New Proposed Syllabus

(With effect from 2013-14)

S.E. Biotechnology

Second Year Biotechnology

Faculty of Engineering and Technology

North Maharashtra University, Jalgaon

NORTH MAHARASHTRA UNIVERSITY, JALGAON
STRUCTURE OF TEACHING & EVALUATION
S.E. (BIOTECHNOLOOGY) W.E.F.2013-2014

Semester III

Course Code	Name Of The Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs/Week	Tutorial Hrs/Week	Practical Hrs/Week	Total	ISE	ESE	ICA	ESE		
	Engineering Mathematics –III	A	3	1	--	4	20	80	--	--	100	4
BTL-301	Concepts in Biotechnology	B	3	--	--	3	20	80	--	--	100	3
BTL-302	Bioprocess Calculations	D	3	1	--	4	20	80	--	--	100	4
BTL-303	Unit Operations-I	D	3	--	--	3	20	80	--	--	100	3
BTL-304	Microbiology	D	3	--	--	3	20	80	--	--	100	3
	Soft Skills –III	C	1	--	2	3	--	--	50	--	50	2
BTP-305	LAB Microbiology	D	--	--	4	4	--	--	50	50	100	2
BTP-306	LAB Concepts In Biotechnology	B	--	--	2	2	--	--	50	--	50	1
BTP-307	LAB Unit Operations-I	D	--	--	2	2	--	--	25	25	50	1
TOTAL			**16**	**2**	**10**	**28**	**100**	**400**	**175**	**75**	**750**	**23**

Semester IV

Course Code	Name Of The Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs/Week	Tutorial Hrs/Week	Practical Hrs/Week	Total	ISE	ESE	ICA	ESE		
BTL-401	Biochemistry	D	3	--	--	3	20	80	--	--	100	3
BTL-402	Immunology	D	3	1	--	4	20	80	--	--	100	4
BTL-403	Biostatistics	D	3	1	--	4	20	80	--	--	100	4
BTL-404	Unit Operations –II	D	3	--	--	3	20	80	--	--	100	3
BTL-405	Process Heat Transfer	D	3	--	--	3	20	80	--	--	100	3
BTP-406	LAB Computer Applications	B	1	--	2	3	--	--	50	--	50	2
BTP-407	LAB Biochemistry	D	--	--	2	2	--	--	25	25	50	1
BTP-408	LAB Immunology	D	--	--	2	2	--	--	25	25	50	1
BTP-409	LAB Unit Operations –II	D	--	--	2	2	--	--	50	--	50	1
BTP-410	LAB Process Heat Transfer	D	--	--	2	2	--	--	25	25	50	1
TOTAL			**16**	**2**	**10**	**28**	**100**	**400**	**175**	**75**	**750**	**23**

NOTE: As Microbiology practical requires 4 hrs workload for performance of practical hence two laboratory hours are merged to form four hours slot.

*Computer based numerical methods in Bioprocess Engineering.

S.E. Biotechnology

Semester-III

Second Year Biotechnology

Faculty of Engineering and Technology

North Maharashtra University, Jalgaon

Engineering Mathematics -III

Course Outline

Engineering Mathematics -III	EM-III	
Course Title	Short Title	Course Code

Course Description:

This course is aimed at introducing the fundamentals of basic Mathematics to undergraduate students. The background expected includes a prior knowledge of Mathematics from first year engineering or diploma and familiarity with various laws, principles and theories. The goals of the course are to understand the basic principle of Mathematics and its application in different area.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	03	15	40	03
Tutorial	01	15	12	01

Prerequisite Course(s): EM-I, EM-II/ Diploma Mathematics.

General Objective:

The basic necessity for the foundation of Engineering and Technology being Mathematics, the main aim is to teach mathematical methodologies and models, develop mathematical skill and enhance thinking and decision making power of student.

Learning Outcomes:

After completion of this course learner will be able to:

1. Apply knowledge of mathematics in engineering and technology.

2. Identify, formulate and solve engineering problems.

3. Design Mathematical models for engineering problems and solve them.

Course Content

SE Biotechnology **Engineering Mathematics-III** **Semester – III**

Teaching Scheme
Theory : 3 hours/ week
Tutorial : 1 hour/ week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE) : 03 Hours
Internal Sessional Examination (ISE) : 20 Marks

UNIT – I **No of Lecture: 8 Hours, Marks: 16.**

Linear Differential Equations:

- Solution of LDE of order n with constant coefficients.
- Method of variation of parameters (Only second order).
- Cauchy's linear equation.
- Legendre's linear equation.

UNIT – II **No of Lecture: 8 Hours, Marks: 16.**
Applications of Linear Differential Equations and Partial Differential equations

- Applications of linear differential equations to Chemical Engineering.
- Applications of Partial Differential equations to

i) One dimensional heat flow equation $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial x^2}$

ii) Two dimensional heat flow equation $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$

UNIT – III **No of Lecture: 8 Hours, Marks: 16.**
Laplace Transform

- Definition and Existence of Laplace transforms.
- Laplace Transform of elementary/standard functions.
- Theorems & Properties of Laplace Transform (without proof).
- Inverse Laplace Transform.

- Laplace Transform of Unit step function.
- Solution of differential equations using LT.

UNIT – IV **No of Lecture: 8 Hours, Marks: 16.**
Statistics and Probability distributions

- Introduction to Mean, Mode, Median standard deviation, Variance, Coefficient of variation.
- Moments, Skewness and kurtosis.
- Correlation and Regression.
- Binominal Distribution.
- Poisson distribution.
- Normal distribution.

UNIT – V **No of Lecture: 8 Hours, Marks: 16.**
Vector Calculus

- Introduction to Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields.
- Vector integration: Line Integral, Surface and Volume integrals.
- Gauss's, Stoke's and Green's Theorems (without proof).

Reference Books:

1. H.K. Dass - Advanced Engineering Mathematics (S. Chand Publication) New Delhi.
2. Erwin Kreyszig - Advanced Engineering Mathematics (Wiley Eastern Ltd.)
3. B.S. Grewal - Higher Engineering Mathematics, Khanna Publication, Delhi
4. Wylie C.R. & Barrett - Advanced Engineering Mathematics - McGraw Hill
5. B.V. Raman - Engineering Mathematics - Tata Mc- Graw – Hill.
6. A Text Book of Engineering Mathematics, By N. P. Bali, Laxmi Publication.

Concepts in Biotechnology

Course Outline

Concepts in Biotechnology	CB	BTL-301
Course Title	Short Title	Course Code

Course Description: This course is introduced for learning the basic fundamentals of Life sciences to undergraduate students. The prospectus includes a prior knowledge of Biotechnology. The goals of the course are to understand the basic principles of Biotechnology and its applications in different areas.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	03	15	40	03

Prerequisite Course(s): 10^{th}&12^{th} STD Zoology, Botany.

Objective of the Subject:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. Students will understand how these cellular components are used to generate and utilize energy in cells.
3. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or Physiological changes, or alterations of cell function brought about by mutation.
4. Students will learn the basic principles of inheritance at the molecular, cellular and Organism levels.
5. Students will understand relationships between molecule/cell level phenomena ("Modern" genetics) and organism-level patterns of heredity ("classical" genetics).
6. Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.

Learning outcomes:

By completion of this course students will able:

1. To apply all knowledge about basic sciences such as mathematics, physics, chemistry and biology to all problems in molecular biology and genetics.
2. To be able to understand all knowledge about living organisms which is main subject of molecular biology and genetics.
3. To be able to use current techniques and analysis methods in molecular biology and genetics.
4. Understand the current concepts in Cell Biology, Stem Cell Biology and Development.
5. Know the basic cellular processes including heredity, transcription/translation (the central dogma), cellular replication and their role in development, physiology and higher level biological organization.
6. Know the structure/function of the basic components of prokaryotic and eukaryotic cells including macromolecules and organelles.
7. Demonstrate proficiency with at least one instrument commonly used in biological research (microscope, etc).

Course Content

SE Biotechnology Concepts in Biotechnology Semester - III

Teaching Scheme
Theory : 3 hours/ week
Practical: 2 hours/week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE) : 03 Hours
Internal Sessional Examination (ISE) : 20 Marks
Internal Continuous Assessment(ICA) :50Marks

UNIT – I **No. of Lecture: 8 Hours, Marks: 16**

Cell Biology and Cell Theory

Structural organization of life, Concepts of modern cell, history of cell, Cell theory, Structure of cell:- Cell shape, size and cell number, Types of cells:- Prokaryotic cells and Eukaryotic cells, Chemistry of cells.

UNIT – II **No. of Lecture: 8 Hours , Marks :16**

Study of Intracellular Components of Cell

Cell organelles:-Structure & Functions of: Mitochondria, Plastids:- Chloroplast, Chromoplast, Nucleus, Ribosomes, Golgi complex, Endoplasmic Reticulum, Endosomes, Lysosomes, Peroxisomes.

UNIT – III **No. of Lecture: 8 Hours , Marks :16**

Cell Division

Cell cycle, mitosis, meiosis, genetic and biochemical approaches for the study of cell division, mitotic cell division, cell cycle check points, meiotic cell division, embryonic cell division, cell death, the cell cycle of cancer, central cell cycle control systems.

UNIT – IV **No. of Lecture: 8 Hours , Marks :16**

Basic Concepts in Genetics

Introduction to gene, Mendels law of segregation, Assumption involved in segregation, physical basis of segregation, Law of Independent Assortment: - Introduction, two characters of independent segregation, test cross of dihybrid & trihybrid, physical basis of independent assortment, Gene vs Allele: A modified concept, fine structure of gene.

UNIT – V **No. of Lecture: 8 Hours , Marks :16**

Elements of Genetics.

Chromosomes:- Introduction, chromosome number, size, morphology, chemical composition of chromosome and function, Structural chromosomal aberrations:- Introduction, origin of structural aberrations, structure of chromosomal aberrations, variation in chromosomal number, Mutation:- Introduction, characteristics of mutations, classification, spontaneous and induced mutations, Population genetics:- Introduction, gene frequency, genotype frequency, gene pool.

References:

1. B.D. Singh " Genetics" Kalyani Publications.
2. P.K.Gupta" Cell&MolegcularBiology"Rastogi Publications.
3. S.C. Rastogi" Cell& Molecular Biology" New Age International Publications.
4. C.B. Pawar" Cell Biology" Himalaya Publications.
5. C.B. Pawar" Cell and Molecular Biology" Himalaya Publications.

Bioprocess Calculations

Course Outline

Bioprocess Calculations	BPCAL	BTL-302
Course title	Short title	Course code

Course Description:

The goals of the course are to understand the basic principles of Bioprocess Calculations and their applications in different areas. It is highly essential to know the stoichiometry of the processes, conditions to achieve maximum product formation and recycle of the unused materials for better economy. Therefore, knowledge of process calculations is the first and foremost requirement for the success of a Biotechnology Engineering student

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	03	15	40	03
Tutorial	01	15	12	01

Prerequisite Course(s):10th and 12th STD Chemistry, Biology, Mathematics.

Objective of the subject:

1. To make the student familiar with the basic chemical calculations
2. To study the material balance of unit operations used in process industries.
3. To study the material balance of bioreactions.
4. To understand the energy balance of physical operations.
5. To understand energy balance of bioreactions.
6. To make student familiar with psychrometric chart, steam table etc.
7. To make the student familiar with combustion of fuels.

Learning Outcomes:

After successful completion of this course the student will be able to:

1. Differentiate between different units and dimensions and solve relevant problems.
2. To have the ability to identify, formulate and solve engineering problems.

3. Have gained fundamental skills in solving material balance problems with and without bioreactions.
4. Have gained fundamental skills in solving energy balance problems with and without bioreactions.
5. Understand humidity, humid heat, humid volume, dry-bulb temperature, wet-bulb temperature, psychometric chart & steam table.
6. To find out the energy requirements for combustion of fuels.

Course Content

SE Biotechnology **Bioprocess Calculations** **Semester -III**

Teaching Scheme	**Examination Scheme**	
Theory : 3 hours/ week	End Semester Examination (ESE)	: 80 Marks
Tutorial : 1 hour/ week	Paper Duration (ESE)	: 03 Hours
	Internal Sessional Examination (ISE)	: 20 Marks

UNIT-I **No. of Lectures. – 08, Marks: 16.**

Units & Dimensions:

Basic & Derived Units, Dimensional Analysis, Dimensional & Empirical Equations. Different Ways of Expressing Units of Quantities & Physical Constants.

Properties of Gases, Liquids &Solids: Ideal & Real Gas Laws, Critical Properties, Properties of Mixtures & Solutions , Kay's Rule.

UNIT-II **No. of Lectures. – 08, Marks: 16.**

Material Balances without reaction:

Law of conservation of mass, Material balance of unit operations such as Distillation, Mixing, Evaporation, Leaching, Liquid -Liquid Extraction and Solid Liquid Extraction. Numerical based on bioprocesses.

UNIT-III **No. of Lectures – 08, Marks: 16.**

Material Balances with reaction:

Concept of limiting &excess reactants, conversion, yield and Selectivity . Material Balance of biochemical reactions & photochemical reactions. Material balance with recycle, by pass and purge stream of Bioprocesses.

UNIT-IV **No. of Lectures. – 08, Marks: 16.**

Energy balances:

Basic Energy Concept ,Units, Enthalpy, General Energy Balance equation ,Enthalpy Change in Non reactive Processes: sensible heat change, heat capacity, specific heat, sensible heat change with constant Cp, Change of Phase : Enthalpy of Condensations, Heat of solution, study of steam table, energy balance calculations without reaction, enthalpy change due to reaction, heat of combustion, heat of reaction for process with biomass production, heat of reaction with oxygen as electron acceptor, heat of reaction with oxygen not the electron acceptor, energy balance equation for cell culture, fermentation energy balance, Numericals based on above.

UNIT-V **No. of Lectures. – 08, Marks: 16.**

Humidity & Combustion

Humidity & saturation, Define Humid Volume, Humid Heat, Dry bulb temperature, Wet bulb temperature etc. Psychometric chart, solubility diagrams. Combustion: Introduction, fuels, calorific value of fuels, air requirements.

Reference Books:

1. Bhatt & Vora ,Stoichiometry :Tata McGraw Hill.
2. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint ofElsevier.
3. Durga Prasad Rao& DVS Murthy ,Process Calculations for Chemical Engineers:McMillanIndia, New Delhi .
4. K A Gavhane , Introduction to Stoichiometry : NiraliPrakashan.
5. Hougen O.A, Watson K.M, &Ragatz R.A. Chemical Process Principles Part-I Asia Publishing House, Mumbai.
6. Himmelblau D.M. Basic principles and calculations in Chemical Engineering, Prentice Hall Publication.
7. Shekhar Pandharipande and Samir Mushrif, Process Calculations. Pune Vidyarthi Griha Prakashan, Pune

Unit Operation –I

Course Outline

Unit Operation –I	**UO-I**	**BTL-303**
Course title	Short title	Course code

Course Description: The goals of the course are to understand the basic principles of fluid mechanics and their applications in different areas. The subject needs to be studied by the biotechnology students to understand the characteristics and properties of fluids as regards to the processing of raw ingredients in the industry.

	Hours per Week	**No. of Weeks**	**Total Hours**	**Semester Credits**
Lecture	03	15	40	03

Prerequisite Course(s): 10th and 12thStd Science, Mathematics.

Objectives of the Course:

1. To study dynamics of fluid flow.
2. To know the fluid properties and applications for energy conservation by studying fluid statics.
3. To make the students analyze the flow measurement principles and equipments.
4. To study and classify different types of pumps, blowers and compressors.
5. Student will be able to select right size pump for given pipeline or a system
6. To make the student familiar with boundary layer phenomenon.
7. To apply scientific method strategies to fluid mechanics, analyze qualitatively and quantitatively the problem situation, propose hypotheses and solutions.

Learning Outcomes:

After successful completion of this course the student will be able to:

1. Understand the following terms in relation to fluid mechanics: viscosity, density, specific gravity, and surface tension. Measure the properties listed above for any given fluids.
2. Apply their knowledge to minimize head losses and evaluate flow through a pipe system by using different types of flow meters.
3. Understand the principles of manometer to calculate pressure of the fluids.
4. Apply knowledge of pumps, blowers and compressors in different areas of engineering and technology for transportation of fluids and gases.
5. Understand the importance of boundary layer flow in engineering applications.

Course Content

SE Biotechnology **Unit Operation –I** **Semester - III**

Teaching Scheme
Theory : 3 hours/ week
Practical : 2 hour/ week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE) : 03 Hours
Internal Sessional Examination (ISE) : 20 Marks
Internal Continuous Assessment (ICA) :25 Marks
End Semester Examination (ESE) (OR) :25 Marks

UNIT-I **No. of Lectures. – 08, Marks: 16.**

Properties of Fluid

Definition of fluid, mass density, specific weight, specific volume, specific gravity .viscosity concept, viscosity measurement: cone and plate viscometer, use of viscometer with fermentation broths, factor affecting broth viscosity, surface tension, capillarity. Types of fluid: ideal fluid, real fluid, Newtonian and non Newtonian, ideal plastic fluid etc. Numerical based on above.

UNIT-II **No. of Lectures. – 08, Marks: 16.**

Dynamics of Fluid Flow

Continuity equation, Euler's equation of motion, Bernoulli's equations for different conditions. pressure measurements: Hydrostatic law. Pascal law, principle and types of manometer, Numericals based on above.

UNIT-III **No. of Lectures. – 08, Marks: 16.**

Flow through Pipeline System

Major and minor losses, friction factor, friction factor chart, distribution of flowing fluids through branched pipe. Numerical based on above.

Boundary layers flow: Boundary layer flow, laminar boundary layer over a flat plate, turbulent boundary layer, laminar sub layer, boundary layer thickness: displacement thickness, momentum thickness, energy thickness.

UNIT-IV **No. of Lectures. – 08, Marks: 16.**

Flow measurement

Flow through Orifice meter, Nozzle meter, venturi meters, Rotameter and pitot tube. Reynolds experiment. Numerical based on above. Other flow measuring devices such as Ultrasonic flow meters, Anemometers, Electromagnet flow meters.

UNIT-V **No. of Lectures. – 08, Marks: 16.**

Pumping of Fluids

Pumping equipments: working and construction of the Reciprocating pump, Positive Displacement Pump, Centrifugal pumps, Peristaltic pump. NPSH calculations. Blowers & Compressors. Numerical based on above.

Reference Books:

1. Dr. R. K. Bansal, Fluid Mechanics: Laxmi Publications, New Delhi.
2. W.L. McCabe & J.C. Smith, Unit operations in chemical engineering: McGraw Hill/Kogakusha Ltd.
3. I P. Chattopadhaya Unit operations of chemical engineering-volume I: Khanna Publication New Delhi, 2nd edition 1996.
4. V.P. Gupta, Alam Singh and Manish Gupta Fluid Mechanics, Fluid mechanics and hydrostatics: CBS publishers New Delhi.
5. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.

Microbiology

Course outline

Microbiology	MB	BTL-304
Course Title	Short Title	Course Code

Course Description:

This course is aimed at introducing the fundamentals of basic Microbiology to undergraduate students. The background expected includes a prior knowledge of Biology from HSC (science). The goals of the course are to understand the basic principles of life sciences and their applications in Engineering trade.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	03	15	40	03

Prerequisite Course(s): 11th, 12th Biology.

General Objective:

To build a necessary platform for analyzing the complex issues in microbiology, including the evolution and diversity of microbes; cell structure and function; metabolism; information flow and the role of microbes in ecosystems.

Learning Outcomes:

1. To apply their knowledge in research related to the use of microbes for human welfare like food production, pigment production, pharmaceutical products etc.
2. To communicate the fundamental concepts of microbiology, both in written and in oral format;
3. Should be able to analyze and simplify the complex issues in microbiology.

Course Content

SE Biotechnology **Microbiology** **Semester-III**

Teaching Scheme
Theory : 3 hours/ week
Practical : 4 hour/ week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE) : 03 Hours
Internal Sessional Examination (ISE) :20 Marks
Internal Continuous Assessment (ICA) :50 Marks
End Semester Examination (ESE) (PR) : 50 Marks

UNIT-I **No. of Lectures. – 08, Marks: 16.**

Introduction of Microbiology

Microbiology and its Scope; History of Microbiology: Contribution of Various Scientists in the Development of Microbiology, Incidences of Microorganisms in Environment, Classification of Microorganisms: Prokaryotes and Eukaryotes (Cell Structure), Morphology and Physiology of Bacteria, Yeast, Molds, Algae and Viruses

UNIT-II **No. of Lectures. – 08, Marks: 16.**

Techniques in Microbiology

Microscopy, nutritional requirements of microorganisms and microbial culture media, isolation, identification and maintenance of cultures (preservation), characteristics of pure culture, enumeration techniques.

UNIT-III **No. of Lectures. – 08, Marks: 16.**

Microbial Control

Basic terms: sterilization, disinfection, antiseptic, sanitizer, germicide, microbiostasis, antimicrobial agents, preservatives, factors influencing antimicrobial activity, mechanisms of cell injury, physical and chemical methods of control of microorganisms with principle, temperature, desiccation, osmotic pressure, surface tension, radiations, filtration, antiseptics and disinfectants, halogens, heavy metals, detergents, dyes.

UNIT-IV **No. of Lectures. – 08, Marks: 16.**

Microbial Growth

Modes of Cell Division, Microbial Growth Kinetics: Growth Rate & Generation, Mathematical expression for Growth, Growth Curve, Diauxic Growth Curve, Continuous Culture: Chemostat

and Turbidostat, Synchronous Culture: Selection by Size and Age, Selection by induction techniques.

UNIT-V **No. of Lectures. – 08, Marks: 16.**

Antibiotics & Other Chemotherapeutic Agents

Characteristics of Chemotherapeutic Agents, Antibiotics and their Mode of Action, Antifungal Antibiotics.

Reference Books:

1. M.J. Pelczar, Jr. E.C.S. Chan and N.R. Krieg, Microbiology 5th Ed. , TMH Book Company.
2. Powar and Daginawala, General Microbiology, Vol I and vol II , Himalaya Publishing House.
3. R.C.Dubey & D.K.Maheshwari, A Textbook of Microbiology, S. Chand Publications.
4. Stainer R.Y., Ingraharn J.L., Whoolis M.L. and Painter P.R. General Microbiology. The McMillan Press Ltd

Soft Skills – III

COURSE OUTLINE

Course Title	Short Title	Course Code
Soft Skills – III	**SK-III**	

Course Description: Through this course we have tried to prepare the students for the industry. Most companies test mathematical and logical ability through an aptitude test. This subject aims at working on these skills of a student through strategies formulae and practice exercises.

Lecture	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
	1	14	14	2

Prerequisite Course(s): Fundamental knowledge of High School Mathematics.

COURSE CONTENT

Soft Skills – III **Semester-III**

Teaching Scheme **Examination Scheme**

Lecture: 1 hour / week **Internal Continuous Assessment (ICA): 50 Marks**

Unit-I: Arithmetic-1 **No. of Lect. – 3, Marks: 10**

a. Basic Formulae

i. Divisibility Rules.
ii. Speed Maths.
iii. Remainder Theorem.
iv. Different Types of Numbers.
v. Applications.

b. HCF, LCM and Linear Equations

i. HCF – Successive Division and Prime Factorization Methods.
ii. LCM – Successive Division and Prime Factorization Methods.
iii. Applications.
iv. Linear Equations – Elimination Method.
v. Substitution Method.
vi. Applications.

c. Averages and Mixtures

i. Concept of Average.
ii. Faster Ways of Finding It.
iii. The Allegation Method.
iv. Applications.

Unit-II: Arithmetic–II **No of Lect. – 3, Marks: 10**

a. Percentages

i. Concept of Percentage.
ii. Working with Percentages.
iii. Applications.

b. Profit and Loss

i. Difference between Cost and Selling Price.
ii. Concept of Profit Percentage and Loss Percentage.
iii. Applications.

c. Time and Work

i. Basic Time and Work Formula.
ii. Relation between Time and Work.
iii. Applications.

Unit-III: Arithmetic–III **No of Lect. –3, Marks: 10**

a. Permutations and Combinations

i. Sum Rule of Disjoint Counting.
ii. Product Rule of Counting.

iii. Concept of Factorial.
iv. Permutations.
v. Linear Permutations.
vi. Combinations.
vii. Circular Permutations.
viii. Applications.

b. Probability

i. Definition and Laws of Probability.
ii. Mutually Exclusive Events.
iii. Independent Events.
iv. Equally Likely Events.
v. Exhaustive Events.
vi. Cards.
vii. Dice.
viii. Applications.

c. Time and Distance

i. Speed.
ii. Conversion Factors for Speed.
iii. Average Speed.
iv. Moving Bodies – Passing, Crossing and Overtaking.
v. Relative Speed.
vi. Boats and Streams.
vii. Applications.

Unit-IV: Non-Verbal Reasoning **No of Lect. 2, Marks: 10**

a. Analogies

i. Examples.
ii. Applications.

b. Classification

i. Examples.
ii. Applications.

c. Sequences

i. Examples.
ii. Applications.

Unit-V: Analytical Reasoning **No of Lect. – 3, Marks: 10**

a. Analytical Puzzles

i. Classification Puzzles.
ii. Ordering Puzzles.
iii. Assignment Puzzles.
iv. Applications.

b. Letter and Number Series

i. Different Types of Letter Series.
ii. Different Types of Number Series.
iii. Mixed Series.

c. Coding and Decoding

i. Letter Coding.
ii. Number Coding.
iii. Mixed Coding.
iv. Odd Man Out.
v. Applications.

Guide lines for ICA:

ICA will be based on credit tests and assignments submitted by the student in the form of journal.

Reference Books:

1. R. S. Aggarwal, "Quantitative Aptitude", S. Chand Publication, New Delhi, 2012.
2. R. S. Aggarwal, "A Modern Approach to Verbal Reasoning", S. Chand Publication, New Delhi, 2012.
3. R. S. Aggarwal, "A Modern Approach to Non-Verbal Reasoning", S. Chand Publication, New Delhi, 2012.

LAB Microbiology

Lab Course Outline

LAB Microbiology	LAB MB	BTP-305
Course Title	Short Title	Course Code

Laboratory	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	4	15	48	2

Course Description:

In this laboratory, course emphasis is on the understanding of basics of identification, isolation, cultivation of microorganisms from the enormous diversity found in environment and its application for the human welfare. The learner here can use this knowledge and apply in allied branches of Biotechnology as required.

Prerequisite Course(s): Course of Chemistry & Biology at HSC level and FE.

General Objective:

The objective of the laboratory is to impart the fundamental knowledge of biology at the microscopic level to the students and develop their ability to apply the specific procedures to analyze the experimental results.

In this lab, students will be familiar with the use of microorganisms as lab tools and various biological equipments which they can apply in research and Development in the field of Biotechnology

Learning Outcomes:

1. After successful completion of this lab student will be able to:
2. Use the microscope effectively and observe and identify the characteristics of microorganisms.
3. Stain the microbes for better visualization and characterization of cells and cell organelles
4. To identify and examine the microorganisms from the food sample and environment.
5. Enumerate the microbes by various methods including viable cell count, haemocytometer and turbidity measurement.
6. To prepare the media and cultivate the microorganisms by different methods.
7. Isolate the microorganisms by streak plate method, pour plate method, serial dilution method etc.
8. Different techniques for the maintenance and preservation of microorganisms.

9. To study the effect of antimicrobial agent , UV radiation & heat on microbial growth.
10. To examine the water samples microbiologically.

Lab Course Content

(Note: Minimum EIGHT Experiments from the following)

1. Study and use of microscope
    a. Examination of prepared slides
2. Preparation of laboratory media:
    a. Autoclaving,
    b. Preparation of agar slants and agar plates.
    c. Preparation of liquid media.
3. Isolation & Cultivation of microorganisms (Bacteria & Fungi) on solid and liquid media and observation of cells
    a. By streak plate method
    b. By pour plate method.
    c. By spreading
    d. Observation of cells:
        i. Cultural characteristics,
        ii. Biochemical characteristics
4. Staining techniques:
    a. Simple staining,
    b. Gram staining,
    c. Lactophenol cotton blue mounting of fungi.
5. Isolation by serial dilution method, maintenance & preservation.
6. Influence of antimicrobial agent, UV radiation & heat on microbial growth.
7. Study of bacterial growth curve. (Turbidity measurement as direct expression of growth)

LAB Concepts in Biotechnology

Lab Course Outline

LAB Concepts in Biotechnology	**LAB CB**	**BTP-306**
Course Title	Short Title	Course Code

Laboratory	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	2	15	20	1

Course Description:

Course emphasis is on the understanding of basic structure & identification and of Cell morphology. The learner here can use this knowledge and apply in allied branches of Biotechnology as required.

Prerequisite Course(s): Botany, Zoology

Course Objectives:

1. To study the cell morphology of animal, plant and bacterial cell.
2. To study mitosis of onion root tips.
3. To isolate different types of cell organelles: nucleus, mitochondria, lysosomes.

Course Outcomes:

By completion of this course students will able to:

1. To stain and distinguish animal, plant and bacterial cells.
2. To explain structure and functions of cell organelles.
3. To explain mitosis & meiosis in plant cell.
4. To isolate cell organelles by designing the specific protocol.
5. To identify different types of chromosomes.
6. To explain Karyotyping of animal, plant & bacterial cell

Lab Course Content

Practical 2 Hrs/ weeks
(Note: Minimum EIGHT Experiments from the following)

Practical Work:

1. Cell staining of Animal cell.
2. Cell staining of Plant cell.
3. Cell staining of Bacteria cell.
4. Mitosis of onion root tips
5. Meiosis of earthworm ovary
6. Microscopic identification of bacterial chromosomes.
7. Microscopic identification of Plant chromosomes.
8. Microscopic identification of Animal chromosomes.
9. Isolation of cell organelles: nucleus, mitochondria, lysosomes.
10. Karyotyping of animal, plant & bacterial cell.

LAB Unit Operation -I

Lab Course Outline

LAB Unit Operation -I	LAB UO-I	BTP-307
Course Title	Short Title	Course Code

Laboratory	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	2	15	20	1

Course Description: This course is intended to provide engineering students with a background in important concepts and principles of Unit operation –I.

Prerequisite Course(s): 10^{th} and 12^{th}Std Physics, Chemistry, Math's

General Objective: The objective of the laboratory is to impart the fundamental knowledge of Unit operations to the students and develop their ability to apply the specific procedures to analyze the experimental results.

Learning Outcomes:

After successful completion of this lab course the student will be able to:

1. Determine properties of Fluids .
2. Analyzed the characteristics curves of Centrifugal Pump.
3. Determine the coefficient of Venturi meter, Orifice meter, Nozzle meter.
4. Identify the fluids flow laminar , turbulent by Reynolds Experiment.
5. Estimate to minor losses in pipes.
6. Determine the fanning friction factor for given pipe.
7. Study of the different types of Fans, Blowers & Compressors.

Term Work Shall be based on any 08 experiments mentioned below.

List of the Experiments.

1. Determination of Viscosity.
2. Study of Manometers
3. Verification of Bernoulli's theorem.
4. To determine the coefficient of Venturi meter.
5. To determine the coefficient of Orifice meter.
6. To determine the coefficient of Nozzle meter.
7. Reynolds Experiment.
8. Minor losses in pipe.
9. To determine the fanning friction factor for given pipe.
10. Notches & Weirs.
11. To study the characteristics curves of Centrifugal Pump.
12. To study of the different types of Fans, Blowers & Compressors.

S.E. Biotechnology

Semester-IV

Second Year Biotechnology

Faculty of Engineering and Technology

North Maharashtra University, Jalgaon

Biochemistry

Course outline

Biochemistry	BCH	BTL-401
Course Title	Short Title	Course Code

Course Description:

This course is aimed at introducing the fundamentals of basic Biological chemistry to undergraduate students. The background expected includes a prior knowledge of Biology and chemistry from HSC (science) and first year engineering knowledge. The goals of the course are to understand the basic principles of life sciences and their applications in engineering trade.

	Hours/weeks	No.Weeks	Total Hours.	Semester Credits
Lecture	03	15	40	3

Prerequisite Course(s): 11th, 12th Biology, Chemistry

General Objective:

To build a necessary platform for analyzing the chemical basis of biological phenomenon, including the introduction to biomolecules and their role in biological systems, fundamentals of techniques used in biochemistry.

Learning Outcomes:

At the end of the course, students will be able to;

1. To identify the classes of biomolecules and their role in the biological system.
2. To explain the functions and properties of biomolecules
3. To explain the synthesis of biomolecules in biological system and how it directly relate the energy generation in body.
4. To separate biomolecules from the source by biochemical techniques and its application for human welfare

Course Content

SE Biotechnology **Biochemistry** **Semester-IV**

Teaching Scheme	**Examination Scheme**
Lectures :3 Hrs/week	End Semester Exams (ESE) : 80 Marks.
Practical : 2 Hrs/Week	Duration of Paper (ESE) : 3 Hours.
	Internal Sessional Exam (ISE) : 20 Marks.
	Internal Continuous Assessment (ICA) : 25 Marks
	End Semester Exam (ESE) (PR) : 25 Marks

UNIT –I **No of Lecture: 8 Hours, Marks: 16**

Carbohydrates & their Metabolism

Structure, Classification & Functions of Carbohydrates: Monosaccharides, Oligosaccharides, Polysaccharides. Metabolism: Glycolysis, Gluconeogenesis. TCA cycle, Pentose phosphate pathway , Glyoxylate cycle & Electron Transport Cycle (Brief), Regulation of glycolysis & TCA.

UNIT –II **No of Lecture: 8 Hours, Marks: 16**

Proteins & Amino Acids

Structure, Classification &Functions of Amino acids & Proteins. Metabolism: Amino acid degradation: Summary of amino acid catabolism, amino acid degradation to pyruvate, Acetyl COA, & α- ketoglutarate, Urea cycle. Biosynthesis: Amino acid synthesis overview, six essential amino acid synthesis, synthesis of glutamate, glutamine, proline & arginine.

UNIT –III **No of Lecture: 8 Hours, Marks: 16**

Lipids & their Metabolism

Structure & Functions of lipids: Triacyglycerols, Glycerophospholipids, sphingolipids, Cholesterol, phosphatidylinositols, eicosanoids. Oxidation of fatty acids. Biosynthesis: Fatty acids, Triacylglycerols, & Cholesterol, Glyceroneogenesis

UNIT –IV **No of Lecture: 8 Hours, Marks: 16**

Nucleotides & Vitamins

Vitamins: Introduction, Classification, Biochemical Functions, RDA, Dietary Sources, Deficiency. Structure & Functions of nucleotides. Biosynthesis of nucleotides: denovo synthesis of purine & pyrimidine synthesis and its regulation, salvage pathway.

UNIT –V **No. of Lecture: 8 Hours, Marks: 16**

Enzymes & Membrane transport

Enzymes: Introduction, Classification, mechanism of enzyme action, factors affecting enzyme activity (concentration of enzyme, substrate, temperature, pH), units of enzyme activity. Membrane transport: Architecture of membranes: Fluid mosaic model. Passive transport: Solutes, glucose, chloride-bicarbonate exchanger, Active transport: Na+. K+ ATPase, F-type ATPase, P-type ATPase.

Reference Books:

1. U Satyanarayana & U. Chakrapani, Biochemistry.
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Principles of Biochemistry, International Student version
3. Lehninger A.L., Neston D.L., N.M. Cox "Principles of Biochemistry", CBS Publishers & Distributors.
4. Lubert Stryer "Biochemistry", W.H. Freemen & Co. , New York.
5. Weil J.H. "General Biochemistry", New Age International (Pvt. Ltd.).
6. Murray R.K. and others (Eds). Harper's Biochemistry, 25th Edn. Appleton and Lange Stanford.

Immunology

Course Outline

Immunology	IMM	BTL-402
Course Title	Short Title	Course Code

Course Objective:

This course is introduced for learning the basic fundamentals of the defense mechanism of human body. The prospectus includes a prior knowledge about the immunity, mechanisms and the therapy or treatment for curing the diseases.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**03**	**15**	**40**	**03**
Tutorial	**01**	**15**	**12**	**01**

Prerequisite Course(s): 10th & 12th Std Zoology.

Objective of the Subject:

To build a necessary platform for analyzing the chemical basis of immune system, including the introduction to immune organs and their role in biological systems, antibodies, and other immune molecules, fundamentals of techniques used in immunology.

Learning outcomes:

- The course is designed to give an understanding of the basic principles of modern immunology and an introduction to methods used in immunological research.
- Students will be able to describe the cells, molecules and pathways involved in the induction and regulation of innate and adaptive immune responses and how regulatory responses can be exploited therapeutically.
- Demonstrate an understanding of how vaccines work and of the requirements for developing new safe and effective injectable and mucosal vaccines.
- Integrate information on the role of the immune system in asthma and chronic obstructive pulmonary disease and the use of this information to develop new therapies for these conditions.

Course Content

SE Biotechnology **Immunology -** **Semester - IV**

Teaching Scheme	**Examination Scheme**	
Lectures :3 Hrs/week	End Semester Exams (ESE)	: 80 Marks.
Practical : 2 Hrs/Week	Duration of Paper (ESE)	: 3 Hours.
Tutorial : 1Hr/Week	Internal Sessional Exam (ISE)	: 20 Marks.
	Internal Continuous Assessment (ICA)	: 25 Marks
	End Semester Exam (ESE) (PR)	: 25 Marks

UNIT – I **No of Lecture: 8 Hours, Marks: 16**

Introduction to Immunology

Properties of immune response, Innate and acquired Immunity, active and passive immunity.

Cells & Tissues of Immune System: Lymphocytes, Classes of lymphocytes, antigen presenting cells, NK Cells, Mast Cells, Dendritic Cell, LPT cells, Organs of the Immune System, Bone marrow, Thymus, Lymph node, Spleen, MALT.

UNIT – II **No. of Lecture: 8 Hours , marks :16**

Molecular Immunology

Molecular structure of antibody, Classification, Isotypes, Synthesis assembly and expression of immunoglobulin molecules, Nature of antigens, function and diversity, Generation of anti-body diversity, Antigens: Different characteristics of antigens, mitogens, Hapten, Adjuvants.

UNIT – III **No. of Lecture: 8 Hours, marks :16**

MHC Molecule & Immune Mechanism

Discovery of MHC complex, Role of MHC, Structure of MHC molecule, Binding of peptides to MHC molecules, MHC restriction.

Mechanism of Immune Response: Cytokines, T- cell receptors, B cell activation cell complement system, antigen processing and presentation, regulation of immune response.

UNIT – IV **No. of Lecture: 8 Hours, marks :16**

Immunological Techniques

Antigen- antibody reactions, Immuno diffusion, immuno - electrophoresis, ELISA, RIA, Rocket immuno - electrophoresis, Agglutination reaction, Precipitation reaction, Flow cytometry.

UNIT –V **No. of Lecture: 8 Hours , marks :16**

Applied Immunology

Immune system in health and disease, autoimmunity, hypersensitivity, Immunology of graft rejection methods and precautions, GVHD, Hybridoma technology: - Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

References:

1. C.V. Rao " A Textbook of Immunology" Narosa Publishing House.
2. Kuby " A Textbook of Immunology" Freeman Publication.
3. Roitt I.M. (1998) Essentials of Immunology. ELBS, Blackwell Scientific Publishers, London.
4. Ivan Riot- Essentials of Immunology (6th Edition), Blakswell Scientific Publications, Oxford, 1988.

Biostatistics

Course Outline

Biostatistics	**BST**	**BTL-403**
Course Title	**Short Title**	**Course Code**

Course Description

This course is a combination of both elementary probability and basic statistics with a strong emphasis on engineering and science applications. The course coverage explores the treatment of data; probability; probability distributions; probability densities; curve fitting; correlation and regression; sampling distributions; inferences concerning means; inferences concerning variances; inferences concerning proportions; analysis of variance; factorial experimentation. This course will create interest to the students for probability and statistics.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	45	03
Tutorial	01	15	12	01

Objective of the subject:

1. Students will understand the Probability distribution. Namely, Binomial, Poisson and Normal distribution are discussed which will allow them to apply to engineering problems.
2. Students will understand what is meaning of bi-variate data and correlation between them.
3. Students will learn how to fit a curve to a given data.
4. Students will also understand the meaning of sampling.
5. Students will learn to test a hypothesis based on a sample.
6. Students will also learn various tests, for large sample and small sample.
7. Students will learn Experimental design.
8. Students will learn 2^2, 2^3 designs

Learning Outcomes:

1.Will be able to use Probability distributions effectively. Also will be able to know a given set of data will follow which distribution.

2.Will be able to calculate the mean and variance of a probability distribution.

3.Can correlate bivariate data and set relationship among data.

4.Can use sampling for performing any real experiment which is otherwise very expensive.

5.Will be able to use t-test, F-test and chi-square test etc. for Goodness of fit to test hypotheses.

6.Able to apply Randomization to avoid confounding the variable under investigation with other uncontrollable variables.

Course Content

SE Biotechnology **Biostatistics** **Semester - IV**

Teaching Scheme	**Examination Scheme**	
Lectures :3 Hrs/week	End Semester Exams (ESE)	: 80 Marks.
Tutorial : 1Hr/Week	Duration of Paper (ESE)	: 03 Hours.
	Internal Sessional Exam (ISE)	: 20 Marks.

UNIT – I **No of Lecture: 8 Hours, Marks: 16**

Probability Distributions

Random variables, The mean and variance of a Probability distribution, The Binomial and Poisson distributions, The Poisson's approximation to the Binomial Distribution. Continuous random variable, and Normal Distribution, Normal approximation to the Binomial Distribution.

UNIT – II **No of Lecture: 8 Hours, Marks: 16**

Curve Fitting

The method of Least Square, Curvilinear regression (quadratic, exponential), Correlation coefficient and its properties, Inferences about the correlation coefficient-(Normal Population)

UNIT – III **No of Lecture: 8 Hours, Marks: 16**

Sampling

Definitions of (population, sample, statistic, parameter, hypothesis, null hypothesis, alternative hypothesis, critical region, level of significance), Interval estimation, Confidence interval, confidence limit, Sampling, types of sampling, type-I error, type-II error. Test of sampling for single mean, two means.

UNIT – IV **No of Lecture: 8 Hours, Marks: 16**

Tests of Significance

Hypotheses concerning one proportion, Hypotheses concerning two proportions. Small sample test (1. Student t-test for an assumed mean and equality of means of two populations when sample observations are independent, 2. F-test for comparison of variances of two populations,) Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.

UNIT – V **No of Lecture: 8 Hours, Marks: 16**

Experimental Designs

Principles of experimental designs, Completely randomized, Randomized block and Latin square designs, Simple factorial experiments of 2^2, 2^3, 2^4, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD.

Reference Books:

1. Miller & Freund's Probability and Statistics for Engineers (Sixth Edition), by Richard A. Johnson.
2. A Text Book of Engineering Mathematics, by N. P. Bali and Manish Goyal.
3. Probability and Statistics for Engineers (India Edition), by Jay L. Devore
4. Gupta S.C. Fundamentals of Statistics. Himalaya Publishing House, New Delhi
5. Statistical methods in biology by Norman T.J. Bailey (3rd Edition), Cambridge University Press (1995).
6. Khan. Biostatistics. Tata Mc Graw Hill Publishers.
7. Daniel W.W.(9TH Edn., 2009). Biostatistics: A Foundation for Analysis in the Health Sciences. John Wiley and Sons Inc. New York.
8. Sharma N.K.(1996). Statistical Techniques. Mangal Deep Publications, Jaipur, India.

Unit Operation –II

Course outline

Unit Operation –II	**UO-II**	**BTL-404**
Course title	Short title	Course code

Course Description: The goals of the course are to understand the basic principles of mechanical operation and their applications in different areas of engineering and technology.The subject also includes solids handling and process characteristics for solids to process in industrial operations.

	Hours / Week	**No. of Weeks**	**Total Hours**	**Semester Credits**
Lecture	03	15	40	03

Prerequisite Course(s): Engineering Mechanics and Mathematics

Objective of the subject:

1. To make the student familiar with properties of solid.
2. To understand separation technique
3. To understand laws of crushing and grinding.
4. To study the industrial importance of mechanical operations.
5. To make student familiar with Fluidization and types of conveyors.

Learning Outcomes:

After successful completion of this course the student will be able to:

1. Understand the handling of solid and size reduction of solid.
2. Identify the separation technique.
3. Classify the solid according to size .
4. Understand the separation technique of fluid and solid.

5. Understanding basic principles of particles preparation and their characterization.

Course Content

SE Biotechnology **Unit Operation –II** **Semester -IV**

Teaching Scheme	**Examination Scheme**	
Lectures :3 Hrs/week	End Semester Exams (ESE)	: 80 Marks.
Practical : 2 Hrs/Week	Duration of Paper (ESE)	: 03 Hours.
	Internal Sessional Exam (ISE)	: 20 Marks.
	Internal Continuous Assessment (ICA)	: 50 Marks

UNIT-I **No. of Lecture: 8 Hours, marks :16**

Size Reduction

Properties of solids, Particle size, Specific surface area of the Mixture, Average particle size. Mechanism of size reduction , Energy utilization , crushing Efficiency , Energy for size reduction , Laws of crushing ,Types of equipment on the various stages of reduction such as Jaw crushers, Gyratory crusher, Hammer mill , Ball mill , Ultra fine grinders etc., Power requirement , Numerical based on above.

UNIT –II **No. of Lecture: 8 Hours, marks: 16**

Screening & Handling of Solids

Separation of solids by screening , Different types of screens , Capacity and efficiency of screen , Actual & ideal screens ,Screen analysis , Screening equipments such as Grizzly, Gyratory screens , Trommels , Shaking screens , Oscillating Screens. Material Balance over screen , Calculation of screen Effectiveness . Numerical based on above.

Handling of solids: Nature & characteristics of bulk solid, conveyor, Types of conveyor such as belt conveyor, Chain and flight conveyors, Screw conveyors and pneumatic conveyors.

UNIT III **No. of Lecture: 8 Hours, marks: 16**

Classification of solids & Sedimentation

Equipments for classification such as Gravity settling tank, Spitzkasten , Drag classifier , Elutriator , Cone classifier , Double cone classifier, Rake classifier, Cyclone separator, Magnetic separators, Electrostatic separator, Floatation Equipment , jigging , tabling etc.

Sedimentation: Laboratory batch sedimentation, Thickeners, Calculation of area & depth for continuous thickeners. Numerical based on sedimentation.

UNIT IV **No. of Lecture: 8 Hours, marks: 16**

Filtration & Centrifugation

Filtration: Equipments for filtration, constant pressure & constant rate filtration, filter calculations, Optimum time cycle, Handling of compressible cakes and use of filter aids , Washing of Cake .Numerical based on above .

Centrifugation: Centrifugation calculations, Filtration in a centrifuge, Equipments of centrifugal filtration .Problems on centrifugal Filtration. Comparison of sedimentation & centrifugation.

UNIT V **No. of Lecture: 8 Hours, marks: 16**

Fluid Solid Systems

Fluidization: Characteristics of fluidized systems, Effect of fluid velocity on pressure Gradient, Minimum fluidization velocity, types of fluidization , Application of fluidization such as fluidized bed catalytic cracking, in chemical and process industries, Fluidized bed combustion.

Numerical based on above.

References:

1. R. S. Hiremath and A.P. Kulkarni , Unit operations of Chemical Engg. (Mechanical operations Vol.-I: Everest publication.

2. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.

3. W.L. McCabe and J.C. Smith, Unit Operations of Chemical Engg. : Tata McGraw Hill

4. J. M. Coulson and R.F. Richardson, Chemical Engg. Vol. I & II : Butter worth & Heinemann.

5. I. P. Chattopadhaya, Unit Operations of Chemical Engg. Vol. I : Khanna Publications, Delhi.

Process Heat Transfer
Course Outline

Process Heat Transfer	**PHT**	**BTL-405**
Course title	Short title	Course code

Course Description:

This course introduces students to key concepts and principles required to analyze problems involving heat exchange and energy conversion. Objective of the course is to study modes of heat transfer and development of relations to calculate hear transfer rate.

Lecture	**Hours / Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	15	40	03

Prerequisite Course(s): 10^{th} and 12^{th} Std Physics, Chemistry, Mathematics.

Objective of the subject:

1. To make the student familiar with conduction, convection and radiation phenomenon.
2. To understand condensation and boiling operations with regards to the processing of bio chemicals.
3. To develop the relations for rate of heat transfer to achieve optimized operations.
4. To study the types of heat exchanger and their uses in different industrial operations.
5. To study the types of evaporator and their uses for various industrial processes and applications.

Learning Outcomes:

After successful completion of this course the student will be able to :

1. Demonstrate general applications of heat transfer modes as conduction, convection and radiation in biochemical process industry.
2. Control the different parameters which are required for various biochemical processes.
3. Know the working and principle of all types of evaporators which are used in industries.
4. Know working and principles of all types of Heat Exchanger equipments which are widely used in biochemical, fermentation and pharmaceutical industries.
5. Apply their knowledge to condensate and boiling the various types of biochemicals and other fluids used in industries.
6. Design of heat exchange equipments.

Course Content

SE Biotechnology **Process Heat Transfer** **Semester -IV**

Teaching Scheme	**Examination Scheme**	
Lectures :3 Hrs/week	End Semester Exams (ESE)	: 80 Marks.
Practical : 2 Hrs/Week	Duration of Paper (ESE)	: 3 Hours.
	Internal Sessional Exam (ISE)	: 20 Marks.
	Internal Continuous Assessment (ICA)	: 25 Marks
	End Semester Exam (ESE) (OR)	: 25 Marks

UNIT-I **No. of Lecture: 8 Hours, marks :16**

Conduction in solids

Fourier's law of heat conduction, steady state heat conduction through walls (single and multilayer), heat flow through cylinder, sphere, unsteady state heat conduction, Lumped capacity. Thermal insulation, Optimum thickness of Insulation, Critical radius of insulation.

Numericals based on above.

UNIT-II **No. of Lecture: 8 Hours, marks :16**

Convection

Classification of convection(natural convection and force convection), individual and over all Heat transfer coefficients, Fouling factor ,Flow arrangement in heat exchanger, Log mean temperature difference(LMTD), Wilson Plot .

Numericals based on above.

UNIT-III **No. of Lecture: 8 Hours, marks :16**

Radiation heat transfer

Fundamental of radiation, black body radiation, Kirchhoff's law, radiant heat exchange between nonblack surfaces, Combined heat transfer by conduction, convection and radiation.

Heat transfer to boiling liquids**:** Pool boiling of saturated liquid .Boiling point curve.

Numericals based on above.

UNIT-IV **No. of Lecture: 8 Hours, marks :16**

Condensation & Evaporation

Heat transfer to fluids with phase change: Condensation, Drop wise and film wise Condensation, Condensation on vertical plate .

Evaporation: Types of evaporator (Jacketed pan evaporator, Calendria type evaporator, single effect evaporator. forced circulation evaporator, Multiple effect evaporator.

Numericals based on single effect evaporator.

UNIT-V **No. of Lecture: 8 Hours, marks :16**

Heat exchange equipments

Heat exchangers (Double pipe ,Shell and tube ,Kettle type ,plate type Heat Exchangers).

Effectiveness factor, capacity and NTU.

Numericals based on above.

Reference Books:

1. W.L.McCabe and J.C.Smith , Unit operations in chemical engineering. McGraw Hill/Kogakusha Ltd.
2. Dawande S.D. Principals of Heat Transfer and Mass Transfer. Central Techno Publications, Nagpur.
3. Coulson & Richardson , Chemical engineering. – Volume. I, Pergamon Press
4. Kern D.Q. Process Heat Transfer, McGraw Hill Book 1NC New York, 1950
5. D.S. Kumar, Process Heat Transfer, S.K. Kataria and Sons Publisher, New Delhi
6. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.

Course Outline

Lab Computer Applications	**Lab CA**	**BTP-406**
Course Title	Short Title	Course Code

Course Description: This laboratory course is dealing with applications of computers for designing the various formulas required for Bioprocess engineering programme with a comprehensive study of the C++ programming language.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**01**	**15**	**10**	**01**
Laboratory	**02**	**15**	**16**	**01**

Prerequisite Course(S): Computer Programming, Engineering Mathematics I and II.

General Objectives:

1. Students will learn to solve matrix equations using Matrix Inversion method.
2. Students will learn to solve Differential equation of first order by various methods like Taylor's series method, Modified Euler's method, Runge Kutta's 4^{th} order method.
3. Students will also learn to solve Numerical Integrations by various methods like, by Picards method, Trapezoidal Rule, by Simpson's $1/3^{rd}$ Rule, Simpson's $3/8^{th}$ rule.

Learning Outcomes:

Students completing this course will able to apply knowledge of Basic Science using knowledge of C and C++ language in Bioprocess Engineering Problems. Students will demonstrate their ability to solve Bioprocess Engineering Problems using computer interface. Students will be able to provide a definite solution to various designing problems in Bioprocess Engineering field.

Course Content

SE Biotechnology **Lab Computer Applications** **Semester – IV**

Teaching Scheme
Theory : 1 hours/ week
Practical : 2 hours/ week

Examination Scheme
Internal Continuous Assessment (ICA): 50 Marks

Theory:

Introduction to object oriented programming

(a) Structure of C++ programming.

(b) Tokens, keywords, constant in C++.

(c) Derived data types, operators, expression in C++.

(d) Function in C++.

(e) Classes and objects in C++.

Introduction to Polymath and Bioprocess Engineering problems based softwares.

Fundamental concepts of Matrices, Numerical Differentiation & Numerical Integration.

Lab Work: (Any Eight from the following)

1. To solve Matrices using Matrix Inversion Method.
2. To solve Matrices using Gauss Elimination method.
3. To solve Differential equation of first order by Taylor's series method
4. To solve Differential equation of first order by Modified Euler's method
5. To solve Differential equation of first order by Picards method
6. To solve Differential equation of first order by Runge Kutta's 4^{th} order method
7. To solve Numerical Integration by Weddle's rule.
8. To solve Numerical Integration by Trapezoidal Rule
9. To solve Numerical Integration by Simpson's $1/3^{rd}$ Rule
10. To solve Numerical Integration by Simpson's $3/8^{th}$ rule

Reference Books:

1. E Balagurusamy “Object Oriented Programming with C++”, Tata McGraw Hill, 4/E,2008.
2. Yashavant Kanetkar, “Let Us C” , BPB Publications ,10/E, 2010.
3. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 6th Edition, Tata McGraw Hill.
4. David M. Himmelblau, Basic Principles & Calculations in Chemical Engineering, 6th Edn., Pearson Education Pvt.Ltd., New Delhi.
5. S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall

LAB Biochemistry

Lab Course Outline

LAB Biochemistry	LAB BCH	BTP-407
Course Title	Short Title	Course Code

Practical	Hours/ Week	No. of Weeks	Total Hours	Semester Credits
	02	15	26	1

Course Description:

In this laboratory, course emphasis is on the understanding of basics of qualitative and quantitative identification and estimation of biomolecules from the enormous diversity of source in environment. The learner here can use this knowledge and apply in allied branches of Biotechnology as required.

Prerequisite Course(s): Course of Chemistry & Biology at HSC level and FE.

General Objective:

The objective of the laboratory is to impart the fundamental knowledge of chemical basis of biology at the research level to the students and develop their ability to apply the specific procedures to analyze the experimental results.

In this lab, students will be familiar with the use and application of biomolecules in laboratory and various equipments which they can apply in research and Development in the field of Biotechnology

Learning Outcomes:

After successful completion of this lab student will be able to:

- Estimate the amount of different biomolecules like carbohydrates, proteins, nucleic acids from various sources.
- Understand the basic principle of isoelectric precipitation.
- To apply the basic properties of biomolecules for their separation from mixture.
- To extract the lipids from various biological sources.
- To understand the basic principles of thin layer chromatography and gel electrophoresis.

Lab Course Content

Practical -2 Hrs/ weeks

(Note: Minimum Eight Experiments from the following)

1 Estimation of carbohydrates.

a. Estimation of reducing sugars by Dinitrosalicylic acid method.

2. Estimation of proteins.

a. Estimation of proteins by Lowry method.

3. Estimation of nucleic acids:

4. Isoelectric precipitation.

5. Separation of amino acids by paper chromatography.

6. Separation of sugars by paper chromatography.

7. Extraction of Lipids.

8. Thin layer Chromatography.

9. Gel Electrophoresis.

10-11. Assay of enzyme activity and enzyme kinetics.

12. Identification and estimation of an intermediate of EMP pathway.

13. Cell fractionation.

14. Vitamin Assay.

LAB Immunology

Lab Course Outline

LAB Immunology **LAB IMM** **BTP-408**

Course Title Short Title Course Code

Laboratory	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	2	15	16	01

Course Description:

Course emphasis is on the understanding of basic concepts in immunology. The learner here can use this knowledge and apply in allied branches of Biotechnology as required. The course is also helps for the study of antigen antibody interaction.

Course Objectives:

1) To study the antigen antibody interaction.
2) To study the analytical techniques such as ELISA, Ouchterlony diffusion.
3) To study the advanced techniques of the antigen antibody interactions such as Precipitin reaction, Antibody titer test, Agglutination reaction.

Course Outcomes:

By completion of this course students will able to:

1) To apply the basic fundamentals in antigen antibody reaction for designing the experiment.
2) To perform the analytical techniques in immunology is the industry.

Lab Course Content

Practical -2 Hrs/ weeks

(Note: Minimum Eight Experiments from the following)

Practical Work Shall be based on any 08 experiments mentioned below.

1. Immunoelectrophoresis.
2. Radial immunodiffusion.
3. Antigen –Antibody interaction: The Ouchterlony procedure
4. Introduction to ELISA reactions
5. Western Blot Analysis – demo.
6. Immunology of pregnancy test – demo.
7. Latex agglutination test
8. Precipitin reaction
9. Antibody titer test
10. Agglutination reaction.

LAB Unit Operation -II

Lab Course Outline

LAB Unit Operation-II	**LAB UO-II**	**BTP-409**
Course Title	Short Title	Course Code

Laboratory	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	02	15	16	01

Course Description: This course is intended to provide engineering students with a background in important concepts and principles of Unit operation –II.

Prerequisite Course(s): Engineering Mechanics and Mathematics.

General Objective: The objective of the laboratory Course is to impart the fundamental knowledge of unit operations to the students and develop their ability to apply the specific procedures to analyze the experimental results.

Learning Outcomes:

After successful completion of this lab course the student will be able to:

1. Separate of solids by sedimentation techniques .
2. Ascertain the fineness number and to study the differential & cumulative screen analysis of the sand.
3. Determine power requirement for crushing.
4. Determine the rate of filtration ,specific cake resistance and filter medium resistance
5. Find out the rate of filtration
6. Calculate minimum fluidization velocity
7. Determine the effectiveness of the Vibrating screen.
8. Mini Pulveriser : To study the Mini Pulveriser
9. Cyclone Separator : To study the operating behavior of cyclone separator and to find out its efficiency.

Lab Course Content

Practical -2 Hrs/ weeks

TW / Practicals:

Term Work Shall be based on any 08 experiments mentioned below. List of the Experiments.

1. To study the separation of solid by sedimentation
2. Sieve Shaker: To ascertain the fineness number and to study the differential & cumulative screen analysis of the sand
3. Ball Mill :To verify the laws of crushing & grinding
4. Jaw Crusher : To verify the laws of crushing & grinding
5. Plate & Frame Filter Press: To determine the rate of filtration ,specific cake resistance and filter medium resistance
6. Rotary Vacuum Filter: To find out the rate of filtration
7. Fluidization : To observe and study the behavior of the bed during fluidization and to calculate minimum fluidization velocity
8. Sigma Kneader Mixer : To study the sigma Kneader Mixer
9. Vibrating Shifter : To find out the effectiveness of the Vibrating Shifter
10. Mini Pulveriser : To study the Mini Pulveriser
11. Cyclone Separator : To study the operating behavior of cyclone separator and to find out its efficiency
12. Ribbon Blender : To study the Ribbon Blender & to find out the mixing index

LAB Process Heat Transfer

Lab Course Outline

LAB Process Heat Transfer	**LAB PHT**	**BTP-410**
Course Title	Short Title	Course Code

Laboratory	Hours/ Week	No. of Weeks	Total Hours	Semester Credits
	02	15	16	01

Course Description:

In this laboratory course emphasis is on the understanding of basics of Process heat transfer

Prerequisite Course(s): Engineering Physics and Chemistry I and II, Mathematics.

General Objective: The objective of the laboratory is to impart the fundamental knowledge of Process heat transfer to the students and develop their ability to apply the specific procedures to analyze the experimental results.

Learning Outcomes:

After successful completion of this Lab course the student will be able to:

1. Demonstrate general applications and use of heat exchange equipments in industries.
2. Control the different parameters which are required for various processes industries .
3. Apply their knowledge to condensate and boiling the various types of fluids used in industries.
4. Determination of emissivity of test plate.
5. Determination thermal conductivity of metals and insulators.

Lab Course Content

Practical -2 Hrs/per Week

(Note: Minimum EIGHT Experiments from the following)

1) Conductivity of metals and / or insulator.
2) Experiment on Pin fins.
3) Experiment on forced convection apparatus.
4) Experiment on natural convection apparatus.
5) Determination of emissivity of test plate.
6) Stefan Boltzmann apparatus .
7) Parallel / counter flow heat exchanger.
8) Study of pool boiling phenomenon and critical heat flux.
9) Study of heat transfer in evaporator .
10) Temperature profile in a rod .
11) Study of evaporators .
12) Drop wise and film wise condensation .