THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE

DEGREE COURSE

B.Sc. BIOCHEMISTRY

UNDER CBCS

(with effect from 2008-2009)

The Course of Study and the Scheme of Examinations

Year / Semester	Part	Subject	Paper	Title of the Paper	Ins. Hrs / Week	Credit	Exam Hrs	Max. Mark		
								IA	Uni. Exam.	Total
I Year I Semester	I	Language	Paper I		6	3	3	25	75	100
	II	English	Paper I		6	3	3	25	75	100
	III	Core	Paper I	Cell Biology	6	4	3	25	75	100
	III	Core Practical	-		3	-	-	-	-	-
	III	Allied	Paper I	(to choose 1 out of 3) 1. Chemistry I 2. Bio-physics I 3. Bio-instrumentation I	4	4	3	25	75	100
	III	Allied Practical	-		3	-	-	-	-	-
	IV			Environmental Studies	2	2	3	25	75	100
I Year II Semester	I	Language	Paper II		6	3	3	25	75	100
	II	English	Paper II		6	3	3	25	75	100
	III	Core	Paper II	Bio-molecules	6	4	3	25	75	100
	III	Core Practical	Practical I		3	4	6	40	60	100
	III	Allied	Paper II	(to choose 1 out of 3) 1. Chemistry II 2. Bio-physics II 3. Bio-instrumentation II	4	4	3	25	75	100
	III	Allied Practical	-		3	2		20	30	50
	IV			Value Education	2	2			50	50
II Year III Semester	I	Language	Paper III		6	3	3	25	75	100
	II	English	Paper III		6	3	3	25	75	100
	III	Core	Paper III	Biophysical and Biochemical Techniques I	3	3	3	25	75	100
	III	Core Practical			3	-	-	-	-	-
	III	Allied	Paper III	(to choose 1 out of 3) 1. Zoology I 2. Microbiology I 3. Statistics for Life Sciences I	4	4	3	25	75	100

Year / Semester	Part	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam Hrs	Max. Mark		
								IA	Uni. Exam.	Total
	III	Allied Practical	-		3	-	-	-	-	-
	IV	Skill based Subject I	Paper I	Fundamentals of Computers	3	3	3	25	75	100
		Non-Major Elective I	Paper I	Diagnostic Biochemistry I	2	2	3	25	75	100
II Year IV Semester	I	Language	Paper IV		6	3	3	25	75	100
	II	English	Paper IV		6	3	3	25	75	100
	III	Core	Paper IV	Biophysical and Biochemical Techniques II	3	3	3	25	75	100
	III	Core Practical	Practical II		3	6	6	40	60	100
	III	Allied	Paper IV	**(to choose 1 out of 3)** 1. Zoology II 2. Microbiology II 3. Statistics for Life Sciences II	4	4	3	25	75	100
	III	Allied Practical			3	2	3	20	30	50
	IV	Skill based Subject II	Paper II	Computer Applications	3	3	3	25	75	100
		Non-Major Elective II	Paper II	Diagnostic Biochemistry II	2	2	3	25	75	100
III Year V Semester	III	Core	Paper V	Enzymes & Intermediary Metabolism	5	5	3	25	75	100
	III	Core	Paper VI	Genetics and Molecular Biology	4	5	3	25	75	100
	III	Core	Paper VII	Human Physiology & Nutritional Biochemistry	4	5	3	25	75	100
	III	Core Practical			5	-	-	-	-	-
	III	Elective Practical			3	-	-	-	-	-
		Elective I	Paper I	Medical Lab Technology I	6	4	3	25	75	100
	IV	Skill based Subject III	Paper III	Biostatistics I	3	3	3	25	75	100
III Year VI Semester	III	Core	Paper VIII	Clinical Biochemistry	6	6	3	25	75	100
	III	Core	Paper IX	Biotechnology	6	6	3	25	75	100
	III	Core Practical	Practical III		6	9	6	40	60	100
	III	Elective Practical		Medical Lab Technology	3	5	6	40	60	100
		Elective II	Paper II	Medical Lab Technology II	2	2	3	25	75	100
		Elective II	Paper II	Immunology	4	4	3	25	75	100
	IV	Skill based Subject IV	Paper IV	Biostatistics II	3	3	3	25	75	100
	V	Extension Activities				1		-	-	50
				Total	**180**	**140**				**3700**

THIRUVALLUVAR UNIVERSITY

B.Sc. BIOCHEMISTRY

SYLLABUS

UNDER CBCS

(with effect from 2008-2009)

I SEMESTER

PAPER I

CELL BIOLOGY

UNIT-I

An overall view of cells-origin and evolution of cells. Cell theory. Classifications of cell- Prokaryotic and Eukaryotic cells. Composition of prokaryotic and eukaryotic cells. Molecular composition of Cells- Water, Carbohydrates, Lipids, Nucleic acids, and Proteins.

UNIT-II

Cell membrane- Fluid Mosaic Model of membrane structure. Membrane proteins and their properties. Membrane carbohydrates and their role. Transport across membranes-diffusion, active and passive transport.

UNIT-II

Endoplasmic reticulum - types, structure and functions. Golgi apparatus- structures and functions. Lysosomes- structure and functions, morphology & functions of peroxisomes and glyoxysomes, ribosomes - types, structure and functions.

UNIT-IV

Mitochondria: Structure and function. Cytoskeleton: Types of filaments and their functions. Microtubules: Chemistry and function (esp. cilia and flagella)

UNIT-V

Nucleolus-structure and functions. Chromosome-chromatin structure, the cell cycles-phases of cell cycle. Meiotic and mitotic cell divisions, cell- cell communications, cell recognition, cell adhesion and cell functions.

References

1. Cell biology structure and functions-David and Sadava, Jones Bartlett publishers.
2. Molecular Cell Biology - Lodish, Berk, Zipursky, Baltimore, Freeman.
3. Cytology-P.S. Verma, V.K. Agarval, S. Chand Publications.
4. Cell Biology-N.Arumugam, Saras Publications.
5. Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
6. Biochemistry - Garrett Grishmam. 3'rd edition. International student's edition.
7. Biochemistry by L . Veerakumari , MJP publishers,Chennai-5.

ALLIED I

(to choose any 1 out of the given 3)

PAPER I.1

CHEMISTRY I

UNIT - I

1.1 Extraction of Metals Minerals and Ore difference - Minerals of Iron, Aluminum and Copper - Ore Dressing or concentration of Ore - Types of Ore Dressing Froth Floatation and Magnetic separation.

1.2 Refining of Metals - Types of Refining - Electrolytic, Van Arkel and Zone Refining.

1.3 Extraction of Uranium and Thorium.

UNIT - II

2.1 Cyclo-alkanes preparation properties of Cyclo-hexane -- Bayers strain theory.

2.2 Polarization - Inductive effect, mesomeric effect and steric effect - (Acid and Base strength.)

2.3 Stereo isomerism - Types, Causes of optical activity of (lactic acid) and tartaric acid - Racemisation - Resolution - Geometrical isomerism - maleic and fumaric acid.

UNIT - III

3.1 Chemical Kinetics - Distinction between Order and Molecularity - derivation of First order rate equation - half life period of first order reaction - determination of rate constant of hydrolysis of ester

Catalysis - catalyst - auto catalyst - enzyme catalyst - promoters - catalytic poisoning - Active center - Distinction between homogeneous and heterogeneous catalysts - Industrial application of catalysts.

3.3 Photochemistry - Grothus Drapers law, stark einsteines law - quantum yield - photosynthesis, phosphorescence - fluorescence - chemiluminescence's - photosensitization.

UNIT - IV

4.1 VSEPR Theory - Shapes of Simple Molecules BF_3, PCl_5, SF_6 and XeF_6

4.2 Fuels - Calorific value of fuels - Non-conventional fuels - need of Solar energy - Applications - Bio-fuels.

4.3 Osmosis - Osmotic pressure - reverse osmosis - desalination of sea water.

UNIT - V

5.1 Nuclear Chemistry - Definition of Half life period - Group displacement law - Radioactive series. Nuclear Fission and Fusion - Application of nuclear chemistry in Medicine, agriculture, industries - C^{14} dating.

5.2 Crude Oil - Petroleum - Petroleum Refining - Cracking - Applications of Cracking. Naphthalene - Preparations, Properties and uses of Naphthalene - Structure of Naphthalene.

5.3 Elements of symmetry - unit cell - crystal lattice - types of cubic lattice - one example for each.

PAPER I.2

BIO-PHYSICS I

UNI-I

Introduction: Illustration of Biophysics: Application of Physics and Chemistry in Biological Sciences. Scientific theory behind the formation of Biomolecules and origin of life. DNA- carrier of genetic message by an experimental proof. DNA, the master plan for cell formation and all cell activities. Central Dogma (DNA → RNA → Protein). An out line of Darwin's theory of evolution.

UNIT-II

Biophysics, the basis: Biophysics is the basis of Biomolecules and molecular system: Membrane Biophysics. Nerve cell, bioelectrical and biochemical conduction of nerve impulses, Membrane potential, resting potential and action potential. Gross bioelectrical phenomenon of ECG and EEG. Molecular basis of muscle contraction, ultra structure and / or molecular basis of vision and hearing.

UNIT-III

Acid and bases-Lewis concept of acid and bases, titrable acidity. pH, pOH, buffer, pH of body fluids, buffers in the body fluids, RBCs and tissues. Measurement of pH by indicator and glass electrode.

UNIT-IV

Zwitter ion, pH dependent ionization of amino acid and protein. Structure of protein (primary, secondary, tertiary and quaternary). Different types of bonds that stabilize the protein. Denaturation and renaturation of protein. Behaviour of protein in solution. Structure and biological function of fibrous protein (keratine, collagen), globular protein (Hemoglobin, Methhemoglobin).and lipoproteins.

UNIT-V

DNA-double helical structure, Watson-Crick model and base pairing. Fundamental units of nucleic acid- purine, pyrimidine, nucleosides and nucleotides. Size of DNA,

Structure of different type of nucleic acid. Special features of double helical DNA. A,B and Z types of DNA. Nucleic acid- Denaturation and annealing of DNA. Synthesis of polynucleotide by Konberg's enzyme. A brief outline of structure and role of different types of RNA.

Reference

1. Biophysics-Principles and Techniques-M.A. Subramanian, MJP Publishers, Chennai-5.

2. Biophysics- M.V. Volbenshtein, MIR publishers, Moscow,1983.

3. Aspects of Biophysics-William Hughes, John Willey and Sons, N.Y., 1979.

4. Biophysical Science-L.E.Ackermann, L.B.E. Ellis and Williams, 1979.

5. Biophysics-Concepts and Mechanisms-E.J. Casey, Von Nostrand Reinhold co., N.Y., 1962.Affiliated to East-West press, New Delhi.

PAPER I.3

BIO INSTRUMENTATION I

UNIT-I

Introduction: Introduction of various instrument utilized in Biochemistry, Biomedical and Bioscience laboratories. Basic electronic principles that operate instrument like diode, transistors and their uses in amplifier, operational amplifier and its applications

UNIT-II

Eletrophoretic techniques: General principles, factors affecting migration rate-sample, electrical field,

Buffer, voltage and supporting medium. Electrophoresis with paper, cellulose acetate, starch, agar and poly acrylamide, SDS-PAGE, Immunoectrophoresis, Tisselius moving boundary electrophoresis.

UNIT-III

Electrochemical Techniques: Principle of Electrophoretic techniques-Reference electrode, measurement of pH by hydrogen and glass electrode, ion - selective electrode and geas sensor. Oxidation-Reduction (Redox) potentials - Principles, potentiometric titration of oxidation-reduction reactions; Redox dyes and their uses.

Oxygen electrode-principles, operation of a Clark electrode, applications of Oxygen electrode.

UNIT-IV

Approach to Biochemical investigation: Whole animal studies, isotonic salt solution, Osmotic pressure and Osmotic balance, perfusion of isolated organs, tissue slice techniques, methods of using plant and microbial materials, tissue and cell culture-methods of homogenization of tissues and cell fractionation.

UNIT-V

Centrifugal techniques: Basic principle of centrifugation. Differential, density gradient, isopycnic and equilibrium centrifugation techniques. Preparative and analytical ultra centrifugation techniques with special reference to determination of molecular weight of macromolecules (derivation included).

Books Recommended

Practical Clinical Biochemistry - Harold Varley, CBS, New Delhi.

Medical Laboratory Technology-Kanai L. Mukherjee, Tata McGraw Hill., Vol. I,II,III.

Clinical Chemistry- Ranjana Chawla.

Laboratory manual in Biochemistry - Jayaraman.

Biochemical methods - S.Sadasivan and Manickam.

Introduction to Practical Biochemistry - David T. Plummer

ENVIRONMENTAL STUDIES

(For all UG Degree Courses)

UNIT-I: INTRODUCTION TO ENVIRONMENTAL SCIENCES: NATURAL RESOURCES :

Environmental Sciences - Relevance - Significance - Public awareness - Forest resources - Water resources - Mineral resources - Food resources - conflicts over resource sharing - Exploitation - Land use pattern - Environmental impact - fertilizer - Pesticide Problems - case studies.

UNIT-II: ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION:

Ecosystem - concept - structure and function - producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem.

Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses of biodiversity - biodiversity at global, national (India) and local levels - Hotspots, threats to biodiversity - conservation of biodiversity - Insitu & Exsitu.

UNIT-III: ENVIRONMENTAL POLLUTION AND MANAGEMENT

Environmental Pollution - Causes - Effects and control measures of Air, Water, Marine, soil, solid waste, Thermal, Nuclear pollution and Disaster Management - Floods, Earth quake, Cyclone and Land slides. Role of individuals in prevention of pollution - pollution case studies.

UNIT-IV: SOCIAL ISSUES - HUMAN POPULATION

Urban issues - Energy - water conservation - Environmental Ethics - Global warming - Resettlement and Rehabilitation issues - Environmental legislations - Environmental production Act. 1986 - Air, Water, Wildlife and forest conservation Act - Population growth and Explosion - Human rights and Value Education - Environmental Health - HIV/AIDS - Role of IT in Environment and Human Health - Women and child welfare - Public awareness - Case studies.

UNIT-V: FIELD WORK

Visit to a local area / local polluted site / local simple ecosystem - Report submission

REFERENCES

1. KUMARASAMY, K., A.ALAGAPPA MOSES AND M.VASANTHY, 2004. ENVIRONMENTAL STUDIES, BHARATHIDSAN UNIVERSITY PUB, 1, TRICHY

2. RAJAMANNAR, 2004, ENVIRONEMNTAL STUDIES, EVR COLLEGE PUB, TRICHY

3. KALAVATHY,S. (ED.) 2004, ENVIRONMENTAL STUDIES, BISHOP HEBER COLLEGE PUB., TRICHY

II SEMESTER

PAPER II

BIO-MOLECULES

UNIT-I : Carbohydrates

Classification of carbohydrates, stereo isomerism and optical isomerism of sugars, anomeric form and mutarotation. Occurrence, structure and biological importance of mono, di and polysaccharide (esp. starch, glycogen and cellulose). An introduction to mucopolysaccharide (proteo glycon). Reaction of Carbohydrates due to the presence of hydroxyl, aldehyde and ketone groups.

UNIT-II : Amino acids

Classification and structure of amino acids based on structure. Essential amino acids. Stereo and optical isomerism. Classification and structure of standard amino acid as zwitter ion in aqueous solution.

UNIT-III : Proteins

Introduction, classification based on solubility, shape, composition and function. Structure of proteins-Primary, secondary, tertiary and quaternary. Chemical synthesis of poly peptide chain and solid phase polypeptide synthesis. Biologically important peptides-structure and functions (esp. insulin, glutathione, vasopressin).

UNIT-IV : Lipids

Introduction, definition of fatty acids. Classification, nomenclatures, structures, properties of fatty acids (Essential Fatty Acids) Structure and function of prostaglandins, tri-acyl glycerol. Structure and functions of phospholipids (esp. lecithin cephalin, phospotidyl inositol and phospotidyl serine) spingo myelin, plasmologens. Structure and function of glycolipids, cholesterol.

UNIT-V : Nucleic acid

Nature of genetic material, structure of purine and pyrimidine, nucleotide. Composition of DNA and RNA-Watson crick model of DNA. Types of nucleic acid (DNA and RNA). Properties of nucleic acid include Tm, denaturation and renaturation, hypo and hyper chromicity.

References

1. Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
2. Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange Medical Books. 25th edition.
3. Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company.
4. Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5. Biochemistry-Dr. Ambika Shanmugam, Published by Author.
6. Biomolecules-C.Kannan , MJP Publishers,Chennai-5.

CORE PRACTICAL I

Objectives

1. Students should know the principles, theory and calculations of each experiment.
2. They should know to prepare all the solutions by themselves. They should standardize their solutions individually.

1. EXPERIMENT INVOLVING TITRIMETRIC PROCEDURES

a. Estimation of amino acids by formal titration.
b. Estimation of ascorbic acid by titrimertic method using 2, 6-dichlorophenol indophenol.
c. Determination of saponification value of edible oil.
d. Determination of Acid number of edible oil.
e. Estimation of reducing sugar from biological fluids by Benedict's titrimertic method.
f. Iodine value of oil.

2. QUALITATIVE ANALYSIS.

a. Reactions of simple sugars including glucose, fructose, galactose, mannose, pentose, maltose, sucrose, lactose, starch, glycogen and dextrin.
b. Reactions of proteins - solubility, Biuret, Millon's xanthoproteic test, denaturation by heat, pH change and precipitation by acidic reagents. Color reactions of amino acids like tryptophan, tyrosine, cystine, methionine, arginine, praline and histidine.
c. Reactions of lipids - solubility, saponification tests for unsaturations, Liebermann Burchard test for Cholestrol.

ALLIED I

(to choose any 1 out of the given 3)

PAPER II.1

CHEMISTRY II

UNIT - I

1.1 **Co-ordination Chemistry:**

Nomenclature of co-ordination compounds - Werner Theory of Co-ordination Compound - Chelation - Functions and structure of Haemoglobin and Chlorophyll.

1.2 **Industrial Chemistry:**

Fertilizers and manures - Bio-fertilizers- Organic Manures and their importance - Role of NPK in plants - preparation and uses of Urea, Ammonium nitrate, potassium nitrate and super phosphate of lime.

1.3 Contents in Match sticks and match box - Industrial making of safety matches. Preparation and uses of chloroform, DDT, gamhexane and Freon.

UNIT - II

2.1 **Carbohydrates:**

Classification - structure of glucose - Properties and uses of starch - uses of Cellulose Nitrate - Cellulose acetate.

2.2 **Amino Acid and Protein:**

Classification of Amino Acids - preparation and properties of Glycine - Classification of Protein based on Physical properties and biological functions

2.3 Primary and Secondary structures of protein (Elementary Treatment only) composition of RNA and DNA and their biological role. Tanning of leather - alum (aluminum tri chloride tanning - vegetable tanning)

UNIT - III

3.1 **Electro Chemistry:**

Specific and equivalent conductivity - their determination - effect of dilution of conductance.

3.2 Kohlrawsh Law - Determination of dissociation constant of weak Electrolyte using Conductance measurement - Conductometric Titrations

3.3 P^H and determination by indicator method - Buffer solutions - Buffer action - Importance of buffer in the living system - Derivation of Henderson equation.

UNIT - IV

4.1 Paints - Pigments - Components of Paint - Requisites of a good paint. Colour and Dyes - Classification based on constitution and application.

4.2 **Vitamins:**

Biological activities and deficiency diseases of Vitamin A, B, C, D, E and K - **Hormones** - Functions of insulin and adrenaline.

4.3 Chromatography - Principles and application of column, paper and thin layer chromatography

UNIT - V

5.1 **Drugs-** Sulpha Drugs - Uses and Mode of action of Sulpha Drugs -- Antibiotics - Uses of Penicillin, Chloramphenicaol, streptomycin. Drug abuse and their implication alcohol - LSD

5.2 **Anaesthetics** - General and Local Anaesthetics - Antiseptics - Example and their application. Definition and one example each for analgesics antipyretics, tranquilizers, sedatives, causes for diabetes, cancer and AIDS.

5.3 Electrochemical corrosion and its prevention - fuel cells.

PAPER II.2

BIO-PHYSICS II

UNIT-I

Colloidal state 1: Size of colloidal particles. Different types of colloidal dispersion (sol, aerosol, emulsion, foam, gel). Preparation of lyophilic and lyophobic sols. Protective colloids, gold number. Stability of colloids. Precipitation coagulation, flocculation of colloidal particles. Colloidal particles of milk and blood with their functions.

UNIT-II

Colloidal state 2: Properties of colloids (surface tension, viscosity, surface absorption, detergent action, electrical, optical and kinetic properties). Phenomenon of osmosis and osmo regulation in the body. Electro osmosis, Donnan membrane equilibrium, its applications - artificial kidney(dialysis of blood). Biophysical and chemical composition of architecture of biomembrane (esp.cell membrane).

UNIT-III

Determination of molecular weight of macro molecules: By chemical composition, sedimentation, molecular sieving, light scattering and osmotic pressure methods.

Units of measurement of solutes in solution. eg. Normality, molarity, molality, milli equivalents and milli osmol, ionic strength. Examples for these concepts.

UNIT-IV

Biophysical basis for gaseous exchange in lungs and tissues partial pressure of CO2 (pCO2) and O2 (pO2). Influence of O2 and CO2 in RBC and body fluids during respiration. Physiological curve of formation and dissociation of oxyhemoglobin (HbO2) and carbondioxide hemoglobin (HbCO2). Various physiological factors in these curves.

UNIT-V

Application of Biophysical chemistry in chemical equilibria: Equilibrium constant, Law of mass action, Lechatlier Braun principle. Some simple system to illustrate chemical equilibria - formation and dissociation of NH_3, HI, $CaCO_3$. Biological application of chemical equilibria - Acid formation in stomach (hyper acidity and ulcer in stomach and duodenum) while using medicines like aspirin, paracetamol and antibiotics. Mechanism of neutralization of acid formed in digestive track by antacid drugs. Formation of stones in kidney and gall bladder.

Reference

1. Biophysics-Principles and Techniques-M.A. Subramanian, MJP Publishers, Chennai 5.
2. Biophysics-M.V. Volbenshtein, MIR publishers, Moscow,1983.
3. Aspects of Biophysics-William Hughes, John Willey and Sons, N.Y., 1979.
4. Biophysical Science-L.E.Ackermann, L.B.E. Ellis and Williams, 1979.
5. Biophysics-Concepts and Mechanisms-E.J. Casey, Von Nostrand Reinhold co., N.Y., 1962.Affiliated to East-West press, New Delhi.

PAPER II.3

BIO INSTRUMENTATION II

UNIT-I

Chromatographic techniques: General principles of chromatography. Principles, operational procedure and applications of paper, thin layer, ion exchange, molecular sieving, affinity and gas-liquid chromatography. High performance liquid chromatography (HPLC).

UNIT-II

Instrumental operation based on electromagnetic radiation-I: Basic principle, energy, wave length, wave number and frequency. Absorbance and emission spectra. Beer-Lambert's law, absorption and its transmittance.

UNIT-III

Instrumental operation based on electromagnetic radiation-II: Spectrophotometry- Principle, instrumentation and application with reference to assay of vitamins like thamine and riboflavin.

Flame photometry: Atomic absorption and emission spectrophotometry- Principles, instrumentation and application (Sodium, Potassium analysis).

UNIT-IV

Radio isotope Techniques I: Atomic structure, radiation, type of radio active decay, half-life, and units of radioactivity. Detection and measurement of radioactivity - Methods based upon ionization GM counter, excitation (Scintillation counter).

UNIT-V

Radio isotope Techniques II: Auto radiography and isotope dilution techniques.

Application of radio isotopes in the elucidation of metabolic pathways, clinical scanning and radio dating, radio immuno assay.

Biological hazards of radiation and safety measures in handling radio isotopes.

References

1. Biochemical Guide to Principles & techniques of Practical Biochemistry - Keith Wilson & Kenneth Goulding, Cambridge Presss.
2. Prnciples & Techniques of Practical Biochemistry - Keith Wilson and John Walker, Cambridge Press.
3. Introduction to Practical Biochemistry - Shawney, Randhir Singh, Narasa Pub, N.Delhi.
4. Analytical Biochemistry - R.B Turner, Elsevier, N.Y.
5. Biomedical Instrumentation - M. Arumugam, Anuradha agencies, Chennai
6. Principles and Techniques of Practical Biochemistry-Bryan L. Williams & Keith Wilson, Cambridge Univ. Press.
7. Instrumental Methods of Analysis-Chatwal & Anand, Himalayan Publication.

ALLIED PRACTICAL

CHEMISTRY

VOLUMETRIC ANALYSIS

1) Estimation of hydrochloric acid using std. sulphuric acid
2) Estimation of Borax using std sodium carbonate
3) Estimation of sodium hydroxide using std sodium carbonate.
4) Estimation of $FeSO_4$ using std. Mohr salt Solution.
5) Estimation of Oxalic acid using std $FeSO_4$
6) Estimation of FAS using Std oxalic acid
7) Estimation of Fe^{2+} using diphenylamine / N phenyl anthranilic acid as indicator.

ORGANIC ANALYSIS:

Reactions of aldehyde (aromatic), carbhohydrate, carboxylic acid (mono and dicarbox ylic), phenol, aromatic primary amine, amide and diamide. Systematic analysis of organic compounds containing one functional group and characterizationsss by confirmatory tests.

ALLIED PRACTICAL

BIO-PHYSICS

EXPERIMENTS ON COLLOIDS AND GELS

1. Preparation of lyophylic and lyophobic sols.
2. Preparation and protective action of colloids.
3. Measurement of viscosity of a colloidal sol.
4. Preparation of gel (agar, gelatin or starch) and demonstration of diffusion.
5. Simple experiments involving dialysis.

EXPERIMENTS ON PROPERTIES OF LIQUID

Determination of surface tension and viscosity of water and body fluids (plasma, blood and C.S F.)

ESTIMATION OF pH.

Determination of pH of biological samples (blood, plasma, urine, saliva), phosphate buffer by glass electrode.

COLORIMETRIC ESTIMATION

1.Estimation of Protein by Biuret method

2.Estimation of amino acids by ninhydrin method

3.Esimation of hemoglobin cyanmethemoglobin method.

Books Recommended

1. Practical Clinical Biochemistry - Harold Varley, CBS, New Delhi.
2. Medical Laboratory Technology-Kanai L. Mukherjee, Tata McGraw Hill., Vol. I, II, III
3. Clinical Chemistry- Ranjana Chawla.

4. Laboratory manual in Biochemistry - Jayaraman.
5. Biochemical methods - S.Sadasivan and Manickam.
6. Introduction to Practical Biochemistry - David T. Plummer.

ALLIED PRACTICAL

BIO-INSTRUMENTATION

Spectrophotometric / Colorimetric Estimation:

1. Estimation of creatinine by Jaffe's method.

2. Estimation of urea by Diacetyl Monoxime method.

3. Estimation of glucose by O - Toluidine method.

4. Estimation of cholesterol by Zak's method.

5. Estimation of DNA.

6 Estimation of RNA.

Chromatographic separation:

1. Paper chromatographic separation and detection of amino acids and simple sugars.

2. Chromatographic separation of chlorophyll ii, carotenes of flower, p-igments, proteins using column.

3. Separation of polar and non-polar lipids any thin layer chromatography.

4. Separation of proteins by SDS-PAGE.

Experiments Enzymes

1. Effect of pH, temperature and substrate concentration for amylase and urease.

2. Analysis of serum for Transaminases (SGOT, SGPT) activity and alkaline phosphatase activity.

References

1. Biochemical Guide to Principles & techniques of Practical Biochemistry - Keith Wilson & Kenneth Goulding, Cambridge Press.
2. Prnciples & Techniques of Practical Biochemistry - Keith Wilson and John Walker, Cambridge Press.

3. Introduction to Practical Biochemistry - Shawney, Randhir Singh, Narasa Pub, N.Delhi.
4. Analytical Biochemistry - R.B Turner, Elsevier, N.Y.
5. Biomedical Instrumentation - M. Arumugam, Anuradha agencies, Chennai
6. Principles & Techniques of Practical Biochemistry-Bryan L. Williams & Keith Wilson, Cambridge Univ. Press.
7. Instrumental Methods of Analysis-Chatwal & Anand, Himalayan Publication.

VALUE EDUCATION
(For all UG Degree Courses)

UNIT-I

Value Education - Definition - relevance to present day - Concept of Human Values - self introspection - Self esteem.

UNIT-II

Family values - Components, structure and responsibilities of family - Neutralization of anger - Adjustability - Threats of family life - Status of women in family and society - Caring for needy and elderly - Time allotment for sharing ideas and concerns.

UNIT-III

Ethical values - Professional ethics - Mass media ethics - Advertising ethics - Influence of ethics on family life - psychology of children and youth - Leadership qualities - Personality development.

UNIT-IV

Social values - Faith, service and secularism - Social sense and commitment - Students and Politics - Social awareness, Consumer awareness, Consumer rights and responsibilities - Redressal mechanisms.

UNIT-V

Effect of international affairs on values of life/ Issue of Globalization - Modern warfare - Terrorism. Environmental issues - mutual respect of different cultures, religions and their beliefs.

Reference Books

1. T. Anchukandam and J. Kuttainimathathil (Ed) Grow Free Live Free, Krisitu Jyoti Publications, Bangalore (1995)
2. Mani Jacob (Ed) Resource Book for Value Education, Institute for Value Education, New Delhi 2002.
3. DBNI, NCERT, SCERT, Dharma Bharti National Institute of Peace and Value Education, Secunderabad, 2002.
4. Daniel and Selvamony - Value Education Today, (Madras Christian College, Tambaram and ALACHE, New Delhi, 1990)
5. S. Ignacimuthu - Values for Life - Better Yourself Books, Mumbai, 1991.
6. M.M.M.Mascaronhas Centre for Research Education Science and Training for Family Life Promotion - Family Life Education, Bangalore, 1993.

WEBSITES AND e-LEARNING SOURCES:

www.rkmissiondhe/.org/education.html/

www.clallam:;org/lifestyle/education.html/

www.sun.com/../edu/progrmws/star.html/

www.infoscouts.com

www.secretofsuccess.com

www.1millionpapers.com

http://militarlyfinance.umuc.edu/education/edu-network.html/

III SEMESTER

PAPER III

BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES I

UNIT-I

Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity, Ionic strength, Millimoles. Osmosis, Osmotic pressure, Osmolarity and its application. Concept of isotonic, hyper and hypotonic solution and its importance in biology.

UNIT-II

Concept of pH, pOH, buffer and its application, buffer capacity. Henderson - Hasselbalch equation and its importance. Buffer in body fluids, Red blood cells, white blood cells, tissues and its role.

UNIT-III

Principle, instrumentation and applications of hydrogen electrode, glass electrode in determation of pH. Principle, instrumentation and applications of Clark oxygen electrode.

UNIT-IV

Principles of electrophoresis, factor affecting electrophoretic mobility - sample, electric field, supporting medium, composition of buffer. Sodium dodecyl sulphate, poly acrylamide gel electrophoresis (SDS- PAGE) and its application. Determination of molecular weight of protein by SDS PAGE.

UNIT-V

Principle, methodology and application of immuno electrophoresis. Tiscelius moving boundary electrophoresis and its application in serum protein separation. Principle, methods and application of Agarose gel electrophoresis.

References :

1. A Biochemical Guide To Principles And The Techniques Of Practical Biochemistry- Keith Wilson And Kenneth Goulding, Cambridge Press.
2. Principles And Techniques Of Practical Biochemistry- Keith Wilson And John Walker, Cambridge Press.
3. Introduction To Practical Biochemistry - Shawney, Randhir, Singh, Narasr Pub, N.Delhi.
4. Analytical Biochemistry - R.B. Turner, Elsevier, N.Y.
5. Biomedical Instrumentation - M. Arumugam, Anuradha Agencies, Chennai.
6. Principles And Techniques Of Practical Biochemistry - Bryan L, Williams And Keith Wilson, Cambridge Univ, Press.
7. Instrumental Methoods of Analysis - Chatwal And Himalayan Publication.
8. Biophysical Chemistry - Upadhyay and Upadhyay Nath, Himalayan Publication.

ALLIED II

(to choose any 1 out of the given 3)

PAPER III.1

ZOOLOGY I

Objective :

To study the systemic and functional morphology of invertebrates and Chordates.

UNIT-I

Study types including Life histories. Protozoa - Entamoeba, Porifera-Sycon. Coelenterata-Obelia geniculata. Platyhelminthes-Taenia solium

UNIT-II

Annelida-Earthworm, Arthropoda-Prawn, Mollusca-Fresh water mussel, Echinodermata-Sea Star.

UNIT-III

Chordata-Prochordates , General Characters, Morphology of Amphioxus

Vertebrates : Shark.

UNIT-IV

Type Study Frog and Calotes.

UNIT-V

Type Study Pigeon and Rabbit.

Note : In chordata to study only morphology, digestive system, Respiratory system, circulatory system and urinogenital system.

References :

1. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology. Vol. [Chordata] I & II.S. Viswanathan [Printers and Publisher] Pvt. Ltd., Madras, 891p.
2. Kotpal Series, 1988-1992. Rastogi Publication, Meerut.
3. Jordan E.L. and P.S. Verma 1993. Invertebrata Zoology 12th Edition. S. Chand Co. Ltd., New Delhi

PAPER III.2

MICROBIOLOGY I

UNIT-I

Definition and scope of Microbiology, History and Recent Developments, Spontaneous generation, Biogenesis, Contribution of Louis Pasteur, Leewen Holk, Lazzarn - Spallanzani, John Tyndall, Joseph Lister, Robert Koch, Microscopy - Simple, Compound, Light Microscopy Dark ground, Phase contrast, Flurescence and Election microscopy.

UNIT-II

Five Kingdom consept cell Theory, Binomial Nomendature of microbes, species concept, classical approach with examples, Anatomy of Prokaryotes and Eukaryotes, ultra structure and function of cellwall and cell organelles.

UNIT-III

Culture Techniques, Media preparation, Preservation of cultures, Aerobic and Anaerobic culture techniques, Microbial morphology - wet mount, Hanging drop staining methods, Dyes, Simple - Differential and Special staining techniques Acid fast staining spore stain, Capsule stain, staining for met achromatic Granules, Development of Laboratory Techniques for pure and Mixed culture.

UNIT-IV

Antimicrobial chemotheraphy - Antibiotics - source, classification mode of action - Antimicrobial resistance - Tests for Sensitivity to Antimircrobial agents and its Quality control classical techniques of Microbial identification - Morphological, Physiological and Biochemical properties.

UNIT-V

Measurement of microbial growth Batch and continuous culture, Growth Determination - Growth curve. Structural characteristics of algae - Cholrella, Fungi - Mucor and Protozoa - Entamoeba.

PAPER III.3

STATISTICS FOR LIFE SCIENCES I

Objective

To apply Statistical Techniques for Bio-Sciences.

UNIT-I

Nature and Scope of statistical methods and their limitations-Collection, Classification, Tabulation of Statistical data - uses of frequency table -Diagrammatic and Graphical Representation of Statistical data.

UNIT-II

Measure of Central Tendency-Mean, Median, Mode, and their Merits and Demerits.

UNIT III

Measure of Dispersion - Range, Mean Deviation, Quartile Deviation, Standard Deviation, Co-Efficient of Variation - Skewness - Karl Pearson's and Bowley's Coefficient of Skewness.

UNIT IV

Events and Sets - Sample Space - Concept of Probability - Addition and Multiplication Theorem on Probability - Conditional Probability - Independence of Events.

UNIT-V

Bivariate Frequency Table and its Uses - Correlation Analysis-Scatter diagram - Karl Pearson's Correlation Coefficient - Spearman's Rank Correlation - Regression Analysis - Regression lines - Fitting of Straight line using Method of Least Squares.

Note : The proportion between theory and problems shall be 20:80

Books for Reference

1. Sunder Rao - Bio statistics.
2. Zar. J-Bio statistical analysis, Prentice Hall of India.
3. S. C. Gupta of V.K.Kapoor - Fundamental of Mathematical Statistics, Sultan &Sons.
4. Scholes, W.L-Statistics for bio logical sciences, Addison Wesley.
5. S. P. Gupta - Statistical Methods, Sultan Chand & Sons
6. Lewis, A .E (1971)-Bio-Statistics
7. Daniel : Bio-Statistics, John Wiley & Sons

SKILL BASED SUBJECT I

PAPER I

FUNDAMENTALS OF COMPUTER

UNIT-I

Computer fundamentals - Introduction, Definition, importance, uses & Advantages. Binary number system, types of computer, computer language, package, operating system, network. Difference between computer and human being.

UNIT-II

Classification of computers- digital, analog, hybrid, micro, mini and super computers. Generation of computer, personal and advance computers and its types. Microsoft windows- windows fundamental. Managing the file system, printing in windows, windows accessories, control panel.

UNIT-III

Memory unit- primary and Auxiliary. Computer hardware- Input unit, Central processing Unit (CPU), output unit, UPS and external modem. MS Word- Introduction, starting MS Word, Standard menus–file, edit, view, Formatting a text, layouts, inserting a diagram, graph, page numbers, borders, bullet & numbering, spelling and grammer, letter and mailing, mail merge, tables and its applications.

UNIT-IV

MS Excel- - Introduction, starting MS excel, creating a worksheet, page setup, print area, paste special, formula. Insert & formatting- cells, rows, columns and sheets. Functions, hyperlink, pivot charts, sorting, filters, header and footers, formula bars, status bar, options and its application.

UNIT-V

MS Power point- - Introduction, power point file types, creating a presentation, using color schemes, viewing a presentation, managing slide shows , adding pictures, transaction effects, animations, action setting and action buttons and its application. Introduction to HTML- program using HTML Tags, application & limitations.

References :

1. Computer fundamental, V.K. Jain
2. Working in Microsoft office, Ron Mansfield
3. Multimedia, System design, Prabhat k. Andleigh, Kiran Thakrar.
4. Internet & World Wide Web, third edition, Dietel, Dietel, Gold Berg.
5. programming in C, Balaguru Samy.

NON MAJOR ELECTIVE I

PAPER I

DIAGNOSTIC BIOCHEMISTRY I

UNIT-I

Specimen collection and processing (Blood, urine, feaces), anti-coagulant and preservatives for blood and urine. Transport of specimens.

Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity, Osmolarity, Ionic strength. Examples of this concept. Osmosis and its application. Isotonic solution, hyper and hypotonic solution.

UNIT-II

Blood sugar level - factors controlling blood sugar level - hypo, hyper glycemia, Diabetes mellitus, types - GTT.

UNIT-III

Metabolism of Bilirubin- Jaundice - types differential diagnosis and liver function tests.

UNIT-IV

Renal functional test - clearance test - Urea, Creatinine, Inulin, PAH test, concentration and dilution test.

UNIT-V

Gastric functional tests - collection of gastric contents, examination of gastric residues, FTM stimulation test, tubeless gastric analysis.

IV SEMESTER

PAPER IV

BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES II

UNIT-I

General principle of chromatography. Partition and adsorption chromatography. Principle, operation procedure and applications of paper chromatography and their types. Principle, instrumentation, application of thin layer chromatography, ion exchange chromatography, and molecular gel exclusion chromatography and its application in separation of macromolecules.

UNIT-II

Basic principle of centrifugation techniques, sedimentation rate, Svedberg unit/ sedimentation coefficient. Preparative ultracentrifuge, Differential centrifugation, density gradient centrifugation, rate zonal, isopycnic isodensity, equilibrium isodensity centrifugation. Analytical ultracentrifuge method - determination of molecular weight by sedimentation in an ultracentrifuge.

UNIT-III

Basic principle of electromagnetic radiation, energy, wavelength, wave number, frequency. Absorption and emission spectra. Beer lambert's law. Basic principle, instrumentation, application of colorimetry techniques. Principle, instrumentation, application of UV- visible spectroscopy.

UNIT-IV

Principle, instrumentation of spectrofluorimetry techniques. Principle, instrumentation, application in atomic absorption spectroscopy. Principle, instrumentation of flame photometry. Application in analysis of trace elements-sodium and potassium.

UNIT-V

Radiation, type of radioactive decay, half-life, unit of radioactivity.

Detection and measurement of radioactivity - Methods based upon ionizatiom (GM Counter), excitation(Scintillation counter).

Autoradiography and isotope dilution techniques.

Application of radioisotoptes in the elucidation of metabolic pathyways, clinical scanning and radio dating, RIA.

Biological hazards of radiation and safety measures in handling radio isotopes.

References :

1. A Biochemical Guide To Principles And The Techniques Of Practical Biochemistry- Keith Wilson And Kenneth Goulding, Cambridge Press.
2. Principles And Techniques Of Practical Biochemistry- Keith Wilson And John Walker, Cambridge Press.
3. Introduction To Practical Biochemistry - Shawney, Randhir, Singh, Narasr Pub, N.Delhi.
4. Analytical Biochemistry - R.B. Turner, Elsevier, N.Y.
5. Biomedical Instrumentation - M. Arumugam, Anuradha Agencies, Chennai.
6. Principles And Techniques Of Practical Biochemistry - Bryan L, Williams And Keith Wilson, Cambridge Univ, Press.
7. Instrumental Methoods Of Analysis - Chatwal And Himalayan Publication.
8. Biophysical Chemistry - Upadhyay And Upadhyay Nath, Himalayan Publication.

CORE PRACTICAL II

1. VOLUMETRIC ANALYSIS

a. Use of potassium permanganate in the estimation of iron, oxalate and nitrite.

b. Estimation of calcium from biological fluids like blood, milk and urine.

c. Use of potassium permanganate in the standardization of sodiumthiosulphate and estimation of copper by Iodimetry.

d. Estimation of chloride by Mohr's method.

e. Estimation of chloride by Volhard's method.

2. BIOCHEMICAL PREPARATIONS

a. Preparation of Starch from potatoes.

b. Preparation of Casein and Lactalbumin from milk.

c. Preparation of Albumin from egg.

3. PREPARATION OF BUFFERS

Phosphate buffer, Tris buffer and Citrate buffer.

4. Colorimetric Estimation

a) Estimation of inorganic phosphorus by Fiske and Subbarow method.

b) Estimation of Amino acid by Nindyrin method.

c) Estimation of Protein by Biuret method.

ALLIED II

(to choose any 1 out of the given 3)

PAPER IV.1

ZOOLOGY II

Objective :

To study the principles of Cell biology, Genetics, Developmental Biology, Physiology, Ecology and Evolution.

UNIT-I

Cell Biology-Structure of animal cell Genetics : Molecular structure of genes - Gene function. Genetic Engineering and its application, sex linked inheritance.

UNIT-II

Embryogenesis - Cleavage and gastrulation of Amphioxus. Human Physiology : Excretion - kidney failure and transplantation.

UNIT-III

Diseases of Circulatory system - Blood Pressure, Heart diseases-Ischemia, Myocardial infarction, Rheumatic heart diseases, Stroke.

UNIT-IV

Pollution - Environmental degradation, methods of sewage treatment, effluents, solid wastes and recycling process - Green house effect - Global warming - Acid Rain.

UNIT-V

Evolution Theories - Lamarkism & Darwinism.

References :

1. Ekambarantha Ayyar, and Ananthakrishnan, T.N. 1993 Outlines of Zoology, vol I & II Viswanathan and co Madras.

2. Sambasiviah I, Kamalakara Rao. A.P. Augustine Chellappa, S [1983] Text Book of Animal Physiology, S. Chand & Co., New Delhi.

3.Verma and Agarwal [1983] Text Book of animal Ecology, S. Chand & Co., New Delhi.

4.Verma and Agarwal and Tyagi [1991] Chordate Embryology S. Chand & Co. New Delhi.

5.Rastogi and Jayaraj [2000] Text Book of Genetics. Rastogi Publications, Meerut

6. Verma and Agarwal 2000 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co.

PAPER IV.2

MICROBIOLOGY II

UNIT-I

Soil Microbiology - Soil structure, Soil formation, Characterisation of Soil Types and importance, Biofertilizers.

UNIT-II

Aquatic Microbiology, Sewage Treatment - Physiological and Biological. Microbes in air, Distribution and Source of Airborne Organisms.

UNIT-III

Food Microbiology, Microbial Spoilage of food, food preservation techniques, Microbes in Milk and their source, Pasteurisation techniques. Industrial Production - Pencillin.

UNIT-IV

Morphology, Classification, Characteristics Pathogenecity, Laboratory diagnosis and prevention of Infections caused by following organisms mycobacteria, dermatophytes, Hepatitis, Entamoeba histolytica, Antigens - Antibody reactions.

UNIT-V

Biotechnology - Definition of a Gene, structure, Cloning Techniques, Genomic library. Nan technology - SCP production. Gene Theraphy methods.

PAPER IV.3

STATISTICS FOR LIFE SCIENCES II

Objective

To apply Statistical Techniques for Bio-Sciences.

UNIT-I

Concept of Random variables and distributions - standard distributions -Binomial, Poisson and Normal distributions.

UNIT-II

Concept of sampling distributions-standard error-asymptotic and exact tests based on normal, t, chi-square and F distributions.

UNIT-III

Principles of Scientific Experimentation- Randomization, Replication and local Control - Analysis of Variance - One way and Two way Classification - Completely Randomized Design, Randomized Block Design and Latin Square Design.

UNIT-IV

Non-parametric tests - Run, Median, Sign, Mann - Whitney and Wilcoxon - Signed Rank Test.

UNIT-V

Introduction to Vital Statistics - Simple Mortality and Fertility Rate-Birth rate and life Tables.

Note : The proportion between theory and Problems shall be 20:80

Book for Reference

1. Sunder Rao-Bio Statistics.
2. Zar.J-Bio Statistical Analysis, Prentice Hall of India.
3. S.C.Gupta of V. K.Kapoor-Fundamental of Mathematical Statistics, Sultan Chand & Sons.
4. Scholes, W.I - Statistics for Biological Sciences, Addison Wesley.
5. S. P. Gupta - Statistical Methods, Sultan Chand & Sons.
6. Lewis, A .E (1971)-Bio-Statistics.
7. John Fruend : Mathematical Statistics, Prentice Hall of India.

ALLIED PRACTICAL

ZOOLOGY

MAJOR PRACTICAL

CD*/Model/Chart - Anatomical observation and comment

Cockroach - Digestive and nervous system.

Frog - Digestive and Urino-genital system. Arterial system & Venous system

MINOR PRACTICAL

Slides / Model / Chart - Identification (draw and label)

1. Body setae of Earthworm
2. Mouth parts of mosquito
3. Mouth parts of Honeybee
4. Any one suitable / relevant vertebrate Brain
5. Placoid scale of shark

Spotters

Entamoeba, Sycon, Obelia, Taenia solium (entire, scolex) earthworm (entire, Pineal setae) Prawn [entire], Fresh water mussel, Sea star, T.S. of arm of sea star to show tube feet, shark-entire, Shark [placoid scale] Frog, Calotes Pigeon entire [feather], Rabbit

Sphygnomanometer

* References :

1. Prof. Baskaran, HOD of Zoology
   Iyyanadar Janagiammal College
   Sivakasi, Ph.No. 04562 - 254100
2. WWW.Prodissector.Com.
3. WWW.Sciencelass.Com.
4. WWW.ento.vt.edu.

ALLIED PRACTICAL

MICROBIOLOGY

1. Clearing of glassware, sterilization techniques.
2. Gram stain, Motility (Hanging drop)
3. Enumeration of soil microbes.
4. Enumeration of sewage microbes.
5. Assessment of milk quality by MBET test.
6. Streak plate, pour plate techniques.
7. Isolation of puncture techniques.
8. Wet mount preparation fungal material.
9. Serial dilation techniques.
10. Slant preparation.
11. Study of SCP, blue greens algee
12. Assessment of Air quality
13. Plant viral diseases like TMV, Tomato milting HIV, Virus structure diseases.
14. Micro photographs in Biotechnology of Microbes and Microbial products demonstration and identification.
15. Diseases like Tuberculosis, Chorine beefier diphtheria demonstration identification.
16. Medically important pathogens micro photographs demonstration.
17. Root Nodules Rhizobium isolation and identification methods.

ALLIED PRACTICAL

STATISTICS FOR LIFE SCIENCES

Note

Use of scientific calculator shall be permitted for practical examination. Statistical and Mathematical tables are to be provided to the students at the Examination Hall.

1. Construction of Univariate and Bi-Variate distributions with Sample size not exceeding 100.
2. Graphical and diagrammatic representation of data.
3. Numerical computation of measures of central tendency, measures of dispersion-measure of Skewness.
4. Fitting of Binomial and Poisson distributions and testing its goodness of fit.
5. Computation of correlation, Rank correlation and Regression equations.
6. Exact test based on t, F and chi-square distributions.
7. Chi-square test for independence of attributes and its applications to biological studies.
8. Analysis of variance-one way, two way Classification.
9. Completely Randomized Design, Randomized Block Design and Latin Square Design.
10. Non - parametric tests.

P.S.* The syllabus content involves more of Technical aspects of Statistical methods, only statistics faculty alone can be appointed as Examiners.

Book for Reference

1. Sunder Rao-Bio statistics.
2. Zar.J-Bio Statistical Analysis, Prentice Hall of India.
3. S.C.Gupta & V. K.Kapoor-Fundamental of Mathematical Statistics, Sultan Chand & Sons.
4. Scholes, W.I-Statistics for Bio logical Sciences, Addison Wesley.
5. S. P. Gupta - Statistical Methods.
6. Lewis, A .E (1971)-Bio-statistics.
7. Daniel .E. Bio Statistics, John Wiley.

SKILL BASED SUBJECT II

PAPER II

COMPUTER APPLICATIONS

UNIT- 1

Operating system - MS DOS, DOS Features, MS DOS opening and closing, DOS commands, Batch Files. Windows XP- opening and closing, background setting, date and time adjustment, note pad, word pad, painting. Unix features & commands.

UNIT- 2

Computer Language - Types, Introduction to C and Importance, constants, variables, data types, declaration of variables. Operators - Arithmetic, relational, logic, assignment and conditional operators. Introduction to Arrays and pointers.

UNIT -3

Internet - introduction, importance, requirements for internet. Electronic mailing, chatting, search engine, web pages. Multimedia - introduction, applications, components and its uses. Multimedia design, multimedia concept.

UNIT-4

Computer maintenance - causes of failure, components failure, temperature and humidity, dust and other particle, power line problems. computer virus- introduction, types, symptoms, virus avoiding methods, antivirus programs.

UNIT- 5

Computer application in banking, industries, educational institutions, hospitals, Research institutions - ISRO, BARC. Network - local area network, wide area network. Introduction to telecommunication. Downloading software and files, copying CD/DVD.

References :

1. Computer fundamental, V.K. Jain
2. Working in Microsoft office, Ron Mansfield
3. Multimedia, System design, Prabhat k. Andleigh, Kiran Thakrar.
4. Internet & World Wide Web, third edition, Dietel, Dietel, Gold Berg.
5. Programming in C, Balaguru Samy.

NON MAJOR ELECTIVE II

PAPER II

DIAGNOSTIC BIOCHEMISTRY II

UNIT-I

Inborn errors of metabolism - Alkaptonuria, Phenyl ketonuria, Cystinuria, Galactosemia, Fanconi's syndrome and Albinism.

UNIT-II

Plasma enzymes in diagnosis - Functional and non functional plasma enzymes - Isoenzymes. Myocardial Infarction, acute pancreatitis, liver diseases and muscle wasting.

UNIT-III

Cholesterol - importance, Lipoproteins - Factor affecting blood cholesterol - Atherosclerosis, Risk factor.

UNIT-IV

Iron absorption and excretion - Anemia - classification. Sickle cell anemia and Talassemia .

UNIT-V

Hormones - Definition and classification- Thyroid hormone- thyroid function test, male sex hormones and female sex hormone.

References:

1. Clinical chemistry in Diagnosis & Treatment - P.D. Mayne, ELBS/ Arnold, N.Delhi.
2. Clinical chemistry - W.J. Marshall and S.K. Bangert [1995]
3. Textbooks of medicine - K.V. Krishnedas [1996], Jaypee Brothes.

4. Principles of internal medicine [1998] - Harrison, T.R. Fauci, Branuwalad and Isselbaeher, McGraw Hills.
5. Clinical Biochemistry with clinical correlation - Devin, Wiley.
6. Practical clinical biochemistry - Harold Varley, CBS, New Delhi.
7. Medical Laboratory technology - kanai L. Mukherjee, Tata McGraw Hill Publication and Co. ltd., vol. I, II, III.
8. Clinical chemistry in diagnosis and treatment, Joan F. ZilvaA, PR Pannall, Llyods - Luke [medical Books ltd., Lon
9. Biochemistry - U.Sathyanarayana & U. Chakrapani, Third edition, Book and Allied (p) ltd.
10. Text book of medical biochemistry - Fourth edition- MN. Chatterjee, Rana Shine, jaypee Publisher.

V SEMESTER

PAPER V

ENZYMES AND INTERMEDIARY METABOLISM

UNIT-I: Enzymes

Definition, units, various classifications, nomenclature, specificity, isoenzymes, factors affecting enzyme activity - pH, temperature, enzyme concentration. Lock and key mechanism, Michaelis menten equation, Line weaver Burk plot. Enzyme inhibition - competitive, Non competitive, Uncompetitive (Concepts with example).

UNIT-II: Carbohydrates metabolism

Electron transport chain and Oxidative phosphorylation, High energy compounds. Glycolysis, Glocogenesis and glycogenolysis, Citric acid cycle, Gluconeogenesis, HMP shunt.

UNIT-III: Lipid metabolism

Biosynthesis of fatty acid, cholesterol, triglycerides and phospholipids. Degradation of fatty acids by β- oxidation. Phospholipids and formation of ketone bodies.

UNIT-IV: Protein Metabolism

Degradation of proteins, Oxidative, Non- Oxidative deamination and decarboxylation of amino acids, Urea Cycle and Creatinine formation.

UNIT-V: Nucleic acid metabolism

Biosynthesis and degradation of purine and pyrimidine nucleotides, uricotelic and urotelic system, inhibitors of nucleotides biosynthesis.

BOOKS RECOMMENDED

1. Enzymes - Dixon and Webb
2. Understanding enzymes - palmer
3. Enzyme kinetics - Saegel
4. Lehninger's principles of Biochemistry - Nelson and cox

5. Lippincoot's Biochemistry - P.C. Champe
6. Harper's Biochemistry - Murray
7. Biochemistry - Voet and Voet

PAPER VI

GENETICS AND MOLECULAR BIOLOLGY

UNIT-I

Mendelian genetics: Mendel's laws of inheritance, test cross, back cross and laws incomplete dominance

UNIT-II

DNA as genetic material, highly repetitive, moderately repetitive and unique DNA sequences. Types of replication, evidence for semi conservative replication. Replication in prokaryotes and inhibitors of replication. DNA polymerases I, II, III, topoisomerases, Okazaki fragments, DNA ligases. Reverse transcriptase, retroviruses, satellite DNA and Cot value.

UNIT-III

Prokaryotic transcription central dogma, RNA polymerases, role of sigma factor, initiation, elongation and termination. (Rho - dependent and independent). Inhibitors of transcription, post transcriptional modification of prokaryotes. Basic concept of one gene - one enzyme hypothesis.

UNIT-IV

Translational activation of amino acids, initiation, elongation and termination of protein synthesis in prokaryotes. Inhibitors of protein synthesis. Post translational modification of proteins. Genetic code - definition, deciphering and silent features of genetic code, composition of pro and eukaryotic ribosome, structure of t-RNA , coding and non coding strands of DNA role of signal peptides.

UNIT - V

DNA repair mechanism-excision, SOS and UV repair. Prokaryotic gene regulation-Operon, Lac operon , positive and negative control. Gene mutation types, point mutation, transition transversion frame shift, insertion and deletion.

References.

1. Genes VIII 2004. Benjamin Lewin, Oxford Univ press.
2. Cell and Molecular Biology - 3rd Editioin (2002).G Karp. John Wiley and Sons N.Y
3. Molecular cell biology - David Freifielder 2nd Edition, Narosa publishing House.
4. Lehinger's principle of Biochemistry (2000), Nelson and Cox.
5. Harper's Biochemistry - Rober K. Murray, Daryl K.Grammer, McGrawHill, Lange Medical Books
6. Biochemistry of Nucleicacids - Adam et al
7. Molecular biology - SC Rastogi CBS publishing 2nd Edition
8. Cell biology and Genetics - P.S. Verma and V.K.Agarwal, S. Chand publication
9. Advance molecular cell biology - R.M.Twyman.W.wisden Viva book House Yadav - Ist Edition 1998.
10. Genetics - Manju yadav Ist Edition 2003, Discovery publishing House.

PAPER VII

HUMAN PHYSIOLOGY AND NUTRITION BIOCHEMISTRY

UNIT-I: Respiratory and Circulatory System:

Components of transport of Oxygen and Carbon dioxide, Role hemoglobin in transport. Mechanism of respiration, Chloride shift, Bhor's effect. Introduction, function, types, of Circulatory organ. Design of Blood vessels, Blood Flow, blood pressure, Cardiac muscle, ischemic disease.

UNIT-II: Digestive and excretory system

Components of Digestive system, Digestion, absorption of carbohydrates, protein, lipids. Mechanism of HCL formation, Role of various enzymes involved in digestive process. Structure and function of kidney, Mechanism of urine formation, Glomerular filtration rate (GFR).

UNIT-III: Endocrine and Nervous System

Brief outline of various endocrine glands and their secretion, physiological role of hormones. Nervous system - Brain, spinal cord, nerve cells, and nerve fibers. Synapse, chemical and electrical synapses, nerve impulses, action potential and neurotransmission.

UNIT-IV: Nutrition and Dietary System

Definition if food nutrition, basic food groups, Physiological role and nutritional significance of carbohydrates, protein, lipids, vitamins and minerals. Protein malnutrition (Kwashiorkar) and undernutrition (marasmus) and their preventive, curative measures.

UNIT-V: Nutritive and Calorific Value of Food.

Unit of energy measurements of food stuffs by Bomb colorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Nutritive value of protein, essential amino acid. Composition of balanced diet for infants, pregnancy and lactating women, old age.

Reference

1. Human physiology, 2nd edition- BJ Mejer, HS Meij, AC Meyer, AITBs publishers abd distributers.
2. Cell physiology by Giese, 5th edition, W.B saunderscompany, Tokyo, Japan.
3. A text book of animal physiology, KA Goel, KV Sastri, Rastogi publications Meerut.
4. Animal physiology and Biochemistry- RA Agarval, Anil. K, Srivastava, Kausshal Kumar, S. Chand & Co.
5. A Hand Book of Basic Human physiology- K. Saradha subramanyam, S. Chand & Co., Ltd.
6. Guide to physiology- Y. Rajakshmi, S. Chand & Co., Ltd.

ELECTIVE I

PAPER I

MEDICAL LABORATORY TECHNOLOGY I

UNIT-I: Laboratory care and instrumentation

Code of conduct for laboratory personnel - safety measures in the laboratory-chemical/Reagents, labelling, storage and usage. First Aid in laboratory accidents - Precautions and first aid equipments.

UNIT-II: Laboratory equipments.

Working of microscope - Phase contrast, Fluorescence, Electron microscope. Centrifuge, analytical balance, colorimeter - Usage and care. Glass wares, serological water bath, incubator.

Reporting laboratory tests and keeping records. Sterilization, preparation of reagents. General approach to quality control, quality control of quantitative data.

UNIT-III: Urine Analysis

Composition, collection, preservation, gross examination, interfering factors, chemical examination. Significance of sugar in urine, ketone bodies in urine, bile pigments, hematuria, uric acid, microscopic examination of the urinary sediment.

UNIT- IV: Stool Examination

Specimen collection- inspection of faeces- odour, pH, Interfering substance. Test for occult blood, faecal fat, microscopic examination of stool specimen.

UNIT-V: Clinical Hematology

Collection of blood - Anticoagulant, preservation, Estimation of Hb, PCV<WBC<RBC, Platelets, ESR. Clotting time, bleeding time - normal value, clinical interpretation. Blood grouping

SKILLED BASED SUBJECT III

PAPER III

BIOSTATISTICS I

UNIT-I

Nature and scope of statistical methods and their limitations. Collection, classification, tabulation of statistical data.. Organization of data - Individual series, discrete series, continuous series / class interval. Diagrammatic and graphical representation of statistical data (bar diagram, line diagram, pictogram, histogram & horizontal and vertical bar diagram).

UNIT-II

Measure of central tendency - Introduction, Characteristics of a good average, Mean, Median, Mode (Raw, Discrete & Continuous data) Merits and demerits.

UNIT-III

Measure of Dispersion- Introduction, definition, classification & properties. Range - Introduction, definition, location of range in individual, discrete, continuous series, merits and demerits of Range. Standard deviation, Variance, Coefficient of Variation.

UNIT- IV

Probability - Introduction, Definition, Kinds of Probabilities. Sample Space - Addition and Introduction, definition of mean deviation, quartile deviation – simple problems. Permutation and Combination - Definition, Factorial symbol, formula with example.

UNIT-V

Correlation Analysis - Introduction, Definition, uses, correlation and causation, kinds of correlation. Types of correlation - Positive and negative, linear and non linear, simple and multiple, partial and total correlation.

Books for References:

1. Sundar Rao - Biostatistics.
2. Daniel - Biostatistics, John wiley & sons
3. Lewis, A. E (1971) - Biostatistics
4. Gupta S.P,(1997) Biostatistical Methods, S. Chand & Sons
5. Sundar Rao P.S.S, Jesudian.G& Richard.J [1987], An Introduction for Biostatistics [2nd edition] Prestographit, vellore, India

6. Biostatistics - P. Rama Krishna, Saras Publication [1995].
7. elhance D.N [1972], Fundamentals of statistics kitab mahal, allahabad.
8. Lewis, A.E [1971]- Bio-Statistics.
9. Daniel: Biostatistics, John Wiley 7 Sons.
10. Zar. J - BioStatistical analysis, prentice Hall of India.

VI SEMESTER

PAPER VIII

CLINICAL BIOCHEMISTRY

UNIT-I: Basic concepts of Clinical Biochemistry

A brief review of units and abbreviations used in expressing concentrations and standard solutions. specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens.

UNIT-II: Diseases related to carbohydrate metabolism

Regulation of blood sugar, Glycosuria - types of glycosuria. Oral glucose tolerance test in normal and diabetic condition. Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis.

UNIT-III: Inborn errors of metabolism

Introduction - clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism, tyrosinemia, and hamophilia.

UNIT-IV: Organ function test

Lipid and lipoproteins: Classifications, composition, mode of action - Cholesterol. Factors affecting blood cholesterol level. Dyslipoproteinemias, IHD, atheroscelorosis, risk factor and fatty liver.

Liver function test: Metabolism of bilirubin, jaundice - types, differential diagnosis. Liver function test - Icteric index, Vandenberg test, plasma protein changes, PT.

Renal function test : Clearance test – Urea, Creatinine, Inulin, PAH test, Concentration and dilution test.

Gastric function test : Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis.

UNIT-V

Clinical enzymology

Functional and non- Functional plasma enzymes. Isoenzymes with examples. Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting.

BOOK RECOMMENDED

1. Text book of Clinical Biochemistry - Carl A. Burdis and Edward R Ashwood
2. Text book of Medical Biochemistry - Dr. M.N. Chatterjee and rane shinde
3. Clinical chemistry in diagnosis and treatment - Philip D. Mayne
4. Clinical chemistry – William Hoffman
5. Clinical Biochemistry with clinical correlation – Devin, Wiley
6. Practical clinical biochemistry – Harold Varley, CBS, New Delhi

PAPER IX

BIOTECHNOLOGY

UNIT-I

Biotechnology: Definition and scope, types and branches of biotechnology. Genetic engineering tools - Restriction endo nucleases, SI nucleases, DNA ligases, Alkaline phosphatase, Reverse transcriptase, DNA polymerase, poly nucleotide kinase, terminal transferase. Use of Linkers and Adapters. Cloning vectors: Plasmid, Cosmid, Phage, YAC, Binary vector, Shuttle vector and Expression vectors.

UNIT-II

Methods of gene transfer - transfection, electroporation. Recombinant selection and screening methods, Insertional inactivation. Techniques of cloning - Southern, Northern and Western blotting techniques, DNA hybridization techniques. Gene amplification PCR.

UNIT-III

Plant tissue culture - Media composition, nutrients, growth regulators, initiation and differentiation. Callus and suspension culture. Micro propagation, Somatic embryo genesis and somoclonal variation. Protoplast isolation, protoplast fusion and regeneration of plants.

UNIT-IV

Equipment and requirements for animal cell culture, laminar flow, CO_2 incubator, natural media, synthetic media, substrate for cell culture, substrate treatment, desegregations of tissues, establishment of cell culture

UNIT-V

Transgenic plant and transgenic animal, Herbicide resistant, stress resistant, pesticide resistant and insect resistant, transgenic plant, transgenic fish and transgenic sheep. Valuable product from animal cell culture - Tissue plasminogen activator (TPA). Hybridoma technology - monoclonal antibodies.

Books Recommended:

1. Concept in biotechnology - D. Balasubraniam et al., Universal press India 1996.
2. Plant tissue culture - Razdan, Oxford IBH Publisher.
3. Animal cell culture - Freshney, IRL Press.
4. Animal Biotechnology - 2005. A.K. Srivastava, R.K. Singh and M.P. Yadav Oxford & IBH.
5. Molecular biotechnology 2006 - Channarayappa Univ. Press
6. Molecular Biology & Biotechnology - H.D. Kumar(1997), Vivas publishing house Pvt .Ltd
7. Molecular biotechnology - principle and application of recombinant DNA 3rd edition Bernard, R. Glick Jack, J. Pasternak 2003, Library of Congress cataloging in publication data.
8. A text book of Biotechnology - R. C. Dubey, S. Chand & co
9. Biotechnology - Prakash, S. Lohar, MJP publisher, Chennai -5.

CORE PRACTICAL III

1. COLORIMETRIC ESTIMATION

b. Estimation of Creatinine by Jaffe's method.
c. Estimation of urea by Diacetyl monoxine method.
d. Estimation of DNA.
e. Estimation of RNA.
f. Estimation of glucose by
    1. Folin Wu
    2. O- Toludine methods

2. ELECTROPHORETIC TECHNIQUES

SDS - PAGE and Agarose Gel Elcectrophoresis.

3. EXPERIMENTS ON ENZYMES BY COLORIMETRY

b. Effect of pH, temperature and substrate concentration for amylase and urease.
c. Assay of activity of alkaline phosphatase in serum.
d. Assay of serum Transaminases (SGOT, SGPT).

4 .CHROMATOGRAPHIC SEPARATIONS

a. Paper chromatography separations and detection of amino acids and simple sugars.
b. Chromatographic separations of chlorophyll carotenes of flower pigments and proteins using colulmn.
c. Separation of polar and nonpolar Lipids by thin layer chromatography.

ELECTIVE PRACTICAL

MEDICAL LABORATORY TECHNOLOGY

1. HAEMATOLOGY

Hematology, Hemoglobin shali's method, RBC count, PCV, ESR, Total and differential WBC count, Platelet count, Blood grouping, ABO system, Rh System Clotting time, Bleeding time

Serology – VDRL, CRP, RA, HIV, HBs Ag, Pregnancy test.

2. MICROBIOLOGY

Sterilization and disinfection, culture, gram staining, media preparation, antibiotic sensitivity testing

3. URINE AND FAECES ANALYSIS

1. Collection of urine and faecal samples
2. Faecal analysis to detect fats, undigested food and blood
3. Qualitative analysis of urine for normal and pathological conditions.

Books Recommended

1. practical clinical Biochmistry - Harold varley, CBS, New delhi
2. Medical Laboratory Technology – Kanai L. Mukherjee, Tata McGraw Hill Publication and co. ltd., Vol, I, II, III
3. Clinical chemistry – Ranjana Chawla
4. laboratory Manual in Biochemistry – Jayaraman
5. Biochemical methods – S.Sadasivan And manickam
6. Introduction to practical biochemistry – David T. Plummer

ELECTIVE II

PAPER II

MEDICAL LABORATORY TECHNOLOGY II

UNIT-I: Blood Banking

Blood grouping- ABO System, ABO Grouping, Rh typing,. Coomb's test,. Blood transfusion - Blood donors, donor screening, drawing of blood, compatibility testing, cross matching, blood transfusion complications.

UNIT-II: CSF and Other body fluids

Cerebrospinal fluid and the body fluids. Semen analysis, sputum examination, pregnancy test - Interpretation.

UNIT-III: Endocrine function test

Thyroid function test - thyroid hormones, function. Clinical disorder- diagonosis.T_4, I^{131} Uptake, TSH, Stimulation test, FT_4, FTI, TSH, TBG.

UNIT-IV: Medical Parasitology

Amoebiasis, malarial parasities – life cycle, pathogenesis of malaria – acute and chronic filariasis – diagnosis

UNIT-V Medical microbiology

Culturing of organisms from various specimens. Cu;ture media and antibiotic sensitivity test (pus, urine, Stool, sputum, throat swab, gram staining, Zielh –Neilson staining (TB,Lpra bacilli). Safety procedure in microbiological techniques.

References:

1. Medical Laboratory Technology - L. Mukherjee. Vol. I, II, III. Tata Mcgraw - Hill Publishing Company Limited
2. Medical Laboratory Technology - V>H. Talib
3. Clinical Laboratory practices in CMC procedur, CMC, Vellore.
4. Medical lab technology - Ramnik Sood.

ELECTIVE III

PAPER III

IMMUNOLOGY

UNIT-I

Innate and Acquired immunity, antibody and cell mediated immune response, primary and secondary lymphoid organs, structure of T, B and NK cell, structure and function of Neutrophils, Eosinophils and Basophiles, Macrophages – Phagocytosis and inflammation.

UNIT-II

Antigen - Properties specificity, cross reactivity, antigenecity, Immunogenecity, antigen determinants, Haptens, adjuvants, self antigen [MHC]. Antibodies- properties, classes, sub classes of Immunoglobulins - structure, specificity and distribution. Antigen and antibody intraction, precipitation and agglutination, complement, cytokines.

UNIT-III

Allergy and Hypersensitivity – type – I, II, III and IV their clinical manifestation. Immune diseases – Rheumatoid arthritis - Myasthenia gravis. Immunity to bacteria & Virus.

UNIT-IV

Transplantation – Allograft rejection, graft Vs Host reaction, Immunosuppressor – mechanism of graft rejection. Outline of tumor cells and treatment.

UNIT-V

Precipitation in gel: Ouchterlony procedure, radial immuno duffision, Immuno electrophoresis, Electro immunoduffision, RIA and ELISA.

Books Recommended

1. Immunology - J. kannan, MJP Publishers, Chennai-5
2. Immunology - Riot Ivanna, Jonathan Brastoff, David Male, 1993.
3. Immunology - Janis Kuby, 4th edition, 2000.
4. Immunology - An introduction, Tizarrd, r. Jan 1995.
5. Fundamendal of Immunology - Lippincot praven publications, 4th edition.
6. Essential and clinical Immunology - Halen chapel, Mansal Haney, Siraj misbah & Nial Snowdan.
7. Immunology - Geoffrey zubay, W.M.C, Brown publishers, 4th edition 1992.
8. Immunology - The immune system in health & disease, 3rd edition.

SKILLED BASED SUBJECT IV

PAPER IV

BIOSTATISTICS II

UNIT-I

Theoretical Distribution – Definition, Type of Theoretical Distribution, Binomial distribution and Poisson distribution- Definition, characteristics and Properties. Normal distribution, normal curve, standard Normal distribution - characteristics and Properties.

UNIT-II

Regression Analysis – Introduction, Definition, uses, types of regression- Positive and negative, linear and non linear, simple and multiple, partial and total. Regression equation – Regression equation of X on Y and Y on X.

UNIT-III

F-test and it's application, testing of Hypothesis – Null hypothesis, alternative hypothesis, standard error.

UNIT-IV

Chi- Square test- Introduction, Characteristics of Chi- Square test, Assumption, degree of freedom, application of chi- square test, t-test – Application and its Uses.

UNIT-V

Analysis of Variance- Introduction, techniques of Analysis of variance (ANOVA) – One way and two way classification, steps involved in analysis.

Books for References:

1. Sundar Rao- Biostatistics.
2. Daniel – Biostatistics, John wiley & sons
3. Lewis, A. E (1971) – Biostatistics
4. Gupta S.P,(1997) Biostatistical Methods, S. Chand & Sons

5. Sundar Rao P.S.S, Jesudian.G& Richard.J [1987], An Introduction for Biostatistics [2nd edition] Prestographit, vellore, India
6. Biostatistics – P. Rama Krishna, Saras Publication [1995].
7. elhance D.N [1972], Fundamentals of statistics kitab mahal, allahabad.
8. Lewis, A.E [1971]- Bio-Statistics.
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