maintaining the ecosystem balance. This course throws light on various unconventional uses of microorganisms in various industries and</p>   |

|         |   |  |     |            |
|---------|---|--|-----|------------|
|         |   | environmental benefits of use of the microorganisms. This course also outlines various biological methods of waste management and application of microbes in bioremediation. |     |            |
| 8       | Outline syllabus  |  |     | CO Mapping |
| ©t<br>r | <b>Unit 1</b>   | <b>Microbial Ecology</b>   |     |            |
|         | A   | Ecological Concepts: Introduction to ecosystem; types of ecosystem; food chain and food web; biological magnification and eutrophication                                     |     | CO1        |
|         | B   | Microbial diversity: estimates of total number of species; Shannon and Simpsons indices of microbial diversity, Unculturable bacteria  |     |            |
| C       | Culture independent molecular methods for understanding microbial community- Partial and whole community analysis |  |     |            |
|         | <b>Unit 2</b>   | <b>Role of Microorganisms in Environment</b>   |     |            |
|         | A   | Role of microbes in biogeochemical cycles: nitrogen cycle: different phases of nitrogen cycle, microbes involved in different stages of nitrogen cycle                       |     | CO2        |
|         | B   | Carbon, Phosphorous and Sulphur cycle  |     |            |
|         | C   | Production of microbial bio-fertilizers, bio-pesticides, soil conditioners to enhance crop yields.   |     |            |
|         | <b>Unit 3</b>   | <b>Role of Microorganisms in Remediation</b>   |     |            |
|         | A   | Bioremediation- <i>in situ</i> and <i>ex situ</i> techniques   |     | CO3        |
|         | B   | Biodegradation of recalcitrant compounds-lignin, pesticides; Bioaccumulation of metal and detoxification   |     |            |
|         | C   | Degradation of xenobiotics by microorganisms; Degradative plasmids   |     |            |
|         | <b>Unit 4</b>   | <b>Role of Microorganisms in Mining and Energy Production</b>  |     |            |
|         | A   | Microbial technology in mining: Bioleaching; Biomining; Bio-beneficiation  |     | CO4        |
|         | B   | Recovery of oil and MEOR; Bioconversions   |     |            |
|         | C   | Microbial technology for energy production- Concept of microbial fuel cell- principle; types and applications, Use of microorganisms in the production of biogas             |     |            |
|         | <b>Unit 5</b>   | <b>Role of Microorganisms in Waste Management</b>  |     |            |
|         | A   | Landfill- structure and types, involvement of microbes in initial adjustment phase, transition phase, acid phase   |     | CO5        |
|         | B   | Methane formation and maturation phase of a landfill operation   |     |            |
|         | C   | Compositing- types; Design and operational consideration of microbial composting   |     |            |
|         | Mode of examination   | Theory   |     |            |
|         |   | CA   | MTE | ETE        |

|  |                        |  |     |     |  |
|--|------------------------|--|-----|-----|--|
|  | Weightage Distribution | 30%  | 20% | 50% |  |
|  | Text book/s*           | <b>1. Environmental Science.</b> Ahluwalia VK, Malhotra S. Ane Books India @2006. ISBN 81-8052-023-4.<br><b>2. Environmental science.</b> Miller GT, SpoolMan ES. 14 <sup>th</sup> Edition. Brooks/Cole @2013. ISBN 13: 978-81-315-2473-2. |     |     |  |
|  | Other References       | <b>1. Environmental Biotechnology.</b> Fulekar MH. CRC Press @2014. ISBN 978-1-57808-528-8.<br><b>2. Fundamentals of Ecology.</b> Odum EPO and Barret W. Brooks/Cole @2005. ISBN 0534420664.   |     |     |  |

**Course Outcome**

| <b>Course Outcome No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|--------------------------|------------|------------|------------|------------|------------|
| CO1                      | 3          | 2          | 1          | 1          | 1          |
| CO2                      | 1          | 3          | 1          | 1          | 1          |
| CO3                      | 1          | 1          | 3          | 1          | 1          |
| CO4                      | 1          | 1          | 1          | 3          | 1          |
| CO5                      | 1          | 1          | 1          | 1          | 3          |
| CO6                      | 3          | 3          | 3          | 3          | 3          |

**MSB 204: Genomics****L-T-P: 4-0-0****Credit: 4**

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School : SBSR</b>         |                       | <b>Batch : 2018-20</b>   |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 3</b>   |            |
| 1                            | Course Code           | <b>MSB 204</b>   |            |
| 2                            | Course Title          | <b>Genomics</b>  |            |
| 3                            | Credits               | 4  |            |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |            |
|                              | Course Status         | Core   |            |
| 5                            | Course Objectives     | <ol style="list-style-type: none"> <li>1. To comprehend the basic principles of genomics, so that may use it for understanding biological functions and apply for human benefit..</li> <li>2. To acquire knowledge of techniques and strategies involved in understanding a genome</li> </ol>  |            |
| 6                            | Course Outcomes       | <p>After successfully completion of this course students will be able to:</p> <p>CO1. Comprehend the fundamentals of genomics and principles of DNA sequencing and analysing tools.</p> <p>CO2. Identify the advantages and disadvantages of various DNA sequencing methods and choose the appropriate genome analysis pipeline.</p> <p>CO3. Apply the concept of molecular markers and its application in genome analysis and mapping</p> <p>CO4. Comprehend the fundamentals of functional genomics and comparative genomics and apply it to solve problems</p> <p>CO5. Appreciate the power of microbial genome analysis and its application in industry, agriculture and medicine for human welfare.</p> <p>CO6. Be familiar with the different techniques used in genome analysis and choose rationally the appropriate methodology for solving problems.</p> |            |
| 7                            | Course Description    | <p>This course provides a window to the methods and applications of genomics in the study of genomics. It gives a glimpse of the amazing world microbes that are so diverse at genome level and consequently express unique characters. It will explore how the techniques and genomic data in general have been used to understand biology. It will also indicate how this diversity can be exploited for various industries.</p>   |            |
| 8                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Genomic Diversity</b>   |            |
|                              | A                     | Concept of Genome  | CO1        |
|                              | B                     | Principles of DNA sequencing techniques, Automated DNA sequencing, Pyrosequencing, New generation Sequencing methods   | CO1, CO6   |

|  |                        |   |     |     |           |
|--|------------------------|---|-----|-----|-----------|
|  | C                      | Primary, derivative and composite biological databases  |     |     | CO1, CO6  |
|  | <b>Unit 2</b>          | <b>Whole Genome Sequencing</b>  |     |     |           |
|  | A                      | Whole genome sequencing methods   |     |     | CO2, CO6  |
|  | B                      | Genome assembly and annotation  |     |     | CO2, CO6  |
|  | C                      | Analysis of sequence data (gene prediction, conserved domain prediction, motifs), Metagenomics  |     |     | CO2, CO6  |
|  | <b>Unit 3</b>          | <b>Mapping techniques</b>   |     |     |           |
|  | A                      | Types of genome maps,   |     |     | CO3 , CO6 |
|  | B                      | Introduction to molecular markers (RFLP, AFLP, EST, STS, SNP)   |     |     | CO3, CO6  |
|  | C                      | Application of markers in mapping techniques, Significance of markers in sequencing projects  |     |     | CO3, CO6  |
|  | <b>Unit 4</b>          | <b>Genomics</b>   |     |     |           |
|  | A                      | Functional genomics, Concept of forward and reverse genomics  |     |     | CO4       |
|  | B                      | Investigation of gene function by reverse genomic tools, mutagenesis  |     |     | CO4, CO6  |
|  | C                      | Comparative Genomics, application in Functional genomics  |     |     | CO4, CO6  |
|  | <b>Unit 5</b>          | <b>Application of Genomics</b>  |     |     |           |
|  | A                      | Pharmaco-genomics and its application with special reference to SNP and SNP databases   |     |     | CO5, CO6  |
|  | B                      | Genomics and its application in agriculture and industry  |     |     | CO5, CO6  |
|  | C                      | Reverse vaccines, Human genome project  |     |     | CO5, CO6  |
|  | Mode of examination    | Theory  |     |     |           |
|  | Weightage Distribution | CA  | MTE | ETE |           |
|  |                        | 30%   | 20% | 50% |           |
|  | Text book/s*           | 1. Brown T.A., <i>Genomes, 3<sup>rd</sup> Edition</i> . Wiley-Liss (2006).  |     |     |           |
|  | Other References       | 1. Bioinformatics and Functional genomics by Jonathan Pevsner, 2nd edition, John Wiley and Sons (2008)<br>2. Introduction to genomics by Arthur M. Lesk, Oxford University Press (2007) |     |     |           |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

**MSB206: Enzyme Technology****L-T-P: 4-0-0****Credit – 4**

|                              |                       |  |            |
|------------------------------|-----------------------|--|------------|
| <b>School: SBSR</b>          |                       | <b>Batch: 2018–20</b>  |            |
| <b>Program: M.Sc.</b>        |                       | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch: Biotechnology</b> |                       | <b>Semester: 3</b>   |            |
| 1                            | Course Code           | <b>MSB206</b>  |            |
| 2                            | Course Title          | <b>Enzyme Technology</b>   |            |
| 3                            | Credits               | 4  |            |
| 4                            | Contact Hours (L-T-P) | 4-0-0  |            |
|                              | Course Status         | Compulsory   |            |
| 5                            | Course Objective      | <p>With this Course the students</p> <ol style="list-style-type: none"> <li>1. will acquire knowledge fundamental Knowledge of Enzymes</li> <li>2. Will get useful exploitation of enzymes physical and kinetic properties</li> <li>3. Use Enzymes biocatalysts in the biotransformation</li> <li>4. Know the Industrial, Research and Therapeutic applications of Enzymes</li> </ol>  |            |
| 6                            | Course Outcomes       | <p>After successfully completion of this course students will be able to:</p> <p>CO1. Define and Classify Enzymes and its fundamentals properties</p> <p>CO2. Examine Enzyme Kinetics, Perform and calculate enzyme specificity and activity</p> <p>CO3. Evaluate Enzyme Inhibition and its types, Competitive and Non-competitive inhibition and its significance</p> <p>CO4. Understand Allosteric Enzymes regulation, Covalent modification, Determine the role of co-enzymes, Enzyme constitution and immobilization</p> <p>CO5. Evaluate Applications of Enzymes in industry, Enzymes in clinical diagnostics. sensors for clinical processes and environmental, Microbial analyses, Engineered Enzymes.</p> <p>CO6. To analyse Enzymes principles, properties, Kinetics, Inhibition, Allosterism, Co-Enzymes, Engineered Enzymes, Application of Enzymes in various industries, research and therapeutic aspects</p> |            |
| 7                            | Course Description    | This course covers fundamentals to applications necessary for the useful exploitation of enzymes both as tools for the enzymatic analyses and as biocatalysts in the biotransformation on the unique structural-functional properties of enzymes and its microbial industrial and research utilization.  |            |
| 8                            | Outline syllabus      |  | CO Mapping |
|                              | <b>Unit 1</b>         | <b>Properties of Enzymes</b>   | CO1,6      |
|                              | A                     | Classification of enzymes, Structural conformations of enzyme proteins   | CO1,6      |
|                              | B                     | Enzymes as biocatalysts, Catalytic power, Activation energy  | CO1,6      |
|                              | C                     | Substrate specificity, Mechanisms of enzyme action, Ribozymes and abzymes  | CO1,6      |

|  |                        |   |     |       |
|--|------------------------|---|-----|-------|
|  | <b>Unit 2</b>          | <b>Enzyme Kinetics</b>  |     | CO2,6 |
|  | A                      | Factors affecting rates of enzymatic reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time)   |     | CO2,6 |
|  | B                      | Overview of Michaelis-Menten equation and its transformation, Lineweaver-Burke plot   |     | CO2,6 |
|  | C                      | Evaluation of kinetic parameters ( $K_M$ , $V_{max}$ )  |     | CO2,6 |
|  | <b>Unit 3</b>          | <b>Enzyme Inhibition</b>  |     | CO3,6 |
|  | A                      | Irreversible and reversible inhibition  |     | CO3,6 |
|  | B                      | Competitive, non-competitive and un-competitive inhibition  |     | CO3,6 |
|  | C                      | Enzyme inhibition kinetic studies, Determination of $k_{cat}$ .   |     | CO3,6 |
|  | <b>Unit 4</b>          | <b>Regulation of Enzyme Activity</b>  |     | CO4,6 |
|  | A                      | Allosterism, Kinetic analysis of allosteric enzymes   |     | CO4,6 |
|  | B                      | Covalent modification, Feed-back inhibition, Membrane bound enzymes   |     | CO4,6 |
|  | C                      | Isoenzymes and marker enzymes, Constitutive and inducible enzymes   |     | CO4,6 |
|  | <b>Unit 5</b>          | <b>Applications of Microbial Enzymes</b>  |     | CO5,6 |
|  | A                      | Microbial enzymes in textile, leather, wood industries and detergents   |     | CO5,6 |
|  | B                      | Enzymes in clinical diagnostics and Enzyme sensors for clinical processes and environmental analyses  |     | CO5,6 |
|  | C                      | Engineered enzymes, Enzymes as therapeutic agents   |     | CO5,6 |
|  | Mode of examination    | Theory  |     |       |
|  | Weightage Distribution | CA  | MTE | ETE   |
|  |                        | 30%   | 20% | 50%   |
|  | Textbook/s*            | Palmer T., Bonner P. L., "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Woodhead Publishing, 2007.   |     |       |
|  | Other References       | <ol style="list-style-type: none"> <li>1. Copeland R. A., "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis", Wiley, 2006.</li> <li>2. Guisán J. M., "Immobilization of Enzymes and Cells (Methods in Biotechnology)", Humana Press, 2010.</li> </ol> |     |       |



| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

## MSB203: Intellectual Property rights and ethical issues

L-T-P 4-0-0

Credits 4

|                                 |                          |  |                           |
|---------------------------------|--------------------------|--|---------------------------|
| <b>School: SBSR</b>             |                          | <b>Batch : 2018-20</b>   |                           |
| <b>Program: MSc</b>             |                          | <b>Current Academic Year: 2018-19</b>  |                           |
| <b>Branch:</b><br>Biotechnology |                          | <b>Semester: 3</b>   |                           |
| 1                               | Course Code              | <b>MSB203</b>  |                           |
| 2                               | Course Title             | <b>IPR and Industrial Ethics</b>   |                           |
| 3                               | Credits                  | 4  |                           |
| 4                               | Contact Hours<br>(L-T-P) | 4-0-0  |                           |
|                                 | Course Status            | Compulsory   |                           |
| 5                               | Course Objective         | To elucidate the ways of protection of intellectual property and research with the help of WIPO and its different treaties. To correlate different instruments of IP protection and their enforcement in different countries. To understand different quality management issues related to biotechnology   |                           |
| 6                               | Course Outcomes          | By the end of this course students will be able to:<br>CO1: Administer and follow the guidelines of WIPO.<br>CO2: Understand the patents, copyrights and trademarks.<br>CO3: Understand the character merchandising and franchising.<br>CO4: Understand the utility of IPRs in biotechnology.<br>CO5: Understand about quality standards.<br>CO6: Learn the quality assurance. |                           |
| 7                               | Course Description       | <i>Intellectual property</i> (IP) includes intangible creations of the human intellect, and primarily encompasses copyrights, patents, and trademarks. It also includes other types of rights, such as trade secrets, publicity rights, moral rights, and rights against unfair competition. Present paper deals with knowledge of types and protection of different IPRs.     |                           |
| 8                               | Outline syllabus         |  | CO Mapping                |
|                                 | <b>Unit 1</b>            | <b>Introduction to Intellectual Property Rights</b>  | <b>CO1, CO6</b>           |
|                                 | A                        | The concept of intellectual property,  |                           |
|                                 | B                        | WIPO- history, mission and activities, structure, administration.  |                           |
|                                 | C                        | Importance of IPR in biotechnology   |                           |
|                                 | <b>Unit 2</b>            | <b>Patents &amp; Copyrights</b>  |                           |
|                                 | A                        | Patents-basic concepts   | CO2, CO3, CO6             |
|                                 | B                        | Infringement, compulsory licenses.   |                           |
|                                 | C                        | Copyright and related rights; piracy and infringement  |                           |
|                                 | <b>Unit 3</b>            | <b>Trademarks</b>  | <b>CO2, CO3, CO4, CO6</b> |

|  |                        |   |     |     |  |
|--|------------------------|---|-----|-----|--|
|  | A                      | Definitions, Signs which serve as trademarks,   |     |     |  |
|  | B                      | Trademark piracy, and counterfeiting  |     |     |  |
|  | C                      | Character Merchandising.  |     |     |  |
|  | <b>Unit 4</b>          | <b>Work ethics</b>  |     |     | <b>CO2, CO3,<br/>CO4, CO5,<br/>CO6</b> |
|  | A                      | Work ethic – Self learning, self egoism   |     |     |  |
|  | B                      | Accountability  |     |     |  |
|  | C                      | Management of staff and inventory   |     |     |  |
|  | <b>Unit 5</b>          | <b>Ethics in industries</b>   |     |     | <b>CO3, CO4,<br/>CO6</b>               |
|  | A                      | Risk-Benefit Analysis   |     |     |  |
|  | B                      | Team work, Working with colleagues and sharing of work, work flow related difficulties  |     |     |  |
|  | C                      | Minimum input and maximum output; proactive ness.   |     |     |  |
|  | Mode of examination    | Theory  |     |     |  |
|  | Weightage Distribution | CA  | MTE | ETE |  |
|  |                        | 30%   | 20% | 50% |  |
|  | Text book/s*           | 1. Managing intellectual capital: organizational, strategic and policy dimensions Oxford Univ. press 2005 Teece, David J.   |     |     |  |
|  | Other References       | 2. Techniques used in Bio product analysis, Butterworth Heinemann Ltd, 2017.<br>3. Law relating to patents, trademarks, copyright designs geographical indications. Universal Law Publishing house by Wadehra, B.L. |     |     |  |

### Course Outcome

| No  | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| CO1 | 3   | 1   | 1   | 1   | 1   |
| CO2 | 1   | 3   | 1   | 1   | 1   |
| CO3 | 1   | 1   | 3   | 1   | 2   |
| CO4 | 2   | 2   | 1   | 3   | 1   |
| CO5 | 1   | 1   | 1   | 1   | 3   |
| CO6 | 3   | 3   | 3   | 3   | 3   |

**MSP206: Enzyme Technology Lab****L-T-P: 0-0-3****Credits 2**

|                              |                        |   |           |            |
|------------------------------|------------------------|---|-----------|------------|
| <b>School: SBSR</b>          |                        | <b>Batch: 2018-20</b>   |           |            |
| <b>Program: M.Sc.</b>        |                        | <b>Current Academic Year: 2018-19</b>   |           |            |
| <b>Branch: Biotechnology</b> |                        | <b>Semester: 03</b>   |           |            |
| 1                            | Course Code            | <b>MSP206</b>   |           |            |
| 2                            | Course Title           | <b>Enzyme Technology Lab</b>  |           |            |
| 3                            | Credits                | 2   |           |            |
| 4                            | Contact Hours (L-T-P)  | 0-0-3   |           |            |
|                              | Course Status          | <b>Compulsory/Elective</b>  |           |            |
| 5                            | Course Objective       | To give students a thorough understanding of enzymes and enzyme kinetics.<br>To make students learn the working and operation of enzymes as well as measurement of enzyme activity  |           |            |
| 6                            | Course Outcomes        | CO1: To understand the mode of action of salivary amylase<br>CO2: Preparation of standard curve for calculation of enzyme activity.<br>CO3: Assaying the activity of industrially important amylase enzyme using 3,5-Dinitrosalicylic acid method.<br>CO4: To determine the pH optima of amylase enzyme<br>CO5: To determine the temperature optima of amylase enzyme<br>CO6: To give students a thorough understanding of enzymes and enzyme kinetics. |           |            |
| 7                            | Course Description     | This course is designed to make students learn about enzymes, measurement of their activity in terms of IU and katal as well as understanding the kinetics of enzymes.  |           |            |
| 8                            | Outline syllabus       |   |           | CO Mapping |
|                              | <b>Unit 1</b>          | <b>Salivary amylase</b>   |           | CO1        |
|                              |                        | Mode of action of $\alpha$ -amylase on starch   |           | CO1        |
|                              | <b>Unit 2</b>          | <b>Calculation of Enzyme Activity</b>   |           | CO2        |
|                              |                        | Preparation of standard curve   |           | CO2        |
|                              | <b>Unit 3</b>          | <b>Assaying the activity of industrially important amylase</b>  |           | CO3        |
|                              |                        | 3'5'- Dinitrosalicylic acid method  |           | CO3        |
|                              | <b>Unit 4</b>          | <b>pH optima</b>  |           | CO4        |
|                              |                        | To determine the pH optima of amylase enzyme  |           | CO4        |
|                              | <b>Unit 5</b>          | <b>Temperature optima</b>   |           | CO5        |
|                              |                        | To determine the temperature optima of amylase enzyme   |           | CO5        |
|                              | Mode of exam           | Jury/Practical/Viva   |           |            |
|                              | Weightage Distribution | CA<br>60%   | MTE<br>0% | ETE<br>40% |
|                              | Textbook/s*            | 1. Palmer T., Bonner P. L., "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Woodhead Publishing, 2007.  |           |            |
|                              | Other References       | 2. Copeland R. A., "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis", Wiley, 2006.   |           |            |

|  |  |  |
|--|--|--|
|  |  | 3. Guisán J. M., “Immobilization of Enzymes and Cells (Methods in Biotechnology)”, Humana Press, 2010. |
|--|--|--|

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 2          |
| CO4                          | 2          | 2          | 1          | 3          | 1          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |

**MSB256: Genomics and Bacterial Genetics Lab**  
**L-T-P 0-0-3**

**Credits 2**

|                              |                        |   |     |            |
|------------------------------|------------------------|---|-----|------------|
| <b>School: SBSR</b>          |                        | <b>Batch:2018-20</b>  |     |            |
| <b>Program: M.Sc.</b>        |                        | <b>Current Academic Year: 2018-19</b>   |     |            |
| <b>Branch: Biotechnology</b> |                        | <b>Semester: 3</b>  |     |            |
| 1                            | Course Code            | MSB256  |     |            |
| 2                            | Course Title           | Genomics and Bacterial Genetics Lab   |     |            |
| 3                            | Credits                | 2   |     |            |
| 4                            | Contact Hours (L-T-P)  | 0-0-3   |     |            |
|                              | Course Status          | Compulsory  |     |            |
| 5                            | Course Objective       | To learn methods of gene prediction, annotation and sequence analysis and Microbial genetics.<br>Understand how gene expression is controlled.  |     |            |
| 6                            | Course Outcomes        | After finishing the course the students will be able to<br>CO1: Learn about various biological databases and their operations.<br>CO2: Sequence retrieval and sequence alignment using various softwares.<br>CO3: Identify the various ORFs in an unknown sequence.<br>CO4: Find out if any protein is being encoded by the sequence and its characteristics.<br>CO5: Will be able to isolate plasmid from the bacterial cells and perform restriction digestion studies on it.<br>CO6: Design experiments, analyse experimental results and communicate data through writing |     |            |
| 7                            | Course Description     | The course aims to appraise the students to basic and high throughput techniques in Genomics and Bacterial genetics and their applications.   |     |            |
| 8                            | Outline syllabus       |   |     | CO Mapping |
|                              | <b>Unit 1</b>          | <b>Practical related to Biological Databases</b>  |     |            |
|                              |                        | Sub unit – a ,b, c  |     | CO1, CO6   |
|                              | <b>Unit 2</b>          | <b>Practical related to alignment</b>   |     |            |
|                              |                        | Sub unit –c   |     | CO2, CO6   |
|                              | <b>Unit 3</b>          | <b>Practical based to Microbial strain</b>  |     |            |
|                              |                        | Sub unit- a   |     | CO3, CO6   |
|                              | <b>Unit 4</b>          | <b>Practical related to Microbial genetics</b>  |     |            |
|                              |                        | Sub unit – c  |     | CO4, CO6   |
|                              | <b>Unit 5</b>          | <b>Practical based upon Microbial Genome Analysis</b>   |     |            |
|                              |                        | Sub unit - a  |     | CO5, CO6   |
|                              | Mode of examination    | Practical/Viva  |     |            |
|                              | Weightage Distribution | CA  | MTE | ETE        |
|                              |                        | 60%   | 0%  | 40%        |

## List of Practical's:

| <b>Week 1</b> | <b>Unit 1</b> | <b>Practical based on</b>         |   |
|---------------|---------------|-----------------------------------|---|
| Week 1-2      | a             | Lab expt.1                        | Find out the major data bases dealing with primary data along with their home server address.   |
| Week 3        |               | Lab expt.2                        | Align all the nucleotide sequences provided using bioedit. Translate one of them into amino acid in all six frames. Give the graphic view and mark the conserved regions. |
|               | <b>Unit 2</b> | <b>Practical related to study</b> |   |
| Week 4        | b             | Lab expt.3                        | Perform BLAST nucleotide for the nucleotide sequence provided and predict the gene. Report the most similar accession number and give its detail.                         |
|               |               | Lab expt.4                        | To perform ORF scan on the given sequence and find out the viable ORFs.   |
|               | <b>Unit 3</b> | <b>Practical based upon</b>       |   |
| Week 5        | a             | Lab expt.5                        | Perform BLAST and find out the conserved domain number and protein family number for it.  |
| Week 6        | b             | Lab expt.6                        | Prepare a pure culture of a bacterial strain.   |
| Week 7        | Mid term      |                                   |   |
|               | <b>Unit 4</b> | <b>Practical based upon study</b> |   |
| Week 8        | a             | Lab expt.7                        | Isolate plasmid from bacterial cells.   |
| Week 9-10     | b             | Lab expt.8                        | Perform Restriction digestion of isolated plasmids  |
|               | <b>Unit 5</b> | <b>Practical related</b>          |   |
| Week 11-14    | a, b and c    | Lab expt.9                        | Conduct PCR for specific Genes in Bacteria  |
|               |               | Lab expt.10                       | Quantify and Analysis Bacterial Genome  |

|  |                  |   |  |
|--|------------------|---|--|
|  | Text book/s*     | Genomics And Proteomics Principles Technologies And Applications by Taylor & Francis June 2017 ISBN 9781771881142 |  |
|  | Other References | Practical Microbiology by CKJ Panker, Orient Longman. 2017  |  |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 1          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 2          | 3          | 2          |
| CO5                          | 1          | 1          | 1          | 1          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |



## MMB204: Food Microbiology

L-T-P: 4-0-0

Credit - 4

|                                  |                          |  |            |
|----------------------------------|--------------------------|--|------------|
| <b>School : SBSR</b>             |                          | <b>Batch : 2018-20</b>   |            |
| <b>Program: M.Sc.</b>            |                          | <b>Current Academic Year: 2018-19</b>  |            |
| <b>Branch:<br/>Biotechnology</b> |                          | <b>Semester: 04</b>  |            |
| 1                                | Course Code              | MMB204   |            |
| 2                                | Course Title             | Food Microbiology  |            |
| 3                                | Credits                  | 4  |            |
| 4                                | Contact Hours<br>(L-T-P) | 4-0-0  |            |
| Course Status                    |                          | Compulsory   |            |
| 5                                | Course Objective         | The course is designed to prepare students with a basic understanding of the microbes involved in biological processes such as fermentation and spoilage. The course provides a foundation for careers in microbiology, food microbiology, or research in all branches of food sciences.   |            |
| 6                                | Course Outcomes          | After the successful completion of this course students will be able to:<br>CO1. Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.<br>CO2. Understand the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods.<br>CO3. Identify ways to control microorganisms in foods.<br>CO4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.<br>CO5. Utilize laboratory techniques to detect, quantify, and identify microorganisms in foods.<br>CO6. Understand the role of fermentation and preservation in food science. |            |
| 7                                | Course Description       | The 'Food Microbiology' course outlines the basic principles of Microbiology. This course also sheds light upon fermentation and is designed to make student learn the preservation of food products. The course also further encompasses the concept of identification and quantification of microorganisms in foods.   |            |
| 8                                | Outline syllabus         |  | CO Mapping |
|                                  | <b>Unit 1</b>            | <b>History development and microbes in food</b>  |            |
|                                  | A                        | Historical developments  | CO1, CO2   |
|                                  | B                        | Important of Microorganisms in food  |            |
|                                  | C                        | Factors affecting growth of microbes in food   |            |
|                                  | <b>Unit 2</b>            | <b>Spoilage of Foods</b>   |            |
|                                  | A                        | Spoilage of meat   | CO3, CO4   |
|                                  | B                        | Spoilage of Milk and milk products   |            |
|                                  | C                        | Spoilage and defects of fermented food products  |            |

|  |                        |  |     |     |              |
|--|------------------------|--|-----|-----|--------------|
|  | <b>Unit 3</b>          | <b>Biological transformation of food</b>   |     |     |              |
|  | A                      | Fermentation   |     |     | CO3, CO6     |
|  | B                      | Production of fermented products   |     |     |              |
|  | C                      | Importance of fermentation   |     |     |              |
|  | <b>Unit 4</b>          | <b>Preservation of food</b>  |     |     |              |
|  | A                      | General principles of food preservation  |     |     | CO6          |
|  | B                      | Chemical Preservation of food  |     |     |              |
|  | C                      | Preservation of food by radiation  |     |     |              |
|  | <b>Unit 5</b>          | <b>Food Borne Diseases</b>   |     |     |              |
|  | A                      | Bacterial and nonbacterial infection   |     |     | CO4,CO5, CO6 |
|  | B                      | Food borne diseases: Salmonellosis, Botulism, Listeriosis  |     |     |              |
|  | C                      | Detection of Microbes in food  |     |     |              |
|  | Mode of examination    | Theory   |     |     |              |
|  | Weightage Distribution | CA   | MTE | ETE |              |
|  |                        | 30%  | 20% | 50% |              |
|  | Textbook/s*            | 1. Jay, J.M. (2008) Modern Food Microbiology (Sixth Edition). Aspen Publishers, Inc. Gaithersburg, Maryland.   |     |     |              |
|  | Other References       | 2. Adams, M. R. and Moss, M. O. (2005) Food Microbiology (Second edition). Royal Society of Chemistry Publication, Cambridge.<br>3. Ray, B. (2005) Fundamental food microbiology (Third edition). CRC Press, New York, Washington D.C.<br>4. Frazier, W. C. and West off, D. C. (2007) Food Microbiology. Tata McGraw Hill Publishing Company Ltd. New Delhi.<br>5. Banwart G J. (1989). Basic Food Microbiology. AVI publication. |     |     |              |

| Course Outcome No | PO1 | PO2 | PO3 | PO4 | PO5 |
|-------------------|-----|-----|-----|-----|-----|
| CO1               | 3   | 1   | 1   | 1   | 1   |
| CO2               | 1   | 3   | 1   | 1   | 1   |
| CO3               | 1   | 1   | 3   | 2   | 1   |
| CO4               | 1   | 1   | 1   | 3   | 2   |
| CO5               | 1   | 1   | 1   | 2   | 3   |
| CO6               | 3   | 3   | 3   | 3   | 3   |

## MSB205: CANCER BIOLOGY

L-T-P 4-0-0

Credits 4

|                     |                       |   |
|---------------------|-----------------------|---|
| <b>School: SBSR</b> |                       | <b>Batch : 2018-20</b>  |
| <b>Program: MSc</b> |                       | <b>Current Academic Year: 2018-19</b>   |
| <b>Branch: BT</b>   |                       | <b>Semester: 04</b>   |
| 1                   | Course Code           | <b>MSB205</b>   |
| 2                   | Course Title          | <b>CANCER BIOLOGY</b>   |
| 3                   | Credits               | 4   |
| 4                   | Contact Hours (L-T-P) | 4-0-0   |
|                     | Course Status         | <b>Elective</b>   |
| 5                   | Course Objectives     | 1. Understanding about types of cancer and carcinogens<br>2. Acquire enough knowledge about different models and strategies of cancer research.<br>3. Develop the concept of various genes involved in metastasis of cancer and their signalling pathways, which in turn help in designing different therapies for it.<br>4. Analyse the impact of angiogenesis on cancer growth and metastasis.  |
| 6                   | Course Outcomes       | CO1: Identify type and stage of tumours and identify genetic/non-genetic factors involved<br>CO2: Analyze the impact of angiogenesis and tumour microenvironment on cancer growth and metastasis<br>CO3: Comprehend the effect of cell death in defence against cancer<br>CO4: Assemble the several modes through which cellular environment triggers cancer and elicits immune response<br>CO5: Evaluate the effectiveness of study models and existing screening and treatment options, identify new drug targets<br>CO6: Understand the progression of cancer, associated risk factors, molecular mechanisms, prevention and treatment |
| 7                   | Course Description    | Cancer Biology is course about the detailed introduction on types of cancer, agents causing cancer. It also helps in understanding about the molecular mechanisms of cancer establishment and its progression by the process of metastasis and angiogenesis. This course also describes about the various model system which are used to study cancer and its treatment.  |
| 8                   | Outline syllabus      | CO Mapping  |
|                     | <b>Unit 1</b>         | <b>Introduction to Cancer Biology</b>   |

|  |                        |   |     |     |          |
|--|------------------------|---|-----|-----|----------|
|  | A                      | Definition and classification   |     |     | CO1, CO6 |
|  | B                      | Cellular Oncogenes  |     |     |          |
|  | C                      | Tumour Suppressor genes   |     |     |          |
|  | <b>Unit 2</b>          | <b>Characteristics of Tumour</b>  |     |     |          |
|  | A                      | Invasion-metastasis-molecular mechanism   |     |     |          |
|  | B                      | Angiogenesis-process  |     |     | CO1, CO6 |
|  | C                      | Hypoxia and VEGF  |     |     |          |
|  | <b>Unit 3</b>          | <b>Autophagy and Apoptosis</b>  |     |     | CO3, CO6 |
|  | A                      | Autophagy-types   |     |     |          |
|  | B                      | Apoptosis-intrinsic and extrinsic pathways  |     |     |          |
|  | C                      | Crosstalk between autophagy and apoptosis   |     |     |          |
|  | <b>Unit 4</b>          | <b>Microenvironment of tumour cells</b>   |     |     | CO4, CO6 |
|  | A                      | Stroma interaction  |     |     |          |
|  | B                      | Tumour immunology   |     |     |          |
|  | C                      | Cancer stem cells   |     |     |          |
|  | <b>Unit 5</b>          | <b>Cancer prevention and treatment</b>  |     |     | CO5, CO6 |
|  | A                      | Mouse models of cancers   |     |     |          |
|  | B                      | Drug resistance and molecular diagnosis   |     |     |          |
|  | C                      | Therapeutic approaches  |     |     |          |
|  | Mode of examination    | <b>Theory</b>   |     |     |          |
|  | Weightage Distribution | CA  | MTE | ETE |          |
|  |                        | 30%   | 20% | 50% |          |
|  | Text book/s*           | Weinberg R.A., "The Biology of Cancer", Garland Science, 2006.  |     |     |          |
|  | Other References       | 1. Pecorino L., "Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics", Oxford University Press, 2012.<br>2. Ruddon R.W., "Cancer Biology", Oxford University Press, 2007. |     |     |          |

| <b>Course Outcome<br/>No</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> |
|------------------------------|------------|------------|------------|------------|------------|
| CO1                          | 3          | 1          | 1          | 1          | 1          |
| CO2                          | 2          | 3          | 1          | 1          | 1          |
| CO3                          | 1          | 1          | 3          | 1          | 1          |
| CO4                          | 1          | 1          | 1          | 3          | 1          |
| CO5                          | 1          | 2          | 2          | 2          | 3          |
| CO6                          | 3          | 3          | 3          | 3          | 3          |