GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF BIO-CHEMISTRY

(Effective for those admitted from 2017-2018 onwards)

SYLLABI

M.Sc., BIO-CHEMISTRY

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

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M.Sc., BIOCHEMISTRY

(Effective for those admitted from 2017-2018 onwards)

SEMESTER - I
CC 1 - BIOMOLECULES

Subject Code: 17P1B1	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To understand the basis of structure and functions of micromolecules and macromolecules.*

Unit I: Carbohydrates – Definition, functions and classification. Structure, chemistry, reactions and properties of monosaccharides. Disaccharides- Lactose, Maltose and Sucrose. Polysaccharides - Storage and structural polysaccharides - Starch, Glycogen, Inulin, Cellulose, Chytin and Pectin. Glycosaminoglycans – Structure and biological role of hyaluronic acid, chondroitin sulphate and heparin. Sialic acid. Glycoproteins. Bacterial cell wall polysaccharides.

Unit II: Proteins – Definition, functions and classification based on their functions, chemical nature, solubility and nutritional importance. Properties of proteins. Structure of proteins- Primary, Secondary, Tertiary and Quaternary. Collagen, Hemoglobin, Myoglobin - Structure and functions. Ramachandran plot, Bonds stabilizing the protein structure. Peptide bond, Chemical synthesis of peptides. Biological importance of peptides. Protein sequencing.

Unit III: Lipids - Introduction, Classification - simple, compound and derived lipids. Functions of lipids. Fatty acids - nomenclature, classification and properties. Triacylglycerol - structure and properties. Structure and functions of prostaglandins. Phospholipids and Glycolipids - structure and functions. Steroids – structure and functions of cholesterol, Bile acids and sex hormones - structure and functions. Lipoproteins.

Unit IV: Nucleic acids – Chemistry and properties of bases, Nucleosides, Nucleodides, Synthesis of Oligonucleotides. Watson and Crick model of DNA, Types of DNA – A, B and Z form, Properties of DNA; Density, Viscosity, Hypochromicity, Denaturation, Renaturation and Cot curve. DNA sequencing. Structure, types and functions of RNA.

Unit V: Vitamins - Definition and classification. Water soluble vitamins - Structure and functions of vitamin C, Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, Pantothenic acid, Folic acid and Cobalamin. Fat soluble vitamins - Structure and functions of vitamins A,D,E and K.

References:

1) Stryer.L, 2001, Biochemistry, W.H.Freeman & Co, NEW YORK,
2) Voet. D Voet, J.G, 2006, Fundamentals of Biochemistry, 2nd edition, John Wiley&Sons.
3) David L.Nelson Michael M. Cox 2005, Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman &Co, New York.
4) Conn, E. E, Stumpf, P. K., 2004, Outline of Biochemistry, 5th edition, John Wiley & Sons.
5) Mathews, C.K., Van Holde, K.E Ahern.K.G, 2003, Biochemistry, 3rd edition, Pearson International.
6) West, E.S and Todd.W.R, 1974, "Text Book of Biochemistry" 4th edition, Oxford IBH Publishing Co. Pvt. Ltd. New Delhi.

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SEMESTER - I

CC 2 - BIOPHYSICAL AND ANALYTICAL CHEMISTRY

Subject Code: 17P1B2	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To study the fundamental mechanism, Principle and Applications of modern Analytical Instruments.*
- *To Practice the methodology and interpretation in the current research*

Unit I: Acids, bases and buffer systems in living body. Henderson-Hasselbalch equation. pH-Effect of pH on biological – biological buffer systems, methods of pH determination and types of electrode –Glass and Calomel electrode and its applications. Surface tension and viscosity of blood. Colloids – types of charge, precipitation, emulsification, dialysis and Donnan equilibrium.

Unit II: Electrophoresis, electrophoretic support media, factors affecting electrophoresis, types of electrophoretic techniques – Zonal and disc electrophoresis. High and low voltage electrophoresis. PAGE, Isoelectrofocussing, Isotachophoresis, Capillary and Immunoelectrophoresis. Electrophoresis of nucleic acids.

Unit III: Radio isotope Techniques: Nature and units of radioactivity, detection and measurement of radioactivity. Geiger-Muller counter, Solid and liquid scintillation counting, Quenching, scintillation cock tail's, Autoradiography. Application of isotopes in biology, Hazards and prevention of radioisotopes.

Unit IV: Chromatography techniques. Paper, Thin layer, Column, Ion-exchange, Exclusion chromatography. Chromato focusing, affinity chromatography, GLC and HPLC and their applications. Centrifugation: Principles, Differential and Analytical centrifugation, Density gradient centrifugation; Analysis of subcellular fractions, Ultracentrifuge and its Application.

Unit V: Spectroscopy : Basic law of light absorption, optical rotatory dispersion, circular dichorism, X-ray diffraction, UV- Visible spectrometry, Spectro flurimetry, Atomic absorption spectro photometer, Flame photometry, IR, Mass spectrometry, Electron Spin Resonance, Nuclear Magnetic Resonance – principles, instrumentation and applications.

References

1. Keith Wilson John Walker, 2004, Practical Biochemistry – Principles and Techniques, 5th edition, Cambridge University Press.
2. David T Plummer, 2004, An Introduction To Practical Biochemistry, 3rd edition, Tata McGraw-Hill Publishing Co, Ltd.
3. John G. Webster, 2004, Bioinstrumentation, John Wiley & Sons. Inc.
4. Upadhyay, Upadhyay and Nath, 2001, Biophysical Chemistry - Principles and Techniques, Himalaya Publishing House.
5. Veerakumari.L, 2004, Analytical Biochemistry, MJP Publishers.
6. Rodney Boyer, 2004, Modern Experimental Biochemistry, 3rd edition, Pearson Educational International.

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SEMESTER - I
CC 3 - CELL AND MOLECULAR BIOLOGY

Subject Code: 17P1B3	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To learn the molecular level of both Prokaryotic and Eukaryotic Cell and its functions.*
- *To understand the special aspects of Genetic Code, Nucleosomes and plasma membrane*

Unit I: Molecular organization of prokaryotic and eukaryotic cells. Structure and function of mitochondria, Endoplasmic reticulum, Golgi complex, Lysosomes and peroxisomes. The cyto Skeleton – microtubules, microfilaments and intermediate filaments. The nucleus, nucleolus and chromosomes.

Unit II: Plasma Membrane: Structure, function and models of membrane. Inter cellular communication. Membrane transport – Active (Na K ATPase) and Passive transport, group translocation, porins. Programmed cell death-Carcinogenesis. Cell cycle- phases, regulation by cyclin and cyclin dependent kinases.

Unit III: Nucleosomes – Organization of Histone octomer. Replication – Semi conservative, rolling circle, cairn's model. Mechanism of DNA Replication, enzymes involved in replication synthesis of Okazaki fragments, events in the replication fork. Gene mutation – mutagenic agents and repair mechanism, outlines of Transposans and Retroposons.

Unit IV: Genetic code – Features, Wobble base hypothesis. Transcription – prokaryotic and eukaryotic Transcription. Initiation, open promoter complex, closed promoter complex and termination, anti termination, post transcriptional modifications, RNA processing and splicing.

Unit V : Prokaryotic and Eukaryotic translocation. Ribosomes, role of tRNA – Initiation, elongation and termination, post translational modifications, Inhibitors and regulation of translation. Regulation of gene expression in prokaryotes *Lac* operon and Tryptophan operon. Regulation of eukaryotic gene expression.

References:

1. Benjamin Lewin, 2004, GENES VIII, Pearson Educational International.
2. Lodish et. al., 2004, Molecular and Cell Biology, 5th edition, W.H. Freeman Co, New York.
3. Watson, J.D et. al. 2004, Molecular Biology of the Gene, 5th edition, Pearson Education International.
4. Philip Sheeler Donald E. Binanchi, 1987, Cell and Molecular Biology, 3rd edition, John Wiley & Sons Inc.
5. Cooper, G.M Hausman, R.E, 2004, The Cell-A Molecular Approach" 3rd edition, ASM Press, Washington.
6. Wayne M. Becker Lewis J. Klein Smith, 2004, THE Word of the Cell" 5th edition, Pearson Education.
7. David Freifelder, 2007, Molecular Biology, 2nd edition, Jones Bartiett Publication.

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SEMESTER - I

CC 4 - BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATIONS

Subject Code: 17P1B4	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To practice the statistics, Computer and its application in Bioinformatics.*
- *To apply the statistical methods in research and projects.*

Unit I: Introduction, scope and definition, Statistical methods, functions and limitations of statistics. Collection, organization and representation of data. Measures of central tendency – mean, median and mode. Measures of dispersion – range, quartile deviation, mean deviation, standard deviation and coefficient of variation, standard error.

Unit II: Skewness and Kurtosis, Types of skewness, Measures of skewness, Karl – Pearson's co-efficient of skewness, Bowley's measure of skewness, Measure of skewness based on moment, Types of kurtosis, correlation analysis – types and methods, Karl pearson's Co-efficient of Correlation, rank correlation, regression analysis – regression line and regression equation, Chi square test, Students 't' test, F test and ANOVA.

Unit III: Introduction to Bioinformatics, Information network, Database – nucleic acid, genome, protein sequence databases.
DNA, RNA, Protein sequence searches, sequence alignment, algorithms. FASTA, BLAST, Gene prediction software.

Unit IV: Genomics, proteomics, Human genome project, Microbial genome project, Phylogenetic relationship, Phylogenetic trees, Discovery of drugs, Pharmacogenomics, Application of JAVA and UNIX programme in bioinformatics, Basic information on biojava & bioinformatics projects.

Unit V: Introduction to Windows Operating system, MS – Word, Excel, Power point, Pdf, Journal-Impact Factor and Index. Application of computer packages in Biostatistics-SPSS, MINITAB.

References:

1) Orpita Bosu, 2007, Bioinformatics-Experiments, Tools, Databases, Algorithms, Oxford University Press.
2) Brian Francis, Murray Aitkin, John Hinde, Ross Darnell, 2009, Statistical Modeling in R, 1st edition, Oxford University Press.
3) Bryan Bergeron, 2002, Bioinformatics and Computing, 1st edition, Prentice Hall.
4) Arthur M. Lesk, 2002, Introduction to Bioinformatics"1st edition, Oxford University Press.
5) Christopher W. Sensen, 2002, Essentials of Genomics and Bioinformatics**,** 1st edition, Wiley, John & Sons.

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SEMESTER – I

CC 5 – PRACTICAL I

Subject Code: 17P1BP1	Credits: 4	External Marks: 60	Hours: 6

Objective:

- *To learn the skills in Qualitative and Quantitative analysis of Biomolecules.*
- *To ascertain the knowledge of Analytical Techniques.*

QUALITATIVE ANALYSIS

1) Carbohydrate
2) Amino Acids
3) Lipids

QUANTITATIVE ANALYSIS (Titrimetric Analysis**)**

1) Estimation of Sugar
2) Estimation of Protein
3) Estimation of Nucleic Acid
4) Acid Number of oil
5) Iodine number of oil
6) Saponification of oil
7) Ascorbic Acid
8) Estimation of Amino Acid by Formal Titration

DEMONSTRATION

1) Paper Chromatography
2) Electrophoresis

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SEMESTER - II

CC 6 – ENZYMOLOGY

Subject Code: 17P2B5	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To understand the concepts and classification and Mechanism of action of enzymes.*
- *To study about enzyme kinetics and applications of enzymes in industry, medicine and clinical laboratory.*

Unit I: Historical aspects of enzymology. Nomenclature and classification of enzymes according to IUB. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes - classical methods of purification and crystallization - separation based on molecular size, electric charge, solubility difference and selective adsorption, criteria of purity, units of enzyme activity. Turn over number, specific activity. Methods of Enzyme assay Active site definition, organization and determination of active site residues.

Unit II: Thermodynamic terms and basic concepts - types of thermodynamic systems. Enthalpy and Entropy biochemical reactions, biological thermodynamic standard state, activation energy and free energy. Coenzymes - Structure and function of Thiamine, Pyrophosphate, Nicotinamide, Flavin nucleotides, Biotin, Pyridoxal phosphate, Coenzyme A, Tetrahyrofolate and Vitamin B12.

Unit III: Kinetics of catalyzed reaction: Single substrate reactions, Concept and derivation of Michaelis – Menten equation, Limitations of Michaelis-Menten Kinetics. Line - weaver burk plot, Briggs Haldane relationship. Eadie -Hofstee plot, Hanes plot, Eisenthal -Cornish Bowden plot. Determination and significance of kinetic constant. Bisubstrate reactions - Sequential, Non - sequential reactions, King and Altman equation, Monad Wyman and Changeux. Inhibition kinetics - competitive, non-competitive and uncompetitive. Allosteric inhibition, Cooperative, cumulative and feedback inhibition.

Unit IV: Criteria of chemical reactions - Collision & transition state theories, specificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, covalent and electrostatic catalysis -nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis., Mechanism of enzymes action: mechanism of action of lysozyme and chymotrypsin. Multienzymes system - Mechanism of action of pyruvate dehydrogenase and fatty acid synthase complex .Isoenzymes- LDH.

Unit V: Applications of enzymes in Industry. Immobilization and Immobilized enzymes. Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Applications of immobilized enzymes. Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and Ribozymes. Enzymes of clinical importance - diagnostic significance and therapeutic effects. Enzyme Engineering- Introduction and Applications only.

References:

1. Enzymes (Longman, London) - Dixon, M. and Webb, J.F.: 1979.
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry Kindle Edition-T Palmer , 2007.
3. Biochemistry- Stryer, I, (II Ed) W.H. Freeman & Co., New York) 1988.
4. Biochemistry - Voet, D. and Voet, J.G, (John Wiley & Sons Inc., New York) 1990.
5. Fundamentals of Enzymology- Price and Stevens: (Oxford University Press) 1999.
6. Fundamentals of Enzymology (Oxford Science Publications) 2nd Edition, Nicholas C. 1989.

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SEMESTER - II

CC 7 - BIOENERGETICS AND METABOLISM

Subject Code: 17P2B6	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To understand the biochemical reactions and energy formation through metabolic pathways with their regulatory mechanisms.*

Unit I: **Bioenergetics:** Free energy and Entropy. Enzymes involved in biological oxidation reduction reactions; High energy compounds; Electron transport chain - organization and role in electron capture. Inhibitors of electron transport; Oxidative phosphorylation and its regulation; F_0/F_1 ATPase structure and mechanism of action. Chemiosmotic theory. Inhibitors, ionophores and uncouplers of oxidative phosphorylation; Substrate level phosphorylation. Mitochondrial transport systems - ATP/ADP exchange and Malate/Glycerophosphate shuttle.

Unit II: **Carbohydrates metabolism:** Introduction, Glycolysis, Pyruvate dehydrogenase complex. Citric acid cycle, Pentose phosphate pathway and Gluconeogenesis pathway and their regulation, Lactic acid cycle, Metabolism of fructose and galactose, Glycogen metabolism and its regulation; Metabolic adaptation in Starvation and Diabetes mellitus.

Unit III: **Lipid metabolism:** Introduction, Alpha, Beeta and Omega oxidation of fatty acids, Oxidation of unsaturated fatty acids, Biosynthesis of saturated fatty acids, Fatty acid synthase multienzyme complex. Metabolism of triacylglycerols, phospholipids and cholesterol. Formation of ketone bodies and their oxidation. Regulation of fatty acid and Cholesterol biosynthesis.

Unit IV: **Amino acids and protein metabolism:** Introduction, General reactions in the degradation of amino acids- Deamination, Decarboxylation and Transamination reactions; Urea cycle, Essential and Nonessential amino acids - Introductin, Biosynthesis of glutamine, serine, glycine, proline, tyrosine and phenylalanine and Degradation of valine, proline, cysteine, phenylalanine and methionine.

Unit V: **Nucleic acid metabolism:** Degradation of nucleic acids; Deoxyribonucleases and Ribonucleases; Biosynthesis and degradation of purine nucleotides; Biosynthesis and degradation of pyrimidine nucleotides; Regulation of purine and pyrimidine nucleotide metabolism; Metabolism of porphyrins.

References:

Robert K. Murray et. al. 2003, Harper's Illustrated Biochemistry" 26th edition, Lange Medical Publication.

David L.Nelson Michael M. Cox, 2005, Lehninger Principles of Biochemistry, 4TH edition, W.H. Freeman &Co, New York.

Thomas M. Devlin, 1997, Text Book of Biochemistry, John Weily & Sons.

Stryer .L, 2001, Biochemistry, W.H. Freeman & Co.

Voet.D Voet J.G, 2006, Fundamentals of Biochemistry, 2nd edition, John Wiley & Sons.

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SEMESTER - II

EC 1 – IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code: 17P2B7EC	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To understand the basic and advanced immunological reactions in the human system and know, How to diagnose the diseases through immunological techniques.*

Unit I: Immunity- innate and acquired immunity. cells and organs of the immune system; cells and Bone marrow, thymus and bursa of fabricus. Lymph node, spleen and mucosal associated lymphoid tissue. Antigens- Definition, antigenicity, antigenic determinants, haptens and epitopes. Antibodies- Structure, classification and functions.

Unit II: Immune response- Primary and secondary response. Humoral and Cell mediated immunity. . Complements system- components, nomenclature, and activation of complement, classical and alternate pathway. Antibody biosynthesis- theories of antibody formation- side chain, Clonal selection and class switching theory.

Unit III: Lymphokines and cytokines. Antigen processing and presentation. MHC complex- gene organization. HLA genes- class I and class II antigens, structure and function. Histocompatibility testing- lymphocytotoxicity test – cross matching. Transplantation- types, genetics of transplantation.

Unit IV: Hypersensitivity: types – I, II, III, IV, V. Immunotolerance, Autoimmunity- the spectrum of autoimmune diseases. HIV life cycle, diagnosis and treatment. Classification of tumor antigen.

Unit V: Active and passive immunization. Toxoids, Killed and attenuated Vaccines. Recombinant vaccines, Anti-idiotypic Vaccines and subunit vaccines. Immunological techniques- Principles and Production of antisera, precipitation, agglutination, complement fixation test, Immunodiffusion, immuno electrophoresis and immuno fluorescence. Hybridoma technique- Production and application, merits and demerits. Radio-Immuno Assay. Enzyme immunoassay-ELISA and EMIT.

References:

1. Getrey Zubay, 1972, Immunology, 4th edition, W.M.C Brown Publication.
2. Ivan Roitt Janthar Brotf, 1993, Immunology, 3rd edition, Morby Publication.
3. Nhini Shetty, 1996, Immunology, New age international publication.
4. Gregory J. Bancrt, 2004, Infection and Immunity, 2nd edition, Oxford University Press.
5. Janis Kuby, 1997, Immunology, 3rd edition, W.H.Freeman Company, New York.

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SEMESTER - II

EC 2 - PHARMACOLOGY

Subject Code: 17P2B8EC	Credits: 5	External Marks: 75	Hours: 4

Objectives:

- *To educate the students in the field of Drug development*
- *To learn the different types of drugs and their mode of action for their future carrier development .*

Unit I: Classification of drugs based on source, route of drug administration, drug absorption and distribution. Drug metabolic pathway - phase I - oxidative reactions- Epoxidation, hydroxylation, C - N system, C - O system and C -S system. phase II - reductive reactions - hydrolytic reaction. conjugation- Amino acids, sulphates, acetic acid, glutathione, mercapturic acid, methyl conjugation and transformation. Hard drugs - definition, biophosphanates and pyrophospahte. Soft drugs - definition and examples. Drug receptor and drug action, forces involved in the drug receptor complex.

Unit II: Anti-inflammatory drugs: steroid Anti inflammatory drugs and Non steroidal Anti-inflammatory drugs, Examples, pathways, mechanism of action and therapeutic uses. pharmacokinetics: Definition, Importance, Toxicity, Distribution, Factors involved and Elimination. Drug adverse effects: Classification, Detection and prevention.

Unit III: Pharmacotherapy of gout and rheumatoid arthritis, therapeutic gases-oxygen and carbon dioxide, enzyme therapy, mechanism of enzyme catalysis, types of catalysis and inhibition (chymotrypsin, aspartic proteases), vitamins, vaccines and hypoglycemic drugs. Organic pharmaceuticals-their role as preservatives and food additives.

Unit IV: Chemotherapy: Anticancer drugs: Introduction, types of neoplasm, metastasis, causes of cancer and its treatment (chemotherapy only).
Antibiotics - classification, structure, activity and uses of penicillin, cephalosporin, streptomycin and chloromphenicol, tetracycline. action of alkaloids, antiviral anti malarial substances.

Unit V: Biochemical mechanism of drug resistance, Multiple drug resistance (MDR), Common multidrug-resistant organisms (MDROs), Antifungal resistance, Antiparasitic resistance, Antibiotic resistance and Modes of Antibiotic action. Drug tolerance : Definition and types - Pharmacodynamic tolerance, Pharmacokinetic (metabolic) tolerance and Behavioral tolerance.
Drug addiction: Definition, Risk factors, Mechanism, Diagnosis and treatment. Drug abusers: Definition, Classification and sign and its symptoms.

References:

1. W.C.Bowman, M.J.R and G.B.West.1968. Text Book of pharmacology, Black well scientific Inc.Oxford,
2. Jayashree Gosh, 1996, Text Book of Pharmaceutical chemistry edition, S.Chand & Co.New Delhi.
3. Mehta, S.C.Kar, Ashutossh,2009, pharmaceutical pharmacology, 1st edition, New age International
4. Kar, Asutosh,2010, Medicinal chemistry,5th Edition, New age International
5. Dr. S.P. Maity and R.N.Chatterjee, Pharmacology, 2012, Books and Allied Pvt. Ltd.

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SEMESTER - II
CC 8 – PRACTICAL II

Subject Code: 17P2BP2	Credits: 4	External Marks: 60	Hours: 6

Objectives :

- *To provide knowledge and training on enzyme analysis.*
- *To understand the factors influence the enzyme reactions.*

Acid phosphatase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Alkaline Phosphatase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Amylase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Urease

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Demonstration

1. Preparation of various buffer using pH meter

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SEMESTER - III

CC 9 - HUMAN PHYSIOLOGY

Subject Code: 17P3B9	Credits: 5	External Marks: 75	Hours: 6

objectives:

- *To study the structure, composition and disorders of all organs.*
- *To learn the functions of all organs.*

Unit I : Body Fluid and Blood

Body fluid : Body fluid compartments, composition, capillary structure and filtration across capillary wall.

Blood: Composition, functions of plasma, RBC, WBC and platelets. Blood coagulation mechanism. Blood groups and Blood Buffers (Hemoglobin and Bicarbonate). Lymph: composition and function.

Circulatory system: Elementary principles of circulation, vasomotor circulation, blood pressure and structure of heart.

Unit II: Nerve and Muscle

Organization of nervous system: central and peripheral nervous system, structure of brain and neuron, excitability, action potential, conduction of nerve impulses, nerve fiber type and neurotransmitters.

Muscle : Skeletal muscle, Smooth muscle and Heart muscle - structure, contraction and relaxation. Cardiac cycle . Electrocardiogram.

Unit III: Renal Physiology

Structure of kidney and Nephron. Glomerular filtration, tubular reabsorption and secretion. Renal role in acid base balance, mechanism and regulation of miturition and renal failure. normal and abnormal constituents in urine.

Unit IV: Gastro Intestinal Physiology

Digestive system - Composition and functions of digestive secretions, saliva, gastric juice, bile, pancreatic and intestinal secretions. Absorption and transport of carbohydrates, proteins and lipids. Role of dietary fiber. Gastrointestinal hormones. Body temperature: Heat production and lose, Regulation and abnormality of body temperature.

Unit V: Special Senses and Sports Physiology

Special senses : Structure and functions of eye, ear and taste and olfaction.

Sports physiology : The muscle, respiration, cardiovascular system and body fluids and salts in exercise. Drugs and athletes.

References :

1) Concise Medical Physiology : SK Chaudhuri, New Central Book Agency, 8/1, Chintamoni Daslane, Calcutta - 9.
2) BDS Text book of Physiology and Biochemistry. G.H. Bell, D. Emsile - Smith, C.R, Peterson Churchill Livingstone.
3) Talwar. G.P, Srinivastava. I, M Mondgil. K.D, 1989, Text book of Biochemistry Human Physiology, Prentice Hall India.
4) Guyton Hall, 2006, Text book of Medical physiology, Blackwell Publishing House
5) Stephen J. Warburton, 2006, Comparative Developmental Physiology, Oxford University Press.

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SEMESTER - III

CC 10 - ADVANCED CLINICAL BIOCHEMISTRY

Subject Code: 17P3B10	Credits: 5	External Marks: 75	Hours: 6

Objective:

- *To know the fundamental principle, Mechanism and diagnosis of different diseases in modern clinical field.*

Unit 1: Specimen collection and processing-Collection of blood - Vein puncture, Skin puncture, arterial puncture, anticoagulants. Collection of urine, urine preservatives, test for urinary components, Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF – Collection, composition, chemical examination and clinical investigation in meningitis and Encephalitis. Amniotic fluid- Origin, collection, composition and analysis of amniotic fluid. Automated instruments in analysis.

Unit II: Serology- C Reactive Protein test, immunology test for pregnancy. Rheumatoid arthritis (RA) test. Hematology- ESR, Screening for sickle cell anemia, coagulation test and prothrombin time. Hemoglobin- Haemoglobinopathies, thalassemia and related disorders, normal and abnormal hemoglobin, haemoglobinaemia, Haemoglobinuria. Myoglobin related disorders. Porphyrins and disorders-porphyria.

Unit III: Blood sugars – Its maintenance, hyper and hypoglycemia. Regulation of blood glucose concentration – Diabetes mellitus – Complications, secondary degenerative diseases. Laboratory diagnosis of early and latent diabetes. Glucose tolerance test. Glycogen storage diseases, galactosemia and fructosuria. Disorders of purine and pyrimidine metabolism-Leisch Nyhan syndrome, hyperuricemia, Gout, hypouricemia and orotic aciduria. Disorders of lipid metabolism – lipoprotenemia, lipid storage disease, Gaucher's disease, Taysach's disease, Niemann pick's disease, fatty liver and atherosclerosis.

Unit IV: Clinical enzymology – Principles of diagnostic enzymology- factors affecting enzymes level in blood. Principles of assay and clinical significance of transaminases, creatine kinase, lactate dehydrogenase, glucose 6 phosphate dehydrogenase and ceruloplasmin. Enzyme pattern in diseases- Myocardial infarction, Hepatobiliary diseases and nephritic syndrome.

Unit V: Liver function test and related disorders- Cirrhosis, Jaundice, Hepatitis, Fatty liver and Cholestasis. Renal function test and related disorders- Acute renal failure, glomerulonephritis. Analysis of urinary calculi. Oncology- Oncogenes, tumor suppressor genes, alfa fetoprotein, carcinoembryonic antigens, leukemia. Free radicals in disease- introduction, oxygen toxicity, free radicals and free radicals induced lipid peroxidation. Free radical scavengers- super oxide dismutase, catalase and peroxidase.

References:

1. Philip D. Mayne, 1994, Clinical Chemistry in Diagnosis and Treatment, 6th edition, ELBS Publication.
2. Karperetl, D.L, 2005, Harrison's Principles of Internal Medicines, 16th edition, Vol. I Vol. II, Mc-Graw Hill publication, New York.
3. Bishop. Lipincot, 2000, Clinical Chemistry, Principles and Procedure, Correlations press.
4. Christopher Haslett et. al. 2002, Davidson's Principles and Practice of Medicine, 19th edition, Elsevier Science.
5. John F. Zilva, 1988, Clinical Chemistry in Diagnosis and Treatment, Medical Publishers, Chicago.

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SEMESTER - III
EC 3 - ENDOCRINOLOGY AND NEUROCHEMISTRY

Subject Code: 17P3B11EC	Credits: 5	External Marks: 75	Hours: 6

Objectives:

- *To know the detailed secretions, composition, function and receptors of hormones.*
- *To educate the organization, function, chemistry and conduction of nerve impulse and transmission.*

Unit I: Neuro endocrine system-Definition, classification of hormones, molecular basis of hormonal action, steroid hormone action, Intracellular second messengers-cAMP, protein kinases, tyrosine kinases, adenylate cyclase system, ANP, guanyl cyclase, calcium. Control of hormone release, regulation by releasing factors, prohormones and feedback control. Growth factors- Erythropoietin, Nerve growth factor, epidermal growth factor and fibroblast growth factor.

Unit II: Hypothalamus and Pituitary hormones- Vasopressin and Oxytocin. Hypothalamic releasing factors. Anterior pituitary hormones-actions and feedback regulation of synthesis. Hypo and Hyperactivity of Pituitary hormones-Gigantism, acromegaly, Dwarfism and Diabetes insipidus. Thyroid hormones-Synthesis, secretions, transport, metabolic fate and biological actions, anti-thyroid agents, hyperthyroidism and hypothyroidism. Parathyroid hormones-Biological actions, regulation of calcium and phosphorous metabolism.

Unit III: Pancreatic hormones- cell types of the islets of Langerhans. Insulin-Biosynthesis, regulation of section, biological actions and mechanism of action. Glucagon, somatostatin. Adrenal hormones-glucocorticoids, mineralocorticoids-biological effects and mechanism of action. Adrenal medulla-catecholamines - biological actions. Abnormal secretion of adrenal hormones-Addison's disease and Cushing's syndrome, Gonadal hormones-Androgen, estrogen-biological actions.

Unit IV: Brain-Chemical composition, neuro transmitters and cyclic AMP. Biochemical aspects of learning and memory: encephalins and endorphins.
Nervous system-general organization, functional unit, chemistry, resting and action potential, conduction of nerve impulse, synaptic transmission and neuro muscular junction.

Unit V: Prostaglandins-chemistry and nomenclature, biosynthesis - the cyclo oxygenase pathway, metabolism. Biological actions of prostaglandins, prostacyclins and thromoboxanes. Synthetic prostaglandin analogues and their therapeutic uses. Leukotrienes-chemistry, synthesis-Lipoxygenase pathway and their role in hypersensitive reactions.

References:

1. Mac E. Hadley, 2004, Endocrinology, 5th edition, Pearson Education.
2. Donald W.Pfaff, 2006, Principles of Hormone/Behaviors relations, 1st edition, Academic Press.
3. Long staff. A, 2002, Instant Notes on Neuroscience, 1st edition, Viva books Private Limited.
4. Robert K. Murray et. al. 2003, Harpers Illustrated Biochemistry, 26th edition, Lange Medical Publication.
5. Email S.Smith, 2000, Principles of Biochemistry-Mammalian Biochemistry, McGraw-Hill publication.

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SEMESTER - III
EC 4 - BIOTECHNOLOGY AND GENETIC ENGINEERING

Subject Code: 17P3B12EC	Credits: 5	External Marks: 75	Hours: 6

Objectives

- *To learn the uses of technology in biological science.*
- *To understand and learn the genetically modified organisms produced by genetic engineering with their applications.*

Unit I: Principles of genetic engineering and rDNA technology - Cutting and joining of DNA molecules, Restriction enzymes and their types, DNA ligases, Alkaline phosphatase. Double linkers, Adaptors and Homopolymeric tailing. Essential features of cloning vectors. Plasmids - pBR322 and pUC, Phage vectors - λ and M13, Cosmids and High capacity cloning vectors -YAC, PAC and BAC. Shuttle vectors, Expression vectors. Gene cloning in bacteria and yeast. Selection and screening of recombinants.

Unit II: Genomic DNA library, cDNA synthesis and cloning, Chromosome walking, Gene transfer methods-Calcium phosphate precipitation, PEG stimulated, Liposome mediated, Electroporation, Microinjection, Viral vectors, Agrobacterium mediated transformation, Ti plasmids - Cointegrative and Binary vectors, Particle bombardment gun (biolistic) method.

Unit III: Transgenic plants. Viral, Pest and Herbicide resistant plants. Plant as Bioreactors. Plant tissue culture - Callus culture, Micropropagation and Protoplast culture. Anti-sense RNA technology and applications. PCR technology. Blotting techniques - Southern, Northern and Western blotting.

Unit IV: Transgenic animals - Production and applications. Animal cell culture – Methods and Applications. Gene therapy. Principles and applications of stem-cell technology. Production of Insulin, Vaccines, Antibodies, Interferons and Somatostatin.

Unit V: DNA fingerprinting and foot printing with its applications. Bacterial leaching and biomining. Bioreactors - Design and types of fermentors, batch and continuous bioreactors. Downstream processing. Bioethics - Ethical issues in production of genetically engineered foods and transgenic plants and animals.

References:

1. Benjamin Lewin, 2004, Genes VIII, Pearson Educational international.
2. Brown T.A, 2003, Gene Cloning- An introduction, 3rd edition, Chapman Hall.
3. Old Primrose, 2001, Principles of gene manipulation, 6th edition, Black Well Science.
4. Watson, 2001, Recombinant DNA, 2nd edition, Scientific American Books.
5. Adrian Slater, 2003, Plant Biotechnology, Oxford University Press.
6. John E.Smith, 1996, Biotechnology, 3rd edition, Cambridge University Press.

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SEMESTER - III
CC 11 – PRACTICAL III

Subject Code: 17P3BP3	Credits: 4	External Marks: 60	Hours: 6

Objectives:

- *To practice the students in the field of Clinical and its approaches.*
- *To motivate the students with modern techniques.*

I. Hematological studies

1. Estimation of hemoglobin content by Hemoglobinometer
2. Total RBC count.
3. Total WBC count.
4. Differential WBC count (DC).
5. Determination of clotting time
6. Determination of Prothrombin time
7. Determination of ESR.
8. Grouping of blood and Rh typing.

II. Biochemical analysis of blood

1. Estimation of blood glucose by Ortho toluidine method
2. Estimation of serum proteins (A: G ratio)
3. Estimation of blood urea
4. Estimation of serum uric acid
5. Estimation of serum creatinine.
6. Estimation of serum triglycerides.
7. Estimation of serum cholesterol.
8. Estimation of serum calcium.
9. Estimation of serum bilirubin.
10. Estimation of serum Iron.

III. Urine Analysis

1. Identification of normal and abnormal constituents of urine.

IV. Immunological techniques

1. Widal test – rapid slide test for typhoid
2. VDRL test – test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy
4. Immunoelectrophoresis
5. ELISA – demonstration.

V. Spotters

1. Sphygmomanometer
2. Hemocytometer
3. Micropipette

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SEMESTER - IV

CC 12 - MICROBIAL AND PLANT BIOCHEMISTRY

Subject Code: 17P4B13	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- To understand the fundamental and Biochemical pathways in plants and Microbes
- To aware the students in the field of pathogenesis.

Unit I: Structure of bacteria, fungi and algae. Viruses: morphology, structure, reproduction and mode of infection. Microbial growth : Nutritional patterns among organisms, physical and chemical requirements for growth, culture media, mixed and pure cultures, preservation of cultures, phases of growth, measurements of microbial growth- Sterilization and Staining techniques.

Unit II: SOIL MICROBIOLOGY: Different soil microbes. Biogeocycle- carbon, Nitrogen and sulphur cycles.

AQUATIC MICROBIOLOGY : Fresh water microbial flora, effects of pollution, chemical pollution- test for water purity, salinity, BOD, COD, Microbial load. Water treatment- Sewage treatment- primary, secondary treatment- sludge digestion, septic tank, oxidation ponds and tertiary treatment. Water borne diseases.

FOOD MICROBIOLOGY: Microbial spoilage- Fresh food, milk and canned food. Food preservation- temperature, canning, pasteurization and sterilization methods in food industry.

MYCOTOXICOSIS: Mycotoxins of food contaminants like *A.flavus, P.rubrum, P.citrinum,* and *A.canidus* and *stachybotraya citra.*

Unit III: Photosynthesis: Chloroplast structure and function- CO_2 fixation by C3, C4 and CAM plants. Hill's reaction, Photorespiration, Photophospharylation. Nitrogen metabolism, transport and storage of nitrogen. Trace elements in plant nutrition. Translocation of Organic and Inorganic substances. Plant pigments- isoprenoids, anthocyanina and secondary metabolites eg. Flavanoids, alkaloids, phenolics, tannins and lectins.

Unit IV: Germination changes in composition and enzyme activities in seed, factors affecting germination. Structure and functions of plant hormones- Auxins, gibberellins and absicic acid. Plant breeding- principles of plant breeding, important conventional methods of breeding. Self and cross pollination and vegetative propagated crops. Genetic variability. Patterns of variation in morphology and life history in plants.

Unit V: Plant pathogens: common plant pathogens of interest of India, portals of entry, transmission of plant pathogen by vector. Plant diseases caused by bacteria, fungi and viruses, their effects on respiration, photosynthesis and water uptake. Defensive mechanism including resistance to infections.

References:

1. Frank B. Salisbury Clean W.Ross, 2004, Plant Physiology, 4th edition, Thomson Wordsworth.
2. Arvind Kumar S.S Purohit, 2005, Plant Physiology Fundamental and Applications, 2nd edition, Agrobios.
3. Ananthanarayan. R CK Jayaram Paniker. 2005, Text Book of Microbiology, 7th edition, Orient Longman.
4. Michael J. Pelczar et. al. 2004, Microbiology, 5th edition, Tata Mc-Graw Hill.
5. Lan sings. M Prescott et. al. 2003, Microbiology, 5th edition, Mc-Graw Hill.

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SEMESTER - IV

CC 13 - INDUSTRIAL BIOCHEMISTRY AND NANOTECHNOLOGY

Subject Code: 17P4B14	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To provide wide knowledge on industrial production and applications of organic compounds and enzymes.*

Unit I: Basics of biochemical engineering - Control and applications of industrial processes. Process evaluation and Development. Upstream and Downstream processing and scale up. Industrial production of lactic acid, Ethanol, Acetone, Vinegar, Riboflavin, Vitamin B_{12}, Penicillin, Streptomycin, Amino acids. Brewing beer and Wine. Single cell proteins.

Unit II: Development of new drug / molecules and elucidation of their mechanisms of actions. Formulations - Pharmacokinetics and Pharmacodynamics, Factors affecting drug efficacy. Drug resistance. Traditional medicines. Biotransformation. Large scale production of humanized monoclonal antibodies. Vaccine development.

Unit III: Introduction to different categories of food. Constituents of food products and their functional properties. Introduction to food processing, Intermediate moisture food, Food spoilage, Intrinsic and Extrinsic factors affecting the quality and life of food material. Food storage and preservation techniques, Food poisoning and Intoxication, By product utilization and scale up. Molasses and alcohol production.

Unit IV: Industrial production of enzymes from traditional sources. Industrial applications of proteases, carbohydrases (amylases and cellulases) and lipases. Enzymes as diagnostic, analytical and therapeutic agents. Marketed enzymes. Baking and food enzymes. Textile enzymes. Digestive enzymes. Enzymes of biological importance - Nucleotidase and Glucose 6 phosphate dehydrogenase.

Unit V: Nanotechnology and its applications in biosciences (basics only): Biosystems at the Nanoscale, interaction of nanoparticles with biomolecules, dendrimers, quantum dots, nanotubes, nanoshells. Concepts of property. Types of IPRs. Patent - Criteria of patentability, Non patentable invention, Patent specification. TRIPs.

References:

1. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, Mc Graw Hill, New York (1986).
2. Biochemical Engineering, S Aiba, A.E. Humphrey, Nancy F. Mills, University of Tokyo Press. (1978).
3. Principles of Fermentation technology, PF Stanbury, A Whitaker, SJ Hall (1997)
4. Methods in Enzymology Ed by K.Mosbach Vol 44 (1976),Vol 135,135a (1987
5. Enzymes by Dixon and Webb, Academic Press (1964)
6. The essential, understanding nanosciences and nanotechnology- T.Pradeep, Tata McGraw- Hill Publishing Company Limited,2007.

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SEMESTER - IV

EC 5 - FOOD AND NUTRITIONAL BIOCHEMISTRY

Subject Code: 17P4B15EC	Credits: 4	External Marks: 75	Hours: 5

Objective:

- *To learn the food groups, classification and Nutritional requirements for normal and different categories of human beings.*
- *To Understand the role of Micro and Macro nutrients and vitamins in our health.*

Unit I: Food - Sources, composition, properties and storage of common foods. Functions of food in relation to health - Classification of foods based on nutrients. Food preservation - reasons for preserving foods, principles, methods of preservation. Food addictive in processed food and their effects. Food groups to provide nutritive requirement for normal health- body building foods, energy foods and protective foods.

Unit II: Basics for computing nutrient requirements: Latest concepts in dietary recommendations, RDA – ICMR and WHO: Uses and limitations. Definition of unit of energy – cal, RQ, SDA and NPU. Energy metabolism: Basal and resting metabolism – influencing factors, Methods to determine energy requirements and expenditure. Sources and functions of essential nutrients – Proteins (high biological and low biological value), Carbohydrates and fats. Sources and functions of dietary fibre, Pro and Prebiotics.

Unit III: Micro and macro mineral nutrients: Distribution sources, metabolic functions and deficiency manifestations – Calcium, Phosphorus, Sodium, Potassium, Iron, Copper, Selenium and Zinc.
Fat and water soluble vitamins – Occurrence, properties and functions – Hyper and Hypovitaminosis. Role of Vitamin as Antioxidant.

Unit IV: Nutrition through life cycle. Special needs of Infants, children, adolescents, pregnant and lactating women, convalescents and old persons.
Food technology- Preparation of infant's Food, Food safety and Food Hygiene.

Unit V: Principles of diet therapy, Diet during stressed conditions- laborers. Patients- therapeutic diets for anemia - Iron deficiency anemia, Pernicious anaemia, Megaloblastic anaemia. Malnutrition - Kwashiorkor, Marasmus and Marasmic Kwashiorkor. Obesity, Diabetes mellitus - IDDM, Non - IDDM, Cancer, Cardiovascular Diseases and allergy.

References:

1. Krause's Food and Nutrition Therapy,Kathleen mahan L, Sylvia Escott-stump MA, 12th edition, International edition, Saunders Elsevier publications, , ISBN 978-0-8089-2378-7.
2. Principles of Nutrition and Dietetics, Swaminathan M, Second Edition, The Bangalore Printing and Publishing Co., Ltd.,1997.
3. Food Science, Srilakshmi B, Fourth Edition, New Age International (P) Limited, Publishers,2009.

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SEMESTER - IV
CC 14 – PRACTICAL IV

Subject Code: 17P4BP4	Credits: 4	External Marks: 60	Hours: 6

Objectives:

- *To apply the technical approaches in the Research.*
- *To educate the students in the awareness of food and its analysis.*

Experiment: Semi quantitative

1. Isolation of casein from milk
2. Isolation of lactose from bovine milk
3. Isolation of glutamic acid from gluten

Experiment Quantitative

1. Estimation of reducing sugar in milk – Benedicts or Anthrone Method
2. Estimation of iron content in apple juice
3. Estimation of albumin from the egg white
4. Estimation of polyphenols by folin- denis method
5. Determination of rancidity in edible oil: Kries test

TISSUE ANALYSIS

1. Estimation of RNA, DNA, Protein and Sugar.

QUALITATIVE ANALYSIS OF SOME COMMON FOOD ADULTERANTS

1. Edible oil
2. Milk and milk products
3. Beverages, spices and condiments

TECHNIQUES

Sterilization Technique
Preparation of Media
Isolation of Bacteria (Staining)

References:

1) **Beedu Sashidhar Rao, Viay Deshpande** Experimental Biochemistry . I.K International PVT Ltd

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SEMESTER – IV

PW 1 – PROJECT WORK

Subject Code: 17P4BPW	Credits: 4	External Marks: 80	Hours: 14