Savitribai Phule Pune University, Pune

T.E. (Biotechnology) Syllabus Structure for 2015 Course

(W.e.f. Academic Year 2017-18)

T.E. (Biotechnology) Syllabus and Structure for 2015 Course
(W. e. f. Academic year 2017-18)
SEMESTER – I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Tutorial	Practical	In-Sem. paper	End-Sem. paper	TW	PR	OR		
315461	Biochemistry-II	4	--	--	30	70	--	--	--	100	4
315462	Mass Transfer	4	--	2	30	70	50			150	5
315463	Reaction Engineering	4	--	2	30	70	--	--	50	150	5
315464	Genetic Engineering	3	--	--	30	70	--	--	--	100	3
315465	Fermentation Technology	3	--	2	30	70	50	--	--	150	4
315466	Biochemistry-II Lab		--	2	--	--	-	50	-	50	1
315467	Skill Development in Genetic Engineering	--	--	2	--	--	50	--	-	50	1
315468	Audit Course 3	-	-	-	-	-	-	-	-	-	-
	Total	**18**	**--**	**10**	**150**	**350**	**150**	**50**	**50**	**750**	**23**
	Total of Part-I	**28 Hours**			**750**						

SEMESTER – II

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Tutorial	Practical	In-Sem. paper	End-Sem. paper	TW	PR	OR		
315469	Computational Techniques & Biostatistics	3	1	--	30	70	--	--	--	100	3
315470	Immunology and Diagnostics	3	-	--	30	70	--	--	--	100	3
315471	Bioseparation-I	4	-	2	30	70	--	50	--	150	5
315472	Instrumentation and process Control	4	-	2	30	70	--	--	50	150	5
315473	Bioinformatics	4	-	2	30	70	--	--	50	150	5
315474	Demonstration of Diagnostics	--	--	2			50	--	--	50	1
315475	Seminar	--	1	-	--	--	50	--	-	50	1
315476	Audit Course 4	-	-	-	-	-	-	-	-	-	-
	Total	**18**	**02**	**08**	**150**	**350**	**100**	**50**	**100**	**750**	**23**
	Total of Part-II	**28 Hours**			**750**						

SEMESTER-I

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315461: Biochemistry II
Credit: 04

Teaching Scheme:
Theory: 4 hr/week

Examination Scheme:
In Sem-30 Marks
End Sem- 70 Mark
Total -100 Marks

Prerequisites: -

- Students should have the basic knowledge of Biochemistry

Course Objectives:

- To provide an understanding about function and kinetics of enzymes
- To make students acquainted about role and mechanism of hormones
- To make students aware about role of biochemistry in clinical diagnostics

Course Outcomes:

On completion of the course, learner will be able to:

- Understand the fundamentals of enzyme functioning and its application in clinical diagnostics.
- Explain the characteristics of chemicals like hormones which control biological processes.

Course Contents

Unit 1 **(7 Hrs)**

Protein and structure- Primary structure, secondary structure (alpha helix, beta sheets, turns and loops), tertiary structure (myoglobin), quaternary structure (hemoglobin), determination of three dimensional structure of protein from its amino acid sequence, Ramchandran plot, correlation between protein misfolding and certain neurological diseases.

Unit 2 **(7Hrs)**

Hormones and signal transduction pathway - Basic physiology, hormone cascade, hormones (insulin, glucagons, epinephrine, growth hormone, thyroid, parathyroid), glucose homeostasis, signal transduction , role of heterotrimeric G protein, 7TM receptors, and signaling pathways, insulin signaling, EGF signaling, defects in signal transduction pathways.

Unit 3 **(7 Hrs)**

Coenzymes - Coenzyme A, Thiamine diphosphate, pyridine nucleotides, flavins and lipoic acid Coenzyme II Biotin and pyridoxal phosphate. Enzyme inhibition: feedback inhibition, irreversible and reversible inhibition (competitive, non-competitive, uncompetitive), allostericinhibition.

Unit 4 **(7 Hrs)**

Enzymes – Naming and classification of enzymes, enzyme cofactors, kinetics of enzyme catalyzed reactions,MichaelisMenten equation, effect of pH, temperature on enzyme activity, purification of enzyme, substrate specificity of enzyme, Factors leading to rate enhancement of enzyme catalyzed reactions: Acid-base catalysis, proximity and orientation effects, covalent catalysis, strain or distortion and change in environment, regulatory enzyme, isozymes, multi-enzymes

Unit 5 **(7 Hrs)**

Biochemical response to environmental changes - Detection of various organic compounds by olfaction, biochemistry of vision, taste, hearing and touch, ATP dependent pumping of ions and molecules across membrane, (Na/k pumps), Muscle contraction: motor proteins, myosin and actin, kinesin and dynein.

Unit 6 **(6 Hrs)**

Clinical Biochemistry - Hyper glycaemia, hypoglycemia, LDL, HDL, VLDL, cholesterol, application of biochemistry in monitoring systemic diseases. Cerebrospinal fluid, composition in health and disease, Blood coagulation, clotting factors, mechanism of coagulation, fibrinolysis, fibronectins, water and electrolyte balance.

Text Books:

1. D J Voet, J G Voet, C W Pratt, “Principles of Biochemistry”, 3rd ed., John Wiley & Sons, Inc. 2008
2. D T. Plummer, “An Introduction to practical biochemistry”, Tata McGraw Publishing Company Ltd, 1988
3. D L Nelson, M M Cox “Principles of Biochemistry”, 4th ed., W.H. Freeman and company, New York, 2007

Reference Books:

1. D L Nelson, M M Cox "Principles of Biochemistry", 4th ed., W.H. Freeman and company, New York, 2007

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015Course)
315462: Mass Transfer
Credit :05

Teaching Scheme:

TH: 04 hr/week
PR: 02 hr/week

Examination Scheme:

In Sem-30 Marks
End Sem- 70 Mark
Term Work : 50 Marks
Total -150 Marks

Prerequisites: -

- Basic knowledge of subjects like Material Balances and stiochiometry, heat transfer and fluid flow unit operations.

Course Objectives:

- To introduce basic concepts of mass transfer, mass transfer operations and its applications.
- To give emphasis on importance of mass transfer knowledge while working in bioprocess industries.
- To study comprehensively mass transfer operations like distillation, absorption, drying and crystallization in detail.
- To make students aware of designing methods and calculations for efficient mass transfer equipments.
- To make students apply the concepts of mass transfer to biological systems and operations.

Course Outcomes:

On completion of the course, learner will be able to–

- Apply and develop processes based on mass transfer principles.
- Apply various design criteria to obtain better yield and productivity.
- Gain knowledge in enhancing the formulation, delivery and increase the bioavailability of bio-products.

Course Contents

UNIT 1 **(8Hrs)**

Introduction, General principles of Mass Transfer, Classification of Mass Transfer Operations, Choice of separation method, Methods of conducting mass transfer operations, Design principles Diffusion and Mass transfer, Types of diffusion - Molecular diffusion, Turbulent diffusion, Diffusion in Solids, Fick's and Maxwell law of diffusion, Molecular Diffusion in gases and liquids, Diffusivities of gases and liquids, types of solid diffusion, Numerical relating various types of diffusion, Theories of Mass transfer, Mass, Heat and Momentum transfer analogies, Introduction to Inter phase mass transfer, Equilibrium, Two resistance theory, Local and overall mass transfer coefficients, Use of local overall, coefficients, Stages, Cascades.

UNIT 2 **(8 Hrs)**

Drying: Definition, Principles, Equilibrium in drying, Drying hysterisis, Types of moisture binding, Drying operations, Batch drying, Rate of batch drying, Rate of drying curve, Mechanism of batch drying, Mechanism of moisture movement in solid continuous drying, Time required for drying, Classification of drying equipments, Numerical relating drying operations.

UNIT 3 **(6 Hrs)**

Crystallization: Principle rate of crystal growth, Population balance and size distribution, Calculations of yield, Enthalpy balances, Equipment

UNIT 4 (**8 Hrs)**

Distillation: Definition, Vapor-liquid equilibria for Ideal and Non-ideal systems, Relative volatility, Ideal solutions-Raoult's law, Azeotropes, Positive and negative deviations from Ideality, Multi component system, Methods of distillation-Continuous rectification, Differential, Flash, Azeotropic, Extractive, Low pressure, Steam distillation, Batch rectification, Molecular distillation.

UNIT 5 **(8 Hrs)**

Tray tower calculations

Continuous rectification for binary system, Multistage tray towers-McCabe Thiele method, Tray efficiencies, Reflux ratio-Total reflux, Minimum reflux ratio, Optimum reflux ratio, Fenske's equation, Types of reboilers, Types of condensers-Total condensers, partial. Condensers, NTU, HTU, HETP concept and calculations.

UNIT 6 **(8 Hrs)**

Gas Absorption: Mechanism of gas absorption, Equilibrium in gas absorption, Ideal liquid solutions, Non ideal liquid solutions, Choice of solvent for absorption, L/G ratios for absorbers, Absorption factor, Real trays and Tray efficiency, Use of Reflux, absorption with chemical reaction, Material balances – one component transferred in counter current flow, Numerical relating counter current operations

Reference Books:

1. Coulson J.M. and |Richardson J.F., "Chemical Engineering", Vol I & II–McGraw Hill International
2. Alan Shivers Foust, Leonard A. Wenzel, L. Bryce Andersen, Louis Maus, Curtis W. Clump, "Principles of Unit Operations in Chemical Engineering", John Wiley & Sons, January 1st 1980
3. Buford D. Smith, "Design of Equilibrium Stage Processes", McGraw-Hill, New York, 17 June 2004

Suggested List of Laboratory Assignments

Group A

- Liquid-Liquid diffusion – To calculate the diffusion co-efficient for a liquid-liquid system.
- Solid-Liquid diffusion –To calculate the diffusion co-efficient for a solid-liquid system.
- Interphase Mass transfer Co-efficient- To calculate the individual and overall Mass transfer co-efficient.

Group B

- Process of Crystallization and its characteristics.
- Tray Dryer- To study the characteristics of Tray Dryer
- Fluidized Bed Dryer- To study the characteristics of fluidized bed Spray dryer.

Group C

- Differential/Steam distillation
- Liquid-Liquid Extraction to calculate the partition co-efficient of LLE.
- Batch/ continuous leaching
- To study the design and operating principle of spray dryer

Savitribai Phule Pune University, Pune

Third Year of B.Tech. Biotechnology (2015 Course)

315463: Reaction Engineering

Credit :05

Teaching Scheme:

TH: 04 hr/week
PR: 02 hr/week

Examination Scheme:

In Sem - 30 Marks
End Sem - 70 Marks
Oral - 50 Marks
Total - 150 Marks

Prerequisites: -

- Basic knowledge of subjects like Material Balances and stoichiometry, fluid flow unit operations, mass transfer and thermodynamics.

Course Objectives:

- To make students to understand the concept of molecularity, order, type of chemical reactions.
- To analyze the experimental data for the reactor design.
- To study the heterogeneous fluid solid kinetics and design the heterogeneous reactor.
- To study the effect of pore diffusion on the conversion and reactor design.
- To study enzyme catalyzed reaction and its kinetics.

Course Outcomes:

- An ability to apply the basics of chemical reaction kinetics.
- An understanding of homogeneous reactor design.
- An understanding of parameter affecting the conversion of reaction.
- An understanding of homogeneous reactor reactor design.
- An ability to apply concepts of reaction kinetics to biochemical reaction.

Course Contents

UNIT 1 **(8Hrs)**

Defining a rate equation and it's representation, Classification of reactions – single and multiple reactions, elementary and non-elementary reactions, Definition and significance of rate of reaction,molecularity and order of reactions, factors affecting rate of reaction, Temperature dependency from Arrhenius law, Collision theory, transition state theory, rate equation, activation energy, searching for a reaction mechanism, rate controlling step.

UNIT 2 **(8 Hrs)**

Introduction to Reactor design: Conversion of mass in reactors, Different types of reactors: Batch (Constant and variable volume), Mixed flow reactor, plug flow reactor, performance equation for ideal stirred tank reactor, tubular flow reactor, batch reactor– concept of space time and space velocity, Integral analysis of variable volume batch reactor, problems on performance and conversion, fixed bed and fluidized bed reactor

UNIT 3 **(8 Hrs)**

Non-ideal Reactor Systems: Definition of non-ideality, age distribution, RTD studies, Residence time distribution curves – F , C and E curves, their significance and the relation between them, Models for non-ideal reactions, dispersion model, tanks in series model segregated flow model, Temperature dependency from Arrhenius law, Collision theory, transition state theory

UNIT 4 **(8 Hrs)**

Heterogeneous Reactions: Introduction – examples of heterogeneous systems: solid liquid systems, catalysis, surface kinetics rate of reaction for shrinking spherical particles, the concept of rate controlling step, fluid particle reactions – progressive conversion model, shrinking core model, determining controlling resistance and rate equation

UNIT 5 **(8 Hrs)**

Heterogeneous systems, mixed flow reactors, packed bed catalytic reactor, fluidized bed reactors, slurry and trickle bed reactors, performance equation for porous catalysts, diffusion in liquids in porous catalyst, surface diffusion, Mass transfer with reaction, effectiveness factor, selectivity for porous catalyst.

UNIT 6 **(8 Hrs)**

Enzyme catalyzed reactions: Introduction to MichaelisMenten kinetics, enzyme inhibition kinetics, application of reaction engineering to biochemical reactions;

Microbial growth kinetics: Product distribution, fractional yields, substrate and product limiting microbial fermentation, Monod growth kinetics, kinetic implications of endogenous and Maintenance metabolism, environmental effects on growth kinetics, enzyme deactivation kinetics.

Text Books:

1. O.Levenspiel, "Chemical Reaction Engineering", John Wiley Publishers
2. H. Scott, Fogler, "Elements of Chemical Reaction Engineering", Academic Press
3. C.G. Hill, "An Introduction to Chemical Reaction Kinetics& Reactor Design"
4. Carberry & Verma, "Chemical and Catalytic reaction Engineering"

Reference Books:

1. J. Smith, "Chemical Engineering Kinetics", McGraw Hill Publication
2. Bishoffand Fromment, "Reactor design and analysis", Oxford University Press

Suggested List of Laboratory Experiments

Reaction Engineering: (Any 8)

1. Reaction kinetics of first order reaction
2. Reaction kinetics of pseudo first order reaction-Acid catalyzed hydrolysis of ethyl acetate
3. Reaction kinetics of a second order reaction – Saponification of ethyl acetate
4. Design of PFR
5. Design of CSTR
6. Design of CSTR combination in first order reactions
7. Non ideal reactions-F & C curves in CSTR
8. Non ideal reactions-F & C curves in PFR
9. Evaluation of PFR followed by CSTR
10. Design of two PFR in series

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315464: Genetic Engineering
Credit :03

Teaching Scheme:
TH: 03 hr/week

Examination Scheme:
In Sem - 30 Marks
End Sem - 70 Marks
Total - 100 Marks

Prerequisites: -

- Knowledge of Genetics and Molecular Biology

Course Objectives:

- To give Introduction to various techniques used in Genetic Engineering.
- Give an overview of recombinant DNA technology.
- Bring Understanding the underlying molecular tools used
- Impart Management of information generated in the experiments by applications of the techniques

Course Outcomes:

On completion of the course, learner will be able to–

- To impart knowledge of theoretical aspects of techniques used in molecular biotechnology.
- To orient students towards use of these techniques with respect to the research work.
- To introduce these techniques to students in 'Hands on' training during the practical of the course work

Course Contents

UNIT 1 **(6Hrs)**

Techniques and tools in genetic engineering: Blotting techniques, PCR-design and optimization, PCR types – RTPCR, colony PCR, real time PCR.

DNA sequencing methods: sequencing strategies, Sangers Sequencing, pyrosequencing, automation, base calling, applications and impact of sequencing, Human genome project, micro arrays,

UNIT 2 **(6 Hrs)**

Enzymes used in GE: Restriction enzymes, DNA ligase: adapters, linkers, homopolymer tailing,

Cloning vectors: Plasmids, basics of plasmids, lambda phage, insertional, replacement lambda vectors, in-vitro packaging, M13 vectors, phagemids, cosmids, Multiple cloning sites, selection markers, Expression Vectors, artificial chromosomes (BACs, YACs)

UNIT 3 **(5 Hrs)**

Gene Cloning strategies: genomic libraries, PCR in cloning, cDNA libraries, amplification of gene libraries, strategies for screening of libraries: hybridization, colony PCR, immunological screening, blue white selection, selection based on nutrient deficiency

UNIT 4 **(6 Hrs)**

Cloning in bacteria, competency, broad host range plasmids, copy number significance, cloning in gram positive bacteria, Cloning in yeast and fungi: Cloning in *S. cerevisae*, problems in cloning, vectors for yeast, promoters, significance of *Pichia pastoris*, YAC's classical and circular

UNIT 5 **(6 Hrs)**

Gene transfer technologies: Transformation,, Transfection, Electroporation, Gene transfer to animal cells: bacterial vectors, Viral vectors – Adenovirus, Baculovirus, retro virus, strategies for transformation of animal cells: Pronuclear microinjection, Recombinant retroviruses, transfection of ES cells to get chimeras, Gene transfer to plants: Callus culture, protoplast transformation, strategies Agrobacterium mediated, Particle bombardment, *In planta* transformation, plant viruses

UNIT 6 **(6 Hrs)**

Modification of bacteria and viruses: live vaccines, Animal transgenesis - Applications, Transgenic plants – Applications, Applications of rDNA technology in health and agriculture: Humulin, Hep B, factorVIII, DNA diagnostics, Bt cotton, Golden rice. DNA markers for improvement of quality and yield of crops, Gene therapy

Text Books:

1. Principles of Gene manipulation and Genomics by Primrose and Twyanman (Blackwell Publishers)
2. From Genes to Genomes: Concepts and applications of DNA technology by J. W. Dale and M.V.Schantz (Wiely Publishers)

Reference Books:

1. Molecular biotechnology by Pasternack and Glick
2. From Genes to clones by Winnacker. PANIMA
3. Gene cloning and DNA Analysis: An introduction (4th edition) by T. A. Brown
4. Molecular Cloning: A Laboratory Manual *(Fourth Edition)* By Michael R. Green, Howard Hughes Medical Institute, University of Massachusetts Medical School; Joseph Sambrook, Peter MacCallum Cancer Institute, Melbourne, Australia

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315465: Fermentation Technology
Credit:04

Teaching Scheme:

TH : 03 hr/week
PR : 02 hr/week

Examination Scheme:

In Sem - 30 Marks
End Sem - 70 Marks
Term Work : 50 Marks
Total - 150 Marks

Prerequisites: -

- Basic knowledge of Biology and biochemistry

Course Objectives:

1. To introduce the history, fundamental concepts and significance of microbial fermentation at industrial and domestic level
2. To train the students in concepts of media preparation, nutritional requirements and sterilization of media at industrial level
3. To introduce different types of microbial fermentation processes, both classical and advanced to the students
4. To introduce different types of microbial processes, both classical and advanced to the students
5. To introduce to the students, the different methods and engineering aspects of fermentation processes
6. To introduce the mathematical concepts of scale up and its significance in techno commercial feasibility at industrial level

Course Outcomes:

On completion of the course, learner will be able to–

a. Students are made aware of different types of microbial fermentations and the microorganisms used for the same
b. The graduates are made aware of fundamentals of different types of fermentation processes
c. Students are made aware of different media types used at industrial level and their sterilization methods
d. Students are educated about different types of fermenters and their operation
e. Students are trained in different types of microbial bio-processes like antibiotic, vitamin and enzyme production.
The graduates would be able to understand fundamentals of and carry out elementary calculations regarding scale up

Course Contents

UNIT 1 **(6 Hrs)**

Introduction to Microbial Fermentation, microbial / Industrial fermentation: Applications for production of industrially important products, Examples of classical fermentation systems, Concept of upstream processing - Screening and isolation of microbes, Preserving industrially important microbes, Inoculum preparation

UNIT 2 **(6 Hrs)**

Media Preparation and optimization, Different types of media, sources of nutrients i.e. carbon, nitrogen etc., effect of media components on fermentation, media preparation, optimization for maximum yield, Sterilization: Need for sterilization, different types of sterilization techniques – their mechanism of destruction, *in situ* sterilization, HTST

UNIT 3 **(5 Hrs)**

Microbial production of industrially important products: Alcohols and acids, Microbial fermentation of organic acids viz. Citric, gluconic, fumeric, itaconic, gibberellic and kojic acids, Activities of lactic acid bacteria and industrial production of lactic acid, Activities of acetic acid bacteria and production of vinegar, Alcohol Production: wine and other alcoholic beverages, glycerol, beer

UNIT 4 **(6 Hrs)**

Production of Antibiotics and Microbial enzymes, Antibacterial antibiotics: penicillin, streptomycin, chloromycetin, tetracyclines, semisynthetic penicillins; Antifungal antibiotics, Microbial production of vitamins B2 and B12

UNIT 5 **(6 Hrs)**

Isolation, Production and use of microbial enzymes, Methods of Immobilization, immobilized enzymes and their applications, Case studies of Fructose, Glucose production using enzymes. Single Cell protein Production, Fungal, algal Protein Production, Microbial Transformations.

UNIT 6 **(6 Hrs)**

Submerged and solid state fermentation, advantages and disadvantages, applications of SLF and SSF, Scale-up: Principles, theoretical considerations &techniques used, Sterilization, inoculum development, operation parameters Concept of downstream processing, Fermentation and product recovery costs, yields, product recovery, product purity, fermentation efficiency, case example such as ethanol economics; Introduction to GMPs

Text Books:

1. Casida, "Industrial microbiology", Newage Publication, 2001
2. Stanbury, Whitaker, S.Hall. "Principles of Fermentation Technology", Second Edition, Elsevier publication
3. Bailey and Ollis, "Biochemical Engineering Fundamentals", McGraw Hill, NewYork

Reference Books:

1. Trevor Horwood, "Enzymes", 2001
2. Prescott and Dunn, "Industrial microbiology", CBS publications 4thEdition, 1999
3. M.Y. Young, "Comprehensive Biotechnology Vol. 1- 4:, Pergamon Press
4. T.D. Brock, "Biotechnology: A Text Book of Industrial Microbiology", SmaeurAssociates, 1990
5. Paulin M. Doran, "Bioprocess Engineering Principles", Academic Press, London
6. S. Aiba, A. E. Humphrey, N. F. Milli, "Biochemical Engineering"

Suggested List of Laboratory Assignments

Fermentation Technology (Any 8)

1. Study of fermenter design
2. Estimation of Carbohydrates from Fermentation Broth
3. Estimation of Proteins from Fermentation Broth
4. Fermentation of any two microbial products
5. Use of alginate for cell immobilization
6. Production of Single cell Proteins (SCP) of yeast cells
7. Effect of aeration in fermentation
8. Solid state Fermentation
9. Effect of different media components (Carbon, Nitrogen etc.) on fermentation

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2016 Course)
315466: Biochemistry II Lab
Credit :01

Teaching Scheme: **Examination Scheme:**

PR: 02 Hr /week **PR-50 Marks**
Total -50 Marks

Prerequisites: -

- Basic knowledge of Biochemistry I

Course Objectives:

- To introduce basic concepts of enzyme functioning
- To study the effect of various parameters on enzyme activity need to be monitor in enzyme based processes

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the basic principal of enzyme functioning
- Learn to optimize parameters which affect enzyme activity

Guidelines for Instructor's Manual

1. Students should be briefed with Risk Assessment and Biosafety Levels
2. All the instruments to be validated before use
3. All the experiments should be standardized
4. The instructor is responsible for seeing that the consequences of student are rectified, including correction of damages and violations and take-down of experiments.

Guidelines for Student's Lab Journal

1. Use a bound notebook.
2. Lab notebooks should be done in pen and no erasing or white-out is allowed
3. Number the pages

4. Title and underline each lab exercise at the top of the page and date it. Each lab write-up should be done separately even if more than one exercise is performed in a lab period. Leave enough room in the lab notebook to complete the entire lab including results and discussions.
5. Briefly explain the lab exercise objectives in a few sentences.
6. Record observations, diagrams and results from the exercise.
7. Conclude the report with a brief discussion in essay form.
8. Write neatly, be organized and follow a standard format.

Note: The purpose of the lab notebook is to encourage students to compile and organize their Laboratory notes and to understand the purpose of the laboratory exercises and the meaning of their results**.**

Guidelines for Lab Assessment

Lab Assessment will be based on following points

1. Present/Absent
2. Completion date of journal
3. Regularity
4. Understanding
5. Presentation

Guidelines for Laboratory Conduction

The following rules must be observed during laboratory conduction :

1. Students should wear lab coats before entering the laboratory
2. Students shall keep their belongings on storage rack
3. Loose hair and flowing parts of apparel shall be properly tied before commence of work
4. Enter the usage of chemicals and equipment's in log book

4 Instruction manual should be read before operating any instrument

5. Students should make aware about hazard warning symbols on reagent bottle
6. Protective devices must be worn when it is necessary to protect the eyes and face from splashes

7. All chemicals, glass ware, reagents and plastic wares should be kept on their appropriate place after use
8. Reagents to be stored should be labeled with due discarding date
9. Instructions for proper disposal of waste material should be followed
10. Report accidental cuts or burns to the instructor immediately

Suggested List of Laboratory Assignment

Group A

1. Isolation of enzyme
2. Quantitative assay for enzyme using enzyme substrate reaction
3. To check effect of varying substrate on enzyme activity and to calculate Km and Vmax

Group B

1. Effect of inhibitor on enzyme activity
2. To study the effect of pH on enzyme activity
3. To assess optimum temperature of enzyme

Group C

1. To study specific activity of enzyme
2. Thermo stability of enzyme

Text Books:

1. D T. Plummer, "An Introduction to practical biochemistry", Tata McGraw Publishing Company Ltd, 1988
2. D L Nelson, M M Cox "Principles of Biochemistry", 4th ed., W.H. Freeman and company, New York, 2007

Reference Books:

1. D T. Plummer, "An Introduction to practical biochemistry", Tata McGraw Publishing Company Ltd, 1988
2. D L Nelson, M M Cox "Principles of Biochemistry", 4th ed., W.H. Freeman and company, New York, 2007

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315467: Skill Development in Genetic Engineering

Credit: 01

Teaching Scheme: **Exam Scheme:**
Practical: 2 hr/week **Term Work: 50 Marks**
Total: 50 Marks

Guidelines for Instructor's Manual:

• Students should be briefed with risk assessment and Biosafety levels
• All the instruments to be validated before use
• All the experiments should be standardized
• The instructor is responsible for seeing that consequences of student are rectified, including correction of damages and violations and take-down of experiments

Guidelines for Student's Lab Journal:

• Use provided templates of experiment write ups
• Follow the sequence of experiments as per the index, while arranging journal file
• Draw necessary diagrams with pencil and fill other fields like observations, calculations, conclusion etc. with Pen
• Paste Images e.g. of specialized equipment, Gel pictures, isolated DNA wherever necessary
• Avoid overwriting and copying of results, conclusions etc.

Guidelines for Lab /TW Assessment:

• Each experiment will be assessed based on following terms.
• Student should attend each practical in scheduled batch to gain full marks for that practical
• Regularity will be assessed throughout the semester for practical.
• Presentation of students in laboratory during practical will be assessed.
• Understanding and application of steps involved in practical to achieve good results will contribute in term work/lab assessment.
• For final term work assessment along with above all points, unit test marks, theory lecture attendance will also be considered

Guidelines for Laboratory Conduction:

• Wearing laboratory coats and gloves is compulsory to enter into the laboratory
• Practical’s should be conducted in 3 or 4 batches from total student’s strength for the course

• One practical should be conducted per week for all batches

• Students should be made aware of equipments present in the respective laboratory

• Students should be made aware about chemicals to be handled during performing practicals

• Cleanliness and discipline should be followed during performance of practical course

• Disinfect work surfaces to decontaminate before and after each work session

• Ensure that loose hair and loose flowing parts of your apparel are properly tied before you commence working

• Glassware/Plastic ware Biological material should be labeled appropriately with due discarding date

• Plates/Flasks/Tubes containing microbial material should be autoclaved before discarding

• ETBR containing agarose gels/ or material used for handling ETBR should be discarded in specified discarding bins (sodium hypochloride 10-20%)

• Gel documentation system should be handled in presence of trained laboratory staff/in charge/ concerned teacher

Suggested List of Laboratory Assignments

Group A

Isolation of Genetic Material

1. Isolation of Plant genomic DNA
2. Isolation of Bacterial genomic DNA
3. Isolation of Plasmid DNA
4. Isolation of RNA

Group B

Restriction Enzyme use

5. RE digestion and agarose gel electrophoresis
6. Competent Cell Preparation

Group C

Transformation and Selection

7. Transformation
8. Selection of Transformants
9. PCR (Demo)

315468: Audit Course 3

In addition to credits courses, it is recommended that there should be audit course (non-credit course). Audit course is for the purpose of self-enrichment and academic exploration. Audit course carry no academic credit. Selection of audit courses helps the learner to explore the subject of interest in greater details resulting in achieving objective of audit course's inclusion. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

Criteria:

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the semester grade report for that course, provided students has the minimum attendance as prescribed by the Savitribai Phule Pune university and satisfactory in-semester performance and secured a passing grade in that audit course. No grade point is associated with this "PP" grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Guidelines for Conduction and Assessment:

1. Lecture/Guest lecture
2. Visit (Social/field) and reports
3. Demonstrations
4. Surveys
5. Mini project
6. Hands on experience on specific focused topic
7. IIT Mooc/EDX/NPTEL

Guidelines for Assessment (Any one or more of following but not limited to)

1. Written test
2. Quiz
3. Demonstrations/practical test
4. Presentations
5. IPR/publication
6. Report

Audit course 3 Options (Any one)

1. Leadership and Personality Development
2. Latex

SEMESTER-II

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015Course)
315469: Computational Techniques and Biostatistics
Credit :03

Teaching Scheme:

TH: 03 hr/week
TUT : 01 hr/week

Examination Scheme:

In Sem- 30 Marks
End Sem- 70 Marks
Total -100 Marks

Prerequisites: -

- Basics of Mathematics like Derivatives and Integrals of simple functions.

Course Objectives:

- To make students aware of concept of biostatistics and importance of sampling methods while analyzing the experimental data.
- To make students well acquainted with diagrammatic and graphical presentation of research data.
- To study various computational techniques like linear and polynomial regression, Numerical integration, interpolation methods and their applications in engineering systems.
- To make students familiar with applications of mathematical techniques in various bioprocesses.

Course Outcomes:

On completion of the course, learner will be able to–

- Analyze and interpret experimental data correctly.
- Present data appropriately using diagrams or graphs.
- Develop understanding towards various computational techniques.
- Apply different methodologies in solving a single problem.

Course Contents

UNIT 1 **(6Hrs)**

Biostatistics: Introduction to Biostatistics

Sampling: Introduction, theoretical basis of sampling, Sample method, Essentials of Sampling, random and systematic sampling, cluster sampling, Sample size- determination of sample size, sampling errors

Diagrammatic and graphic presentation: Introduction, Significance of graphs and diagrams, General rules for constructing diagrams, Types of diagrams (Bar, pie chart etc),Frequency distribution graphs

UNIT 2 **(6 Hrs)**

Types of averages: Introduction, Types of averages, Calculation of Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean for discrete series, continuous series, and individual observations

UNIT 3 **(5 Hrs)**

Standard deviation, and Mean deviation, Tests of Significance: Students t-distribution (parametric), Chi square test (nonparametric)

UNIT 4 **(6 Hrs)**

Solutions of Algebraic equations: Bisection method, Regular false method, Solutions of linear simultaneous equations: Newton Raphson method, deductions from NR method, Solutions of Nonlinear simultaneous equations: Newton Raphson method for nonlinear equations

UNIT 5 **(6 Hrs)**

Linear and Polynomial Regression: Method of Least Squares: Fitting of a straight line using linear regression, fitting of a parabola using polynomial regression, fitting of other curves

Numerical Integration: Newton Cote's quadratic formulae; Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule

UNIT 6 **(6 Hrs)**

Finite differences and Interpolation: Forward differences, backward differences, central differences, Factorial notation, Newton's Interpolation formulae with equal intervals: Newton's forward and Newton's backward formulae, Interpolation with unequal intervals: Lagrange's formula, divided differences

Text Books:

1. M.K.Jain, R.K.Jain, S.R.K.Iyengar, "Numerical methods for scientific and engineering computation", 5th edition, New Age International Pvt. Ltd Publishers, December 1, 2005
2. Dr. B.S.Grewal, "Higher Engineering Mathematics", 40th Edition , Khanna Publishers, New Delhi, October 2007
3. S.P.Gupta, "Statistical methods", Sultan Chand and Sons Educational Publishers, New Delhi

Reference Books:

1. Steven C. Chapra, Reynolds P Canale, "Numerical methods for Engineers with software and programming applications", 6th Edition, April 20, 2009

Savitribai Phule Pune University, Pune
Second Year B.Tech Biotechnology (2015 Course)
315470: Immunology and Diagnostics
Credit: 03

Teaching Scheme:
TH : 3 hrs/ week

Examination Scheme:
In Sem- 30 Marks
End Sem- 70 Marks
Total -100 Marks

Contents

Prerequisites: - Knowledge cell biology and microbiology

Course Objectives:

- To introduce concepts of disease resistance in host.
- To learn about the structural features of the components of the immune system.
- To learn functions of immune cells and tissues and organs
- To bring understanding of the mechanisms involved in immune system function in health and disease.

Course Outcomes:

On completion of the course, learner will be able to–

- Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
- Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses
- Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation and memory
- Understand the molecular basis of complex, cellular processes involved in immunity, in states of health and disease

UNIT 1 **(6 Hrs)**

Overview of immune system: Historical Perspective, Innate immunity: Physiological barriers against infection, phagocytosis, inflammation; Cells and organs of immune system, Primary lymphoid organs, secondary, tertiary lymphoid tissues, Functions of T cells and B cells T cell & B cell: maturation and activation

UNIT 2 **(6 Hrs)**

Antigens: study of antigenicity; Antibody: Structure and function, types, Adaptive Immunity Humoral immunity: Activation of B cells, theories of antibody production- clonal selection theory, Cell mediated immunity, TCR, Cell mediated effector responses: cytotoxic T cells, Natural killer cells, ADCC

UNIT 3 **(8 Hrs)**

Major Histocompatibility Complex (MHC), Antigen processing and presentation, Transplantation immunology: Graft rejection, Graft-versus-Host and ethics

UNIT 4 **(8 Hrs)**

Organization and expression of Ig genes, generation of antibody diversity, Monoclonal Antibody, Hybridoma Technology, Antigen – antibody interactions- principles and applications, Various Precipitation and agglutination reactions, RID, ODD, ELISA, RIA

UNIT 5 **(8 Hrs)**

Vaccines: Active and Passive Immunization, role of adjuvants, Designing Vaccines for Active Immunization, Types of vaccines: Whole-Organism Vaccines, Purified Macromolecules as Vaccines, Recombinant-Vector vaccine, DNA Vaccines, Multivalent Subunit Vaccines, Cytokines and Complement System

UNIT 6 **(8 Hrs)**

Hypersensitivity- Type I to IV, Immediate hypersensitivity, Anaphylaxis, Cytotoxic, Haemolytic disease of the newborn, Complex mediated hypersensitivity, Arthus reaction, serum sickness, Delayed type hypersensitivity, allergy test, Immune system in diseases: Cancer, Tuberculosis and AIDS, Autoimmunity :Organ-Specific, Systemic Autoimmune Diseases

Text Books:

1. R. A. Goldsby, T.J. Kindt, B.A. Osborne, “Kuby- Immunology”, 4th Edition
   Essentials of Immunology(6th Edition): Ivan Roit- Blakswell Scientific Publications, Oxford, 1988
2. S. Gangal, S. Sontakke,”A text book of basic and Clinical Immunology” Orient BlackSwan Publisher.

Reference Books:

1. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988
Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315471: Bioseparation-I
Credit :05

Teaching Scheme:

TH: 04 hr/week
PR : 02 hr/week

Examination Scheme:

In Sem - 30 Marks
End Sem - 70 Marks
PR - 50 Marks
Total - 150 Marks

Prerequisites: -

- Basic knowledge of Biomolecules and Unit Operations

Course Objectives:

- To introduce students with bioseparation techniques. To demonstrate students with techniques of cell disruption; this is first step in product isolation.
- Introduce with unit operations and their application in separation of bioproducts.
- To demonstrate techniques for solid liquid extraction
- To make student understand solvent extraction methods and Aqueous Two Phase extraction
- To learn membrane separation techniques , types of membranes and Technology of membrane packaging
- Introduce students with Adsorption Techniques

Course Outcomes:

On completion of the course, learner will be able to–

- Learn the basic bioseparation techniques along with types of cell disruption methods important for intracellular product.
- Understand the basic unit operation and their applications for Biomolecules separation
- Train students with solid- liquid separation methods (Leaching) other than unit operations like filtration, centrifugation etc.
- Understand the use of liquid -liquid separation techniques for biomolecules
- Students will learn advances separation and purification technique like Membrane Technology
- Learn concept of Adsorption and its application on downstream processing

Course Contents

UNIT 1 **(6 Hrs)**

An overview of Bioseparations, Salient features, Advantages, Disadvantages, Need of Bioseparations, Range of Bio products, Mechanical and enzymatic methods of cell disruption, importance of cell disruption in product release

UNIT 2 **(6 Hrs)**

Basic separation techniques: Centrifugation - Ultracentrifugation, Gradient centrifugation, Filtration – Constant pressure and volume filtration, Rate of filtration, Filter medium and filter cake resistance, specific cake resistance, Types of Filters, Washing and dewatering of filter cakes.

UNIT 3 **(5 Hrs)**

Extraction Operations: SLE (Leaching): Definition, Preparation of the solid, Factors effecting leaching operations, Methods of operation, Single stage leaching, Continuous counter current leaching, Leaching equipment.

UNIT 4 **(6 Hrs)**

LLE(Solvent extraction) : Definition, Fields of usefulness, Ternaryliquid equilibria, Equilateral triangular coordinates, Mixture rule, Choice of solvent,Material balances - Single stage extraction, Multistage crosscurrent, countercurrent andco current extraction, Types of extractors – stage type and differential type.

UNIT 5 **(6 Hrs)**

Membrane Separation Techniques: Classification of separation techniques, Definition of a membrane, Criteria of membrane separation processes, Types of membranes, Advantages of membrane separation processes over conventional separation techniques ,Industrial Applications, Membrane separations - Micro filtration, Ultra filtration ,Reverse Osmosis, Piezodialysis, Electro dialysis, Membrane electrolysis, Pervaporation ,Carrier mediated transport- liquid membranes, Membrane contactors, Polarization Phenomenon, Membrane fouling, Membrane modules and Industrial applications of all Processes.

UNIT 6 **(6 Hrs)**

Definition, Types of Adsorption - Physical and Chemical, Nature of adsorbents, Adsorption Isotherms - Langmuir, Freundlich, BET, Heat of adsorption, Introduction toPressure Swing Adsorption (PSA), and Temperature Swing Adsorption (TSA),Equipments for adsorption.

Text Books:

1. B.Shivshankar, " Bioseparations: Priniples and Techniques", Eastern Economy Edition, PHI Learning Pvt. Ltd., Publishing House, New Delhi, 2012
2. Treybal R.E., "Mass Transfer Operations", Third Edition, McGraw Hill International Editions, 1980
3. Coulson J.M. and |Richardson J.F., "Chemical Engineering", Vol I & II –McGraw Hill International Editions, 1980
4. Pauline Doran, " Bioprocess Engineering Principles", Elseveir Publications, New Delhi,2010
5. Michael R. Ladisch, " Biosepration Engineering, Principles, practice and economics", Wiley-Blackwell Publishers ,9 April 2001

Reference Books:

1. Alan Shivers Foust, Leonard A. Wenzel, L. Bryce Andersen, Louis Maus, Curtis W. Clump, "Principles of Unit Operations in Chemical Engineering", John Wiley & Sons, January 1st 1980
2. Warren McCabe, Julian Smith, Peter Harriott, "Unit Operations of Chemical Engineering", McCabe W.L. and Smith J.C. , 7th Edition, McGraw Hill Chemical Engineering Series, 0ctober 27, 2004
3. Buford D. Smith, "Design of Equilibrium Stage Processes", McGraw-Hill, New York,17 June 2004
4. P. A. Belter, E.L. Cussler and W.S. Hu , "A review of Bioseparations (Downstream Processing for Biotechnology)", Wiley Interscience Publishers, New York, 1988

Savitribai Phule Pune University, Pune
Second Year of Biotechnology Engineering (2015 Course)
315472: Instrumentation and Process Control
Credit :05

Teaching Scheme:
TH: 04 hrs/week
PR: 02 hrs/week

Examination Scheme:
Insem: 30 Marks
Endsem: 70 Marks
Oral: 50 Marks
Total Marks: 150

Prerequisites:

Basic Knowledge of Chemical Engineering Subjects Like Mass Transfer, Material Balance Heat Transfer, Reaction Engineering etc.

Problem Solving ability, Information manipulation and Processing skills.

Course Objectives:

- To familiarize students with various aspects (principle of operation, construction, characteristics and applicability) of instruments necessary for measurement of different process parameters encountered in the industry
- To introduce students to the fundamentals of process dynamics – types of processes and different types of inputs as also to study the dynamic and response characteristics of first order systems in detail
- To understand the dynamic and response characteristics of second order systems
- To introduce the concept of process control and to provide knowledge of the different components and working of a control system
- To impart knowledge pertaining to stability analysis of control systems
- To bring students abreast with different advances in process control systems and demonstrate their applications to the bioprocess industry

Course Outcomes:

On completion of the course, learner will be able to :

- Ability to select and operate the most common instruments encountered in the bioprocess industry
- A clear understanding of the most important concepts of process dynamics and ability to predict the dynamic responses of various first order systems
- Ability to predict the dynamic behavior of different second order systems
- Ability to analyze a control system and select controllers based on the problem requirement

Course Contents

Unit 1 **(08 Hrs)**

Instrumentation in Process Industries

Need for measurement of different process parameters, Instruments used for measurement: **Pressure** – Mechanical and electric transducers, Low pressure – McLeod Gauge and Pirani Gauge, **Temperature** - bi-metal thermometers, resistance thermometer, thermistors, thermocouples, Radiation and optical pyrometers, **Flow** – Hot Wire anemometer and magnetic flow meters, Liquid level measurement in open vessels and in pressure vessels, Thermal conductivity measurement of solids, liquids and gases, Measurement of diffusivity in gases.

Unit 2 **(08 Hrs)**

Dynamics of First Order Systems

Introduction

Need for studying process dynamics and control, Laplace transforms and its application to process dynamics, characteristics of ideal forcing functions (step, ramp, pulse, impulse, frequency)

Linear open loop Systems – First Order Systems

Definition, characteristics and physical examples of first order systems such as thermometer, liquid tank, CSTR etc., model transfer function and significance of time constant, Dynamic behavior/Response of first order systems to different forcing functions, linearization of non-linear systems (for single variable systems only)

Unit 3 **(08 Hrs)**

Dynamics of Second Order Systems

Definition, characteristics and physical examples of second order systems such as manometer, interacting and non-interacting tank systems, model transfer function, Dynamic behavior of second order systems to different forcing functions, Response of Second order system – underdamped, critically damped and overdamped, Transportation lag, Processes with complex dynamics.

Unit 4 **(08 Hrs)**

Linear Closed Loop Systems

Control systems, components of a control system, Concept of feedback control, Controller and final controlling element, pneumatic control valve, control system hardware. Different types of control actions – P, PI, PD, PID; transfer functions, open and closed loop response, advantages and limitations of each controller, Block diagram of a control system, servo and regulatory operations, open and closed loop transfer function, overall transfer function, transfer function for change in load and set point, multi-loop control system transfer function.

Unit 5 **(08 Hrs)**

Stability Analysis and Frequency Response Analysis

Concept of stability in control systems, stability criterion, Routh's test for stability, root locus analysis, root locus design and plots, frequency response analysis and stability criterion (Bode plots), controller tuning - Ziegler Nichols and Cohen-Coon methods.

Unit 6 **(08 Hrs)**

Advanced Control Systems and Industrial Applications

Introduction to advanced control systems: Cascade, feed forward, selective, ratio, over ride and split range control strategies; fuzzy logic and neural networks Application to fermentation industries: Speed control, Temperature control, Control of gas supply, Control of pH, Control of dissolved oxygen, Antifoam control.

Text Books:

1. George Stephanopoulos., "Chemical Process control : An Introduction to Theory and Practice"Pearson Prentice Hall
2. Stanbury, P.F. and Whitaker, A., "Principles of Fermentation Technology",Butterworth-Heinemann

Reference:

1. Coughanowr, D., "Process System analysis and control" Mc-Graw Hill
2. A.K.Jairath., "Problems and Solutions of Control Systems", CBS

Following Fields are applicable for course having Laboratory

Guidelines for Instructor's Manual

The Process Control Laboratory is a substantial part of the course “Instrumentation and Process Control” and is constructed to complement the lecture portion of the course. The labs are designed to provide the student with a physical understanding of the fundamental principles and basic concept of Process Control. This understanding is gained through the application of “text book” concepts and equations to real problems.

The student is to read the lab manual chapter assigned to each laboratory period BEFORE coming to the lab. Some labs contain thought questions or require that you perform some derivations before proceeding.

Guidelines for Student's Lab Journal

Write your formal report. This will be an easier task if done soon after lab while the concepts are fresh in your mind. Students who wait for the last minute often discover unanticipated problems.

Formal reports will be due one week after the experiment was performed. Final report should reflect the understanding and work performed by individual on the report. In no case should anything other than the raw data be copied from other students’ work.

Purpose of the experiment: State the overall objective of the laboratory exercise first and then explain the objective of each particular experiment.

Apparatus and procedure: Briefly explain the procedure followed in the experiment. A concise explanation of the equations to be used in the computations should be given. Derivations of these equations are not necessary unless specifically indicated by the instructor or the manual.

Tabulation of computed results: Computed results should be presented in a neat table with all rows and columns clearly defined. Specify the correct units at the heading of each column (row) in the table. **Specify all units clearly.**

Sample calculation: Show one complete set of typical calculations explaining step-by step how the results have been computed (for each type of calculation). One set of actual readings taken in the experiment should be used in the sample calculations. Units should be specified for all computed quantities. Handwritten calculations are OK here, but keep them neat and organized. **Specify all units clearly.**

Discussion: Discuss the results obtained and summarize your conclusions. This section should answer any questions that are stated or implied in the purpose. Assumptions made, difficulties encountered during the experiment, percentage error, and possible sources of error should also be included in the discussion.

Guidelines for Lab /TW Assessment

Attendance is required for all of the lab sessions. Each session, except one demonstration activity, requires the completion of a formal lab report. These reports are the basis of your final lab grade. Each assignment represents a substantial fraction of your total score.

General Guidelines:

Before starting any experiment, clearly define the goals. What question are you answering or what principle are you trying to demonstrate? What data is needed to solve the problem?

Identify the methods of measurement and instrumentation to be used. At the research stations, "play around" with the equipment so that you understand how the instruments work, what you are measuring, and how what you are measuring connects with the physics of the problems at hand.

Perform your calculations before leaving the lab if time allows. This can help you to better understand the concepts and equations presented in lab, and allow you to spot data collection errors while there is still time to take new measurements.

Suggested List of Laboratory Assignments

Sr. No.	**Group A**
1.	Temperature Measurement Using RTD, Bimetal Thermometer.
2.	Temperature Measurement using Thermocouple.
3.	Dynamic Behavior Of Liquid (Mercury) Expansion Thermometer

Group B

1. Level Measurement Using Capacitance Probe
2. Frequency Response using MATLAB.
3. Root Locus using MATLAB

Group C

1. Bode Plot using MATLAB
2. SIMULINK

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315473: Bioinformatics
Credit :05

Teaching Scheme:

TH: 04 hr/week
PR: 02 hr/week

Examination Scheme:

In-Sem - 30 Marks
End-Sem - 70 Marks
Oral - 50 Marks
Total - 150 Marks

Prerequisites: -

- Knowledge about Molecular Biology, Genetic engineering and genome sequencing.
- Basics of computer language like algorithms computer programs and how they function.

Course Objectives:

1. To give an overview of bioinformatics, databases and their applications with respect to genome analysis.
2. To acquaint students with various genomic databases available and the way to access and utilize them.
3. To introduce primary, secondary and structural databases of proteins and the way to access them and retrieve information for a specific purpose.
4. To introduce sequence alignment and make the students understand the concept of algorithms.
5. To introduce phylogeny and tree concept and their application to bioinformatics.

Course Outcomes:

A. Students get introduced to concepts in bioinformatics and get an idea of applying these concepts in genomic data analysis.
B. The students get introduced to various databases available and also understand how to access them for retrieving genomic information of relevance.
C. Students get to know various protein databases, can access and retrieve protein information for a specific aim
D. Students learn the application of phylogenetic analysis and bioinformatics to pharmacology.
E. Students learn sequence alignment and apply it for primer designing and other similar applications they also understand the method to analyze the alignment and its importance.

UNIT 1 **(6Hrs)**

Overview of Bioinformatics and Database

Introduction to Bioinformatics, Terminologies used, Scope and Goals, Overview of applications in vaccine designs, File formats, Annotated sequence databases, Genome and Organism specific Databases, Database Management system: Data structure, Query language Basics of Structured Query Language (SQL), Relational Model, Object Model, Object oriented and Relational databases.

UNIT 2 **(8 Hrs)**

Nucleic Acid Databases

Genbank, DNA Data Bank of Japan (DDBJ), EBI, European Molecular Biology Laboratory (EMBL), NCBI's Data model, Specialized genomic recourses as SGD, UniGene. Data retrieval with the help of Entrez, DBGET, LinkDB and SRS. Database Searching, Description of the entries and Sequence Data File, Sample Sequence Data File, Representation of sequence.

UNIT 3 **(8 Hrs)**

Protein Databases

Polypeptide sequence and properties, Primary, Secondary, Tertiary & Quaternary Structure, Hydrophobicity, Disulphide bonds, Active Sites, Secondary structure composition, backbone flexibility, Ramchandran Plot, **Primary protein Databases** as PIR, SWISS-PROT, TrEMBL. Database Searching, Description of the entries and Sequence Data File, Sample Sequence Data File, Representation of sequence.

UNIT 4 **(7 Hrs)**

Structural Bioinformatics

Secondary databases: Derivation and searching of Patterns, Motifs and Profiles databases like PROSITE, PRINTS, BLOCKS. **Structure Classification databases** as SCOP, CATH, and PDB. Evolution of protein structure and sequences by comparing different organisms. Various tools for protein Structure Visualization Rasmol, Swiss-PDB etc. Proteomics definition and application.

UNIT 5 **(8 Hrs)**

Alignment of sequences

Introduction to sequence alignment, Pairwise and Multiple Sequence Alignment, Dot Plot, Clustering Algorithms, Needleman-Wunsch & Smith-Waterman Algorithm, Local and Global Sequnce Alignment, Substitution Matrices such as PAM and BLOSUM, PSSM, HMM etc., Gaps & gap penalties Calculation of alignment's statistical significance, Importance of Identity matrixes, gaps and penalties, Heuristic method for database similarity searches such as FASTA, BLAST and different variants of BLAST.

UNIT 6 **(8 Hrs)**

Introduction to phylogenetics

Phylogenetic Analysis: Elements of phylogenetic models, Homologs, orthologs and paralogs phylogenetic data analysis: alignment, substitution, parsimony, model building, building the data model (alignment), determining substitution model, phylogenetic prediction, evolutionary tree construction, tree building methods, rooted and unrooted trees, data phylogenetic software like PHYLIP, CLUSTAL W, Tcofee, Phylogenetics on the web

Text Books:

1. Introduction to Bioinformatics, by Arthur M. Lesk Oxford University Press, Oxford University Press.
2. Bioinformatics- Methods & Applications by S.C.Rastogi, N. Mandiratta, P. Rastogi

Reference Books:

1. Bioinformatics Sequence and Genome Analysis by David W. Mount, 2nd edition, Cold Spring Harbor Laboratory Press
2. Bioinformatics: A practical guide to the analysis of genes and proteins A. D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons
3. Bryan Bergeron, “Bioinformatics computing”, Pearson Education [BB].

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315474: Demonstration of Diagnostics

Credit: 01

Teaching Scheme: **Examination Scheme:**
Practical: 2 hr/week **Term Work: 50 Marks**

Prerequisites: - Knowledge cell biology and microbiology

Course Objectives:

- To introduce concepts of disease resistance in host.
- To learn about the structural features of the components of the immune system.
- To learn functions of immune cells and tissues and organs
- To bring understanding of the mechanisms involved in immune system function in health and disease.

Course Outcomes:

On completion of the course, learner will be able to–

- Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
- Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses
- Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation and memory
- Understand the molecular basis of complex, cellular processes involved in immunity, in states of health and disease

Demonstration of Diagnostics methods such as:

1. Differential staining of Peripheral blood smear
2. Quantitation detection of immunoglobulin using precipitation reaction
3. Haem-agglutination – blood grouping
4. Determination of antibody titer by Radial Immuno Diffusion (RID)
5. OuchterlonyImmunodiffusion (ODD)
6. Preparation of ‘O’ and ‘H’ antigens of Salmonella Vaccine preparation

Text Books:

1. R. A. Goldsby, T.J. Kindt, B.A. Osborne, “Kuby- Immunology”, 4th Edition
2. Essentials of Immunology (6th Edition): Ivan Roit- Blakswell ScientificPublications, Oxford, 1988

Reference Books:

1. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988
2. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold springharbor laboratory

Savitribai Phule Pune University, Pune
Third Year of B.Tech. Biotechnology (2015 Course)
315475: Seminar

Credit: 01

Teaching Scheme:	**Examination Scheme:**
Tutorial: 1 hr/week	**Term Work: 50 Marks**

Seminar:

The students should deliver the seminar on a topic approved by authorities and submit the report

315476: Audit Course 4

In addition to credits courses, it is recommended that there should be audit course (non-credit course). Audit course is for the purpose of self-enrichment and academic exploration. Audit course carry no academic credit. Selection of audit courses helps the learner to explore the subject of interest in greater details resulting in achieving objective of audit course's inclusion. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

Criteria:

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the semester grade report for that course, provided students has the minimum attendance as prescribed by the Savitribai Phule Pune university and satisfactory in-semester performance and secured a passing grade in that audit course. No grade point is associated with this "PP" grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

1. Lecture/Guest lecture
2. Visit (Social/field) and reports
3. Demonstrations
4. Surveys
5. Mini project
6. Hands on experience on specific focused topic
7. IIT Mooc/EDX/NPTEL

Guidelines for Assessment:

1. Written test
2. Quiz
3. Demonstrations/practical test
4. Presentations
5. IPR/publication
6. Report

Audit course 2 Options (Any one)

1. Professional Ethics and Etiquettes
2. Experimental data analysis