Faculty of Engineering & Technology

।।अंतरी पेटवू ज्ञानज्योत।।

NORTH MAHARASHTRA UNIVERSITY, JALGAON.

Syllabus For

SECOND YEAR ENGINEERING

BIOTECHNOLOGY

(W.E.F.2007-2008)

NORTH MAHARASHTRA UNIVERSITY, JALGAON

STRUCTURE OF TEACHING & EVALUATION

S.E. (BIOTECHNOLOGY) W.E.F.2007-2008

First Term

Sr. No.	Subject	Teaching Scheme Hours/ Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Concepts in Biotechnology	04	--	03	100	--	--	--
2	Microbiology	04	04	03	100	50	50	--
3	Fluid Flow and Solid Handling	04	02	03	100	25	--	25
4	Process Calculations	04	02	03	100	25	--	--
5	Engineering Mathematics-III	04	--	03	100	--	--	--
6	Computer Applications	--	02	--	--	25	50	--
		20	10		500	125	100	25
	Grand Total	**30**			**750**			

Second Term

Sr. No	Subject	Teaching Scheme Hours/ Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Biochemistry	04	02	03	100	25	50	-
2	Chemistry	04	02	03	100	25	--	-
3	Immunology	04	02	03	100	25	50	-
4	Biostatistics	04	02	03	100	25	--	-
5	Process Heat Transfer	04	02	03	100	25	--	25
		20	10		500	125	100	25
	Grand Total	**30**			**750**			

NORTH MAHARASHTRA UNIVERSITY, JALGAON

STRUCTURE OF TEACHING & EVALUATION

T.E. (BIOTECHNOLOGY) **W.E.F.2008-2009**

First Term

Sr. No.	Subject	Teaching Scheme Hours/Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Bio Process Principles	04	--	03	100	25	--	--
2	Chemical Reaction Engineering	04	04	03	100	25	--	50
3	Mass Transfer-I	04	04	03	100	25	50	--
4	Molecular Biology and Genetic Engineering	04	04	03	100	25	--	25
5	Enzyme Engineering	04	--	03	100	25	--	--
		20	12		500	125	50	75
	Grand Total	32			750			

Second Term

Sr. No.	Subject	Teaching Scheme Hours/Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Instrumentation and Process Control	04	02	03	100	25	--	25
2	Biological Thermodynamics	04	02	03	100	25	--	--
3	Mass Transfer-II	04	04	03	100	25	50	--
4	Biotechnology of Waste Treatment	04	04	03	100	25	--	25
5	Fermentation Biotechnology- I	04	--	03	100	25	--	--
6	Practical Training/Mini Project/Special Study	--	--	--	--	25	--	--
		20	12		500	150	50	50
	Grand Total	32			750			

NORTH MAHARASHTRA UNIVERSITY, JALGAON

STRUCTURE OF TEACHING & EVALUATION

B.E. (BIOTECHNOLOGY) W.E.F.2009-2010

First Term

Sr. No.	Subject	Teaching Scheme Hours/Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Bioprocess Engineering -- I	04	--	03	100	25	--	--
2	Bioprocess Modeling and Simulation	04	04	03	100	25	25	--
3	Bioseparation Processes	04	--	03	100	25	--	--
4	Elective –I	04	--	03	100	--	--	--
5	Fermentation Biotechnology-II	04	04	03	100	25	--	50
6	Project –I	--	02	--	--	25	--	25
7	Seminar	--	02	--	--	25	--	--
		20	12		500	150	25	75
	Grand Total	32			750			

Second Term

Sr. No.	Subject	Teaching Scheme Hours/Week		Examination Scheme				
		Lectures	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	Bioprocess Engineering -II	04	04	03	100	25	--	25
2	Bioprocess Engineering and Economics	04	02	03	100	25	--	25
3	Bioinformatics	04	04	03	100	25	25	--
4	Elective –II	04	--	03	100	25	--	--
5	Project –II	--	04	--	--	100	--	50
6	Industrial Visit / Case Study	--	--	--	--	25	--	--
		16	14		400	225	25	100
	Grand Total	30			750			

Subjects:

Elective-I
1)Advanced Biomaterials
2)Plant Tissue Culture & Plant Biotechnology
3)Protein Engineering
4)Food Biotechnology

Elective-II
1)Metabolic Engineering
2)Biosafety & Bioethics
3)Biomedical Fluid Dynamics
4)Applied Genetic Engineering

S.E. BIOTECH. TERM I

1. CONCEPTS IN BIOTECHNOLOGY

Teaching Scheme: **Examination Scheme:**
Lectures: 4 Hrs./ Week **Paper: 100 Marks**
(3Hrs)

UNIT- I

Introduction to Biotechnology:

Definitions, Historical perspectives, Scope and importance, Commercial potential, An interdisciplinary challenge, A Quantitative approach, Classical vs. Modern concepts, Manufacturing quality control, Product safety, Good manufacturing practices, Good laboratory practices, Marketing,Biotechnology in India and Global trends.

Concept of pH, Buffer, Process flow diagrams, Material and energy balances, fluid flow and mixing, Heat transfer, Mass transfer, Unit operations,Homogeneous reactions, Heterogeneous reactions, Reactor engineering.

Protein Structure and Engineering:

Introduction to the world of Proteins, 3-D Shape of Proteins, Structure Function relationship in Proteins, Purification of Proteins, Characterization of Proteins, Protein based products, Designing Proteins, Proteomics. **(10 Hrs, 20 Marks)**

UNIT- II

Recombinant DNA Technology:

Introduction, Tools of rDNA Technology, Making Recombinant DNA, DNA Library, Introduction of Recombinant DNA into host cells, Identification of Recombinants, Polymerase Chain Reaction (PCR), DNA Probes, Hybridization Techniques, DNA Sequencing, Site-directed mutagenesis.

Genomics and Bioinformatics:

Introduction, Genome Sequencing Projects, Gene prediction and Counting, Genome similarity, SNPs and comparative genomics, Functional Genomics, History of Bioinformatics, Sequences and Nomenclature, Information Sources, Analysis using Bioinformatics tools. **(10 Hrs, 20 Marks)**

UNIT- III

Microbial Culture and Applications:

Introduction, Microbial Culture Techniques, Measurement and Kinetics of Microbial Growth, Scale up of Microbial Process, Isolation of Microbial Products, Strain Isolation and Improvement, Applications of Microbial Culture Technology, Bioethics in Microbial Technology. **(10 Hrs, 20 Marks)**

UNIT-IV

Plant Cell Culture and Application:

Introduction, Cell and Tissue Culture Techniques, Applications of Cell and Tissue Culture, Gene Transfer Methods in Plants, Transgenic Plants with Beneficial Traits, Diagnostics in Agriculture and Molecular Breeding, Bioethics in Plant Genetic Engineering.

(10 Hrs**,** 20 Marks)

UNIT- V

Animal Cell Culture and Applications:

Introduction, Animal Cell Culture Techniques, Characterisation of Cell Lines, Scale-up of Animal Culture Process, Applications of Animal Cell Culture, Stem Cell Technology, Bioethics in Animal Genetic Engineering.

Biotechnology and Society:

Public perception, Role of sciences, Engineering, Arts, Commerce, Patenting - Criterion for patents, Discovery vs Invention,Product and process patent, Reading a patent, National and International Patent Laws, Varietal protection, Patenting of biological systems, Ethical issues in agriculture and health care.

(10 Hrs**,** 20 Marks)

REFERENCES

1. P. K Gupta, Introduction to Biotechnology. Rastogi Publications
2. Smith, Biotechnology. Cambridge Press.
3. Ed. Young M.M., Comprehensive Biotechnology (Vol. I,II.III and IV), Pergamon Press, London.
4. Hammand J., Mc Gravery P. and Yusibov V. (Eds.). Plant Biotechnology. Springer Verlag, 2000

2. MICROBIOLOGY

Teaching Scheme:
Lectures: 4 Hrs./ Week
Practicals : 4 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Practical: 50 Marks
Term Work : 50 Marks

UNIT-I

Microbiology and its scope, microscopy. classification, morphology and physiology of bacteria, yeast, molds, algae and viruses. **(10 Hrs, 20 Marks)**

UNIT-II

Microbial growth kinetics, growth curve, diauxic growth factors influencing growth, continuous and synchronous culture, microbial nutrition and reproduction.

(10 Hrs**,** 20 Marks)

UNIT-III

Pure culture techniques – microbial culture media, isolation, identification and maintenance of cultures, characteristics of pure culture, enumeration techniques.

(10 Hrs**,** 20 Marks)

UNIT-IV

Physical and chemical methods of control of microorganisms, immune response, antigen-antibody interaction. Microbial defense mechanisms under adverse conditions.

(10 Hrs**,** 20 Marks)

UNIT-V

Microbial ecology, incidences of microorganisms in soil, water, air, food and sewage, food spoilage organisms, food borne infections and poisoning organisms.

(10 Hrs**,** 20 Marks)

REFERENCES:

1. M.J. Pelczar, Jr. E.C.S. Chan and N.R. Krieg, Microbiology 5th Ed. , TMH Book Company.
2. Kathleen Talaro and Arthur Talaro. Foundation in Microbiology. W.C.B. Wm. C. Brown Publishers (1994).
3. Stainer R.Y., Ingraharn J.L., Whoolis M.L. and Painter P.R. General Microbiology. The Mc Millan Press Ltd.
4. Robert F. Byod (1984). General Microbiology. Times Mirror / Mosby College Publication.

TERM WORK / PRACTICALS

Term Work Shall be based on any 10 experiments mentioned below.

1-2. Microscopy : Use & care of microscope, examination of prepared slides and wet mounts of bacteria, yeast, molds. Microbial Identification & examination of food samples. Other biomaterials of bacteria, yeast and molds.

3. Micrometry: Measurement of microbial cells.

4. Staining techniques: Simple staining, Gram staining, Endospore staining, Capsule staining.

5-7. Enumeration techniques: Microscopic count using haemocytometer, Viable cell count (By pour plate method) Turbidity measurement as direct expression of growth.

8-9. Culture techniques: Culture media preparation, Cultivation of microorganisms.

10. Isolation of microorganisms by streak plate method.

11. Isolation by serial dilution method, maintenance & preservation.

12. Influence of antimicrobial agent on growth effect of UV radiation & heat on microbial growth.

13. Microbiological examination of water: Coliform & Salmonella counts.

14. Microbiological assay of a growth factor.

REFERENCES:

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.

3. FLUID FLOW AND SOLID HANDLING

Teaching Scheme:
Lectures: 4 Hrs./ Week
Practicals :2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Oral: 25 Marks
Term Work : 25 Marks

Unit-I

Solids and Their Handling

Properties of solids ,screening, industrial screening equipment. Determination of particle size, screen analysis, size reduction of solids,stages of reduction , operating variables, intermediate and fine size reduction, power requirement and mechanism.

Power driven machines: Crushers, grinders, and conveyors.

Problems based on above (10 Hrs**,** 20 Marks)

Unit –II

Filtration: Theory, continuous and batch equipments. Flow of solids through fluids, Equipments for classification of solids. Sedimentation.

Problems based on above. (10 Hrs**,** 20 Marks)

Unit – III

Fluid flow: Properties of fluids, Flow through pipeline.

Fluid statics : Euler's equation, Hydrostatic Law and Pressure Measurement

Transport of fluids,energy relationships, pipe fittings, minor losses in pipe flow.

Problems based on above. (10 Hrs**,** 20 Marks)

Unit IV

Flow measurements: Orifice meter. Nozzle and Venturi meters, Rotameter and Pitot tube.

Other flow measuring devices such as Ultrasonic flow meters, Anemometers, Electromagnetic flow meters, Flow meters using thermistors.

(10 Hrs**,** 20 Marks)

UNIT-V:

Pumping of fluids:

Pumping equipments for liquid, the reciprocating pump, positive displacemement pump, rotary pumps, centrifugal pumps, design & operating characteristics, NPSH calculations, airlift pumps, pumping equipments for gases:

Pumping equipment for gases:

Reciprocating piston compressors, rotary blowers & compressors, centrifugal blowers & compressors including turbo compressors, vacuum-producing equipment.

Power required for compression of gases, clearance volume, multistage compressor efficiency, the power requirement for pumping through pipeline for liquids & gases.

Inroduction to fluidization. **(10 Hrs, 20 Marks)**

REFERENCES

1. W.L. McCabe & J.C. Smith, Unit Operations in Chemical Engineering, McGraw Hill / Kogakusha Ltd.
2. P.Chattopadhaya. Unit Operations of Chemical Engineering-Volm.I, Khanna Publication New Delhi,
3. R.K. Bansal. Fluid Mechanics, Khanna Publications, New Delhi
4. V.P.Gupta, Alam Singh and Manish Gupta, Fluid Mechanics and hydrostatics, CBS Publishers, New Delhi.
5. R.S.Hiremath & A.P.Kulkarni Unit operation of Chemical Engineering (Mechanical Operations Vol-I) : Everest Publication, Pune
6. J. M. and Coulson and R.F. Richardson; Chemical Engg. Vol. I and II : Butter worth and Heinemann.

TERM WORK / PRACTICALS

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

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 the and study the behavior of the bed during fluidisation and to calculate minimum fluidization velocity
8. To determine the coefficient of Venturimeter
9. To determine the coefficient of Orificemeter
10. To determine the coefficient of Nozzlemeter
11. To Verify Bernoulli equation.
12. Reynolds Experiment

4. PROCESS CALCULATIONS

Teaching Scheme:
Lectures: 4 Hrs./ Week
Term Work :2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Term Work : 25 Marks

UNIT-I :

Units and Dimensions:

Basic and derived units, dimensional analysis, dimensional and empirical equations. Different ways of expressing units of quantities and physical constants.

Properties of Gases , Liquids and Solids:

Ideal and real gas laws, critical properties, properties of mixtures & solutions & plane equilibria, Kay's rule.

(10 Hrs**,** 20 Marks)

UNIT-II :

Basic Concept:

Humidity and saturation, Psychometric chart, solubility diagrams.

Thermo Physics:

Concept and calculations of involving energy, heat, work & enthalpy of reversible & irreversible process.

(10 Hrs**,** 20 Marks)

UNIT-III :

Material Balances:

Concept of limiting &excess reactants, Tie element, Recycle, Purging, Bypass etc. in batch, stagewise and continuous operations in systems with and without chemical reactions in unit operations.

(10 Hrs**,** 20 Marks)

UNIT-IV :

Thermo Chemistry:

Heat of formation, combustion, solution, dilution etc. and its effects of pressure and temperature on them. Temp. of reaction, Energy balance for system with and without chemical reaction. Process efficiency.

(10 Hrs**,** 20 Marks)

UNIT-V :

Unsteady material and energy balances in Bioprocesses, Energy balances for nuclear, electro chemical and photo chemical processes

Combustion: Introduction, fuels, calorific value of fuels, air requirements.

(10 Hrs**,** 20 Marks)

REFERENCES

1. Bhat B.I. and Vora S.M ; Stoichiometry ; Tata McGraw Hill Publication ; New Delhi

2. Durga Prasad Rao & DVS Murthy ,Process Calculations for Chemical Engineers. McMillan India, New Delhi .
3. K A Gavahane ; Introduction to Stoichiometry ; Nirali Prakashan.
4. Hougen O.A, Watson K.M, & Ragatz R.A.Chemical Process Principles Part-I Asia Publishing House, Mumbai.
5. Himmelbleau D.M. Basic principles and calculations in Chemical Engineering. Prentice Hall Publication.
6. Shekhar Pandharipande and Samir Mushrif, Process Calculations. Pune Vidyarthi Griha Prakashan, Pune
7. Doran Paulin M. Bioprocess Engineering Principles. Academic Press, An Imprint of Elsevier.

TERM WORK

Term Work Shall be based on any 08 assignments on the following.

1. Properties of solids/liquids/gases.
2. Humidity & Saturation.
3. Thermo physics.
4. Thermo chemistry.
5. Material balances.
6. Energy balances.
7. Nuclear, photo chemical and electro chemical processes.
8. Combustion.
9. Steady state and Unsteady state Material and Energy Balances in Bioprocesses

5. ENGINEERING MATHEMATICS –III

Teaching Scheme: Examination Scheme:
Lectures: 4 Hrs./ Week Paper: 100 Marks (3 Hrs)

UNIT-I:

Liner Differential Equation:

Liner differential equation of order "n" with constant co-efficient , Method of variations, Homogeneous liner differential equation , Legendre's LDE, Application to chemical engineering. Problems involving batch reactor. **(10 Hrs, 20 Marks)**

UNIT-II:

Simultaneous Linear Differential Equations of form :

1) $f1(D)x + f2(D)y = (t)$

$(D)x + (D)y = (t)$

Where, $D=d/dt$.

2) $dx/P = dy/Q = dz/R$.

Partial Differential Equations:

Solutions of (i) One dimensional heat flow equation.

(ii) Two dimensional heat equation (Laplace Equation)

(iii) Laplace Equation in Polar form.Differential equation of first order & higher degree. **(10 Hrs, 20 Marks)**

UNIT-III:

Laplace Transform :

Definition of Laplace Transform, Inverse Laplace transform, Properties and theorems, Laplace transforms of standard functions, Unit step functions, Ramp functions, Impulse functions, Error functions , Jump functions, Laplace Inverse Transform.

Applications to the solutions of liquid systems, consisting of single tank & two tanks in series (Interacting & non-Interacting), Second order systems (Damped vibrator).

(10 Hrs**,** 20 Marks)

UNIT-IV:

Vector Integration :

(i) Line Integral, Surface Integral, Volume Integral.

(ii) Greens Lemma, Stoke's Theorem, Gausse's Divergence Theorem.

Finite Fourier Cosine & Sine transforms, Complex Fourier transforms , Infinite Fourier sine and Cosine transforms, Applications of Fourier transforms to boundary value problems such as one dimensional and two dimensional heat flow problems

(10 Hrs**,** 20 Marks)

UNIT-V:

Numerical Solution of Ordinary Differential Equations :

Taylor's series method, Runga-Kutta method, Piccard's method, Eulers method andLeast square method

Numerical Integration :

Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule and Weddle's rule.

(10 Hrs**,** 20 Marks)

REFERENCES

1. P .N. Wartikar and J.N. Wartikar, Engineering Mathematics III : Pune Vidyarthi Griha Prakashan, Pune
2. Dr. B.S.Grewal, Higher Engineering Mathematics : Khanna Publications ,New Delhi
3. Wylie and Barrott, Advanced Engineering Mathematics : Tata McGraw Hill Publications.
4. Erwin Kreegszig, Advanced Engineering Mathematics : New age International ,New Delhi
5. Dr.Gokhale and A.N. Singh , Engineering Mathematics III : Nirali Publications.
6. Coughnour Donald R , Process System analysis & control : McGraw Hill, 1991.

6. COMPUTER APPLICATIONS

Teaching Scheme:
Practicals : 2 Hrs./ Week

Examination Scheme
Practical: 50 Marks
Term Work: 25 Marks

TERM WORK / PRACTICALS

Term work & practical should be based on following

1. Introduction to computer, O.S, M.S Office, Programming languages
2. History, C editor – C language
3. a+b, a-b ,a*b , a/b , a % b using keyboard
4. Using conditional operator find out largest number
5. If – else – program using if – else
6. For or while or Do while / nesting of for to print table of 1 to 10
7. Addition using function
8. Array - program using array

REFERENCES

1. Kanetkar Yashawant P. Let us C, BPB Publication, New Delhi.
2. Kanetkar Yashawant P. Let us C Solutions, BPB Publication, New Delhi.
3. Byron Gottfried, Schaum's Outlines Programming with C, Tata McGraw Hill Publication.
4. Fielding A. Computing for Biologists.
5. Wool E.J. Microcomputers in Biochemical Education.

S.E. BIOTECH. TERM II

1. BIOCHEMISTRY

Teaching Scheme:
Lectures: 4 Hrs./ Week
Practicals : 2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Practical: 50 Marks
Term Work : 25 Marks

UNIT I

Structure and function of biomolecules; carbohydrates, proteins, lipids and nucleic acids. Biochemical separation methods. Vitamins, enzymes and coenzymes.

(10 Hrs**,** 20 Marks)

UNIT-II

Biological membranes and transport across them. Bioenergetics. Major anabolic and catabolic pathways of carbohydrate metabolism and their regulation; glycolysis, TCA cycle, pentose phosphate pathway, galactose metabolism, electron transport and oxidative phosphorylation, gluconeogenesis.

(10 Hrs**,** 20 Marks)

UNIT-III

Lipid metabolism; transport and oxidation of fatty acids in animal tissues, glycerol metabolism, biosynthesis of fatty acids and triacylglycerol.

Protein metabolism; out lines of amino acid metabolism and their significance.

(10 Hrs**,** 20 Marks)

UNIT-IV

Nucleic acid metabolism; mechanism and biosynthesis of DNA and RNA, reverse transcription. Protein biosynthesis, inhibitors of protein synthesis, transport of proteins and signal peptides.

(10 Hrs**,** 20 Marks)

UNIT-V

Typical metabolic pathways of microbes; Entner-Duodoroff pathway, glyoxilate cycle, phosphoketolate pathway.

Biochemical aspects of Hormone Action.

(10 Hrs**,** 20 Marks)

REFERENCES:

1. Lehninger A.L., Neston D.L., “Principles of Biochemistry”, N.M. Cox, CBS Publishers & Distributors.
2. Lubert Stryer “Biochemistry”, W.H. Freemen & Co. , New York.
3. Weil J.H. “General Biochemistry”, New Age International (Pvt. Ltd.).
4. Murray R.K. and others (Eds). Harper’s Biochemistry, 25th Edn. Appleton and Lange Stanford.

TERM WORK / PRACTICALS

Term Work Shall be based on any 10 experiments mentioned below.

1 Estimation of carbohydrates.
2. Estimation of proteins.
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.

REFERENCES

1. Plummer David T. "An Introduction to Practical Biochemistry", Tata McGraw-Hill Pubblishing 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.

2. CHEMISTRY

Teaching Scheme:
Lectures: 4 Hrs./ Week
Term Work : 2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Term Work : 25 Marks

UNIT- I:

Reaction Mechanism:

Covalent Bond, Homolytic & Heterolytic Fission of Covalent Bond,Electrophiles & Nucleophiles.

Study of reactions with reference to the mechanism involved:

Aldol condensation, Cannizzaro& cross Cannizzaro reactions, Claisen ester condensation, Reimer Tiemann reaction, Grignard reagents & reactions.

SN^1 & SN^2 reactions.

Electrophilic substitution in aromatic rings: Nitration, Sulphonation, Halogenations, Fridel Crafts alkylation& acylations.

Elimination reactions:E_2 , E_1 mechanism.

(10 Hrs**,** 20 Marks)

UNIT-II:

Stereochemistry:

Basic concept of stereochemistry, Structural Isomerism, Different methods of representation of three dimensional molecule on paper, Conformational isomerism: Conformations of Ethane & n-Butane & their relative stability.

Geometrical isomerism: Cis-Trans isomerism shown by alkenes.

Optical isomerism: Measurement of Optical activity by Polarimeter , Specific rotation, Enantiomerism , Necessary conditions of optical activity, Optical isomerism of Lactic acid & Tartaric acid., Distereoisomerism. Baeyer's angle strain concept , Conformations of Cyclohexanes: Equatorial & axial bonds in cyclohexane.

(10 Hrs**,** 20 Marks)

UNIT-III:

Chemical kinetics:

Objective of chemical kinetics, rate of reaction, velocity constant of a reaction, elementary reaction steps & rate expressions, order & molecularity of reaction, factors influencing the reaction rates, integrated rate expressions for 1^{st}, 2^{nd} , 3^{rd} , & zero order reaction (with example), methods for determining order of reactions, experimental investigation of reaction kinetics.

Arrhenius equation, relationship between chemical kinetics & thermodynamics, problem based on above topics.

Fast reactions , Set up for study of Fast reactions

(10 Hrs**,** 20 Marks)

UNIT-IV:

Classical chemical thermodynamics:

Objective & scope, definition of thermodynamic systems.

Heat work reversibility, maximum work, isothermal & adiabatic process, I^{st} law of thermodynamics, II^{nd} law of thermodynamics, entropy, entropy changes, enthalpy & free energy, Gibbs Helmholtz equation, Third law of thermodynamics. Problems based on above topics.

Criteria of chemical equilibrium, Le Chatelier's theorem, its application to some systems likes ammonia, sulphuric acid, and nitric acid.

(10 Hrs**,** 20 Marks)

UNIT-V:

Surface phenomenon:

Surface tension of liquids, adsorption, adsorption of gases by solids, adsorption isotherm, Freundlich adsorption isotherm, the Langmueirs adsorption isotherm, application of adsorption.

Colloids & emulsion:

Types, methods of preparation, determination of particle size, properties, solution of micro molecules, properties of micro molecular solutions.

(10 Hrs**,** 20 Marks)

REFERENCES

1. Glasstone, Thermodynamics for chemist :McMillan India Ltd.
2. Maron-Prutton, Principles of Physical chemistry: Oxford & IBH publishing Co.Pvt.Ltd. New Delhi
3. Puri & Sharma, A textbook of physical chemistry : S. Chand & Co. Delhi
4. B.S.Behl, Physical Chemistry, S. Chand & Co. Delhi
5. Morrison & Boyd, Organic Chemistry: Allyn Bacon Inc.
6. Pine, Organic Chemistry: McGraw Hill Int.Co.

TERM WORK

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

1. Preparation of p-nitro acetanilide by nitration.
2. Preparation of Quinone.
3. Determination of rate constant of Hydrolysis of Methyl Acetate.(1^{st} Order)
4. Determination of rate constant of Saponification of Ethyl Acetate.(2^{nd} Order)
5. Determination of surface tension liquids by Stalagmometer.
6. Preparation of colloidal solution of starch.
7. To verify Freundlich adsorption Isotherm
8. Estimation of Acetone
9. Estimation of Aniline
10. Stability of emulsions

REFERENCES

1. S.S.Dara, Experiments and Calculations in Engineering Chemistry, S. Chand & Co. Delhi
2. S.K.Bhasin, Laboratory manual on engineering Chemistry: Dhanpat Rai Pub.New Delhi.

3. IMMUNOLOGY

Teaching Scheme:
Lectures: 4 Hrs./ Week
Practicals : 2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Practical: 50 Marks
Term Work : 25 Marks

UNIT-I

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, Organs of the Immune System, Bone marrow, Thymus, Lymph node, Spleen, CALT, MALT.

(10 Hrs**,** 20 Marks)

UNIT-II

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, Immunogen, Adjuvants.

(10 Hrs**,** 20 Marks)

UNIT-III

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

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

(10 Hrs**,** 20 Marks)

UNIT-IV

Immunological Techniques:- antigen- antibody reactions, Immuno diffusion, immunoelectrophoresis, ELISA, RIA, fluorescence activated cell sorter.

(10 Hrs**,** 20 Marks)

UNIT-V

Applied Immunology:- Immune system in health and disease, autoimmunity, hypersensitivity, tumor immunity, tissue and organ transplant, Synthetic vaccines.

Hybridoma technology: - Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

(10 Hrs**,** 20 Marks)

REFERENCES

1. R. A. Goldsby, T.J. Kindt, B.A. Osborne Kuby- Immunology (4th Edition)
2. Ivan Riot- Essentials of Immunology (6th Edition), Blakswell Scientific Publications, Oxford, 1988.
3. Paul W.E. (Eds.), Fundamentals of Immunology, Raven Press, New York, 1988.
4. Roitt I.M. (1998) Essentials of Immunology. ELBS, Blackwell Scientific Publishers, London.
5. Barrett J.T. (1983). Text book of Immunology. Mosby, Missouri.
6. Kuby J.(1994). Immunology., 2nd Edn. W.H.Freeman and Company, New York.

TERM WORK / PRACTICALS

Term 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. AIDS KIT-1: Simulation of HIV-1 detection
6. Western Blot Analysis – demo

7. Immunology of pregnancy test – demo
8.Viral antigen detection by rapid immuno-chromatographic cassette assay
9. Latex agglutination test
10. Precipitin reaction
11. Antibody titer test
12. Agglutination reaction

REFERENCE

1. Harlow and David Lane Antibodies A laboratory Manual: (1988), Cold spring harbor laboratory.
2.Talwar G.R. and Gupta S.K. (Eds.). A Handbook of Practical and Clinical Immunology, Vol. 1 and 2 (2^{nd} Edn.). CBS Publishers and Distributors.

4. BIOSTATISTICS

Teaching Scheme:
Lectures: 4 Hrs./ Week
Term Work : 2 Hrs./ Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Term Work : 25 Marks

UNIT-I

Presentation of Data: Frequency distribution, graphical presentation of data by histogram, frequency curve and cumulative frequency curves.

Measure of Location and Dispersion: Mean, Medium, Mode and their simple properties (without derivation) and calculation of median by graphs: range, mean deviation, Standard deviation, Coefficient of variation.

(10 Hrs**,** 20 Marks)

UNIT-II

Probability and Distribution: Random distributions, events-exhaustive, mutually exclusive and equally likely, definition of probability (with simple exercises), definition of binomial, Poisson and normal distributions and their inter-relations, Simple properties of the above distributions (without derivation).

(10 Hrs**,** 20 Marks)

UNIT-III

Correlation and Regression: Bivariate data – simple correlation and regression coefficients and their relation, Limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient, Linear regression and equations of line of regression, Association and independence of attributes.

Sampling: Concept of population and sample, Random sample, Methods of taking a simple random sample. **(10 Hrs, 20 Marks)**

UNIT-IV

Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, T-test for comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.

(10 Hrs**,** 20 Marks)

UNIT-V

Experimental Designs: Principles of experimental designs, Completely randomized, Randomized block and latin square designs, Simple factorial experiments of 22, 23, 24 and 32 types, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD.

(10 Hrs**,** 20 Marks)

REFERENCES

1. Statistical methods in biology by Norman T.J. Bailey (3rd Edition), Cambridge University Press (1995).
2. Gupta S.C. Fundamentals of Statistics. Himalaya Publishing House, New Delhi.
3. Khan. Biostatistics. Tata Mc Graw Hill Publishers.
4. Daniel W.W.(7^{TH} Edn., 1999). Biostatistics: A Foundation for Analysis in the Health. John Wiley and Sons Inc. New York.
5. Sharma N.K.(1996). Statistical Techniques. Mangal Deep Publications, Jaipur, India.

TERM WORK

Any eight assignments based on the following.

1.Mean , Median, Mode and their properties
2.Calculation of median by graphs, range, mean deviation, standard deviation and coefficient of variation.
3. Exercises on probability, bionomial distribution, Poisson and normal distribution.
4. Problems on coefficient of correlation and regression.
5. Problems on line of regression.
6. Sampling distribution of mean and standard error and Problems on large sample tests.
7. Problems on small sample tests and t- tests for correlation and regression coefficients.
8. T- tests for comparison of variances and goodness of fit.
9. Problems on experimental design.
10. Problems on analysis of variances (ANOVA) and its use in R.B.D.

5. PROCESS HEAT TRANSFER

Teaching Scheme:
Lectures: 4 Hrs./ Week
Practicals: 2 Hrs. / Week

Examination Scheme:
Paper: 100 Marks (3 Hrs)
Oral: 25 Marks
Term Work: 25 Marks

UNIT- I:

Heat transfer by conduction in solids;

Fourier's law of heat conduction ,steady state heat conduction through walls (single and multilayer), heat flow through cylinder ,unsteady state heat conduction ,Derivation of Fourier's heat conduction equation in three dimensions , equation for one dimensional conduction , heat conduction through a semi infinite slab , lumped capacity method of unsteady state conduction . Principles of heat flow in fluids.

(10 Hrs, 20 Marks)

UNIT-II:

Typical heat exchange equipment ,counter current and parallel flows, energy balances, overall heat transfer coefficient , log mean temperature difference, individual heat transfer coefficient, calculation of overall coefficient from individual coefficients , transfer units in heat exchangers. Heat transfer to fluids without phase change.

(10 Hrs, 20 Marks)

UNIT- III:

Regimes of heat transfer in fluids, heat transfer by forced convection in laminar and turbulent flow, dimensional analysis method, use of imperials equations heat transfer by forced convection outside tubes, natural convection.

Heat transfer to fluids with phase change.

Dropwise and film type condensation, coefficient for film type condensation, practical use of Nusselt's equations, application to petroleum industries

(10 Hrs, 20 Marks)

UNIT- IV:

Heat transfer to boiling liquids:

Boiling of saturated liquids maximum flux and critical temperature drop, maximum Flux and film boiling.

Radiation heat transfer:

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

(10 Hrs, 20 Marks)

UNIT- V:

Heat exchange equipments:

Heat exchanger single pass 1-1 exchanger, 1-2 shell and tube heat exchanger, correction for LMTD for cross flow, design calculation (Kern Method) in heat exchanger.

Evaporation:

Liquid characteristics and types of evaporator, single effect evaporator calculation, pattern of liquor flow in multiple effect evaporators.

(10 Hrs, 20 Marks)

REFERENCES

1.W.L.McCabe and J.C.Smith , Unit operations in chemical engineering. McGraw Hill/Kogakusha Ltd.

2.Coulson & Richardson , Chemical engineering. – Volume. I , Pergamon Press

3.Kern D.Q. Process Heat Transfer, McGraw Hill Book 1NC New York, 1950

4.D.S.Kumar, Process Heat Transfer, S.K.Kataria and Sons Publisher, New Delhi

5.Dawande S.D. Principals of Heat Transfer and Mass Transfer. Central Techno Publications, Nagpur.

TERM/PRACTICALS

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

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 emmisivity of test plate.
6) Stefan Boltzman 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) Dropwise and filmwise condensation .

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