Department of Biochemistry
SHIVAJI UNIVERSITY, KOLHAPUR
A course under Choice Based Credit System (CBCS)
(following points (minimum) should be covered while designing CBCS course)

- Course code : (to be allotted by the system)
- Title of the course: **Fermentation Technology-I**
- Department at which course will be conducted: Department of Biochemistry
- Duration: 16 weeks.
- Contact session: Theory **4** hours per week.
- Credits: 4 credits
  (1 credit for 15 theory hrs and 1 credit for 12 practical hrs per week)
- Course Coordinator or/Instructor: Dr. P. M. Gurao
- Eligibility: (Prerequisite: LS 141, TB 241, GE 341)
- Intake: Min.: 20 Max.: 60
- Course offered during : Odd semester
- Course Fee: Rs. 2,500/-
- Course contents: Unit 1/Unit 2/Unit 3/Unit 4
- Examination: (methods & details): **Internal Exam.:** 20 Marks; **External Exam.**:80 Marks
- Text books/Reference Books:

Suggested Readings :

1) Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y.
2) Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2nd ed. Cambridge Univ Press Cambridge.
3) Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of Fermentation Technology 2 nd ed.Aditya Books Pvt. Ltd, N.Delhi.
4) Mukhopadhaya S.N. (2001) Process Biotechnology Fundamentals.Viva Books Pvt. Ltd. N.Delhi.
5) Rehm H.J and Reed G. (1985) Biotechnology vol. I & II. VCH, Basel.
6) Stainer R. Y. Ingrahm J. L., Wheelis M. L. and Painter P. R. (1987) General Microbiology 5th Edition, Macmillan Press Ltd. London.

- Any other information if any: This is an optional paper for M.Sc. Biochemistry course whereas credit based choice course (CBCS) for other department students.

FT 341: Fermentation Technology-I (60)
(Prerequisite: LS 141, TB 241, GE 341)

UNIT I (15)

Upstream Processing

Microbial cell growth, kinetics and Stoichiometry, various Methods for growth measurement, Strain improvement by mutation, genetic engineering, etc. Overproduction of metabolites, alternative carbon and nitrogen sources and their composition. Development of innocula for industrial fermentation, design of industrial production media. Alternate metabolic routines for utilization of carbon sources with their regulation and inter-linkage especially for glucose and hydrocarbons, preservation and maintenance of microbes.

UNIT II (15)

Fermentation

Design of fermenter, construction materials, various sterilization techniques for solid, liquid and gases, aeration and agitation, foam, auxillary equipments. Control of various parameters – online and offline monitoring, rheological properties of fermenter, role of computer in fementer operation,

UNIT III (15)

Batch, fed-batch and continuous fermentation.

Effluent treatment, scale up and scale down. Types of fermenters, solid state fermentation, process economics, fermentation economics.

UNIT IV (15)

Downstream Processing

Principle, methodology, instrumentation an applications of cell homogenization techniques liquid-liquid extraction centrifugation, filtration, , distillation, ultrafiltration, precipitation, adsorption chromatography, ion exchange chromatography, gel filtration and affinity chromatography in clarification, concentration, isolation and purification of various metabolites from fermented media

Suggested Readings :

7) Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y.
8) Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2nd ed. Cambridge Univ Press Cambridge.
9) Old R.W and Primose S.D (1995) Principles of Gene Manipulation 5th ed. Blackwell Scientific Pub. Oxford.
10) Bailey J.E and Ollis D.F. (1986) Biochemical Engineering Fundamentals 2nd ed. McGraw Hill Book Company, N. Delhi.

11) Aiba S, Humphrey A. E. and N. F. Millis (1973) Biochemical Engineering, 2nd Edition University of Tokyo Press, Tokyo, Japan.
12) Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of Fermentation Technology 2 nd ed.Aditya Books Pvt. Ltd, N.Delhi.
13) Mukhopadhaya S.N. (2001) Process Biotechnology Fundamentals.Viva Books Pvt. Ltd. N.Delhi.
14) Rehm H.J and Reed G. (1985) Biotechnology vol. I & II. VCH, Basel.
15) Stainer R. Y. Ingrahm J. L., Wheelis M. L. and Painter P. R. (1987) General Microbiology 5th Edition, Macmillan Press Ltd. London

Department of Biochemistry
SHIVAJI UNIVERSITY, KOLHAPUR
A course under Choice Based Credit System (CBCS)
(following points (minimum) should be covered while designing CBCS course)

- Course code : (to be allotted by the system)
- Title of the course: **Bioinformatics**
- Department at which course will be conducted: Department of Biochemistry
- Duration: 16 weeks.
- Contact session: Theory **4** hours per week.
- Credits: 4 credits
  (1 credit for 15 theory hrs and 1 credit for 12 practical hrs per week)
- Course Coordinator or/Instructor: Dr. K. D. Sonawane
- Eligibility: (Prerequisite: LS 141 BC 141, BC 142 BSI 141, BC 241 MB 241 GE 341 or M.Sc. Part I completed students of Botany/Zoology/Microbiology/Biotechnology students).
- Intake: Min.: 20 Max.: 60
- Course offered during : Even semester
- Course Fee: Rs. 2,500/-
- Course contents: Unit 1/Unit 2/Unit 3/Unit 4
- Examination:(methods & details): **Internal Exam.:** 20 Marks; **External Exam.**:80 Marks
- Text books/Reference Books:

Suggested Readings:

1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
2. An introduction to Computational Biochemistry. (C. Stain Tsai, A John Wiley and Sons, Inc., publications).
3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
4. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery.
(Rastogi S. C. Mendiratta, and Rastogi P.)
5. NCBI Web site: http://www.ncbi.nlm.nih.gov

Any other information if any: This is an optional paper for M.Sc. Biochemistry course whereas credit based choice course (CBCS) for other department students.

BI 441: Bioinformatics (60)

(Prerequisite: (Prerequisite: LS 141 BC 141 BSI 141 BC 241 MB 242 GE 341) or M.Sc. Part I completed students of other departments.

UNIT I (15)

PROTEOMICS: PROTEIN SEQUENCE DATABASES AND ANALYSIS:

Protein sequence information, composition and properties, physicochemical properties based on sequence, sequence comparison, Primary databases, Secondary databases. Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment. Useful programs, ClustalW, BLAST.

PROTEOMICS; STRUTURAL DATABASES, PROTEIN STRUCTURE PREDICTION:

Structural databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB). Homology modeling, prediction of protein structure from sequences, three-dimensional structure prediction, protein folding and functional sites, protein folding classes.

UNIT II (15)

GENOMICS: NUCLEOTIDE SEQUENCE DATABASES AND ANALYSIS:

Human Genome project; rough and final draft of HGP, goals of the HGP, Nucleotide sequence databases: GenBank, EMBL, DNA Data Bank of Japan (DDBJ). Recombinant DNA technology, restriction enzymes, resource for restriction enzyme (REBASE), Polymerase chain reaction, primer selection for PCR, applications of BioEdit.

GENOMICS: GENE IDENTIFICATION:

Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST), Sequence Tagged Sites (STS). Approach to gene identification; masking repetitive DNA, database search, codon-bias detection, detecting functional sites in the DNA.

UNIT III (15)

STRUCTURAL BIOLOGY:

Nucleic acids, ribose-ring puckering, conformational study, Ramachandran plot, α-helix, β-sheets, 3_{10}-helix, protein-ligand interactions, biophysical aspects of proteins and nucleic acids.

MOLECULAR MODELING:

Introduction, functions of molecular modeling, molecular mechanics, force field, energy minimization and energy calculation methods, single point calculations, full-geometry

optimization, conformational search, docking, molecular dynamics simulations, molecular modeling packages.

UNIT IV **(15)**

MICROARRAYS:

Concept of microarrays; spotted arrays, oligonucleotide arrays, designing the experiment, Microarray design, microarray experimentation, Applications of microarray technology. Mass spectroscopy for protein analysis, MALDI-TOF, Electrospray ionization (ESI), tryptic digestion and peptide fingerprinting (PMF), profiling and diagnostics, drug target discovery.

PHYLOGENETIC ANALYSIS:

Evolution, elements of phylogeny, phylogenetic tree of life, methods of phylogenetic analysis, comparison of genetic sequence of organisms, phylogenetic analysis tools- Phylip, ClustalW.

Suggested Readings:

1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
2. An introduction to Computational Biochemistry. (C. Stain Tsai, A John Wiley and Sons, Inc., publications).
3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
4. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.)
5. NCBI Web site: http://www.ncbi.nlm.nih.gov

BIOCHEMISTRY
Syllabus for horizontal mobility under CBCS

STRUCTURE OF M. Sc. DEGREE COURSE FOR BIOCHEMISTRY/ BIOTECHNOLOGY/MICROBIOLOGY/ENVIRONMENTAL BIOTECHNOLOGY

Two years M. Sc. program is formulated for developing competent biochemists/biotechnologist/microbiologist for which significant job opportunities exist in this country. The course is based on interdisciplinary nature of Biochemistry, Chemistry, Quantitative Biology, Genetics, Microbiology, Bioinformatics and Biophysics. The program obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. This program gives common basic knowledge (Biochemistry, Enzymology, Molecular Biology, Research Methodology, Biostatistics, Computer science and Bioinformatics) at first year level to become good biochemists/biotechnologist/microbiologist. The specializations introduced in the course at second year level are in the disciplines of Immunochemistry, Neurochemistry, Clinical Biochemistry, Environmental Biochemistry and Toxicology, General Biotechnology, Plant Biotechnology, Microbiology Computational Biochemistry/Bioinformatics and Microbial Technology.

SEMESTER- I

LS 141: Cell Biochemistry
(Prerequisite: B. Sc. Life Science/Chemistry)
BC 141: Proteins – Structure and Functions
(Prerequisite: B. Sc. Life Science/Chemistry)
BC 142: Biomolecules
(Prerequisite: B. Sc. Life Science/Chemistry)
BSI 141: Biostatistics and Bioinformatics with Computer Orientation
(Prerequisite: B. Sc. Life Science/Chemistry)

LC BC 141: Laboratory Course I
(Prerequisite: B. Sc. Life Science)
LC BC 142: Laboratory Course II
(Prerequisite: B. Sc. Life Science)

600 marks

SEMESTER-II

BC 241: Enzymology
(Prerequisite: LS BC 141, BC 142)
MB 241: Molecular Biology
(Prerequisite: LS BC 141, BC 142)
BC 242: Bioenergetics

(Prerequisite: LS BC 141, BC 142)
TB 241: Tools and Techniques in Bioscience
(Prerequisite: LS BC 141, BC 142)

LC BC 241: Laboratory Course III
(Prerequisite: LC BC 141, LC BC 142)
LC BC 242: Laboratory Course IV
(Prerequisite: LC BC 141, LC BC 142)

600 marks

SEMESTER-III (BIOCHEMISTRY)

GE 341: Genetic Engineering
(Prerequisite: LS 141 MB 241)
IC 341: Immunochemistry
(Prerequisite: LC 141 BC 141)
BC 341: Biomembranes & Cytoskeleton
(Prerequisite: LC 141 BC 141, BC 142)
FT 341: Fermentation Technology-I
(Prerequisite: LS 141, TB 241, GE 341)
CB 341: Clinical Biochemistry – I
(Prerequisite: B. Sc. Life Science/Chemistry)
BET 341: Biochemical and Environmental Toxicology- I
(Prerequisite: LS 141 BC 141, BC 142)

LC BC 345: Laboratory Course V
(Prerequisite: LC BC 141, LC BC 142)
LC BC 346: Laboratory Course VI
(Prerequisite: LC BC 141, LC BC 142)

600 marks

SEMESTER-IV (BIOCHEMISTRY)

NC 441: Neurochemistry
(Prerequisite: B. Sc. Life Science/Chemistry)
CC 441: Carcinogenesis and Cell signaling
(Prerequisite: BC 142, MB 241)
MEB 441: Medical and Environmental Biochemistry
(Prerequisite: BC 141, BC 142)
BI 441: Bioinformatics
(Prerequisite: LS 141 BC 141 BSI 141 BC 241 MB 242 GE 341)
FT 441: Fermentation Technology– II
(Prerequisite: FT 341)
CB 442: Clinical Biochemistry – II
(Prerequisite: CB 341)
BET 442: Biochemical and Environmental Toxicology- II
(Prerequisite: BET 341)

LC BC 445: Laboratory Course VII
(Prerequisite: LC BC 345, LC BC 346)
LC BC 446: Laboratory Course VIII (Project Work)
(Prerequisite: LC BC 345, LC BC 346)

Work load for M. Sc I & II

M. Sc. (Each Semester)	Theory	Practicals
	16 hrs	16 hrs
Seminars	2 hrs	(for 1 batch)
Oral Exam	2 hrs	
	20 hrs	

Credit system and Cafeteria approach

Admission:
Intake capacity:
1. 25 students every year on the basis of entrance examination
2. 20 % students from other Universities.

Eligibility for Admission:
A) A candidate possessing B. Sc. Degree with minimum 50% marks with chemistry/ biochemistry/ microbiology/ botany/zoology/biotechnology/life sciences as principal subject with chemistry at B. Sc. I, and who have passed the entrance examination conducted by the Shivaji University shall be held eligible for admission to M. Sc. Course in Biochemistry. Students from other Universities with B. Sc. General Degree and who have passed the entrance examination conducted by the University are also eligible.

Course Work:
1. Student has to complete 96 credits
   Theory courses: 64 credits
   Practical/Project/ Seminar/ Scientific Paper Writing: 32 credits
   (Seminar: 1, Scientific Paper Writing: 1, Project at any University/ Industry/ Institution: 4, Practical course at the Department: 4 or 2)
2. Each Semester student can opt for 1 credit to 32 credits
3. There will be 2 semester in each year and course will be of 4 semesters.
4. Time course: 2 yrs minimum or as and when completes 96 credits.

Class capacity:
Theory: 60 students maximum/per class
Practical courses: 10 students/batch

Examination:

Theory Exam:

External marks: 80 per theory paper (examination at the end of semester)
Internal marks: 20 per theory paper (examination "objective type" to be conducted by respective teacher)

Practical Exam:

1. Continuous evaluation for 100 marks for each Practical courses by respective teacher. Senior teacher will be deputed for each course.
   (Experimental performance will be graded immediately after completion of experiment)

Project evaluation:

By Internal and External Examiner at the end of Fourth Semester (100 marks)

Core courses required for M. Sc. Degree in Biochemistry:

(Compulsory courses for M. Sc. Degree in Biochemistry: LS 141, BC 141, BC 142, BSI 141, BC 241, MB 241, BC 242, TB 241, GE 341, IC 341, BC 341, NC 441, CC 441, MEB 441)

(LS 141 represents: LS: Course name, 1: Semester, 4: credit allotted to the course, 1: Chronological order within that category)

Core Theory courses: 14 x 4 = 56 credits
Core Practical courses: 8 x 4 = 32 credits

Rest credits can be obtained by doing courses at different Departments of the University, or from any other University or within the department.

It is also suggested that every student undertake two hours library work under the supervision of faculty members. It is envisaged that the research projects (dissertation) and specializations will inculcate aptitude for research and practical applications. The students will also have basic inputs on communications skills and computers knowledge (information technology) and learn the basics of scientific writing and presentation.

Course: A Course means a semester course.
Credit: One clock hour theory lecture per week per semester (15 weeks) is equivalent to one credit. (15 hours = 1 credit)
Semester: Each semester consists of 15 weeks.

Cell Biochemistry (60)

Unit I

Water:

Structure of water, interactions viz. ionic/polar-non polar, colligative properties of aqueous solutions.

Concept of pH:

Buffers, Concept of pKa, titration curves, blood buffers and their regulation

Chemical Foundation:

Concept of covalent bond, ionic bond, hydrogen bond and coordinate bond, van der Waals interactions, hydrophobic interactions, bond length and bond energy, Energy rich compounds ATP, Creatine phosphate.

Thermodynamics:

Laws of thermodynamics and their application to living systems. Concept of free energy, enthalpy, entropy and their relation to chemical equilibrium.

Basics of evolution:

Evolution of biomolecules, Miller's experiment, RNA as primitive catalysts, Evolution of prokaryotes and eukaryotes, Phylogeny and construction of evolutionary tree. Divergent and convergent evolution

Unit II

Basic Physiology:

Fundamentals of digestive system, digestion of various biomolecules,

Liver function and function tests (albumin/globulin, AST-ALT, alkaline phosphatase),

Kidney function and function tests (inulin clearance, urea, albumin/creatine ratio, GFR),

Heart function and function tests (LDH)

Unit III

Cell Biology: Cell as a basic unit of life, Cell organization of prokaryotic and eukaryotic cells. Structural and functional capitalization of cell-mitochondria, chloroplast, lysozymes, Golgi bodies, plasma membrane and cytoskeleton, cell wall and nucleus.

Unit IV

Cell cycle and cell division- mitosis and meiosis, Chromosome structure, gene, gene number, gene clusters and pseudogene. Polytene and Lampbrush chromosome. Packing of DNA and supercoiled DNA, nucleosome, inverted repeats, repitative DNA sequence, satellite DNA.

Unit IV

Cell cycle and cell division- mitosis and meiosis, Chromosome structure, gene, gene number, gene clusters and pseudogene. Polytene and Lampbrush chromosome. Packing of DNA and supercoiled DNA, nucleosome, inverted repeats, repitative DNA sequence, satellite DNA.

Suggested readings:

1. Clark M S & Wall W. J. (1996) Chromosomes, Chapman & Hall, London.
2. Textbook of Medical Physiology by A.C. Guyton and J. E. Hall, W.B. Saunders Publication, 9th Edition , 1996
3. Physiology Illustrated by Lipfold and Cogdell
4. Cells by David Prescott
5. Cell Structure and Function by Loewy and Gallant
6. Essential Cell Biology by Albert Bray et al, Garland Publication New York 1997
7. Madigam M.T., Martinko J.M and Parker J. (2001) Biology of Microorganisms 9th ed. Prentice Hall Int. (U.K.) Ltd, London.
8. General Microbiology by Stanier, Adelberg and Ingraham, The Macmillan Press Ltd, Hong Kong.