Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)

Savitribai Phule University of Pune
Second Year Biotechnology Engineering
(2015 Course)

SEMESTER I												
Course Code	Course	Teaching Scheme , Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory(TH)	Tutorials(TUT)	Practical(PR)	On Line	TH	TW	PR	OR	Total	TH/ TUT	PR+OR
215461	Applied Chemistry	04	--	--	50	50	25	--	--	125	04	--
207004	Engineering Mathematics –III	04	01	--	50	50	25	--	--	125	05	--
215462	Fluid Flow & Unit Operations	04	--	02	50	50		--	50	150	04	01
215463	Material Balances & Stoichiometry	03	01	--	50	50	50	--	--	150	04	--
215464	Microbiology	03	--	04	50	50	25	50	--	175	03	02
215465	Technical Communications	01	--	02	--	--	25	--	--	25	01	01
									Total		**21**	**04**
	Audit Course 1	--	--	--	--	--	--	--	--	--	**Grade**	
	Total	19	02	08	250	250	150	50	50	750	**25**	

SEMESTER II												
Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory(TH)	Tutorials(TUT)	Practical (PR)	On Line	TH	TW	PR	OR	Total	TH/TUT	PR/OR
215466	Biochemistry – I	04	--	02	50	50	--	50	--	150	04	01
215467	Heat Transfer	04	--	02	50	50	25	--	--	125	04	01
215468	Cell Biology & Tissue Culture	04	--	02	50	50	25	--	50	175	04	01
215469	Thermodynamics	03	01	--	50	50	25	--	--	125	04	--
215470	Genetics & Molecular Biology	04	--	04	50	50	25	50	--	175	04	02
										Total	**20**	**05**
	Audit Course 2	--	--	--	--	--	--	--	--	--	**Grade**	
Total		**19**	**01**	**10**	**250**	**250**	**100**	**100**	**50**	**750**	**25**	

Abbreviations:

TW : Term Work

OR : Oral
PR : Practical
PP : Passed (Only for non credit courses)
NP : Not Passed (Only for non credit courses)

Semester I

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215461: Applied Chemistry

Credits

TH: 04 PR: 00

Teaching Scheme:
TH: 04 hrs/week

Examination Scheme:
TH On line: 50
TH : 50
TW: 25
Total: 125

Prerequisites: **Students should have the basic knowledge of chemistry**

Course Objectives:

- To make acquainted with functioning of buffering system
- To understand the working of basic biomolecules
- To recognize the clinical manifestations of vitamins and mineral deficiency

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

- Understand the functioning of various buffering system existed in human body
- Recognize the structure and function of various biomolecules
- Correlate various diseases associated with vitamin and mineral deficiency

Course Contents

Unit I **(6 Hrs)**
Water and buffer: Weak interactions in aqueous systems, Ionization of water, weak acid weak bases, Ion product of water, acids and bases, buffers, buffering against pH changes in biological systems, fitness of the aqueous environment for living organisms, Problems using the Henderson-Hasselbalch equation, Blood, Lungs, and buffer: The bicarbonate buffer system, Water as a reactant.

Unit II **(6 Hrs)**
Carbohydrate: Monosaccharides and disaccharides, Polysaccharides, Homopolysaccharides in the role of fuel and structural, Heteropolysaccharides, Glycoconjugates- Proteoglycans, Glycoproteins, and glycolipids, Carbohydrate as informational molecules- Lectin

Unit III **(6 Hrs)**
Proteins: Common Structural features of amino acids, classification of amino acids (on the basis of R groups, functions of uncommon amino acids, acid base properties of amino acids and titration curve.Peptides and proteins, Separation, Purification and characterization of proteins by electrophoresis.Covalent structure of proteins, Investigation of proteins with mass spectrometry, Protein sequences and evolution, The Lambert-Beer law, Ramchandran Plot

Unit IV **(6 Hrs)**

Nucleotides and Nucleic acids: Chatacteristic bases and pentoses, phosphodiester bond, properties of nucleotide bases and three dimensional structure of nucleic acids, Nucleic acid structure, Nucleic acid chemistry, Determination of sequences of DNA, Functions of nucleotides.

Unit V **(7 Hrs)**

Lipids: Storage lipids, Fatty acids as hydrocarbon derivatives, Triacylglycerol, Waxes as energy stores and water repellents, Structural lipids in membranes, Glycerophospholipids, Galactolipids, Sulfolipids, Sphungolipids, Inherited human diseases resulting from abnormal accumulations of membrane lipids, Lipids as signals, cofactors and pigments, Lipid extraction, Adsorption chromatography and Gas liquid chromatography in separation of lipid, Lipid structure determination by Mass spectrometry, Composition and architecture of membranes.

Unit VI **(6 Hrs)**

Vitamins and Minerals: classification and functions of vitamins, (vit B1, B2 ,B6 , B12, vit C), fat soluble vitamins (vit A, D, E, K), recommended dietary allowance , Vitamins defeciencies (night blind ness, keratomalacia, rickets, osteomalacia prolonged clotting time etc.) clinical manifestations of mineral deficiency (termatitis, dementia, diarrhoea, pernicious anaemia, scurvey etc)

Books:

Text:

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:

1. J H Weil, “General Biochemistry”, New Ages International (P) Ltd. 1997.
2. J M Berg, J L Tymoczko, L Stryer , “Biochemistry”, 6th ed., Freeman WH & Company, New York, 2007
3. D L Nelson, M M Cox “Principles of Biochemistry”, 4th ed., W.H. Freeman and company, New York, 2007

Savitribai Phule Pune University, Pune
Second Year B.Tech Biotechnology (2015 Course)
207004 : -Engineering Mathematics –III

Credits

TH/TUT: 04 PR: 00

Teaching Scheme:
TH : 4 hrs/ week
TUT: 01 hrs/week

Examination Scheme:
TH Online : 50
TH : 50
TW : 25
Total :125

Prerequisites: - Differential and Integral Calculus, Taylor series and Infinite series, Linear Differential equations of first order and first degree, Fourier series, Vector algebra.

Course Objectives:

After Completion of the course, student will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Ordinary and partial differential equations applied to Chemical engineering problems, heat and mass transfer.
2. Integral Transforms such as Laplace transform, Fourier transform and applications to ordinary and partial differential equations arising in Vibration theory, Fluid Mechanics, Heat and Mass Transfer and Thermodynamics.
3. Vector differentiation and integration applied to problems in Fluid Mechanics.

Course Outcomes:

At the end of this course, students will be able to:

1) Solve higher order linear differential equations and apply to modeling and analyzing chemical transformation and heat and mass transfer systems.
2) Apply Laplace Transform and Fourier Transform techniques to solve differential equations involved in vibration theory, Liquid level systems and related chemical engineering applications.
3) Perform vector differentiation and integration, analyze the vector fields and apply to fluid mechanics problems.
4) Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents

Unit I: Linear Differential Equations (LDE) and Applications (09 Hours)

LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Applications of LDE to chemical engineering problems and mass spring system.

Unit II: Fourier Transform (FT) (09 Hours)

Fourier integral theorem. Fourier Sine & Cosine integrals. Fourier Transform, Fourier Cosine Transform, Fourier Sine Transforms and their inverses. Finite FT, Application of FT to problems on one and two dimensional heat flow problems.

Unit III: Laplace Transform (LT) and Applications (09 Hours)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. error, First order Bessel's, Periodic, Unit Step, Unit Impulse, ramp, jump, parabolic, Si(t) and Ei(t).

Applications of LT for solving ordinary differential equations, liquid level systems, consisting of single tank and two tanks in series (interacting and non-interacting systems), second order systems (damped vibrator).

Unit IV: Vector Differential Calculus (09 Hours)

Physical interpretation of Vector differentiation. Radial, Transverse, Tangential & Normal components of velocity and acceleration. Vector differential operator, Gradient, Divergence & Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09 Hours)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem.

Applications of vectors to problems in Fluid Mechanics, Continuity equations, Stream lines, Equations of motion, Bernoulli's equations.

Unit VI: Applications of Partial Differential Equations (PDE) (09 Hours)

Basic concepts, modeling of Vibrating string, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Applications of PDE to problems of Chemical and allied engineering.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartika & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work:

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215462: Fluid Flow and Unit Operations

Credits

TH: 04 PR: 01

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

Examination Scheme:
TH Online: 50
TH : 50
OR : 50
Total : 150

Prerequisites: -

Basic Knowledge of Physics and Mathematics.

Problem Solving ability, Information manipulation and Processing skills.

Course Objectives:

- To provide familiarity with the nature and properties of fluids and to understand the basic equations of fluid flow along with their respective applications
- To provide concept of pressure drop and energy losses during fluid flow
- To familiarize students with unit operations based on solid liquid systems and the related equipment's
- To introduce students to particle technology – basic concepts, laws and unit operations involved in pretreatment for different bioprocesses

Course Outcomes:

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

- Characterize fluids encountered in Biotechnology industries and predict their flow behavior.
- Select and operate equipment based on the properties of the material being handled.
- Select, design and operate systems based on fluidization.
- Select and operate equipment based on the properties of the material being handled.

Course Contents

Unit I **(08 Hrs)**

System of units and conversions; Fluid – Definition and important properties, viscosity, temperature and pressure dependence, Newton's law, Classification of fluids; Fluid statics: hydrostatic forces on surface, Pressure and its measurements; Types of flow, Laminar and turbulent flow – Concept of Reynold's number; Formation and separation of boundary layer.

Unit II **(08 Hrs)**

Laws of incompressible potential flow: Mass balances - Continuity equation and its applications to fluid dynamics, Energy balances in fluid dynamics: Euler's equation, Bernoulli's equation and its applications, Flow measurement using venturimeter, orificemeter and pitot tube; Hagen Poiseuelle equation, turbulent flow in pipes, effect of roughness, friction in flowing fluid, Moody,s diagram; Minor losses in pipe flow, effect of fittings and valves.

Unit III **(08 Hrs)**

Introduction to the dynamics of suspended particles: Lift and drag forces, drag coefficients; Flow of solids through fluids: Gravity settling of particles, Terminal velocity, Stoke's law and Newton's law, Free and hindered settling, Sink and float method, Differential settling method; Sedimentation: Batch and continuous, equipments for sedimentation, Kynch theory of sedimentation, Centrifugal settling: Advantages and equipments – cyclones and hydrocyclones.

Unit IV **(08 Hrs)**

Flow of fluid through solids: Characteristics of flow through packed beds - Darcy's equation, Equations for laminar flow (Kozeny Carmen) and turbulent flow (Burke Plummer), Ergun equation; Introduction of fluidization, minimum fluidization velocity, characteristics of fluidized systems, types of fluidization and their applications.

Unit V **(08 Hrs)**

Fluid moving machinery-pumps, Types of pumps: positive displacement pump and centrifugal pumps, Characteristics of Centrifugal Pumps, NPSH; Valves and their types; Mixing and Agitation - Necessity of mixing and agitation, Types of Impellers – Radial and axial flow, Different flow patterns in mixing, Agitator selection, Calculation of power requirement, Mixing equipment; Mixing equipment for pastes and viscous material

Unit VI **(08 Hrs)**

Particle Technology: Properties of solids - Particle size and shape, Mixtures of particles, Determination of particle size; Screening - Standard screen series, screen analysis, Screen effectiveness and capacity, Industrial screening equipment; Size reduction: Crushing efficiency, energy requirements calculations by using different crushing laws, Size reduction equipment: Primary crushers, secondary crushers, Intermediate and fine grinders, Open circuit and Closed circuit grinding.

Books:

Text:

4. R K Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", 9th ed., Laxmi Publications, New Delhi, 2004
5. McCabe, Smith, Harriot, "Unit Operations in Chemical Engineering", 7th ed., Tata McGraw Hill Publications

Reference:

1. R K Rajput, "A Textbook of Fluid Mechanics", S. Chand Ltd., 2008
2. George Granger Brown, "Unit Operation"; Asia Publishing House', First Edition
3. Bird R.B., Stewart W.E., Lightfoot E.N. "Transport phenomena" 2ed., Wiley Publications, 2002.

Guidelines for Instructor's Manual

The Fluid Flow Laboratory is a substantial part of the course “Fluid Flow and Unit Operations” 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 equations of fluid mechanics. 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

Though the class will work in groups to collect data for each set of experiments, reports should be submitted individually. Formal reports should be completed with a computer, including all final calculations, charts, and data tables.

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.

Guidelines for Laboratory Conduction

Safety Guidelines:

Be very careful and aware of the various experiment controls (start button, stop button, speed control) for each lab session.
Ask lab instructor, if you are not sure about what to do.

Make sure all spilled liquids are wiped up immediately.
Do not leave experiments unattended.
Any injuries should be reported immediately for proper care.

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 the experiment. Collect data in a clear and organized fashion. **Be sure to note the units** for each measurement. Also, be sure to participate in the experiment rather than just recording data for your group.

Suggested List of Laboratory Assignments

Sr. No.

Group A

1. Determination of viscosity
2. Flow through venturimeter
3. Flow through orifice meter.

Group B

1. Friction during flow through pipe
2. Verification of Bernoulli’s theorem
3. Verification of Stoke’s law

Group C

1. Verification of Darcy’s law
2. Flow through pipe fittings
3. Flow through packed bed

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215463: Material Balance and Stiochiometry

Credits

TH: 04 PR: 00

Teaching Scheme:

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

Examination Scheme:

TH Online: 50
TH : 50
TW: 50
Total: 150

Prerequisites: -

- Basic concepts of fundamental and derived properties and their units.

Course Objectives:

- To introduce the concept of unit operations and unit processes and develop an ability to perform basic chemical calculations involved in bioprocesses
- To make students conversant with different unit operations used in the process industry and formulate material balances for each step
- To make students conversant with different unit processes and chemical reactions encountered in the process industry and formulate material balances for each step
- Provide familiarity with energy balance calculations involved in different unit operations and unit processes
- To develop an expertise in process design of important unit operations by combining the knowledge of material and energy balances
- To familiarize students with different types of fuels, their properties and related combustion calculations

Course Outcomes:

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

- Sort a bioprocess into different unit operations and processes and apply basic chemical calculations to them
- Apply material balances to different physical steps in a process and thus efficiently design processes and equipments
- Design processes and equipments requiring both physical, chemical and biochemical changes
- Quantify heat and energy changes accompanying unit operations and unit processes
- Effectively combine the knowledge of material and energy calculations for efficient process design of bioprocess equipments
- Predict efficiency of combustion and analyze the requirements and product formation in such operations for optimum use of the fuels

Course Contents

Unit I **(6 Hrs)**

Basic Chemical Calculations: Introduction to unit processes and operations and their symbols, process flow sheet, Basic Chemical Calculations including mole, equivalent weights, solids, liquids, solutions and their properties, properties of gases.

Unit II **(10 Hrs)**

Material Balances without Biological/ Chemical Reactions: Concept, material balance calculations, recycling and bypassing operations, introduction to unsteady state processes.

Unit III **(10 Hrs)**

Material Balances involving Biological/ Chemical Reactions: Concept, material balance calculations, electrochemical reactions, recycling and bypassing operations.

Unit IV **(8 Hrs)**

Energy Balances : Concept, energy and Thermochemistry, energy balances, heat capacity of pure substances and mixtures, latent heats, enthalpy of pure substances and mixtures, absolute enthalpy, heat of reaction, adiabatic reactions, thermochemistry of mixing processes, dissolution, liquid-liquid mixtures, gas-liquid systems.

Unit V **(6 Hrs)**

Stoichiometry and Unit Operations: Distillation, absorption and stripping, extraction and leaching, crystallization, psychrometry, drying, evaporation, introduction to stoichiometry and industrial problems.

Unit VI **(6Hrs)**

Combustion: Calorific values, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations.

Books:

Text:

1. B. I. Bhatt, S.B. Thakore, “Stoichiometry” 5th Edition, Tata McGraw Hill Publications, New Delhi (2011)
2. David M. Himmelblau “ Basic Principles and Calculations in Chemical Engineering” 6th Edition, Eastern Economy Edition, Prentice Hall of India

Reference:

1. K.A. Gavhane, “Introduction to process calculations stoichiometry”, 22nd Edition, Nirali Prakashan (2009)

Guidelines for Lab /TW Assessment

Term work marks will be calculated on the basis of:

- Theory attendance
- Tutorials attendance
- Tutorials evaluation
- Completion date of tutorials

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215464: Microbiology

Credits

TH/TUT: 04 PR: 02

Teaching Scheme:

TH: 04 hrs/week
PR : 04 hrs/week

Examination Scheme:

TH Online: 50
TH : 50
PR: 50
TW: 25
Total: 175

Prerequisites: Basic knowledge of Biology and Chemistry

Course Objectives:

1. To introduce the concept, development and significance of microbiology in day to day life.
2. To train the students to handle, utilize and eliminate microorganisms from different environments
3. To make the students aware of the ubiquitous nature, diversity, physiology, metabolism and growth of different microorganisms and their significance in biotechnology
4. To introduce the concept of diseases and role of microorganism in different diseases

Course Outcomes:

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

A. Graduates are made aware of significance of microbiology
B. Graduates would be trained to identify, handle, cultivate and eliminate microorganisms from different environments
C. Graduates are trained to understand growth requirements of different microorganisms
D. Graduates are able to understand significance of clean and aseptic techniques.
E. Graduates are made aware of different microbiology related processes in the fields of agriculture, medicine and food
F. Graduates can identify general principles of microbiology, underlying cause, treatment and prevention of diseases

Course Contents

Unit I **(8 Hrs)**

Introduction to Microbiology: The History and scope of microbiology, Types of Microorganisms: Bacteria, fungi, algae, protozoa, actinomycetes, viruses. The Study of Microbial Structure: Prokaryotic & Eukaryotic Cell Structure and Function. Microscopy and Specimen Preparation: Types of Microscopes. Microbial classification, Taxonomy.

Unit II **(8 Hrs)**

Microbial nutrition and growth: Nutritional types of microorganisms, Growth and reproduction of bacteria: growth requirements, growth media, pure cultures, growth curve. Enumeration of bacteria, enrichment of bacterial cultures, batch culture, continuous cultures, synchronous culture, factors affecting growth, extremophiles.

Unit III **(8 Hrs)**

Control of Microorganisms by Physical and Chemical Agents: Sterilization and disinfection, Wet and dry heat, filtration, Antimicrobial agents, antibiotics. Drug resistance.

Unit IV **(8 Hrs)**

The Viruses: Introduction and General Characteristics: Classification and structure: Animal viruses, plant viruses, DNA viruses, RNA viruses, oncogenic viruses. Replication of viruses, life cycle, lysogeny, lytic cycle, lambda phage, T4 phages. Methods of cultivation. Antiviral Drugs

Unit V **(8 Hrs)**

Microbiology of air, water, soil, food, milk: waste water, potability of water, microbial interactions in environment, commensalisms, antagonism, symbiosis

Unit VI **(8 Hrs)**

Medical microbiology: The Epidemiology of Infectious Diseases, Human diseases caused by bacteria –Typhoid, Cholera, Shigellosis, Tuberculosis. Viral diseases- Rabies, HIV, influenza, fungal diseases – candidiasis, dermatophytes.

Books:

Text:

1. Prescott Harley Klein, Microbiology, Fifth Edition, “Microbiology”, 5th Edition, The McGraw Hill Companies, 2002
2. Michael Pelczar, “Microbiology”, 5th Edition, Tata McGraw-Hill Education, 1993
3. Michael T., Madigan, John M. Martinko, Jack Parker, “Brock biology of microorganisms”, Prentice Hall, 2000.

Reference:

1. A. J. Salle, “Fundamental Principles of Bacteriology”, 7th edition, Tata McGraw- Hill education.
2. Roger Y. Stainier et al. “General Microbiology” , 5th edition., PHI Publication.
3. Tortora, “Microbiology: An Introduction”, 9th edition, Pearson Education India, 2008.
4. Schlegel H.G. – “General Microbiology” , 8th edition, Cambridge University Press, 1995.
5. Robert Cruikshank, “Medical Microbiology”, Churchill Livingstone, 1975.
6. Thomas Jones Mackie, et al, “Mackie & McCartney medical microbiology: a guide to the laboratory diagnosis and control of infection”, Churchill Livingstone, 1989

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

Please read these instructions now and refer to them regularly!

These instructions must be followed carefully

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 /TW 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

Basic Principles for Students Working in Microbiology Laboratories :

The lab exercises in this course involve the use of living organisms. Although the microorganisms we use are not considered to be highly virulent, **all microorganisms should be treated as potential pathogens** (organisms capable of causing disease).

The following rules must be observed at all times to prevent accidental injury to and infection of yourself and others and to minimize contamination of the lab environment:

1. **Never place books, backpacks, purses, etc., on bench tops.** Always place these in the assigned cubicles. Keep manuals and pens on pull-out desks.
2. Clean your work area with dilute bleach solution at the **beginning AND end** of each lab.
3. **Wash your hands** with soap and dry with paper towels when entering and leaving the lab.
4. Wear a **lab coat** at all times while working in the lab to prevent contamination or accidental staining of your clothing.
5. **Closed-toe shoes** (no sandals) are to be worn in the lab.
6. **Long hair must be tied back** to prevent exposure to flame and contamination of cultures.
7. **Do not place anything in your mouth or eyes while in the lab.** This includes pencils, food, and fingers. Keep your hands away from your mouth and eyes.
8. Eating and drinking are **prohibited** in the lab at all times. This includes gum, cough drops, and candy.
9. **Never pipet by mouth.** Use a mechanical pipetting device.
10. **Do not remove media, equipment, or bacterial cultures from the laboratory.** This is absolutely prohibited and unnecessary.
11. Do not place contaminated instruments such as inoculating loops, needles, and pipettes on bench tops. Loops and needles should be sterilized by incineration, and pipettes should be disposed of in designated receptacles of bleach solution.
12. Carry cultures in a test tube rack when moving around the lab or when keeping cultures on bench tops for use. This prevents accidents and contamination of your person or belongings.
13. **Immediately cover spilled cultures or broken culture tubes with paper towels and then saturate them with disinfectant solution.** Notify your instructor that there has been a spill. After 15 minutes, dispose of the towels and broken items as indicated by your instructor.
14. **Report accidental cuts or burns to the instructor immediately**.
15. At the end of each lab session, place all cultures and materials in the proper disposal area.
16. Electronic devices should not be brought into the lab. This includes, but is not limited to iPods, MP3 players, radios, cell phones, and calculators.

Suggested List of Laboratory Assignments

Group A

1 Study of laboratory equipments.
- Introduction and working of basic laboratory instruments.

2 Bacterial staining
- Simple and negative staining, differential (Gram's staining).

Group B

1 Culture media preparation and aseptic techniques
- Preparation of nutrient media and sterilization:
- Nutrient broth and agar, Sabouraud's agar, Culture transfer techniques.

2 Pure culture techniques
- Streak plate method, Cultural characteristics.

Group C

1 Counting techniques of microorganisms
- Direct Microscopy method, Neubauer's slide.
- Serial dilution, Pour plate method, Surface spread plate method

2 Physical requirements for cultivation of microorganisms (Any one)
- Effect of temperature
- Effect of pH
- Effect of atmospheric oxygen

Group D

1 Study of growth curve of *E. coli.*

2 Control of microbial growth(Any one)
- Thermal death point (TDP)
- Thermal death time (TDT)
- Antibiotic sensitivity test
- Minimum inhibitory concentration (MIC)

Group E

1 Study of Molds and yeast
- Morphology of fungi on media.

2 Microbial study of water, soil, food and air. (Any one)
- Most probable number
- Settle plate technique
- Microbial populations in soil: Antibiotic producing organisms from soil

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215465: Technical Communications
Credits

TH : 00 PR: 01

Teaching Scheme:

TH: 01 hr/week
PR: 02 hrs/week

Examination Scheme:

TW: 25 marks
Total:25 marks

Introduction

Language and Communication: Linguistic communication, barriers to communication, importance of communication

Non verbal Communication: Body language, personal appearance, posture, gestures, facial expression, eye contact, space distancing

Communication in organizations: Pattern of communication, management information,

Personal communication: Face to face communication, telephonic communication, interviews, instruction and dictation, Public speaking and oral presentation; Active Listening

Meetings: Purpose, procedure, chairmanship, participation, physical arrangements

Seminars and Conferences: Types of discussion groups, regulating speech, conducting seminars, organizing conferences, evaluating oral presentations

Group Discussion: Group dynamics, purposes and organization.

Audiovisual Aids: Basic principles and guidelines, types of aids and their use, graphic aids

Formal reports: Definition, preparatory steps, types, structure, style, copy editing

Technical proposals: Definition, key factors, types, contents, format and evaluation

Research papers and articles: Literature survey, reference, writing, and abstract articles etc.

Business correspondence, notices, agenda, advertising etc; email writing

Term work:

Term work shall consist of a journal consisting of regular assignments and presentation completed in the practical class and at home. The total number of assignments should not be less than 10, generally covering the topics mentioned above. As far as possible, submission should be word processed on a computer using a standard package by the student himself. For the purpose of assignments, extensive use of research papers published in technical journals and articles published in magazines and newspapers may be made so that there is no repetition by the individuals. Oral presentations exercises and group discussions should be conducted batch wise so that there is a closer interaction.

Text Books:

1. Krishna Mohan and Meera Banerji “Developing Communication Skills” 2nd Edition, Macmillan Publishers India, 2009.
2. Day (1995), How to write and publish scientific paper, Cambridge Low-priced Edition

Semester II

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215466 : Biochemistry I

Credits

TH: 04 PR : 01

Teaching Scheme:

TH: 04 hrs/week

PR: 02 hrs/week

Examination Scheme:

TH On line: 50
TH : 50
PR: 50
Total: 150

Prerequisites: - Basic Knowledge of structure and function of biomolecules

Course Objectives:

- To provide an introduction to the basic concepts of biochemistry necessary for biochemical and biotechnology studies.
- To examine the main pathways of metabolism and how they are integrated with other pathways within the cell.
- To provide an understanding about disorders occur due to defects in metabolism

Course Outcomes:

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

- Understand metabolism of major classes of biomolecules like carbohydrates, lipids and proteins in living systems and their relation in between
- Apply knowledge of biochemistry to understand genetic diseases involving disorders of metabolism

Course Contents

Unit I (8 Hrs)

Principles of Bioenergetics: Bioenergetics and thermodynamics , Phosphoryl group transfer and ATP, The free energy of hydrolysis of ATP within cells, Energy required to assembly of informational macromolecules, Transphosphorylations between nucleotides, Potential phosphoryl group donor

Unit II (7 Hrs)

Glycolysis,Preparatory phase and Pay off phase, Cancerous tissues and glucose metabolism, feeder pathways for Glycolysis, Fates of pyruvate under anaerobic condition, gluconeogenesis Pentose phosphate pathway of glucose oxidation, Glucose 6-Phosphate dehydrogenase deficier

Unit III (8 Hrs)

Glycogens break down , Synthesis of glycogen and Starch and the role of nucleoside diphospha sugars, TCA cycle, discovery of TCA cycle, intracellular location of the enzymes of the TCA cycle, reactions of the TCA cycle, regulation of the TCA cycle, Electron transport chain, oxidative phosphorylation, cori cycle

Unit IV **(7 Hrs)**

Protein purification (molecular size, solubility difference, electric charge, selective adsorption, affinity chromatography), digestion and absorption of proteins, removal of nitrogen in amino acid degradation, ammonia toxicity, pathways of amino acid degradation, inherited defects of the urea cycle.

Unit V **(7 Hrs)**

Digestion and absorption of lipids beta oxidation of fatty acid, ketone bodies, ketoacidosis, oxidation of fatty acid in peroxisomes, degradation of odd chain fatty acid, oxidation of PUFA. Synthesis of fatty acid: Formation of malonyl CoA, role of fatty acid synthase in synthesis of fatty acids, transfer of acetyl CoA to the cytoplasm, sources of NADPH for fatty acid synthesis.

Unit VI **(7 Hrs)**

In borne errors of metabolism : Disorders of carbohydrate metabolism E.g., glycogen storage disease, Disorders of amino acid metabolism E.g., phenylketonuria, maple syrup urine disease, glutaric acidemia type 1, Urea Cycle Disorder or Urea Cycle Defects E.g., Carbamoyl phosphate synthetase I deficiency, Disorders of fatty acid oxidation Disorders of purine or pyrimidine metabolism E.g., Lesch-Nyhan syndrome.

Books:

Text:

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:

1 J H Weil, “General Biochemistry”, New Ages International (P) Ltd. 1997.
2. J M Berg, J L Tymoczko, L Stryer ,”Biochemistry”, 6th ed., Freeman WH & Company, New York, 2007
3. D L Nelson, M M Cox “Principles of Biochemistry”, 4th ed., W.H. Freeman and company, New York, 2007

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. Lab coat should be wear by students 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 Assignments

Sr. No.	Group A
1	Preparation of percent and molar solution
2	Preparation of phosphate buffer and measurement of pH
3	Testing buffering capacity of a buffer
4	Qualitative testing of glucose using Benedict's reagent
	Group B
1	Determination of λmax
2	Estimation of glucose using ortho-Toluedine method
3	Extractions of proteins from sprouted seeds
4	Protein estimations by Folins method
	Group C
1	Estimation of protein by spectrophotometer at 280 nm.
2	Extraction of cholesterol/lipids
3	Estimation of cholesterol concentration/lipids
4	Isolation of polysaccharide

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215467: Heat Transfer

Credits

TH : 04 PR : 00

Teaching Scheme:

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

Examination Scheme:

TH Online: 50
TH: 50
TW: 25
Total : 125

Prerequisites: - Knowledge of subjects like Material balances stiochiometry and Fluid mechanics**.**

Course Objectives:

1. To make students aware of basic principles and mechanism of heat transfer process.
2. To develop understanding of heat transfer systems and heat balance equations.
3. To study various heat transfer equipments and their application.
4. To provide information about the scope and applications of heat transfer in the field of biotechnology

Course Outcomes:

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

- Understand and apply knowledge of heat transfer principles
- Understand and write heat balances of the system.
- Choose suitable heat transfer equipment for the required process.
- Design heat transfer equipments.

Course Contents

Unit I (8 Hrs)

Introduction: Modes of heat transfer, conduction, convection, and radiation, Fourier's law of heat conduction, thermal conductivity of liquid, gases and solids, Concept of thermal resistance, thermal conductance and contact resistance, Convection: Types, Newton's law of cooling, Radiation: Fundamental facts and definition of terms: Emissivity, absorptivity, black body, gray body, opaque body, Stefan Boltzman law, Kirchoffs law, Planks law, Wien's law, Analogy between heat and momentum transfer, various cases of radiation between two surfaces, The shape factor, , Applications of heat transfer in biotechnology

Unit II (8 Hrs)

Conduction: Differential equation from shell balance for unsteady and steady state conduction. Introduction to unsteady state conduction, Steady state conduction in infinitely long slab, infinitely long hollow cylinder and hollow spheres, Thermal resistance in composite slab and cylinder, Heat losses through pipe, thermal insulation and optimum thickness of insulation, properties of insulator, Heat transfer from extended surfaces with uniform cross section, classification of extended surfaces, efficiency of longitudinal fin.

Unit III **(8 Hrs)**

Convection: individual and overall heat transfer coefficient, Natural and forced convection in laminar and turbulent flow, Analogy between heat and momentum transfer. Principal and heat balance equation in laminar flow and empirical equations for turbulent flow through tube, through annulus, over the plate, Concept of thermal boundary layer and its significance, Heat transfer with phase changes: Condensation: Modes and features; Heat transfer in boiling liquids: Pool boiling of saturated liquid, Concept of maximum heat flux and critical temperature drop.

Unit IV **(8 Hrs)**

Heat exchange equipment: Types of heat exchangers including compact heat exchangers, parallel flow arrangement, fouling factor, LMTD in parallel and counter flow, Effectiveness NTU method, shell and tube heat exchanger.

Unit V **(8 Hrs)**

Evaporation: Types of evaporators, performance, capacity and economy, Boiling point elevation, heat transfer coefficients, Material balance calculations, Multiple effect evaporators: Feed Forward and Feed Backward evaporator, Methods of feeding, capacity and economy, effect of liquid head and boiling point elevation

Unit VI **(Hrs)**

Dimensional analysis, units of various quantities used in heat transfer dimensional analysis, Importance of dimensional analysis in experimental design and data reduction Laminar and forced convection governing equations by Algebraic Rayleigh's method and Buckingham pi theorem, Significance of dimensional analysis in heat transfer, simple calculations for design of heat transfer systems

Books:

Text:

1. S. P. Sukhatme, "A Textbook on Heat Transfer", 4th ed, Universities Press (India), 2005
2. W.L. McCabe, J.C. Smith, P. Harriott, "Unit Operations of Chemical Engineering" 7th Edition. McGraw Hill Publication (2005)

Reference:

1. Frank Kreith, Mark Bohn, "Principles of Heat Transfer" 5th edition, PWS Publishing company, Boston (1997)
2. D. Q. Kern, "Process Heat Transfer", 11th ed., Tata Mc Graw Hill Publication, New Delhi
3. Bird R.B., Stewart W.E., Lightfoot E.N. "Transport phenomena" 2ed., Wiley Publications,2002
4. Sinnout R.K. "Coulson Richardson's chemical engineering vol.6" Pergamon Press, 1993

Guidelines for Instructor's Manual

1. Students should be briefed with risk assessment and safety 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, violations and take down of experiments.

Guidelines for Student's Lab Journal
These instructions must be followed carefully

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 /TW Assessment

Term work marks distribution should be carried out based on following points:

1. Regularity and sincerity of students during lab practical
2. Journal presentation
3. Understanding of the experiment
4. Performance in unit tests
5. Attendance during theory lectures

Guidelines for Laboratory Conduction

1. Please do not touch open wires.
2. Make the connection as per the circuit diagram.
3. Ensure that the connections are properly tightened then Start the power supply.
4. After the experiment is over reduce the dimmerstat to zero.
5. Switch off the power supply and remove the connections.
6. Turn off all valves and water supply completely.

Suggested List of Laboratory Assignments

Sr. No.	Group A – Conduction, Convection and Radiation
1	Heat transfer from fin in a natural convection
2	Heat transfer in forced convection
3	Composite wall apparatus
4	Emissivity Measurement
5	Thermal conductivity of insulating powder
	Group B - Heat Exchanger Equipments
6	Co current and countercurrent heat exchanger
7	Plate type heat exchanger
8	Heat pipe Demonstrator
	Group C –Study Experiments
9	Double effect evaporator Shell and tube heat Exchanger

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215468: Cell Biology & Tissue Culture

Credits

TH : 04 PR : 02

Teaching Scheme:

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

Examination Scheme:

TH Online: 50
TH : 50
TW: 25
OR : 50
Total : 175

Prerequisites: - Basic knowledge of Biology and Chemistry

Course Objectives:

1. To offer basic understanding of how eukaryotic cell functions
2. Different cell types offer different functionality
3. Role of various cell organelles with respect to cell function
4. Application of cell biology in biotechnology

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

1. To understand the structure and function of eukaryotic and prokaryotic cells.
2. To introduce basic techniques in cell biology.
3. Understand the application of cell biology in disease and development of therapy.
4. Give hands-on experience in cell biology techniques such as in-vitro cell culture

Course Contents

Unit I (8 Hrs)

The Cell, Structure of eukaryotic cell, chemical constituents of the cell, sub-cellular compartmentalization and organelles such as nucleus, Cytoplasmic matrix, cytoskeleton, Mitochondria, endoplasmic reticulum, Golgi complex, lysosomes, cellular dynamics, vacuoles, microfilaments, microtubules.

Unit II (8 Hrs)

Biomembranes, structure and function, endocytosis, exocytosis, ion channels, Transport of molecules across the membrane. Membrane proteins: Carrier proteins and active membrane transport, Electrical properties of membranes, action potential, transport of molecules in and out of nucleus.

Unit III **(8 Hrs)**

Intracellular signaling and communication. Extra cellular Matrix (ECM) General principles of communication: ion channels, morphogen, ion channels. Types of receptors GPCR, nuclear receptors and enzyme coupled cell surface receptor and regulated proteolysis of latent gene regulatory protein.

Unit IV **(8 Hrs)**

Cell cycle, Overview, Cell cycle control system, Karyokinesis, Cytokinesis, Control of cell division and growth, Mitosis, Meiosis, Apoptosis.

Unit V **(8 Hrs)**

Tissues: Epithelial tissue, connective tissue, muscle tissue, nervous tissue, blood. Stem cells: Heamatopoeitic stem cells & embryonic stem cells. Cancer: Development of Cancer and properties of Cancer.

Unit VI **(8 Hrs)**

Animal tissue culture: tissue culture media, Types of culture: Primary, explant, organ and continuous culture. Adherent cell lines and suspension cell cultures, Routine characterization of cells. Passaging, Preservation of animal cells.

Plant tissue culture:

Basics: Internal organization of plant, Plant growth hormones, Totipotency.Types of culture: Callus culture, Pollen culture, Anther culture, Protoplast fusion. Application: Production of secondary metabolites, transgenic plants.

Books:

Text:

1. Karp, “Cell and Molecular Biology” John Wiley and Sons Pvt. Ltd
2. Sudha Gangal, ‘Animal tissue culture’, Orient Longman, 2006

Reference:

1. Cooper G.M. & Hausman, “The Cell”,fifth edition, ASM Press.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. “Molecular Biology of the Cell”, 4th edition, Garland Publishing, New York, London, (2002)
3. Harvey Lodish etal “ Molecular Cell Biology”, 4th edition,New York
4. Gilbert S.F., “Developmental Biology”, Seventh edition, Sinai Associates.
5. Howell S.H,”Molecular Genetics of plant development”, Cambridge University Press.
6. Slack, “Essential Developmental Biology”, Blackwell Scientific.
7. Slack JM. “Egg and Ego”.
8. M.K. Razdan , “Introduction to Plant Tissue culture”.
9. Freshney Ian ,”Animal tissue culture”
10. Tortora and Grabowasky “Human anatomy and physiology”, Wiley publication

Guidelines for Instructor's Manual

1. Discuss the syllabus for the course
2. Go through the general procedures for lab safety
3. Review the guidelines for laboratory reports
4. Practice some of the scientific calculations that will be used throughout the semester
5. Practice some basic laboratory methods such as the use of balances, pipets, and Micropipettes
6. Students should be briefed with Risk Assessment and Biosafety Levels
7. All the instruments to be validated before use
8. All the experiments should be standardized
9. 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

Please read these instructions now and refer to them regularly!

These instructions must be followed carefully.

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 /TW 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

Basic Principles for Students Working in Cell Biology Laboratories :

The following rules must be observed at all times to prevent accidental injury to and infection of yourself and others and to minimize contamination of the lab environment:

1. **Never place books, backpacks, purses, etc., on bench tops.** Always place these in the assigned cubicles. Keep manuals and pens on pull-out desks.
2. Clean your work area with dilute bleach solution at the **beginning AND end** of each lab.
3. **Wash your hands** with soap and dry with paper towels when entering and leaving the lab.
4. Wear a **lab coat** at all times while working in the lab to prevent contamination or accidental staining of your clothing.
5. **Closed-toe shoes** (no sandals) are to be worn in the lab.
6. **Long hair must be tied back** to prevent exposure to flame and contamination of cultures.
7. **Do not place anything in your mouth or eyes while in the lab.** This includes pencils, food, and fingers. Keep your hands away from your mouth and eyes.
8. Eating and drinking are **prohibited** in the lab at all times. This includes gum, cough drops, and candy.
9. **Never pipet by mouth.** Use a mechanical pipetting device.
10. **Do not remove media, equipment, or bacterial cultures from the laboratory.** This is absolutely prohibited and unnecessary.
11. Do not place contaminated instruments such as inoculating loops, needles, and pipettes on bench tops. Loops and needles should be sterilized by incineration, and pipettes should be disposed of in designated receptacles of bleach solution.
12. Carry cultures in a test tube rack when moving around the lab or when keeping cultures on bench tops for use. This prevents accidents and contamination of your person or belongings.
13. **Immediately cover spilled cultures or broken culture tubes with paper towels and then saturate them with disinfectant solution.** Notify your instructor that there has been a spill. After 15 minutes, dispose of the towels and broken items as indicated by your instructor.
14. **Report accidental cuts or burns to the instructor immediately**.
15. At the end of each lab session, place all cultures and materials in the proper disposal area.
16. Electronic devices should not be brought into the lab. This includes, but is not limited to iPods, MP3 players, radios, cell phones, and calculators.

Suggested List of Laboratory Assignments

Group A

1. Introduction to Cell biology and tissue culture facility.
2. Microscope, inverted microscope

Group B

3. Cell counting using hemocytometer: RBC and WBC count.
4. Differential count

Group C

5. Preparation and filter sterilization of media for animal cell culture
6. Passage of adherent animal cell cultures.

Group D

7. Cryopreservation of animal cells.
8. Revival of animal cell line.

Group E

9. Cellular metabolic activity assessment using MTT assay
10. Plant tissue culture

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215469: Thermodynamics

Credits

TH/TUT: 04 PR : 00

Teaching Scheme:

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

Examination Scheme:

TH Online: 50
TH : 50
TW: 25
Total: 125

Prerequisites: -

- Basic concepts of fundamental and derived properties like mass, acceleration, kinetic and potential energy, velocity.
- Basic biochemical pathways and general cell metabolism.

Course Objectives:

- To introduce students to basic concepts and fundamental laws of thermodynamics
- To develop an understanding of heat energy and its application to industrial and biochemical processes
- Provide an understanding of the concept of equilibrium and its relevance to solution thermodynamics
- To introduce students to the concept of vapour liquid equilibrium, governing laws and calculations related to it
- To introduce students to concepts related to thermodynamics of chemically reacting systems
- To demonstrate the applications of thermodynamic principles in context of biological systems

Course Outcomes:

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

- Analyze simple systems from thermodynamic aspect as also to apply this knowledge to evaluate the efficiency and feasibility of a physical or biochemical process
- Characterize systems comprising of solutions and mixtures
- Predict equilibrium, conversion and efficiency of a chemical or biochemical processes
- Examine biological systems and biochemical reactions from a thermodynamic view and understand the various applications in this context

Course Contents

Unit I **(8 Hrs)**

Introduction to engineering thermodynamics – Scope and importance, Important definitions: system, surrounding, state and path functions, process etc.; Laws of thermodynamics - First and second laws, reversible and irreversible processes, expansion and compression processes, mathematical statement of first law; Second law of thermodynamics, Carnot cycle and theorems, the concept of entropy, mathematical statement.

Unit II **(6 Hrs)**

Heat Effects: sensible and latent heat effects, temperature dependence of heat capacity, standard heat of reaction, standard heat of formation, standard heat of combustion, Hess's law; Temperature dependence of standard heat of reaction, heat effects of industrial reactions

Unit III **(8 Hrs)**

Solution Thermodynamics: Fundamental property relations, Maxwell relationships, Clausius-Clapeyron equation; Chemical potential; Fugacity and fugacity coefficients for pure species, for species in solution, generalized correlations; Property changes of mixing, Excess properties, excess Gibb's energy, activity and activity coefficients, Margules equation, van Laar equation

Unit IV **(8 Hrs)**

Vapour – liquid and liquid – liquid equilibria: The nature of equilibrium, criteria of equilibrium, ideal solution, partial properties, Raoult's law, Henry's law, Duhem's theorem, Boiling point diagram, VLE by modified Raoult's law, dew point and bubble point calculations

Unit V **(8 Hrs)**

Chemical Reaction Equilibria: Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant; effect of temperature on equilibrium constant, evaluation of the equilibrium constant, relation of equilibrium constant to composition, calculation of equilibrium conversion for single reaction; The phase rule and Duhem's theorem for reacting systems

Unit VI **(6Hrs)**

Application of thermodynamics to biological systems: Energy transformations in biological systems, Examples of applications of laws of thermodynamics to bio-systems, Gibb's free energy concept for bio-changes and its applications; Thermodynamics of biochemical changes - Energy Yielding and Energy Requiring Reactions, feasibility of individual steps and overall reactions

Books:

Text:

1. K V Narayanan, "A Textbook of Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd., 2004
2. Y V C Rao, "Chemical Engineering Thermodynamics", University Press, 1997
3. D T Hayne, "Biological Thermodynamics", Cambridge University Press

Reference:

1. J M Smith, H C Van Ness, “Introduction to Chemical Engineering Thermodynamics”, 7th ed., McGraw-Hill Education, 2005
2. T E Daubert, “Chemical Engineering Thermodynamics”, McGraw-Hill Inc., 1985

Savitribai Phule Pune University, Pune
Second Year of B.Tech. Biotechnology (2015 Course)
215470:Genetics and Molecular Biology
Credits

TH/TUT: 04 PR : 02

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

Examination Scheme:
TH Online: 50
TH :50
PR: 50
TW: 25
Total : 175

Prerequisites: - Basic knowledge of Biology

Course Objectives:

- To introducing students with basic concepts of genetics and Molecular Biology
- To develop an understanding of Nucleic acid structure and physiochemical characteristics
- To introduce students with concepts of central dogma specially DNA replication
- To make students understand roles of RNA at different levels of Central dogma and in other catalytic cellular reactions
- To help students recognize information transfer from DNA to Protein via Transcription
- To make students learn translational process of proteins in Eukaryotes and Prokaryotes and to learn code language of genetic information
- Train students in basic techniques of molecular biology

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

- Understand basic concept of genetics as a discipline.
- Study and draw nucleic acid structure and depict role of nucleic acid in cellular processes
- Understand Process of Replication thoroughly
- Emphasize on role of different types of RNA
- Learn Transcription and effectual transfer of information from DNA to RNA
- Gain knowledge of last step of central dogma i.e. Protein biosynthesis and learn way of information transfer with the help of three letter code.
- Hands on training during the practicals of the course work.

Course Contents

Unit I **(8 Hrs)**

Introduction, Mendelian inheritance pattern study and laws of heredity, Co-dominance, linkage, linkage maps, MacLeod and McCarty's experiment, Hershey and Chase's experiment, Watson-Crick's discovery of structure of DNA, Chargaff's rule, Discovery of RNA, Model systems like *Drosophila, C. Elegans, Zebra fish*

Unit II **(8 Hrs)**

Structure of DNA: A, B (Watson-crick model), and Z structure, Physicochemical properties of DNA, UV absorption, Thermal denaturation, Melting Temperature, hyperchromicity, DNA supercoiling, Nucleic acids in mitochondria, chloroplasts, viruses and bacteria DNA packaging: Chromosome, Chromatin, Chromatid, Euchromatin and Heterochromatin.

Unit III **(10 Hrs)**

Introduction to replication of DNA, Chemistry of DNA synthesis, Mechanism of DNA polymerase, Replication Fork, DNA synthesis at the replication fork, Initiation of DNA replication, Elongation of DNA replication, Finishing replication, Telomere replication.

Unit IV **(6Hrs)**

Types of RNA, Coding and non-coding RNAs, tRNA, mRNA, rRNA, and small RNAs, introns and exons, chemistry of RNA splicing, splicing pathways, alternative splicing, ribozyme, importance of RNA, RNA world theory.

Unit V **(8Hrs)**

Transcription, RNA polymerase, Transcription cycle in bacteria, concept of Operon, Transcription cycle in eukaryotes, Mutation and Repair, Reverse Transcriptase, Study of oncogenes, Introduction to recombination.

Unit VI **(8Hrs)**

Genetic code, Protein biosynthesis, Initiation of translation, Translation elongation, Termination of Translation, regulation, posttranslational modifications, protein synthesis in prokaryotes and eukaryotes, chaperones, heat shock proteins Genetic disorders: Thalassamia and Diabetes

Books:

Text:

1. James D. Watson, Tania A. Baker, Stephen P. Bell, "Molecular Biology of the Gene" 5th edition, Dorling Kindersley (India) Pvt.Ltd.
2. Freifelder D. , "Molecular Biology", Jones and Bartlett Publishers, (1987)

Reference:

1. Benjamin Lewin, “Gene VII”, Oxford University Press, Oxford, New York, (2000)
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. “Molecular Biology of the Cell”, 4th edition, Garland Publishing, New York, London, (2002)
3. T.A. Brown, “Genomes” John Wiley and Sons Pvt. Ltd
4. Ansumbel F.M, Brent R, Kingston R.E, Moore D.D., ‘Curernt protocols in Molecular Biology’ Green Publishing Associates, (1988)
5. Old R W and Primrose SB, “Principles of Gene manipulations: An introduction to Genetic Engineering” Blackwell Science publications, (1993)
6. Sambrook and Russell. Molecular Cloning-A Laboratory Manual Vol 1, 2, 3. Third Edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York 2001

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
- Practicals should be conducted in 3 or 4 batches from total students 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 discared 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

Sr. No.	Group A
1.	Isolation of DNA i. Isolation of genomic DNA from onion ii. Isolation of genomic DNA from Banana

Group B

2. Quantitation of DNA

iii. Study of effect of agarose concentration on Electrophoretic mobility of DNA in gel electrophoresis

iv. Agarose gel electrophoresis of Genomic DNA

v. Quantification and purity check of DNA by Spectrophotometer at 260, 280,230 nm

Group C

3. Plasmid DNA Isolation

vi. Plasmid isolation by miniprep method

vii. Visualization of plasmid on agarose gel

viii. Quantification of Plasmid DNA using Spectrophotometer at 260,280,230 nm

ix. Study experiments: systems like *Drosophila, C. elegans, Zebra fish*