M.Sc. BIOCHEMISTRY

IV SEMESTER

BC 4.1: CLINICAL BIOCHEMISTRY AND ENDOCRINOLOGY

Course Outcome:

CO1: To offer detailed knowledge about the Gastrointestinal hormones and methods of evaluation

CO2: To provide basic concepts on study of Liver diseases and liver functional tests

CO3: To offer basic concepts of the significance of Pancreatic and Thyroidal hormones

CO4: To offer detailed knowledge on the role of enzymes in diagnosis of various diseases

CO5: To provide basic concepts on the biological actions of Hypothalamic and Adenohypophysial hormones

Course Specific Outcome:

CSO1: To offer detailed knowledge on disorders of gastric function, Abnormalities in blood formation

CSO2: To provide basic concepts on biochemical investigations of renal disorders and endocrine disorders of pancreas

CSO3: To offer detailed knowledge on biochemistry of reproductive disorders and hypothalamic disorders

Course Learning Outcome:

LO1: Students will acquire knowledge on Plasma proteins and their variation in diseases

LO2: Students will learn the functions of thyroidal and parathyroidal hormones

LO3: Students will acquire insight into the functions of Renal hormones and biochemical investigation of Renal disorders

LO4: Students will gain insight into biosynthesis of adrenal medullary and adrenal cortical hormones

Unit -1

Gastrointestinal hormones - Gastrin, secretin and cholecystokinin. Disorders of gastric function, methods of evaluation. Pancreatic exocrine secretions, pancreatic diseases, steatorrhoea. Malabsorption syndrome – tests for their evaluation and significance

Plasma proteins – Properties, functions and their variations in diseases, Plasma lipids and lipoproteins, Interrelationship of lipids, lipoproteins and apolipoproteins. Erythropoiesis, abnormalities in blood formation. Anemias. Heamoglobinopathies. Cerebrospinal fluid – composition in health and diseases

Unit – 2

Liver function tests, their significance, Liver diseases – Jaundice, hepatitis, gall stones, cirrhosis and fatty liver. Free radical mechanism and role of reactive oxygen species in diseases. Role of liver in metabolic regulation and drug metabolism. Clinical chemistry of new born

Kidney – Renal hormones –Renin, erythropoietin and angiotensin. Investigations of renal functions, biochemical investigation of renal disorders. Nephritis, nephrotic syndrome and urolithiasis. Compensatory mechanism for acidosis and alkalosis

Unit – 3

Pancreatic hormones – Biosynthesis of insulin, regulation of secretion of insulin and glucagon, their role in carbohydrate,lipid and protein metabolism. Endocrine disorders of pancreas – Diabetes mellitus, melliturias, hypoglycemia. Glucose tolerance test
Thyroidal hormones – Chemistry, function and metabolism. Hypo and hyper thyroidism, tests for thyroid function. Parathyroid hormones – Parathormone and calcitonin, their role in calcium and phosphate metabolism, abnormalities of parathyroid functions and methods of evaluation

Unit – 4

Clinical enzymology - Plasma enzymes in diagnosis and prognosis, Isoenzymes in health and diseases (Liver, cardiac and skeletal muscle enzymes)
Adrenals - Chemistry and biosynthesis of adrenal medullary and adrenal cortical hormones. Disorders of adrenal cortex and adrenal medulla, tests for the evaluation of adrenal functions. Biochemical effects of tumours

Unit – 5

Synthesis,secretion, transport, and biological actions of hypothalamic, Adeno hypophysial and neurohypophysial hormones. Hypothalamic disorders. Pituitary - Clinical syndromes and their evaluation. Penial hormones – Melatonin and serotonin
Chemistry, biosynthesis and role of androgens, estrogens and progesterone. Hormonal regulation of menstrual cycle, Hormonal contraception. Placental hormones. Biochemistry of reproductive disorders, pregnancy toxemia, pregnancy tests

Reference books:

1. Nutritional Elements and Clinical Biochemistry -M.A. Brewster, H.K.Naito
2. Text Book of Biochemistry with clinical correlations-Thomas M. Devlin, 7th ed
3. Clinicalchemistryindiagnosisandtreatment–JoanF.ZilvaandP.R.Pannall
4. Clinical Biochemistry – S.Ramakrishnan,Rajiswami
5. Chemical chemistry -W.J.Marshall&S.K.Bangert, 5th ed
6. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed by Allan Gaw, Michael Murphy, et al., 3rd ed

7. Text book if endocrine physiology- J. E. Griffin, S. R. Ojeda, 4th ed
8. Endocrinology - Mac Hadley, 5th ed
9. Williams Text book of endocrinology- S.Melmed et al., 13th ed
10. General Endocrinology –Turner C.D, J.T.Bagnara, 6th ed

M.Sc. BIOCHEMISTRY

IV SEMESTER

BC 4.2: GENOMICS AND PROTEOMICS

Course Outcomes:

CO1: Enable the students to learn and understand the detailed developments and applications of genomics, proteomics and computational biology studies and their relevance on research platform

CO2: The knowledge acquired by the students will enable them to perform *in-silico* experiments to predict the structures of proteins and there by drug discovery for real life situations

CO3: To expose the students to the available bioinformatics tools to understand the protein and DNA sequence analysis

CO4: To enable the students to get trained in the application of programs used for database searching

CO5: To enable the students to access software which will clarify sequence alignments and predicting the structures of biomolecules

Course Specific Outcomes:

CSO1: The specific outcome of this course is to facilitate the students to understand the fundamental principles of Genomics and proteomics and to develop an understanding of key concepts from the enormous amount of experimental data that is rapidly emerging in this field

CSO2: To enable the student to understand the different areas of genomics

CSO3: To learn about evolutionary relationship of different organisms at molecular level

CSO4: Expose the student to the methods that analyze the protein coding potential of the gene sequence of the DNA

CSO5: Enable the student to explore the possible structure prediction vs expected functional outcome of the desired biomolecule

Learning Outcomes:

The students who complete this course, will be able achieve these outcomes

LO1: It enables the students to understand fundamental principles of structural, functional, and comparative Genomics

LO2: To comprehend the sequence alignment, Database Similarity Searches like BLAST, FASTA etc.,

LO3: The course will aid in learning Phylogenetic analysis which includes phylogenetic tree evolution and phylogenetic programs

LO4: Students will get trained in the principles of proteomics and its application along with fundamental aspects of techniques used in *in-silico* protein structure prediction

LO5: The course will help the student to acquaint with Homology Modeling, molecular docking, and Drug Designing

Unit- 1

Structural genomics- Genome annotation, Gene finding, Gene Prediction Programs - Ab Initio based and Homology based Programs
Functional Genomics – Sequence based, and Microarray based Approaches
Comparative genomics - Orthologs, paralogs, and homologs

Unit-2

Sequence alignment: Similarity, identity and homology. Concept of Alignment –Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment, Application of multiple sequence alignment. Progressive Alignment Algorithm, BLAST, FASTA

Unit- 3

Molecular phylogeny concept. Tree types, Tree construction – Clustering based methods - UPGMA, Neighbor joining; Character based methods - Maximum Parsimony, Maximum Likelihood. Boot strapping - Parametric and Nonparametric; Phylogenetic programs-Clustal-W, COBALT, Phylip, PHYML

UNIT- 4

Types of Proteomics - Protein expression proteomics, Structural proteomics, Functional proteomics, Significance, and applications of proteomics in Biology

Introduction to principle and techniques – 2D gel electrophoresis, DIGE electrophoresis, MALDI- TOF/TOF, Q –TOF. LC-MS, Tandem MS (MS-MS), Micro-arrays of proteins

UNIT- 5

Molecular Modeling –Advancements and Applications, Structural organization of proteins; Understanding Molegro Molecular viewer for protein 3D visualization – RASMOL. Protein secondary structure prediction – Chou Fasman method; Tertiary structure prediction- Homology modeling

Docking studies (Using Molegro Virtual Docker) - Molecule Import and preparation from PDB. Docking, Analysis, Constrains, Data analyser, sidechain flexibility and templet docking

Drug discovery – target identification, target validation, lead identification, lead optimization, Phase I, II and III clinical trials

Reference books:

1. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms - Primrose S.B, 2nd ed
2. Essential Genetics- A Genomics Perspective – Daniel L.Hartl, 5th ed
3. Principles and Practices of Plant Genomics - Chittaranjan Kole, Albert G. Abbott, vol – II
4. Genomes 4 - T. A. Brown
5. Recombinant DNA by J. D. Watson, latest edition
6. Proteome Research Concepts Technology And Application - M.R. Wilkins
7. Principles of Proteomics – Ian Moore
8. Introduction to Proteomics - Mishra Nawin C
9. Principles of Proteomics – Richard Twyman, 2nd ed
10. Introduction to Proteomics - Liebler Daniel C
11. Proteomics- Principles, Techniques and Analysis- Wyatt
12. M. Michael Gromiha, 2010. Protein Bioinformatics: From Sequence to Function, Academic Press.
13. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring HarborLaboratory Press (New York)

M.Sc. BIOCHEMISTRY

IV SEMESTER

BC 4.3: BIOSTATISTICS AND BIOINFORMATICS

Course Outcomes:

CO1: To offer detailed knowledge on study of the measures of central tendency and measurement of dispersion
CO2: To provide basic concepts to learn the laws of probability and probability distributions
CO3: To offer basic concepts of correlation and regression and statistical tests of significance and Analysis of variance
CO4: To provide the basic knowledge on different devices, organization and operating systems used in computers
CO4: To offers the basic knowledge on importance of Human Genome Project, features of organism genome and current trends in genome sequencing.
CO5: To provide the knowledge on features of various data bases and its importance, deposition of data and retrieval of the data from the database.

Course Specific Outcomes:

CSO1: To offer basic concepts of probability theory and distributions, Statistical tests of significance for making statistical inferences
CSO2: To provide basic concepts of different devices and operating systems of computer for making efficient use in day-to-day life
CSO3: To offers the basic knowledge on genome sequence similarities/differences of various organisms in order to understand its functions
CSO4: To offer basic concepts of databases, types, and for making data deposition and retrieval

Learning Outcomes:

LO1: Students will have insight into proper statistical analysis of the data
LO2: Students will learn the importance of mean, standard error, standard deviation and their significance in presenting the data
LO3: Knowing statistical methods will help students in improving their analytical and interpretation skills
LO4: Knowing the devices and operating systems will help students in improving their usage of computers
LO5: Knowing the genome features and genome sequences will help the students to understand the functions of genes
LO6: Students will learn the importance of databases that will be helpful in getting sequences for alignment and for docking studies

Unit-1

Principles of Biostatistics - Biostatistics fundamentals (sample, population, variable); Measures of central tendency - mean, median, mode; Measurement of dispersion - range, variance, standard deviation
Events, Basic principles of probability theory - Addition and Multiplication laws of probability, Bayes theorem, Normal distribution, Binomial distribution, Poisson distribution; Study of bivariate data - correlation, scatter diagram, coefficient of correlation; Regression, Regression lines

Unit- 2

Statistical tests of significance - Statistical inferences - Types of errors; Level of significance - Null hypothesis, Alternate hypothesis; Standard error, Student's 't' test for comparison of means, 'F' - test for comparison of variances, chi square test - goodness of fit; Analysis of variance (ANOVA) - one way classification and two way classification

Unit-3

Organization of computers, External and internal storage devices, Basics of operating systems, Introduction to DOS, Windows, Unix, Linux systems and basic commands; WWW, HTML, HTTP, Intra net and Internet concepts
Introduction to Bioinformatics - History and major developments; Branches of bioinformatics, Scope and applications of Bioinformatics in biology and medicine

Unit-4

Genome projects: Human genome projects, features of yeast genome and Arabidopsis genome.
Sequencing: High throughput DNA sequencing, Whole genome sequencing, Next Generation Sequencing, Strategies for sequencing genomes- shot gun sequencing contig assembly, sequencing editing

Unit- 5

Data Bases: Introduction to Data Bases, features and types of data bases
INSD-International Nucleotide Sequence Database - Gen Bank, EMBL, DDBJ, special focus on NCBI; Protein sequence Data base - Swissprot , Tr- EMBL, PIR, Uniprot and Pfam; Structural Data bases-PDB, CATH, SCOP, MMDB

Reference books:

1. Introduction to Bioinformatics - T.K. Attwood, D.J.Parry-Smith
2. Fundamental Concepts of Bioinformatics - Dane E. Krane, Michael L. Raymer
3. Bioinformatics (Sequence and Genome Analysis)- David W. Mount, 2nd ed
4. Discovering Genomics, Proteomics and Bioinformatics – A. Malcom Campell, L.J Heyer, 2nd ed
5. Biostatistics For Dummies - John Pezzullo
6. Essential Medical Statistics - Betty R. Kirkwood, Jonathan S.C. Sterne, 2nd ed
7. Statistical methods- S.P. Gupta
8. Biostatistics – P.N. Arora, P.K. Malhan, Himalaya Publishing House
9. Schaum's Outline Series on Statistics – Murray L. Spiegel, Larry J. Stephens

M.Sc. BIOCHEMISTRY
IV SEMESTER
BC 4.4: APPLIED BIOCHEMISTRY

Course Outcomes:

CO1: To identify the DNA protein interactions in order to regulate gene expression in both prokaryotes and eukaryotes
CO2: To gain the knowledge about various techniques used in tissue culture to obtain high yielding and disease resistant varieties etc
CO3: To understand the propagation of animal cells and tissues under laboratory conditions and their importance
CO4: To gain knowledge about stem cells and their importance in treatment of diseases
CO5: To acquire knowledge about types of vaccines, their preparation and applications of gene therapy

Course Specific Outcomes:

CSO1: The course highlights the techniques used for identifying DNA protein interactions and DNA markers used in rDNA technology
CSO2: The course covers broad range of plant tissue culture aspects and its applications in production of transgenic plants
CSO3: Major emphasis of the course was on maintaining primary cultures and continuous cell lines and their behaviour under *in vitro* conditions
CSO4: More emphasis of the course was on different properties and types of stem cells and their preservation and applications
CSO5: The course also covers broad spectrum of vaccination strategies and types. It also covers the importance of gene therapy and nanotechnology

Learning Outcomes:

LO1: Students will understand about various types of DNA markers used in rDNA technology and importance of DNA fingerprinting in forensics and also about gene silencing and its implication
LO2: Students will acquire a good knowledge aboutregeneration of plants, somatic embryogenesis, and also about production of secondary metabolites using cell cultures, which will be useful for them to carry out research using plant tissue culture aspects in future
LO3: Students will gain thorough knowledge about the primary cultures and their maintenance, continuous cultures and their maintenance which will be useful for them to carry out research using cell lines in future
LO4: Students will be able to understand the importance of stem cells and use of stem cells in treating diseases like Parkinson’s and Alzheimer’s
LO5: Students will acquire knowledge about different types of vaccines and recent developments in vaccine preparation and delivery and also about the importance of nanoparticles in treatment of diseases and industrial applications

Unit- 1

Nucleic acid and protein interactions: DNA foot printing, CAT assay, Gel shift analysis. DNA markers in genetic analysis – RFLP, Minisatellites, Microsatellites, PCR based RAPD markers, Chromosomal Walking, Chromosomal jumping,DNA fingerprinting, SNPS
Mapping Genes – Somatic cell hybridization mapping, FISH, Transposon tagging; RNA silencing – siRNAs and anti- sense RNAs- their design and applications; shRNA, Epigenetic gene silencing

Unit-2

Plant tissue culture: Culture media – Composition and preparation, Totipotency, Different stages of Micropropagation, Somatic embryogenesis, Somaclonal variations, Artificial seeds, Isolation and culture of protoplasts, Somatic hybridization, cybrids, Anther culture, Plant cell suspension cultures, Production of secondary metabolites through *in vitro* culture,Transgenic plants and their applications

Unit-3

Animal tissue culture: Composition and preparation of culture media, Natural and Synthetic media. Cell culture methods: Suspension and Monolayer Cultures, Primary cultures, established cell lines, Characteristics of transformed cells. Behaviour and characteristics of cells in cultures, Three dimensional cultures - Organ culture, Histotypic culture and Organotypic culture; Transgenic animals and their applications

Unit-4

Stem cells – Properties of stem cells – Potency, Stem cell plasticity,
Types of stem cells - Embryonic stem cells, Adult stem cells, Cord blood stem cells;
Preservation of stem cells, Applications of stem cells in regenerative medicine- Parkinson's disease and Alzheimer's disease;Gene therapy –Types, Strategies and Approaches for gene therapy, Viral and Non-Viral vectors for gene therapy, Gene therapy in Cancer, Cystic Fibrosis, SCID

Unit-5

Vaccines: Principles of vaccination, Design of vaccines, Conventional vaccines – Whole organism- inactive and attenuated, Purified macromolecules,New generation vaccines- Recombinant antigen vaccines, Recombinant vector vaccines, DNA vaccines, Synthetic peptide multivalent sub unit vaccines, Vaccine delivery systems – Liposomes, Micelles, ISCOMS; Strategies for developing vaccines for Malaria, HIV and covid-19. Nanotechnology- Principle and applications in Medicine, Food Science and Environment

Reference books:

1. Plant Cell and Tissue Culture - A Tool in Biotechnology - Neumann, Karl-Hermann et al.,
2. Plant Tissue Culture- Roberta Smith, 3rd ed
3. Introduction to Plant Biotechnology – H.S.Chawla, 3rd ed
4. Textbook of Animal Biotechnology – B.Singh, S.K.Gautham
5. Vaccine Adjuvants and Delivery Systems - Manmohan Singh
6. Nanoparticulate Vaccine Delivery Systems – Martin J.D'Souza
7. Metabolic Engineering: Principles and Methodologies - Aristos A. Aristidou, Jens Nielsen et al.,
8. Human Embryonic Stem Cells - Ann Kiessling , Scott C. Anderson, 2nd ed
9. Concepts and Applications of Stem Cell Biology - Rodrigues**,** Gabriela et al.,
10. Principles of Gene Manipulation: An Introduction to Genetic Engineering - Sandy B. Primrose, Richard Twyman, Bob Old, 6th ed
11. Biotechnology – U.Satyanarayana
12. Nanotechnology : Principles and Applications – R. K. Sindhu, Mansi Chitkara, 1st ed

M.Sc. BIOCHEMISTRY
IV SEMESTER
PRACTICAL - I
BC 4.5: CLINICAL BIOCHEMISTRY

Course Outcomes:

CO1: To offer hands on experience in analyzing blood for haemoglobin, and derivatives, glucose and Glycosylated haemoglobin.
CO2: To provide skills in determining serum creatine and creatinine, uric acid, bilirubin etc.
CO3: To offer knowledge in estimating marker enzymes such as SGOT, SGPT, LDH, creatine kinase etc.
CO4: To provide skills in analysis of plasma for fibrinogen.
CO5: To offer hands on experience in analysis of urine for urea and oxogenic steroids.

Course Specific Outcome:

CSO1: To offer hands on experience in analysis of blood and plasma.
CSO2: To provide skills in analysis of serum.
CSO3: To offer knowledge in analysis of urine.

Course Learning Outcome:

LO1: Students will acquire practical training for estimation of clinically important compounds like blood glucose, serum cholesterol, Glycosylated haemoglobin, calcium, etc.
LO2: This will enable the students to perform diagnostic tests for the diseases related to varying levels of these compounds/chemicals.
LO3: Students will get hands on experience in analyzing marker enzymes in various diseases.
LO4: Students will learn analysis of urine under various conditions.

CLINICAL BIOCHEMISTRY (A)

Analysis of serum for:
Creatine and creatinine
Uric acid by chemical and enzymatic methods
Bilirubin
Chlorides
Calcium
HDL Cholesterol and LDL cholesterol
Total proteins, Albumins and globulins
Thymol turbidity and zinc sulphate turbidity tests
SGOT and SGPT
LDH, Gamma glutamyl transferase

Acid and Alkaline Phosphatase
Creatine Kinase

CLINICAL BIOCHEMISTRY (B)

Analysis of Blood for:
Hemoglobin and derivatives – Spectroscopy
Glucose by chemical and enzymatic methods
Glycosylated hemoglobin
Analysis of Plasma for:
Fibrinogen
Analysis of Urine for:
Qualitative tests and microscopic examination
Urea by micro diffusion method
17 Oxo and 17 – Oxogenic steroids

Reference books:

1. Varley's Practical Clinical biochemistry – Vol – I, Ed.Alan W.Gowen lock
2. Varley's Practical clinical Biochemistry – Vol-II, Ed. Alan W. Gowenlock
3. Clinical diagnosis and management by Lab methods - John Bernard Henry, W.B. Salunders Company, 1984).

M.Sc.BIOCHEMISTRY
IV SEMESTER
PRACTICAL - II
BC 4.6: BIOSTATISTICS AND BIOINFORMATICS

Course Outcomes:

CO1: To offer hands on experience in performing data analysis by using mean, median, mode, variance, and standard deviation
CO2: To provide skills in Data analysis by student t-test and Analysis of variance
CO3: To provide knowledge to calculate correlation coefficient and regression analysis
CO4: To provide the basic knowledge data bases and its importance, deposition of data and retrieval of the data from the database
CO5: To offer the knowledge to compare the unknown DNA/Protein sequence with the deposited sequences in the database by and to perform Pairwise/multiple sequence alignment
CO6: To provide the knowledge on construction of phylogenetic tree using molecular characters
CO7: To offer the knowledge on separation of protein using 2-Dimensional gel electrophoresis

Course Specific Outcomes:

CSO1: To provide skills in data analysis for biological interpretations
CSO2: To provide skills in deposition and retrieval of data from database
CSO3: To provide skills in Pairwise/multiple sequence alignment using BLAST/FAST/CLUSTAL-W to identify similarity
CSO4: To provide skills in Pairwise/multiple sequence alignment using BLAST/FAST/CLUSTAL-W to identify similarity
CSO5: To generate experimental skills in the construction of phylogenetic tree
CSO6: To develop the experimental skills in the separation of proteins using 2-Dimensional gel electrophoresis

Course Learning Outcomes:

LO1: Students will acquire hands-on practical training to plan biological experiments with requisite sample size
LO2: After completion of experiments based on different sample sizesstudents will be able to perform proper statistical analysis of the data using mean, median, mode, variance and standard deviation
LO3: Statistical training will improve computational, mathematical and computer skills of the students by learning theuse of ANOVA, and student t-test
LO4: Students will acquire the hands on experience to deposit and retrieve the data from database
LO5: After completion of the course students will easily perform Pairwise/multiple sequence alignment for unknown sequences using

Sequence similarity searching tools

LO6: After completion of the course students will able to construct phylogenetic tree

LO7: Students will acquire knowledge on separation of proteins

BIOSTATISTICS (A)

Data analysis - Calculating Mean, median, mode, variance, standard deviation, standard error for a given data set.
Student's 't' test and Analysis of variance (ANOVA).
Chi square test - goodness of fit.
Calculation of correlation coefficient, Regression analysis.
Learning to analyse data using SPSS software.

BIOINFORMATICS (B)

Search of databases:
Using DNA sequence, identifying the protein through database
Using amino acid sequence of a protein, identifying the gene through database
Alignment of DNA and protein sequence using BLAST, FASTA
Multiple sequence alignment (MSA) of proteins and nucleic acids
Phylogenetic tree construction using CLUSTAL tools
Demonstration of 2D electrophoresis

Reference books:

1. Bioinformatics sequence, structure and data banks - By Des Higgins Willie Taylor. Practical approach
2. Bioinformatics sequence, structure and data banks - Des Higgins, Willie Taylor –2000
3. Fundamentals of Biostatistics: Practical Approach – Naren Kr Dutta
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey).