

**NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)
Second Year Engineering
(Biotechnology)
Faculty of Engineering and Technology**



**Teacher and Examiner's Manual
TERM - III
W.E.F 2013 - 2014**

Concepts in Biotechnology

Teacher, Paper setter and Examiner should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of structural organization of cell, size, number and chemistry of cell.

1.	Cell Biology and Cell Theory		Lecture required	Reference No
	a	Structural organization of life, Concepts of modern cell	02	01
	b	History of cell, Cell theory, Structure of cell:- Cell shape	02	02
	c	size and cell number, Types of cells	02	02
	d	Prokaryotic cells and Eukaryotic cells, Chemistry of cells.	02	02

Unit - II

Teacher should facilitate learning of Study of Intracellular Components of Cell.

2.	Study of Intracellular Components of Cell		Lecture required	Reference No
	a	Cell organelles:-Structure & Functions of: Mitochondria	02	02
	b	Plastids:- Chloroplast, chromoplast, Nucleus, ribosomes, Golgi complex	03	02
	c	Endoplasmic reticulum, Endosomes	02	02
	d	Lysosomes, peroxisomes.	01	02

Unit - III

Teacher should facilitate learning of Cell Division Process.

3.	Cell Division		Lecture required	Reference No
	a	Cell cycle, mitosis, meiosis, genetic and biochemical approaches for the study of cell division, mitotic cell division.	03	02
	b	Embryonic cell division, cell death,	03	02
	c	The cell cycle of cancer	01	02
	d	Central cell cycle control systems	01	02

Unit – IV

Teacher should facilitate learning Basic Concepts in Genetics.

4.	Basic Concepts in Genetics	Lecture required	Reference No
a	Introduction to gene, Mendels law of segregation, Assumption involved in segregation,	02	03
b	Physical basis of segregation, Law of Independent Assortment	02	03
c	Introduction, two characters of independent segregation, test cross of dihybrid & trihybrid	02	03
d	Physical basis of independent assortment, Gene vs allele: a modified concept of gene, fine structure of gene.	02	02

Unit - V

Teacher should facilitate learning of Elements of Genetics.

5.	Chromosomes	Lecture required	Reference No
a	Chromosomes:- Introduction, chromosome number, size, morphology, chemical composition of chromosome and function.	03	03
b	Structural chromosomal aberrations:- Introduction, origin of structural aberrations, structure of chromosomal aberrations.	01	03
c	Variation in chromosomal number	01	03
d	Mutation: - Introduction, characteristics of mutations, classification, spontaneous and induced mutations, Population genetics:- Introduction, gene frequency, genotype frequency, gene pool.	03	03

Reference Books:

1. S.C. Rastogi, Cell & Molecular Biology, Rastogi Publication
2. P.K. Gupta, Cell & Molecular Biology, Rastogi Publication.
3. B.D. Singh, Genetics, Kalyani Publication.
4. C.B. Pawar “ Cell Biology” Himalaya Publications.
5. C.B. Pawar “ Cell and Molecular Biology” Himalaya Publications.

Bioprocess Calculations

Teacher, Paper setter and Examiner should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of Units, Dimensions, Properties of Gases, Liquids & Solids and its application in different areas.

1.	Introduction to Bioprocess Calculations		Lecture required	Reference No
	a	Basic & derived units, dimensional analysis, dimensional & empirical equations.	02	01
	b	Different ways of expressing units of quantities & physical constants.	02	01
	c	Properties Of Gases, Liquids & solutions: Ideal & real gas laws, critical properties.	02	01
	d	Properties of mixtures & solutions, Kay's rule.	02	01

Unit - II

Teacher should facilitate learning of Material Balances without reactions.

2.	Material Balances without reactions		Lecture required	Reference No
	a	Law of conservation of mass	02	02
	b	Material balance of unit operations such as Distillation, Mixing, Evaporation, Leaching.	03	01
	b	Liquid -Liquid Extraction and Solid Liquid Extraction.	03	01

Unit - III

Teacher should facilitate learning of Material Balances with reactions.

3.	Material Balances with reaction		Lecture required	Reference No
	a	Concept of limiting & excess reactants, conversion, yield and Selectivity.	02	01
	b	Material Balance of biochemical reactions.	03	02
	c	Photochemical reactions.	02	03
	d	Material balance with Recycle ,by pass and purge stream of Bioprocesses (Description Only)	01	02

Unit - IV

Teacher should facilitate learning of basics of Energy balances.

4. Energy balances		Lecture required	Reference No
a	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 Condensation, Heat of solution, Study of steam table.	02	02
b	Energy Balance calculations Without Reaction.	02	02
c	Enthalpy Change Due to Reaction: Heat of combustion. Heat of Reaction for processes with Biomass production , Heat Reaction With Oxygen as a Electron Acceptor	02	02
d	Heat of Reaction With Oxygen Not the Electron acceptor , Energy Balance Equation for cell culture, Fermentation Energy Balance	02	02

Unit - V

Teacher should facilitate learning of basics of Humidity, Saturation, Combustion and its application in different areas.

5. Humidity , Saturation and Combustion		Lecture required	Reference No
a	Humidity & Saturation, Define Humid volume, Humid heat, Dry bulb temperature, Wet bulb temperature etc.	02	01
b	Psychometric chart, Solubility diagrams.	03	01
c	Combustion: Introduction, Fuels, Calorific value of fuels. Air requirements	03	01

Reference Books:

1. B I Bhatt & S M Vora, Stoichiometry fourth Edition :Tata McGraw Hill Publishing Company Ltd New Delhi, 2005.
2. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press, An Imprint of Elsevier, Reprint 2010.
3. Durga Prasad Rao & DVS Murthy ,Process Calculations for Chemical Engineers: Mc Millan India, New Delhi .
4. K A Gavhane , Introduction to Stoichiometry : Nirali Prakashan.
5. Hougen O.A, Watson K.M, & Ragatz R.A. Chemical Process Principles Part-I Asia Publishing House, Mumbai.
6. Himmelbleau D.M. Basic principles and calculations in Chemical Engineering. Prentice Hall Publication.
7. ShekharPandharipande and Samir Mushrif, Process Calculations. Pune Vidyarthi Griha Prakashan, Pune

UNIT OPERATION –I

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of basics of properties of fluid and types of fluid.

1.	Properties of fluid	Lecture required	Reference No
a	Properties of fluid: Definition of fluid, Mass density, Specific weight, Specific volume, Specific gravity , viscosity concept (Numerical expected)	02	01
b	Viscosity Measurement , Cone And Plate Viscometer, Use Of Viscometer With Fermentation Broths,	02	03
c	Factor Affecting Broth Viscosity	01	03
d	Surface tension and Capillarity. (Numerical expected)	02	01
e	Types of fluid- Ideal fluid, Real fluid, Newtonian and non Newtonian, Ideal plastic fluid.	01	01

Unit – II

Teacher should facilitate learning of dynamics of fluid flow its application in different area of Biotechnology.

2.	Dynamics of fluid flow :	Lecture required	Reference No
a	Continuity Equation, Euler's equation of motion a long streamline.	02	01
b	Bernoulli's equations for different conditions. (Numerical expected)	02	01
c	Hydrostatic Law. Pascal law .	01	01
d	Pressure measurements: Principle and types of manometer . (Numerical expected)	03	01

Unit – III

Teacher should facilitate learning of flow through pipes and fundamental of boundary layer flow in Engineering applications.

3.	Flow through pipes and Boundary layer flow	Lecture required	Reference No
a	Flow through pipes: Major and minor losses. (Numerical expected)	2	1
b	Define friction Factor , friction factor chart .	2	1
c	Distribution of flowing fluids through branched pipe. (Numerical expected)	2	1
d	Boundary layer flow : Laminar boundary layer over a flat plate ,Turbulent boundary layer , Laminar sub layer Explain Boundary layer thickness : Displacement thickness, Momentum thickness, energy thickness .(only description)	2	1

Unit - IV

Teacher should facilitate learning of flow measurement and its applications.

4.	Flow Measurement	Lecture required	Reference No
a	Flow Measurement: Flow through Orifice meter, Nozzle meter and Venturi meters. (Numerical expected)	04	01
b	Rotameter and Pitot tube	01	02
c	Reynolds experiment.	01	01
d	Other flow measuring devices such as Ultrasonic flow meters, Anemometers, Electromagnet flow meters	02	02

Unit - V

Teacher should facilitate learning of pumping of fluids and its application in different areas.

5.	Pumping of fluids	Lecture required	Reference No
a	Pumping equipments: Working and construction of the Reciprocating pump. (Numerical expected)	02	01
b	Positive displacement pump	01	02
c	Centrifugal pump (Numerical expected)	02	01
d	Peristaltic Pump	01	02
e	NPSH calculations. (Numerical expected)	01	02
f	Blowers & compressors	01	02

Reference Books:

1. Dr. R. K. Bansal, Fluid Mechanics: Laxmi Publications First Edition, 2005:, New Delhi.
2. W.L. McCabe & J.C. Smith, Unit operations in chemical engineering: McGraw Hill/Kogakusha Ltd
3. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.
4. I. P. Chattopadhaya Unit operations of chemical engineering-volume I: Khanna Publication New Delhi, 2nd edition 1996.

Microbiology

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of Microbiology with its history, scope and importance in Biotechnology.

1.	Introduction of Microbiology	Lecture required	Reference No
a	Microbiology and its Scope	01	01
b	History of Microbiology: Contribution of Various Scientists in the Development of Microbiology	01	01
c	Incidences of Microorganisms in Environment	02	01
d	<i>Classification of Microorganisms:</i> Prokaryotes and Eukaryotes (Cell Structure), Morphology and Physiology of Bacteria, Yeast, Molds, Algae and Viruses	04	01

Unit - II

Teacher should facilitate learning of different basic techniques in Microbiology and its application.

2.	Techniques in Microbiology	Lecture required	Reference No
a	Microscopy	01	01
b	Nutritional requirements of microorganisms and microbial culture media	01	01
c	Isolation, identification and Maintenance of cultures (preservation)	02	01
d	Characteristics of pure culture	02	01
e	Enumeration techniques.	02	01

Unit - III

Teacher should facilitate learning of different techniques and basic terms for the effective control of microorganisms.

3.	Microbial Control	Lecture required	Reference No
a	<i>Basic Terms:</i> Sterilization, Disinfection, Antiseptic, Sanitizer, Germicide, Microbiostasis, Antimicrobial Agents, Preservatives	01	02
b	Factors influencing Antimicrobial Activity	02	02
c	Mechanisms of Cell Injury	02	02
d	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.	03	02

Unit - IV

Teacher should facilitate learning of Microbial Growth and Kinetics.

4.	Microbial Growth	Lecture required	Reference No
a	Modes of Cell Division,	01	01
b	<i>Microbial Growth Kinetics</i> : Growth Rate & Generation, Mathematical expression for Growth, Growth Curve, Diauxic Growth Curve,	03	02
c	<i>Continuous Culture</i> : Chemostat and Turbidostat,	02	02
d	<i>Synchronous Culture</i> : Selection by Size and Age, Selection by induction techniques	02	02

Unit - V

Teacher should facilitate learning of mode of action of different types of antibiotics.

5.	Antibiotics & Other Chemotherapeutic Agents	Lecture required	Reference No
a	Characteristics of Chemotherapeutic Agents	02	01
b	Antibiotics and their Mode of Action	03	01
c	Antifungal Antibiotics.	03	01

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., Ingraham J.L., Whoolis M.L. and Painter P.R. General Microbiology. The McMillan Press Ltd

Soft Skills – III

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate the learning basic foundation of mathematics.

1.	Arithmetic-1	Lecture required	Reference No
a	Number Systems Basic Formulae, Divisibility Rules, Speed Maths, Remainder Theorem, Different Types of Numbers, Applications	01	01
b	HCF, LCM and Linear Equations HCF – Successive Division and Prime Factorization Methods, LCM – Successive Division and Prime Factorization Methods, Applications, Linear Equations – Elimination Method, Substitution Method, Applications	01	01
c	Averages and Mixtures Concept of Average, Faster Ways of Finding It, The Allegation Method, Applications	01	01

Unit II

Teacher should facilitate the learning basic foundation of mathematics.

2.	Arithmetic-2	Lecture required	Reference No
a	Percentages Concept of Percentage, Working with Percentages Applications	01	01
b	Profit and Loss Difference between Cost and Selling Price, Concept of Profit Percentage and Loss Percentage, Applications	01	01
c	Time and Work Basic Time and Work Formula, Relation between Time and Work, Applications	01	01

Unit III

Teacher should facilitate the learning basic foundation of mathematics.

3.	Arithmetic-3	Lecture required	Reference No
a	Permutations and Combinations Sum Rule of Disjoint Counting, Product Rule of Counting Concept of Factorial, Permutations, Linear Permutations, Combinations, Circular Permutations, Applications	01	01
b	Probability Definition and Laws of Probability, Mutually Exclusive Events, Independent Events, Equally Likely Events, Exhaustive Events, Cards, Dice, Applications	01	01

	c	Time and Distance Speed, Conversion Factors for Speed, Average Speed, Moving Bodies – Passing, Crossing and Overtaking, Relative Speed, Boats and Streams, Applications	01	01

Unit IV

Teacher should facilitate learning of critical thinking.

4.	Non-Verbal Reasoning		Lecture required	Reference No
	a	Analogies Different type of examples of analogies and its Applications	01	02
	b	Classification Different type of examples of analogies and its Applications	01	02
	c	Sequences Different type of examples of analogies and its Applications		02

Unit V

Teacher should facilitate the learning of a deep sense of analysis towards solving a problem

5.	Analytical Reasoning		Lecture required	Reference No
	a	Analytical Puzzles Classification Puzzles, Ordering Puzzles, Assignment puzzles, Applications	01	03
	b	Letter and Number Series Different Types of Letter Series, different types of Number Series, mixed Series	01	03
	c	Coding and Decoding Letter Coding, Number Coding, Mixed Coding, Odd Man Out, Applications	01	03

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.

Microbiology

LAB COURSE CONTENT

Teacher should facilitate learning of following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1-2	Study and use of microscope & Examination of prepared	04
3	Preparation of laboratory media:	04
4	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	04
5-7	Staining techniques: a) Simple staining, b) Gram staining, c) Lactophenol cotton blue mounting of fungi.	04
8	Isolation by serial dilution method, maintenance & preservation.	04
9-11	Influence of antimicrobial agent, UV radiation & heat on microbial growth.	04
12	Study of bacterial growth curve. (Turbidity measurement as direct expression of growth)	04

Reference Books:

- 1 H.W. Seeley Jr. and Paul J. Van Demark, "Microbes in action". A laboratory manual of Microbiology. D.B. Taraporevala Sons & Co. Pvt. Ltd.
- 2 Ed. J.R. Norris and D.W. Ribbons, "Methods in Microbiology", Vol. 3 A, Academic Press, London & New York.
- 3 Ronald M. Adas, Alfred E. Brown, Kenneth W. Dobra and Llnas Miller (1986). Basic Experimental Microbiology. Prentice Hall.
- 4 Aneja K.R. (2nd Edn., 1996). Experiments in Microbiology, Plant pathology, Tissue Culture and Mushroom Cultivation. Wishwa Prakashan, New Age International (P) Ltd.
- 5 S. Harisha. An Introduction to Practical Biotechnology. Laxmi Publications (P) Ltd. New Delhi

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical out of 8. Evaluation will be based on paper work and performance in the practical.

CONCEPTS IN BIOTECHNOLOGY

LAB COURSE CONTENT

Teacher should facilitate learning of following lab experiments:

(Note: Minimum EIGHT Experiments from each group.)

List of Experiments		Lab hours required
1	To stain and distinguish animal cells.	02
2	To stain and distinguish plant cells.	02
3	To stain and distinguish bacterial cells.	02
4	To explain structure and functions of cell organelles	02
5	To explain mitosis & meiosis in plant cell.	02
6	To isolate cell organelles by designing the specific protocol.	02
7	To identify different types of chromosomes.	02
8	To explain Karyotyping of animal cell.	02
9	To explain Karyotyping of plant cell.	02
10	To explain Karyotyping of bacterial cell.	02

Reference Books:

1. Harisha S, Laboratory manual of Biotechnology, Laxmi Publications, 2006.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Unit Operation -I

LAB COURSE CONTENT

Teacher should facilitate learning of following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1	Determination of Viscosity.	02
2	Study of Manometers	02
3	Verification of Bernoulli's theorem.	02
4	To determine the coefficient of Venturi meter.	02
5	To determine the coefficient of Orifice meter.	02
6	To determine the coefficient of Nozzle meter.	02
7	Reynolds Experiment.	02
8	To study minor losses in pipe.	02
9	To determine the fanning friction factor for given pipe.	02
10	Study of Notches & Weirs.	02
11	To study the characteristics curves of Centrifugal Pump.	02
12	To study of the different types of Fans, Blowers & Compressors.	02

Reference Books:

- 1 R.K. Bansal. Fluid Mechanics, Khanna Publications, New Delhi

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical out of 8. Evaluation will be based on paper work and performance in the practical.

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TERM - IV
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Biochemistry

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

Teacher should facilitate learning of Carbohydrates & their Metabolism.

1.	Carbohydrates & their Metabolism	Lecture required	Reference No
a	Structure, Classification & Functions of Carbohydrates: Monosaccharides, Oligosaccharides, Polysaccharides	02	01
b	Metabolism: Glycolysis, Gluconeogenesis.	02	01
c	TCA cycle, Pentose phosphate pathway , Glyoxylate cycle	02	01
d	Electron Transport Cycle (Brief),	01	03
e	Regulation of glycolysis & TCA	01	01

Unit - II

Teacher should facilitate learning of Proteins & Amino Acids, their Metabolism and biosynthesis.

2.	Proteins & Amino Acids	Lecture required	Reference No
a	Structure, Classification & Functions of Amino acids & Proteins.	02	01
b	Metabolism: Amino acid degradation: Summary of amino acid catabolism, amino acid degradation to pyruvate, Acetyl COA, & α - ketoglutarate, Urea cycle.	03	01
c	Biosynthesis: Amino acid synthesis overview, six essential amino acid synthesis, synthesis of glutamate, glutamine, proline & arginine. Note: Biosynthesis is expected without structures.	03	03

Unit - III

Teacher should facilitate learning of Sequential Circuit and Shift resister.

3.	Lipids & their Metabolism	Lecture required	Reference No
a	Structure & Functions of lipids: Triacylglycerols, Glycerophospholipids, sphingolipids, Cholesterol, phosphatidylinositols, eicosanoids. (Description without structures.)	03	01, 03
b	Oxidation of fatty acids.	02	01
c	Biosynthesis: Fatty acids, Triacylglycerol, & Cholesterol, Glyceroneogenesis	03	01

Unit - IV

Teacher should facilitate learning of Nucleotides & Vitamins with their structure and functions.

4.	Nucleotides & Vitamins		Lecture required	Reference No
	a	Vitamins: Introduction, Classification, Biochemical Functions, RDA, Dietary Sources, Deficiency. (Description without structures.)	04	01
	b	Structure & Functions of nucleotides. (Description without structures.)	02	01
	c	Biosynthesis of nucleotides: denovo synthesis of purine & pyrimidine synthesis and its regulation, salvage pathway. (Description without structures.)	02	01

Unit - V

Teacher should facilitate learning of Enzymes & Membrane transport

5.	Enzymes & Membrane transport		Lecture required	Reference No
	a	Enzymes: Introduction, Classification, mechanism of enzyme action,	02	01
	b	Factors affecting enzyme activity (concentration of enzyme, substrate, temperature, pH), units of enzyme activity.	02	01
	c	Membrane transport: Architecture of membranes: Fluid mosaic model.	01	02, 03
	d	Passive transport: Solutes, glucose, chloride-bicarbonate exchanger,	01	
	e	Active transport: Na ⁺ . K ⁺ ATPase, F-type ATPase, P-type ATPase.	02	

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. Freeman & 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

Teacher, Paper setter and Examiner should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning about the immune mechanism and action of the system against antigens.

1.	Introduction to Immunology	Lecture required	Reference No
a	Properties of immune response, Innate and acquired Immunity, active and passive immunity.	02	01
b	Cells & Tissues of Immune System: Lymphocytes, Classes of lymphocytes, antigen presenting	02	01
c	NK Cells, Mast Cells, Dendritic Cell, LPT cells, Organs of the Immune System, Bone marrow,	02	01
d	Thymus, Lymph node, Spleen, MALT.	02	01

Unit - II

Teacher should facilitate learning structure of antibodies and their classes.

2.	Molecular Immunology	Lecture required	Reference No
a	Molecular structure of antibody, Classification, Isotypes,	03	01
b	Synthesis assembly and expression of immunoglobulin molecules, Nature of antigens, function and diversity, Generation of anti-body diversity.	03	01
c	Antigens: Different characteristics of antigens	01	01
d	Mitogens, Hapten, Adjuvants.	01	01

Unit - III

Teacher should facilitate learning of MHC B & T cells and mechanism of immune response.

3.	Cell Division	Lecture required	Reference No
a	MHC: Discovery of MHC complex, Role of MHC, Structure of MHC molecule, Binding of peptides to MHC molecules, MHC restriction.	03	01
b	Effector Mechanism of Immune Response: Cytokines, T-cell receptors, B cell activation cell	03	02
c	Complement system, antigen processing and presentation	01	01
d	Regulation of immune response.	01	01

Unit - IV

Teacher should facilitate learning of analytical techniques in immunology.

4.	Immunological Techniques	Lecture required	Reference No
a	Antigen- antibody reactions, Immuno diffusion, immuno electrophoresis	02	01
b	ELISA, RIA, Rocket immuno - electrophoresis,	02	01
c	Agglutination reaction	02	01
d	Precipitation reaction, Flow cytometry	02	01

Unit - V

Teacher should facilitate learning of application of immunology.

5.	Applied Immunology	Lecture required	Reference No
a	Immune system in health and disease, autoimmunity, hypersensitivity, Immunology of graft rejection methods and precautions,	03	01
b	GVHD, Hybridoma technology	02	01
c	Fusion of myeloma cells with lymphocytes,	02	01
d	Production of monoclonal antibodies and their application.	01	01

Reference Books:

1. C.V. Rao " ATextbook of Imuunology" Narosa Publishing House.
2. Kuby " ATextbook of Imuunology" 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

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

Teacher should facilitate learning of Probability Distributions.

1.	Probability Distributions	Lecture required	Reference No
	a Random variables,	01	1 to 5
	b The mean and variance of a Probability distribution,	02	1 to 5
	c The Binomial and Poisson distributions,	01	1 to 5
	d The Poisson's approximation to the Binomial Distribution	01	1 to 5
	e Continuous random variable, and Normal Distribution	01	1 to 5
	f Normal approximation to the Binomial Distribution.	02	1 to 5

Unit - II

Teacher should facilitate learning of Curve Fitting.

2.	Curve Fitting	Lecture required	Reference No
	a The method of Least Square,	02	1 to 5
	b Curvilinear regression (quadratic, exponential),	02	1 to 5
	c Correlation coefficient and its properties,	02	1 to 5
	d Inferences about the correlation coefficient-(Normal Population)	02	1 to 5

Unit - III

Teacher should facilitate learning of Sampling.

3.	Sampling	Lecture required	Reference No
	a Definitions of (population, sample, statistic, parameter, hypothesis, null hypothesis, alternative hypothesis, critical region, level of significance),	04	1 to 5
	b Interval estimation, Confidence interval, confidence limit		
	c Sampling, types of sampling, type-I error, type-II error. Test of sampling for single mean, two means.	04	1 to 5

Unit - IV

Teacher should facilitate learning of Tests of Significance.

4.	Tests of Significance		Lecture required	Reference No
	a	Hypotheses concerning one proportion, Hypotheses concerning two proportions.	02	1 to 3
	b	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)	03	1 to 3
	c	Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.	03	1 to 3

Unit - V

Teacher should facilitate learning of Experimental Designs.

5.	Experimental Designs		Lecture required	Reference No
	a	Principles of experimental designs,	01	1 to 3
	b	Completely randomized, Randomized block and Latin square designs,	02	1 to 3
	c	Simple factorial experiments of 2^2 , 2^3 , 2^4 , Confounding in factorial experiments (mathematical derivations not required);	03	1 to 3
	d	Analysis of variance (ANOVA) and its use in the analysis of RBD.	02	1 to 3

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

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of properties of solid and types of equipment for crushing .

1.	Size Reduction	Lecture required	Reference No
a	Properties of solids, Particle size, Specific surface area of the Mixture, Average particle size.	02	01
b	Mechanism of size Reduction, Energy utilization, Crushing Efficiency, Energy for size reduction. (Numerical expected)	02	01
c	Laws of crushing.	01	01
d	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 expected)	03	01

Unit - II

Teacher should facilitate learning of Screening and Handling of solids.

2.	Screening and Handling of solids	Lecture required	Reference No
a	Separation of solids by screening ,Different types of screens Capacity and efficiency of screen , Actual & ideal screens ,Screen analysis,	02	01
b	Screening equipments such as Grizzly Gyratory screens, Trommels, Oscillating Screens.	02	01
c	Material Balance over screen, Calculation of screen Effectiveness. (Numerical expected)	01	01
d	Nature and characteristics of bulk solids conveyor Types of conveyor such as belt conveyor. Chain and Flight conveyors. Screw conveyors, pneumatic conveyors	03	01, 02

Unit - III

Teacher should facilitate the learning of classification of solid particles & sedimentation.

3.	Classification of solids & Sedimentation	Lecture required	Reference No
a	Classification of solid particles : Equipments for classification such as Gravity settling tank, Spitzkasten, Cone classifier , Double cone classifier, Cyclone separator, Magnetic separators, Electrostatic separator, jigging , Tabling etc	04	01

	b	Sedimentation: Laboratory batch sedimentation, Thickeners, Calculation of area & depth for continuous thickeners. (Numerical expected)	04	01
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Unit - IV

Teacher should facilitate learning of basics of Filtration & Centrifugation

4.	Filtration & Centrifugation		Lecture required	Reference No
	a	Filtration: Equipments for filtration, constant pressure & constant rate filtration, filter calculations, Optimum time cycle, (Numerical expected)	03	01
	b	Handling of compressible cakes and use of filter aids , Washing of Cake.	02	01
	c	Centrifugation: Centrifugation calculations, Filtration in a centrifuge, Equipments of centrifugal filtration.	02	01
	d	Comparison of sedimentation & centrifugation.	01	01

Unit - V

Teacher should facilitate learning of fluid solid systems.

5.	Fluid Solid Systems		Lecture required	Reference No
	a	Fluidization: Characteristics of fluidized systems, Effect of fluid velocity on pressure Gradient, Minimum fluidization velocity	03	01, 02
	b	Types of fluidization , Application of fluidization such as fluidized bed catalytic cracking, in chemical and process industries.(Numerical expected)	03	01
	c	Fluidized bed combustion	02	01, 02

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. Chattopadhyaya, Unit Operations of Chemical Engg. Vol. I : Khanna Publications, Delhi.

Process Heat Transfer

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate learning of conduction in solids .

1.	Conduction in solids	Lecture required	Reference No
a	Fourier's law of heat conduction, steady state heat conduction through walls (single and multilayer)	02	01, 02
b	Heat flow through cylinder, sphere, unsteady state heat conduction, Lumped capacity.	03	01, 02
c	Thermal insulation, Optimum thickness of Insulation, Critical radius of insulation.	03	02

Unit - II

Teacher should facilitate learning of basics of convection .

2.	Convection	Lecture required	Reference No
a	Classification of convection(natural convection and force convection)	02	01, 02
b	Individual and over all Heat transfer coefficients, Fouling factor	02	01, 02
c	Flow arrangement in heat exchanger,	02	01, 02
d	Log mean temperature difference (LMTD), Wilson Plot .	02	01, 02

Unit - III

Teacher should facilitate learning of radiation heat transfer and boiling of liquids.

3.	Radiation heat transfer	Lecture required	Reference No
a	Fundamental of radiation, black body radiation, Kirchhoff's law	02	01, 02
b	Radiant heat exchange between nonblack surfaces, Combined heat transfer by conduction, convection and radiation.	03	01, 02
c	Heat transfer to boiling liquids: Pool boiling of saturated liquid .Boiling point curve.	03	01, 02

Unit - IV

Teacher should facilitate learning of condensation, evaporation and its applications.

4.	Condensation & Evaporation	Lecture required	Reference No
a	Heat transfer to fluids with phase change: Condensation, Drop wise and film wise Condensation, Condensation on vertical plate.	02	01, 02
b	Evaporation: Types of evaporator : Jacketed pan evaporator, Calendria type evaporator,	03	01, 02
c	Single effect evaporator, Forced circulation evaporator, Multiple effect evaporators. Numericals based on single effect evaporator.	03	01, 02

Unit - V

Teacher should facilitate learning of heat exchange equipments.

5.	Heat exchange equipments	Lecture required	Reference No
a	Heat exchangers (Double pipe, Shell and tube, Kettle type, plate type Heat Exchangers).	04	01, 02
b	Effectiveness factor, capacity and NTU.	04	01, 02

Reference Books:

- 1 W. L. McCabe and J. C. Smith , Unit operations in chemical engineering. McGraw Hill/Kogaku Ltd.
- 2 Dawande S.D. Principals of Heat Transfer and Mass Transfer. Central Techno Publica 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

Computer Applications

LAB COURSE CONTENT

Teacher should facilitate learning following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1	To solve Matrices using Matrix Inversion Method.	02
2	To solve Matrices using Gauss Elimination method	02
3	To solve Differential equation of first order by Modified Euler's method	02
4	To solve Differential equation of first order by Picards method	02
5	To solve Differential equation of first order by Runge Kutta's 4 th order method	02
6	To solve Numerical Integration by Weddle's rule.	02
7	To solve Numerical Integration by Trapezoidal Rule	02
8	To solve Numerical Integration by Simpson's 1/3 rd Rule	02
9	To solve Numerical Integration by Simpson's 3/8 th rule	02

Reference Books:

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

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Biochemistry

LAB COURSE CONTENT

Teacher should facilitate learning following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1	Estimation of carbohydrates. a. Estimation of reducing sugars by Dinitrosalicylic acid method.	02
2	Estimation of proteins. a. Estimation of proteins by Lowry method.	02
3	Estimation of nucleic acids:	02
4	Isoelectric precipitation.	02
5	Separation of amino acids by paper chromatography.	02
6	Separation of sugars by paper chromatography.	02
7	Extraction of Lipids.	02
8	Thin layer Chromatography.	02
9	Gel Electrophoresis.	02
10	Assay of enzyme activity and enzyme kinetics.	02
11	Identification and estimation of an intermediate of EMP pathway.	02
12	Cell fractionation.	02
13	Vitamin Assay	02

Reference Books:

- 1 Plummer David T. "An Introduction to Practical Biochemistry", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- 2 Jayraman J. A Laboratory Manual in Biochemistry. New Age International Publishers.
- 3 Sadasivan S. and Manikam K. Methods in Agricultural Biochemistry. Wiley Eastern Ltd., New Delhi.
- 4 S. Harisha. An Introduction to Practical Biotechnology. Laxmi Publications (P) Ltd. New Delhi.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical out of 8. Evaluation will be based on paper work and performance in the practical.

IMMUNOLOGY

LAB COURSE CONTENT

Teacher should facilitate learning following lab experiments:

(Note: Minimum EIGHT Experiments from each group.)

List of Experiments		Lab hours required
1	Immunoelectrophoresis.	02
2	Radial immunodiffusion	02
3	Antigen –Antibody interaction: The Ouchterlony procedure	02
4	Introduction to ELISA reactions	02
5	Western Blot Analysis – demo	02
6	Immunology of pregnancy test – demo.	02
7	Latex agglutination test	02
8	Precipitin reaction	02
9	Antibody titer test	02
10	Agglutination reaction.	02

Reference Books:

1. Harlow and David Lane Antibodies A laboratory Manual, Cold spring harbor Laboratory.
2. Talwar G.R. and Gupta S.K. A hand book of Practical and Clinical Immunology. Vol. 1 & 2. CBS Publishers and Distributors.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical out of 8. Evaluation will be based on paper work and performance in the practical.

Unit Operations II

LAB COURSE CONTENT

Teacher should facilitate learning following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1	To study the separation of solid by sedimentation	02
2	Ball Mill :To verify the laws of crushing & grinding	02
3	Jaw Crusher : To verify the laws of crushing & grinding	02
4	Plate & Frame Filter Press: To determine the rate of filtration ,specific cake resistance and filter medium resistance	02
5	Fluidization : To observe and study the behavior of the bed during fluidization and to calculate minimum fluidization	02
6	Rotary Vacuum Filter: To find out the rate of filtration	02
7	Sigma Kneader Mixer : To study the sigma Kneader Mixer	02
8	Vibrating Shifter : To find out the effectiveness of the Vibrating Shifter	02
9	Mini Pulveriser : To study the Mini Pulveriser	02
10	Cyclone Separator : To study the operating behavior of cyclone separator and to find out its efficiency	02
11	Ribbon Blender : To study the Ribbon Blender & to find out the mixing index	02

Reference Books:

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

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Process Heat Transfer

LAB COURSE CONTENT

Teacher should facilitate learning following lab experiments:

(Note: Minimum EIGHT Experiments from the following.)

List of Experiments		Lab hours required
1	Conductivity of metals and / or insulator.	02
2	Experiment on Pin fins.	02
3	Experiment on forced convection apparatus.	02
4	Experiment on natural convection apparatus.	02
5	Determination of emissivity of test plate.	02
6	Stefan Boltzmann apparatus .	02
7	Parallel / counter flow heat exchanger.	02
8	Study of pool boiling phenomenon and critical heat flux.	02
9	Study of heat transfer in evaporator .	02
10	Temperature profile in a rod .	02
11	Study of evaporators .	02
12	Drop wise and film wise condensation .	02

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.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical out of 8. Evaluation will be based on paper work and performance in the practical.