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# **BSc Honors in Biochemistry Degree Program**

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Faculty of Science  
University of Kelaniya  
BSc Honors in Biochemistry Degree

|                    | Course units                                           |                                                                 | BIOC (No of credits) | CHEM (No of credits) | Status |
|--------------------|--------------------------------------------------------|-----------------------------------------------------------------|----------------------|----------------------|--------|
| University Level 3 | BIOC 44703                                             | Biophysical Chemistry                                           | 03                   |                      | C      |
|                    | *CHEM 44733                                            | Advanced Organic Chemistry I                                    |                      | 03                   | C      |
|                    | *CHEM 44704                                            | Advanced Analytical Chemistry                                   |                      | 04                   | C      |
|                    | BIOC 44724                                             | Cell Biology, Immunology and Neurobiology                       | 04                   |                      | C      |
|                    | BIOC 44734                                             | Advanced Molecular Biology and Molecular Genetics               | 04                   |                      | C      |
|                    | BIOC 44742                                             | Advanced Biochemistry Laboratory                                | 02                   |                      | C      |
|                    | BIOC 44752                                             | Advanced Molecular Biology Laboratory                           | 02                   |                      | C      |
|                    | *CHEM 44753                                            | Analytical and Environmental Chemistry Laboratory               |                      | 03                   | C      |
|                    | *CHEM 44782                                            | Organic Chemistry Laboratory                                    |                      | 02                   | C      |
|                    | BIOC 44761                                             | Industrial/ Professional Training <sup>1</sup>                  | 01                   |                      | C      |
|                    | BIOC 44771                                             | Scientific Communication                                        | 01                   |                      | C      |
|                    | BIOC 44783                                             | Programming for Bioinformatics                                  | 03                   |                      | C      |
| University Level 4 | *CHEM 44864                                            | Advanced Organic Chemistry II                                   |                      | 04                   | C      |
|                    | BIOC 44794                                             | Medicinal Chemistry and Clinical Biochemistry                   | 04                   |                      | C      |
|                    | BIOC 43803                                             | Bioinformatics and Molecular Modelling                          | 03                   |                      | C      |
|                    | BIOC 43818                                             | Research Project/ Dissertation                                  | 08                   |                      | C      |
|                    | BIOC 44824                                             | Food and Nutritional Biochemistry                               | 04                   |                      | C      |
|                    | BIOC 44833                                             | Molecular Markers and Transgenic Technology                     | 03                   |                      | C      |
|                    | BIOC 44844                                             | Bioprocess Engineering                                          | 04                   |                      | C      |
|                    | BIOC 44853                                             | Biochemical Engineering and Management Concepts in Biochemistry | 03                   |                      | C      |
|                    | BIOC 44862                                             | Applied Environmental Biochemistry                              | 02                   |                      | C      |
|                    | <b>Total no of credits in university level 3 and 4</b> |                                                                 | 50                   | 16                   |        |

\*Courses offered under BSc Honors in Chemistry by the Department of Chemistry

<sup>1</sup> Credit not counted for the GPA Calculation

### University Level 3

|                             |                       |           |                      |
|-----------------------------|-----------------------|-----------|----------------------|
| <b>Semester</b>             | 1 or 2                |           |                      |
| <b>Course Code</b>          | BIOC 44703            |           |                      |
| <b>Course Name</b>          | Biophysical Chemistry |           |                      |
| <b>Credit Value</b>         | 3                     |           |                      |
| <b>Compulsory/ Optional</b> | Compulsory            |           |                      |
| <b>Pre-requisites</b>       | -                     |           |                      |
| <b>Co-requisites</b>        | -                     |           |                      |
| <b>Hourly Breakdown</b>     | Theory                | Practical | Independent Learning |
|                             | 45                    | -         | 105                  |

#### **Course Aim/ Intended Learning Outcomes:**

Upon successful completion of this course unit, the student should be able to,

- describe theoretical and practical aspects of advanced enzyme kinetics
- analyze the structure, dynamics, interactions, and functions of biological systems at molecular level
- appraise biophysical methods in modern biomolecular research and technology
- demonstrate the importance of biomolecular modeling in designing novel drugs in pharmaceutical research
- perform computer simulations to manipulate, and optimize 3D models of biomolecules using various software in a laboratory environment.

#### **Course Content:**

##### **Advanced Enzyme Kinetics (20 h)**

The steady state of an enzyme-catalyzed reaction. The Briggs-Haldane treatment. The reversible Michaelis-Menten mechanism. Practical aspects of kinetic studies. Inhibition and activation of enzymes; catalytic poisons, types of reversible inhibition, linear inhibition, specific inhibition, mixed inhibition, competitive inhibition, hyperbolic activation and inhibition. Multi substrate system. Fast reaction, Burst kinetics. Active site titration analysis of enzyme kinetic data. Use of isotopes for studying enzyme mechanism.

##### **Biophysics (25 h)**

Three-dimensional structure of proteins; amino acids, peptides, protein structure, protein folding, protein denaturation. Protein function; reversible ligand binding to proteins (oxygen binding proteins). Conformations of macromolecules; Molecular associations, co-operativity, allosteric interactions. Protein sequences and evolution. Biomechanics; conversion of chemical energy to mechanical force (actin, myosin and molecular motors). Biological membranes and transport; membrane composition and architecture, membrane dynamics, solute transport across membranes (diffusion and Brownian motion, ion permeation and membrane potential). Cellular homeostasis. Physical methods for determination of macromolecular structure; CD, NMR spectroscopy (COSY, TOCSY and NOESY NMR techniques), and X-ray crystallography.

**Teaching/ Learning Methods:** A combination of lectures, take-home assignments, in-class assignments and group discussions, tutorial discussions and problem-based learning (in-class computer laboratory sessions and supporting materials will be provided via Computer Assisted Learning (CAL))

**Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment<br>20%          | Final Assessment<br>80% |                |            |
|---------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20 | Theory<br>80            | Practical<br>- | Other<br>- |

**Recommended Reading:**

1. Nelson, D. L., and Cox, M. M., (2017), *Lehninger Principles of Biochemistry*, W. H. Freeman.
2. Freshet, A., (1993), *Enzyme Structure and Mechanism*, W. H. Freeman.
3. Arrondo, J. L. R., and Alonso, A., (2006), *Advanced Techniques in Biophysics*, Springer-Verlag, Heidelberg.
4. Holtje, H., Folkers, G., Mannhold, R., Kubinyi, H., and Timmerman, H., (2008), *Molecular Modeling, Basic Principles and Applications*, Wiley-VCH.

|                             |                                           |           |                      |
|-----------------------------|-------------------------------------------|-----------|----------------------|
| <b>Semester</b>             | 1 or 2                                    |           |                      |
| <b>Course Code</b>          | BIOC 44724                                |           |                      |
| <b>Course Name</b>          | Cell Biology, Immunology and Neurobiology |           |                      |
| <b>Credit Value</b>         | 4                                         |           |                      |
| <b>Compulsory/ Optional</b> | Compulsory                                |           |                      |
| <b>Pre-requisites</b>       | -                                         |           |                      |
| <b>Co-requisites</b>        | -                                         |           |                      |
| <b>Hourly Breakdown</b>     | Theory                                    | Practical | Independent Learning |
|                             | 60                                        | -         | 140                  |

**Course Aim/ Intended Learning Outcomes:**

Upon successful completion of this course unit, the student should be able to,

- understand various mechanisms behind the regulation of gene expression
- explain processes of cell differentiation, reprogramming and embryonic development at molecular level
- distinguish the types of molecular genetic changes associated with cancer development
- analyze molecular mechanisms involved in photosynthesis
- characterize immune responses to infection
- design immunoassays to investigate regulation of the cell
- explain the biochemical basis of human behavior
- understand the impact of changes on the signal transduction pathways on neurological disease

**Course Content:**

**Cell Biology (20 h)**

Intracellular compartments and transport; membrane trafficking, structure and functions of cytoskeleton, and extracellular matrix. Cell death; autophagy, necrosis and apoptosis. Cell differentiation. Regulation of prokaryotic and eukaryotic gene expression; influence of chromatin structure on gene expression, control of viral transcription. Chromatin remodeling; epigenetic modifications (histone acetylation, and DNA methylation). Genetic control of development; stem cell properties and therapeutic applications. Cell reprogramming; dedifferentiation. Regulation of cell signaling; intracellular and membrane-bound receptors, adaptors and scaffolding protein, activation and deactivation of signaling proteins, second messengers, signal amplification, positive and negative feedback regulation, master regulator proteins (G proteins and NFkB). Chlorophyll structure, photosystems, biochemistry of Calvin cycle, photosynthesis Pathways in C-3, C-4 and CAM plants. Vision. Bioluminescence. Circadian rhythms.

**Immunology (20 h)**

Components of the immune system; innate and adaptive immunity; antigen recognition and antigen receptor molecules their structure and function, Generation of diversity and cell cooperation in the antibody response. Cell mediated immune response; T and B cells. Soluble mediators of the immune response, inflammation, cytokines and other lymphokines, regulation of the immune response.

Immunopathology; immunodeficiency, HIV, hypersensitivity, autoimmune disease, tumor immunology, tissue transplantation and rejection. Vaccines; stimulation of immunity by vaccines and antibody response to vaccination, types of vaccines, and vaccine safety. Immunoassays; Immunohaematology, Immunochemical techniques based on antigen antibody interactions, immuno-histology.

**Neurobiology (20 h)**

Nervous system; neuronal structure and organization, molecular mechanism of synaptic neurotransmission, excitatory and inhibitory neurotransmitters, ionotropic and metabotropic receptors and their function in neurotransmission, biochemical basis of learning and memory, molecular targets of abused drugs and their effects on the nervous system, molecular/ biochemical basis of neuronal disorders (depression, Alzheimer's disease, and toxin-related neuronal dysfunction).

**Teaching/ Learning Methods:** A combination of lectures, tutorial discussions, and problem-based learning (supporting materials will be provided via CAL)

**Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment   | Final Assessment |           |       |
|-------------------------|------------------|-----------|-------|
| 20%                     | 80%              |           |       |
| Details: -              | Theory           | Practical | Other |
| Quizzes/ assignments 20 | 80               | -         | -     |

**Recommended Reading:**

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P., (1994), *Molecular Biology of the Cell*, Garland.
2. Delves, P. J., Seamus, J. M., Burton, D. R., and Roitt, I. M., (2016), *Roitt's Essential Immunology*, Wiley-Blackwell.
3. Barrett, K. E., Barman, S. M., Yuan, J., and Brooks, H. L., (2019), *Ganong's Review of Medical Physiology*, McGraw Hill.
4. Purves, D., George, J., Fitzpatrick, A. D., Hall, W. C., Lmantia, A., Mcnamara, J. O., and Williams, S. M., (2004), *Neuroscience*, Sinauer Publishers.

|                             |                                                   |           |                      |
|-----------------------------|---------------------------------------------------|-----------|----------------------|
| <b>Semester</b>             | 1 or 2                                            |           |                      |
| <b>Course Code</b>          | BIOC 44734                                        |           |                      |
| <b>Course Name</b>          | Advanced Molecular Biology and Molecular Genetics |           |                      |
| <b>Credit Value</b>         | 4                                                 |           |                      |
| <b>Compulsory/ Optional</b> | Compulsory                                        |           |                      |
| <b>Pre-requisites</b>       | -                                                 |           |                      |
| <b>Co-requisites</b>        | -                                                 |           |                      |
| <b>Hourly Breakdown</b>     | Theory                                            | Practical | Independent Learning |
|                             | 60                                                | -         | 140                  |

**Course Aim/ Intended Learning Outcomes:**

Upon successful completion of this course unit, the student should be able to,

- apply advanced gene manipulation techniques in basic and applied research
- demonstrate advanced techniques used in analyzing DNA, protein and their interactions
- analyze population structure using Hardy-Weinberg principle and  $\chi^2$  statistics
- evaluate the heredity and the mechanisms by which genetic factors are transmitted in molecular level

**Course Content:**

**Molecular Biology (30 h)**

Advanced methods of gene cloning for expression; elements on expression vectors (affinity tags/ fusion proteins, secretion signal, protease site, and terminator). Fusion protein production, protein secretion, and affinity tagged proteins, factors affecting recombinant protein expression (initiation of transcription, RNA stability, initiation of translation, translational elongation, polypeptide folding, post-translational processing, inclusion bodies and protein solubility, codon bias), Inducible promoters and applications (TOPO TA cloning). Protein expression systems; bacterial expression systems, yeast expression systems, insect cell/Baculovirus expression system, mammalian cell expression systems (adenoviral, retroviral, and baculoviral vectors), transient and stable transfection. Methods to study transcription, regulation of cellular functions, protein-DNA interactions and protein-protein interactions; gene expression assays, reporter assays, DNA foot printing, chromatin immunoprecipitation (ChIP), two hybrid assays.

**Molecular Genetics (30 h)**

Molecular basis of inheritance patterns, sex inheritance, pedigree and genetic testing, gene interactions, maternal, extra nuclear and epigenetic inheritance patterns, chromosome variations, recombination and transposition at molecular level, bacterial and viral genetic systems, basics of developmental genetics and Immunogenetics, population genetics and genetic variation, quantitative traits, polygenic inheritance and heritability, phylogenetic trees and molecular evolution.

**Teaching/ Learning Methods:** A combination of lectures, tutorial discussions (supporting materials will be provided via CAL)

|                                                                                                                                                                                                                                                                                                   |                         |           |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------|-------|
| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                                       |                         |           |       |
| Continuous assessment and end of semester examination.                                                                                                                                                                                                                                            |                         |           |       |
| Continuous Assessment<br>20%                                                                                                                                                                                                                                                                      | Final Assessment<br>80% |           |       |
| Details: -                                                                                                                                                                                                                                                                                        | Theory                  | Practical | Other |
| Quizzes/ assignments 20                                                                                                                                                                                                                                                                           | 80                      | -         | -     |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                                       |                         |           |       |
| 1. Channarayappa., (2006), <i>Molecular Biotechnology, Principles and Practice</i> , Universities Press Pvt Ltd.<br>2. Dubey, R. C., (2006), <i>A Textbook of Biotechnology</i> , S. Chand & Company Ltd.<br>3. Kumar, H. D., (2000), <i>Modern Concepts of Biotechnology</i> , Vikas Publishing. |                         |           |       |

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------|----------------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                      | 1 or 2                           |                         |                      |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                   | BIOC 44742                       |                         |                      |
| Course Name                                                                                                                                                                                                                                                                                                                                                                                   | Advanced Biochemistry Laboratory |                         |                      |
| Credit Value                                                                                                                                                                                                                                                                                                                                                                                  | 2                                |                         |                      |
| Compulsory/ Optional                                                                                                                                                                                                                                                                                                                                                                          | Compulsory                       |                         |                      |
| Pre-requisites                                                                                                                                                                                                                                                                                                                                                                                | -                                |                         |                      |
| Co-requisites                                                                                                                                                                                                                                                                                                                                                                                 | -                                |                         |                      |
| Hourly Breakdown                                                                                                                                                                                                                                                                                                                                                                              | Theory                           | Practical               | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                               | -                                | 60                      | 40                   |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                |                                  |                         |                      |
| Upon successful completion of this course unit, the student should be able to,                                                                                                                                                                                                                                                                                                                |                                  |                         |                      |
| <ul style="list-style-type: none"><li>● apply laboratory skills to isolate and manipulate native proteins from biological sources</li><li>● use bioanalytical techniques to detect, quantify and check purity of proteins</li><li>● develop methods to evaluate biological activity of enzymes and proteins</li><li>● design experiments and estimate kinetic parameters of enzymes</li></ul> |                                  |                         |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                        |                                  |                         |                      |
| Protein/ enzyme extraction and purification; salting-out, protein dialysis, ion exchange chromatography, size exclusion chromatography, and affinity chromatography. SDS-PAGE. Enzyme kinetics; Km, Vmax, specific activity, and enzyme inhibitors. Immuno-precipitation reactions and immunoassays.                                                                                          |                                  |                         |                      |
| <b>Teaching/ Learning Methods:</b> Two 6 h laboratory classes per week for 5 Weeks, pre-lab quizzes and assignments, homework assignments and lab reports.                                                                                                                                                                                                                                    |                                  |                         |                      |
| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                                                                                                                                   |                                  |                         |                      |
| Continuous assessment and end of semester examination.                                                                                                                                                                                                                                                                                                                                        |                                  |                         |                      |
| Continuous Assessment<br>30%                                                                                                                                                                                                                                                                                                                                                                  |                                  | Final Assessment<br>70% |                      |
| Details: -                                                                                                                                                                                                                                                                                                                                                                                    | Theory                           | Practical               | Other                |
| Quizzes/ assignments/ lab reports 30                                                                                                                                                                                                                                                                                                                                                          | -                                | 70                      | .                    |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                                                                                                                                   |                                  |                         |                      |
| 1. Minch, M. M. J., (1989), <i>Experiments in Biochemistry</i> , Prentice Hall.                                                                                                                                                                                                                                                                                                               |                                  |                         |                      |
| 2. Plummer, D. T., (1987), <i>An Introduction to Practical Biochemistry</i> , McGraw Hill.                                                                                                                                                                                                                                                                                                    |                                  |                         |                      |
| 3. Robyt, J. F., and White B. J., (1990), <i>Biochemical Techniques, Theory and Practices</i> , Waveland Press.                                                                                                                                                                                                                                                                               |                                  |                         |                      |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------|----------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 or 2                                |                         |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | BIOC 44752                            |                         |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Advanced Molecular Biology Laboratory |                         |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2                                     |                         |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Compulsory                            |                         |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                     |                         |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                     |                         |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Theory                                | Practical               | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -                                     | 60                      | 40                   |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                       |                         |                      |
| <p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>• perform gene manipulation techniques competently</li> <li>• apply gene manipulation techniques in basic research</li> <li>• extract molecular data</li> <li>• organize molecular data</li> <li>• interpret molecular data</li> <li>• estimate various genetic parameters from molecular data</li> <li>• apply molecular laboratory skills</li> <li>• develop various biotechnological tools for human use.</li> </ul> |                                       |                         |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |                         |                      |
| Computer based probe and primer designing. Extraction of mRNA from various tissues, synthesis of cDNA, qRT PCR, gene expression analysis. Mutagenesis and generation of novel microbial strains. Sequencing DNA; Computer analysis of protein and DNA sequences.                                                                                                                                                                                                                                                                                     |                                       |                         |                      |
| <b>Teaching/ Learning Methods:</b> Two 6 h laboratory classes per week for 5 Weeks, pre-lab quizzes and assignments, homework assignments and lab reports.                                                                                                                                                                                                                                                                                                                                                                                           |                                       |                         |                      |
| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                       |                         |                      |
| Continuous assessment and end of semester examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |                         |                      |
| Continuous Assessment<br>30%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       | Final Assessment<br>70% |                      |
| Details: -<br>Quizzes/ assignments/ lab reports 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Theory<br>-                           | Practical<br>70         | Other<br>-           |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                       |                         |                      |
| <ol style="list-style-type: none"> <li>1. Jayathilaka, N., Advanced Molecular Biology Laboratory Manual (BIOC 43822)</li> <li>2. Green, H., and Sambrook, J., (2012), <i>Molecular Cloning, A Laboratory Manual</i>, Cold Spring Harbor Laboratory Press.</li> </ol>                                                                                                                                                                                                                                                                                 |                                       |                         |                      |

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| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                 | 1 or 2                            |                       |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                              | BIOC 44761                        |                       |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                              | Industrial/ Professional Training |                       |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                             | 1                                 |                       |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                     | Compulsory                        |                       |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                           | -                                 |                       |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                            | -                                 |                       |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                         | Theory                            | Practical             | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                 | -                     | 50                   |
| <b>Course Aim/ Intended Learning Outcomes:</b><br>Upon successful completion of this course unit, the student should be able to, <ul style="list-style-type: none"> <li>• use laboratory skills in industrial applications</li> <li>• develop creative thinking</li> <li>• develop skills needed to work in an industry</li> <li>• use good record keeping and data management practices in industry</li> </ul> |                                   |                       |                      |
| <b>Course Content:</b><br>An industrial training on application of principles of the biochemistry at a biochemistry resource based industry or institution that carryout biochemistry related work/research to improve their laboratory and generic skills (record keeping and report writing).                                                                                                                 |                                   |                       |                      |
| <b>Teaching/ Learning Methods:</b> Training under the supervisor and guidance of academic staff and relevant industry for ten weeks                                                                                                                                                                                                                                                                             |                                   |                       |                      |
| <b>Assessment Strategy:</b><br>Evaluation of the progress report submitted by the trainee. Percentage given for each subcomponent indicates the percent contribution to the final marks                                                                                                                                                                                                                         |                                   |                       |                      |
| Continuous Assessment<br>100%                                                                                                                                                                                                                                                                                                                                                                                   |                                   | Final Assessment<br>- |                      |
| Details: -<br>Reports 100                                                                                                                                                                                                                                                                                                                                                                                       | Theory<br>-                       | Practical<br>-        | Other<br>-           |
| <b>Recommended Reading:</b><br>1. Research papers, review articles, textbooks related to the work carried out in the industry/ research institute.                                                                                                                                                                                                                                                              |                                   |                       |                      |

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| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 or 2                   |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | BIOC 44771               |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Scientific Communication |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1                        |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Compulsory               |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                        |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                        |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Theory                   | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                          | -         | 50                   |
| <b>Course Aim/ Intended Learning Outcomes:</b><br><p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>• use communication skills for dissemination of knowledge to scientific and general audiences</li> <li>• inform, educate, share, and raise awareness of science-related topics using effective speaking and writing skills for science outreach and inreach</li> <li>• develop knowledge and presentation skills in delivering a scientific seminar on a selected topic</li> </ul>                                                                                                                                                                                                                                                                                                                                                   |                          |           |                      |
| <b>Course Content:</b><br><b>Public Speaking (15 h)</b><br><p>Effective speaking; search, select and gather information on a given topic, communicating complex material (prepare a suitable presentation and do an oral presentation to an audience of academics), visualizing science (visual aids), talking science, storytelling, communicating science to policymakers, communicating controversy, communicating to the media.</p> <b>Scientific Writing (15 h)</b><br><p>Reading research articles; critical reading. Persuasive writing; punctuation, paragraphs, logic, organization, clarity, language features. Writing research articles/ grant proposal/ thesis; structure of a research article (abstract writing, introduction, methodology, results, discussion, conclusion), structure of a grant proposal (objectives and hypothesis), referencing and ethics in writing. Poster presentation.</p> |                          |           |                      |
| <b>Teaching/ Learning Methods:</b> Writing assignments, literature survey, self-study, small group discussion on a research article selected by an academic staff member, feedback from appointed academic staff member.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                          |           |                      |

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| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                       |                       |                |            |
| Continuous assessment and end of semester examination.                                                                                                                                                                                                                            |                       |                |            |
| Continuous Assessment<br>100%                                                                                                                                                                                                                                                     | Final Assessment<br>- |                |            |
| Details: -<br>Assignments 100                                                                                                                                                                                                                                                     | Theory<br>-           | Practical<br>- | Other<br>- |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                       |                       |                |            |
| 3. An article on a selected topic, identified by a senior academic staff member and other related literature.<br>4. Matthews, J. R., and Bowen, J. M., (2007), <i>Successful Scientific Writing: A Step-by-Step Guide for Biomedical Scientists</i> , Cambridge University Press. |                       |                |            |

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| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 or 2                         |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | BIOC 44783                     |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Programming for Bioinformatics |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3                              |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Compulsory                     |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                              |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                              |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Theory                         | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 45                             | -         | 105                  |
| <b>Course Aim/ Intended Learning Outcomes:</b><br><br>Upon successful completion of this course unit, the student should be able to, <ul style="list-style-type: none"> <li>• use basic programming for bioinformatic data analysis.</li> <li>• apply computational analysis of molecular sequences to discover new knowledge about biological systems.</li> <li>• develop practical skills in how to write scripts to analyze data.</li> <li>• write python scripts to process biological data.</li> <li>• analyze different data types including high-throughput sequencing data by using R</li> <li>• develop practical knowledge about the syntax and structure of Perl language</li> <li>• prepare Bioperl modules for designing tools related to biological data handling</li> </ul>                                                                                                                                                                                                                                                                                                                                                                         |                                |           |                      |
| <b>Course Content:</b><br><br><b>Basic Programming for Biological Data Analysis (45 h)</b><br><br>Introduction to programming. Introduction to Python programming; variables, conditionals, loops, data structures, functions, modules. Writing and executing Python scripts. BioPython, Applications of BioPython: transcriptomics, proteomics, metabolomics, molecular phylogenetics. Introduction to R; data Manipulation in R with dplyr, data visualization with ggplot2, reporting with RMarkdown. Applications of R in biological data analysis; simple sequence analysis, annotating gene groups next-generation sequencing, introduction and genomic applications transcriptomics, gene expression microarrays and qrt-pcr, next-generation sequencing in transcriptomics, RNA-seq experiments. Introduction to perl. The concept of Perl Strings and their types, scalar variables. Arrays, how to extract information from both types of Arrays, Hash Array, Perl Functions, File Handling, Using Hashes for the Genetic Code, Gene Expression Data Using Hashes. Bioperl, Uses of Bioperl modules for sequence manipulation, accessing local database. |                                |           |                      |
| <b>Teaching/ Learning Methods:</b> A combination of lectures, Computer laboratories, tutorial discussions, and problem-based learning (supporting materials will be provided via CAL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                |           |                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |           |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------|-------|
| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |           |       |
| Continuous assessment and end of semester examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |           |       |
| Continuous Assessment<br>20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Final Assessment<br>80% |           |       |
| Details: -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Theory                  | Practical | Other |
| Quizzes/ assignments 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 80                      | -         | -     |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |           |       |
| <ol style="list-style-type: none"> <li>1. Model, M. L., (2009), <i>Bioinformatics Programming Using Python: Practical Programming for Biological Data</i>, O'Reilly.</li> <li>2. Hartvigsen, G., (2014), <i>A Primer in Biological Data Analysis and Visualization Using, R</i>, Columbia University Press.</li> <li>3. Ortutay and Ortutay., (2016), <i>Molecular Data Analysis Using R</i>, John Wiley &amp; Sons, Inc.</li> <li>4. Tisdall, J., (2001), <i>Beginning Perl for Bioinformatics</i>, O'Reilly.</li> </ol> |                         |           |       |

### University Level 4

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                               |           |                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------|----------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 or 2                                        |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | BIOC 44794                                    |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Medicinal Chemistry and Clinical Biochemistry |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4                                             |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Compulsory                                    |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -                                             |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                             |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory                                        | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 60                                            | -         | 140                  |
| <b>Course Aim/ Intended Learning Outcomes:</b><br><p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>• demonstrate stages and techniques used in drug development</li> <li>• analyze the mechanisms of drug action</li> <li>• characterize modes of drug absorption, distribution and metabolism</li> <li>• hypothesize strategies to improve activity and reduce side effects of drugs</li> <li>• appraise the use of Biotechnology in drug development and production.</li> <li>• evaluate biochemical indicators and their importance in clinical diagnostics</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                               |           |                      |
| <b>Course Content:</b><br><b>Medicinal Chemistry (30 h)</b><br><p>Mechanisms of drug action; drug action at enzymes, receptors, nucleic acids and lipids. Drug development; high throughput screening of natural products, isolation, purification and structure determination. Lead compounds and lead optimization through synthetic analogs. Structure activity relationships (SAR) and quantitative structure activity relationships (QSAR) Strategies to improve activity and reduce side effects of drugs using SAR. Receptor theories and target based rational drug design. Drug distribution; chemical and metabolic stability. Drug design to overcome pharmacokinetic problems. Synergism. Drug targeting and drug delivery systems. Drug metabolism; drug biotransformation and generation of active/inactive metabolites. Molecular biology/ Biotechnology in drug discovery and production. Preclinical and clinical trials. Regulation, patenting and ethics in drug development and marketing. Development of selected drugs to demonstrate application of principles.</p> <b>Clinical Biochemistry (15 h)</b><br><p>Concept of evidence-based medicine. Pathogenesis of selected diseases and fluctuations of biomarkers during disease. Quantification of these biomarkers in body fluids. Reproductive disorders, disorders of pregnancy and detection of markers in those disorders. Inborn errors of metabolism and screening of newborn. Detection of drugs of abuse, toxic metals, and other selected substances in body fluids. Automation and information handling in clinical laboratories. Collection, preservation, transport and handling of biological samples.</p> |                                               |           |                      |

**Toxicology (15 h)**

Toxic substances; major toxic reactions to common drugs, dose-response curves, protective index, optimal biological dose, maximum tolerated dose, observed adverse effect level (NOAEL), and lowest observed adverse effect level (LOAEL). Risk factors for drug toxicity; drug toxicity risk assessment/safety evaluation, animal models as predictors of human toxicity, adverse drug reactions & individual sensitivity to drugs, role of metabolism in drug adverse effects. Drug overdose. Tolerance. Addiction. Dependence. Idiosyncrasy.

**Teaching/ Learning Methods:** A combination of lectures, tutorial discussions and problem-based learning (supporting materials will be provided via CAL)

**Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment<br>20%          | Final Assessment<br>80% |                |            |
|---------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20 | Theory<br>80            | Practical<br>- | Other<br>- |

**Recommended Reading:**

1. Patrick, G. L., (2017), *An Introduction to Medicinal Chemistry*, Oxford University Press.
2. Burtis, C., Bruns, B., (2007), *Tietz Textbook of Fundamentals of Clinical Chemistry*, Elsevier.

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------|----------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1 or 2                                |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | BIOC 44803                            |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Bioinformatics and Molecular Modeling |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3                                     |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Compulsory                            |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -                                     |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -                                     |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Theory                                | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 45                                    | -         | 105                  |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |           |                      |
| Upon successful completion of this course unit, the student should be able to,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |           |                      |
| <ul style="list-style-type: none"> <li>• describe the importance of biomolecular modeling in designing novel drugs in pharmaceutical research</li> <li>• explore the possibilities of performing computer simulations to manipulate, and optimize 3D models of biomolecules using various software in a laboratory environment</li> <li>• analyze biological sequences to identify functional, structural, or evolutionary relationships</li> <li>• generate new knowledge about biological systems through sequence analysis with the use of different bioinformatics tools</li> </ul>                                                                                                                                                                      |                                       |           |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                       |           |                      |
| <b>Bioinformatics (25 h)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |           |                      |
| Scope of bioinformatics: data acquisition, file formats, primary, secondary and composite biological databases, and biological data retrieval system. Bioinformatics resource portals and software tools. DNA and protein sequence alignment; global and local sequence alignment by dynamic programming, measure of similarity, simple scoring schemes, gap penalties, and substitution scoring matrices. Pair-wise sequence alignment by DOT Matrix and by Heuristic methods (BLAST tools for database searching). Multiple sequence alignment tools, DNA sequence assembly, genome annotation (structural & functional), and genome browsers. Comparative genomics and pharmacogenomics. Integrative protein analysis and molecular interaction networks. |                                       |           |                      |
| <b>Molecular Modeling (20 h)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                       |           |                      |
| Concept of molecular modeling; force field models, energy landscapes and minimization methods, computer simulation methods, molecular dynamics simulation methods, Monte Carlo simulation. Protein structure prediction; sequence analysis and protein folding, protein secondary structure prediction and 3D structure modeling, protein 3D structure visualization, conformational analysis. 3D structure alignment, protein- protein and protein-ligand docking free energy calculations through simulations. Pharmacoinformatics to discover and design new drugs.                                                                                                                                                                                       |                                       |           |                      |
| <b>Teaching/ Learning Methods:</b> A combination of lectures, tutorial discussions and problem-based learning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |           |                      |

|                                                                                                                                                                                                                                                                |                         |                |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|------------|
| <b>Assessment Strategy:</b><br>Continuous assessment and end of semester examination.                                                                                                                                                                          |                         |                |            |
| Continuous Assessment<br>20%                                                                                                                                                                                                                                   | Final Assessment<br>80% |                |            |
| Details: -<br>Quizzes/ assignments 20                                                                                                                                                                                                                          | Theory<br>80            | Practical<br>- | Other<br>- |
| <b>Recommended Reading:</b><br>1. Mount, D. W., and Mount, D., (2004), <i>Bioinformatics, Sequence and Genome Analysis</i> , Cold Spring Harbor Laboratory.<br>2. Leach, A. R., (2009), <i>Molecular Modeling Principles and Applications</i> , Prentice Hall. |                         |                |            |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------|--------------------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1 and 2                        |                  |                                |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | BIOC 43818                     |                  |                                |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Research Project/ Dissertation |                  |                                |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 8                              |                  |                                |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Compulsory                     |                  |                                |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -                              |                  |                                |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -                              |                  |                                |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Theory                         | Practical        | Independent Learning           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -                              | 360              | 40                             |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                |                  |                                |
| <p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>● demonstrate skills to plan and carryout a research project on a Biochemistry related topic, following the scientific process</li> <li>● accumulate experimental data</li> <li>● analyze experimental data</li> <li>● interpret experimental data</li> <li>● arrange the results in a scientific manner</li> <li>● present and defend research findings to the scientific community by a seminar.</li> </ul> |                                |                  |                                |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                |                  |                                |
| A research project in biochemical science or in a related area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                |                  |                                |
| <b>Teaching/ Learning Methods:</b> Literature survey, laboratory and/ or field work, data analysis and interpretation, dissertation, presentations.                                                                                                                                                                                                                                                                                                                                                                                        |                                |                  |                                |
| <b>Assessment Strategy:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                |                  |                                |
| Continuous assessments; dissertation, progress reports, presentations, <i>viva - voce</i> examination. Percentage given for each subcomponent indicates the percent contribution to the final marks.                                                                                                                                                                                                                                                                                                                                       |                                |                  |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                | Final Assessment |                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                | 50%              |                                |
| Details: -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Evaluation by Mentor           | Thesis           | <i>viva – voce</i> examination |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 50%                            | 30               | 20                             |
| <b>Recommended Reading:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                |                  |                                |
| <ol style="list-style-type: none"> <li>1. Research abstracts, research papers, review articles and textbooks related to the research carried out.</li> <li>2. Publication Manual of the American Psychological Association. Washington, DC</li> </ol>                                                                                                                                                                                                                                                                                      |                                |                  |                                |

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| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 or 2                            |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | BIOC 44824                        |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Food and Nutritional Biochemistry |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4                                 |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Compulsory                        |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -                                 |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                 |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory                            | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 60                                | -         | 140                  |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |           |                      |
| <p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>• describe the structure and physiochemical properties of major food components and their use in the food industry</li> <li>• examine biochemical changes occurring in raw foods</li> <li>• characterize effects of processing on food colors, flavors, odors and nutritional quality</li> <li>• examine technology behind processing of food products</li> <li>• evaluate impact of diet and nutrition on human health</li> </ul>                                                                                                                                                                                                                                                   |                                   |           |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |           |                      |
| <b>Food Chemistry (30 h)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |           |                      |
| <p>Food carbohydrates, lipids and protein, their structure, occurrence, physiochemical properties, and application in food industry. Biochemical changes in raw foods; meat, fish, fruit, vegetables, cereal and milk etc. Biochemistry of food spoilage; browning, rancidity, staling etc. Food additives; preservatives, antimicrobials, sweeteners and others. Food colors; natural and artificial food colors, effect of processing on food colors. Flavors and odor; chemical basis of taste, sweet, salty, bitter and sour compounds, flavor enhancement, odor and molecular structure, olfaction, flavors and odors in common foods, effect of food processing on flavors and odors. Food contaminants; natural toxicants, allergens, man-made pollutants, undesirable by products of food processing.</p> |                                   |           |                      |
| <b>Food Technology (15 h)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                   |           |                      |
| <p>Biochemistry and technology behind the processing of dairy products, fats and oil products, nonalcoholic beverages, confectioneries. Effect of food processing on nutritional quality. Food packaging. Food safety, legislation and regulation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |           |                      |
| <b>Nutrition (15 h)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |           |                      |
| <p>Food nutrients; Digestion of carbohydrates, proteins, and lipids and absorption. Energy values of foods and energy expenditure by mammals; Nutritive value of foods – carbohydrates, fats, proteins, vitamins,</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                   |           |                      |

mineral elements, and water. Nutritional status and nutritional requirement; Dietary allowances, nutritional requirements in relation to physical activity and ageing. Nutritional disorders, prevention and therapy; diet and disease, obesity and under nutrition.

**Teaching/ Learning Methods:** A combination of lectures, tutorial discussions and problem-based learning (supporting materials will be provided via CAL)

**Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment<br>20%          | Final Assessment<br>80% |                |            |
|---------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20 | Theory<br>80            | Practical<br>- | Other<br>- |

**Recommended Reading:**

1. Coultate, T. P., (2016), *Food the Chemistry of Its Components*, Royal Society of Chemistry.
2. Wickramanayake, T.W., (1996), *Food and Nutrition*, Hector Kobbakaduwa Agarian Research Publishers.

|                             |                                             |           |                      |
|-----------------------------|---------------------------------------------|-----------|----------------------|
| <b>Semester</b>             | 1 or 2                                      |           |                      |
| <b>Course Code</b>          | BIOC 44833                                  |           |                      |
| <b>Course Name</b>          | Molecular Markers and Transgenic Technology |           |                      |
| <b>Credit Value</b>         | 3                                           |           |                      |
| <b>Compulsory/ Optional</b> | Compulsory                                  |           |                      |
| <b>Pre-requisites</b>       | -                                           |           |                      |
| <b>Co-requisites</b>        | -                                           |           |                      |
| <b>Hourly Breakdown</b>     | Theory                                      | Practical | Independent Learning |
|                             | 45                                          | -         | 105                  |

**Course Aim/ Intended Learning Outcomes:**

Upon successful completion of this course unit, the student should be able to,

- demonstrate theoretical basis of various molecular marker systems and apply systems for crop, livestock improvement and diagnostics
- analyze scientific principles and methodologies underlying transgenic technology and apply methods in basic research
- evaluate advantages, disadvantages, ethical issues, potential biosafety risks associated with GMOs and GMFs.
- appraise gene silencing strategies to study gene function, and to block expression
- examine the general theoretical backgrounds of cell, tissue and organ culture of plants and animals
- evaluate the value of tissue culture techniques for crop improvement, and germplasm conservation.

**Course Content:**

**Molecular Markers (15 h)**

Mapping strategies, recombinant inbredlines, bulk segregant analysis, near isogenic lines, mapping disease resistance genes, mapping QTL, mapping human disease genes; Applications of genetic and physical maps, linkage mapping; Marker assisted selection in breeding; Use of DNA markers in plant and animal authentication and genetic diversity studies; Use of various DNA and protein markers in diseases diagnosis; Human DNA fingerprinting in forensics, CODIS, statistical analysis of DNA profile data and quality control, legal and ethical considerations.

**Transgenic Technology (20 h)**

Design of gene transfer cassettes; Use of selectable markers and reporter genes, Direct and indirect transformation techniques; Choice of expression system; Integration and inheritance of the transgene, analysis and confirmation of the integration, control of transgene expression, problems and limitations with gene transfer, integration, and expression; animal bioreactors and molecular pharming; Transgenic breeding strategies; Safety regulations for transgenics; Ethical issues related to GMOs and GMFs, consumer acceptance, IPR in biotechnology. Gene knockdown; transient and stable gene knockdown

(RNA inference and antisense RNA technology), verification of gene knockdown. RNA delivery methods (lipid-based transfection, nucleofection and viral vectors). Genome editing (ZFN, TALEN, CRISPR-Cas9) and applications. Knockout mice (gain of function vs. loss of function mutations), generation of knockouts (homologous recombination), conditional knockouts (Cre-loxP and Flp recombinase system), and gene knock-in. Animal models of human disease.

### **Tissue Culture (10 h)**

Callus and suspension culture techniques; Invitro-regeneration pathways, organogenesis, and somatic embryogenesis; Somaclonal variation; Micropropagation methods, advantages of clonal propagation; Virus free plants; Germplasm conservation, improved methods for cryopreservation; Animal cell, organ and embryo culture techniques; Importance of stem cells, tissue transplantation, xenotransplantation.

**Teaching/ Learning Methods:** A combination of lectures, tutorial discussions and problem based learning (supporting materials will be provided via CAL)

### **Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment<br>20%          | Final Assessment<br>80% |                |            |
|---------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20 | Theory<br>80            | Practical<br>- | Other<br>- |

### **Recommended Reading:**

1. Channarayappa., (2006), *Molecular Biotechnology, Principles and Practice*, Universities Press.
2. Dubey, R. C., (2006), *A Textbook of Biotechnology*, S. Chand& Company Ltd.
3. Kumar, H. D., (2000), *Modern Concepts of Biotechnology*, Vikas Publishing.
4. Primrose, S. B., (1987), *Modern Biotechnology*, Blackwell Publishing.
5. Smith, J. E., (2004), *Biotechnology*, Cambridge University Press.
6. Street, H. E., (1974), *Tissue Culture and Plant Science*, Academic Press.

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|----------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1 or 2                 |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | BIOC 44844             |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bioprocess Engineering |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4                      |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Compulsory             |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                      |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                      |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Theory                 | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 60                     | -         | 140                  |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |           |                      |
| <p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>● apply bioreactor engineering principles to achieve optimal bioreactor design</li> <li>● assess the production of biochemical products using integrated biochemical processes</li> <li>● analyze metabolic networks and metabolic flux</li> <li>● predict important yield coefficients using the principles of stoichiometry and energetics of microbial growth</li> <li>● strategize reliable methods for scaling-up bioprocesses</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        |           |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |           |                      |
| <p>Concept of bioprocess technology, Major microbial metabolic pathways, metabolic networks, and flux analysis. Bioreactor design, operation, and control, various reactor types, body construction, aeration, agitators and flow patterns, valves and steam traps. Immobilized enzyme reactor systems. Bioreactor sterilization: concept and methods of sterilization, and estimation of sterilizer efficiency. Requirement for control, nature of control strategies, manual control systems and role of sensors, design of a fermentation control system. Physical, chemical and biological environment of bioreactor, oxygen requirements in industrial fermentations, determination of K<sub>La</sub>, Fluid rheology, balance between oxygen supply and demand.</p> <p>Maintenance energy and growth energetics of aerobic and anaerobic processes, mass balance, energy balance, and redox balance in bioreactors. Methods for the determination of mass transfer coefficients, fermentation optimization. Thermodynamics in bioreactors. Dynamical modeling of fermentation systems and scale up and scale down.</p> <p>Batch, fed batch and continuous operation of bioreactors. Media design and optimization. Microbial growth patterns and kinetics, quantitative analysis of microbial growth by direct and indirect methods, substrate utilization and product formation in bioreactors. Yield coefficients, downstream processing and product recovery. Bioprocess methodologies for animal, mammalian and plant cells, utilization of GMOs in bioprocessing, benefits and potential hazards. Quality control and quality assurance in bioprocess.</p> |                        |           |                      |

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|------------|
| <b>Teaching/ Learning Methods:</b> A combination of lectures, tutorial discussions and problem based learning.                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                |            |
| <b>Assessment Strategy:</b><br>Continuous assessment and end of semester examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                |            |
| Continuous Assessment<br>20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Final Assessment<br>80% |                |            |
| Details: -<br>Quizzes/ assignments 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Theory<br>80            | Practical<br>- | Other<br>- |
| <b>Recommended Reading:</b><br>1. Doran, P. M., (1995), <i>Bioprocess Engineering Principles</i> , Academic Press.<br>2. Stanbury, P. F., and Whitaker, A., (2016), <i>Principles of Fermentation Technology</i> , Elsevier.<br>3. Moser, A., (1981), <i>Bioprocess Technology – Kinetics &amp; Reactors</i> , Springer-Verlag.<br>4. Mukopadhyay, S. N., and Learning, M. V., (2019), <i>Process Biotechnology Fundamentals</i> , MV Learning.<br>5. Kargi, S., and DeLisa, M., (2017), <i>Bioprocess Engineering: Basic Concepts</i> , Pearson. |                         |                |            |

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| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1 or 2                                                          |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | BIOC 44853                                                      |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Biochemical Engineering and Management Concepts in Biochemistry |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3                                                               |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Compulsory                                                      |           |                      |
| <b>Pre-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -                                                               |           |                      |
| <b>Co-requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -                                                               |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Theory                                                          | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 45                                                              | -         | 105                  |
| <b>Course Aim/ Intended Learning Outcomes:</b><br><br>Upon successful completion of this course unit, the student should be able to, <ul style="list-style-type: none"> <li>• explain and analyze different quality management frameworks</li> <li>• aware of available techniques, software and web-resources for cheminformatics.</li> <li>• demonstrate and apply the knowledge of chemical engineering concepts and management systems in industrial chemistry</li> <li>• demonstrate and apply the knowledge of chemical engineering concepts and management systems in industrial chemistry</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                 |           |                      |
| <b>Course Content:</b><br><br><b>Quality and Laboratory Management (20 h)</b><br><br>Introduction: Importance of quality in the management process. Concepts of quality management. Quality dimensions of goods and services. Quality management evolution and works of quality founders. Quality policy and quality organizations: International quality organizations. International, regional and national standardization. System of assessment of quality conformity. Management systems and quality management principles for excellence: Quality management systems. Quality control methods. Quality audit and certification of management systems. Sustainable development. Environment management systems. Occupational health and safety management system. Total quality management. Statutory regulations governing health and safety, laboratory design and accreditation, biohazard monitoring and waste minimization and chemical disposal. ISO/IEC 17025:2017<br><br><b>Introduction to Cheminformatics (5 h)</b><br><br>History and evolution of Cheminformatics, Chemical representation, Sequence, 2D, 3D structure, Types of chemical representation<br>Biochemical databases, combinatorial chemistry, combinatorial library design, Application of cheminformatics. |                                                                 |           |                      |

**Fundamentals of Biochemical and Process Engineering (20 h)**

Advanced techniques in biochemical and process engineering.

Unit operations: Mixing, drying, adsorption, separation, filtration, distillation etc.

Process flow sheeting: Types of flow diagrams.

Material and energy balances: Non-reacting and reacting systems with single and multiple reactions.

Reduction and enlargement: Size separation, processes and equipment for size reduction and enlargement.  
Introduction to fluid mechanics.

Heat transfer: Modes of heat transfer and calculations.

Mass transfer: Calculations and different mass transfer operations.

**Teaching/ Learning Methods:** A combination of lectures and tutorials (supporting materials will be provided via CAL)

**Assessment Strategy:**

Continuous assessment and end of semester examination.

| Continuous Assessment<br>20%          | Final Assessment<br>80% |                |            |
|---------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20 | Theory<br>80            | Practical<br>- | Other<br>- |

**Recommended Reading:**

1. Dale, B. G. (2003) *Managing Quality*. Oxford: Blackwell Publishing.
2. Goetsch D. L., Davis S. B. (2003) *Quality Management. Introduction to TQM for Production, Processing and Services*. New Jersey: Prentice Hall.
3. Harmening D.M., (2020) *Laboratory Management: Principles and Processes*. Prentice Hall.
4. Andrew R. Leach & Valerie J.Gillet, (2007) *An Introduction to Cheminformatics*, Springer Publication.
5. Reklaitis G. V., (1983) *Introduction to Material and Energy Balances*, Wiley Publication.
6. Simons S. J. R., (2019) *Concepts of Chemical Engineering for Chemists*, RSC publishing.
7. Cengel Y., Ghajar A., J., (2019) *Heat and Mass Transfer: Fundamentals and Applications*, Mc Grow Hill Publications.
8. Richardson, J.F., Harker, J.H., Backhurst, J.R., (2019) *Coulson and Richardson's Chemical Engineering Volume 2*, Elsevier Publications.

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|----------------------|
| <b>Semester</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 or 2                             |           |                      |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BIOC 44862                         |           |                      |
| <b>Course Name</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Applied Environmental Biochemistry |           |                      |
| <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                                  |           |                      |
| <b>Compulsory/ Optional</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Compulsory                         |           |                      |
| <b>Pre- requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                  |           |                      |
| <b>Co- requisites</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -                                  |           |                      |
| <b>Hourly Breakdown</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Theory                             | Practical | Independent Learning |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 30                                 | -         | 70                   |
| <b>Course Aim/ Intended Learning Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                    |           |                      |
| <p>Upon successful completion of this course unit, the student should be able to,</p> <ul style="list-style-type: none"> <li>• identify and recognize sources, reactions and fate of chemical pollutants in the environment and demonstrate skills of regulating such pollutants</li> <li>• explain the importance of waste minimization and cleaner production</li> <li>• describe the chemical interactions between organisms in an ecosystem</li> <li>• demonstrate skills in detecting and making use of such interactions in pest management strategies</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                 |                                    |           |                      |
| <b>Course Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    |           |                      |
| <p><b>Chemical Ecology (10 h)</b><br/> Chemical interactions in eco-systems; semiochemicals and their classification. Inter species communications; pheromones, intra species communications. Allelochemicals; host –plant compounds, plant and animal defense compounds. Stereochemistry-bioactivity relationship; methodologies in chemical ecology, isolation of volatiles, electrophysiological assay, detection of biological activity, GC-EAD and GC-MS, semiochemicals as a pest control agent.</p> <p><b>Waste Management (10 h)</b><br/> Nature, sources and classification of waste. Reduction, biochemical methods of treatment and disposal of waste. Waste minimization and cleaner production</p> <p><b>Impact of Agrochemicals in the Environment (10 h)</b><br/> Classification, toxicity, mode of action, synthesis, bio pesticides, fate of pesticides in the environment, pesticide risk assessments, best management practices.</p> |                                    |           |                      |
| <b>Teaching/ Learning Methods:</b> A combination of lectures and tutorials (supporting materials will be provided via CAL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |           |                      |
| <p><b>Assessment Strategy:</b><br/> Continuous assessment and end of semester examination.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                    |           |                      |

| Continuous Assessment<br>20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Final Assessment<br>80% |                |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|------------|
| Details: -<br>Quizzes/ assignments 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Theory<br>80            | Practical<br>- | Other<br>- |
| <b>Recommended Reading:</b> <ol style="list-style-type: none"> <li>1. Wright D.A., Welbourn P. (2002). <i>Environmental Toxicology</i>, Cambridge.</li> <li>2. Amdar O.M., Doull J., Kalssen C. D. (1992). <i>Toxicology; The Basic Science of Poisoning</i>, McGraw-Hill.</li> <li>3. Hassal, K. A., (1990) <i>The Biochemistry and Uses of Pesticides</i>, Macmillian.</li> <li>4. Green, M. B., Hartley, G. S., West, T. F., (1987) <i>Chemicals for Crop Improvement and Pest Management</i>, Pregaman.</li> <li>5. Copping, L. G., Hewitt, H. G., (1998) <i>Chemistry and Mode of Action of Crop Protection Agents</i>, RCS.</li> </ol> |                         |                |            |