GU-ART Syllabus for Post Graduate Diploma in Medical Laboratory Techniques

I. BIOCHEMISTRY

1. Overview of Metabolism

Metabolism, Stages of catabolism, Sub divisions of Metabolism, Catabolism vs. Anabolism, regulation of Metabolic pathways, Shuttle systems and membrane transporters

2. Bioenergetics

Concept of Energy, Laws of Thermodynamics, Free energy, ATP as "energy currency" of the cell.

3. Carbohydrate Metabolism

Sequence of Reactions and Regulation of Glycolysis, Pentose phosphate pathway, Oxidative decarboxylation, Citric acid cycle, Gluconeogenesis, Glycogenolysis and Glycogenesis., Mitochondrial respiratory Chain

4. Oxidative Phosphorylation

Mechanism of oxidative phosphorylation - Chemical coupling Hypothesis, Conformational coupling Hypothesis, Chemiosmotic Coupling Hypothesis.Inhibitors and Uncouplers of Electronic Transport system.

5. Amino acid metabolism

Catabolism of amino acids: Transamination, Deamination, Urea Cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids,inborn errors of Amino acid catabolism (Albinism, Alkaptonuria, Phenylketonuria)

6. Lipid Metabolism

Beta-oxidation of fatty acids – a. Palmitic acid {saturated (C 16:0) b. Linoleic acid {unsaturated (C 18:2) Alpha and Omega oxidation of fatty acids, ketogenesis- Ketogenic and Antiketogenic substances, Regulation of ketogenesis

II. GENETICS

1. Mendelian Genetics & its Extension

Overview of Mendelian Genetics Epistasis and Hypostasis, Multiple genes and multiple alleles, Sex linked, sex limited and sex influenced inheritance (with one example each)

2. Chromosome Structure

Eukaryotic Chromosome, Types of Eukaryotic Chromosome (based on centromere position), Eukaryotic and prokaryotic chromosomal organisation, Giant chromosomes (polytene and lampbrush)

3. Gene Mutation

Natural and Induced Mutations, Types of gene mutation (base pair substitution and frame shift) Types of chromosomal aberration, Causative agents of Mutation.

4. Inbreeding and Heterosis

Definition of Inbreeding, Inbreeding depression, Practical applications of Inbreeding. Heterosis – Genetic basis; Application and Evolutionary significance.

5. Inheritance of Human traits

Human karyotype, Pedigree analysis Inheritance of human traits: Brown eyes, Polydactyly, Diabetes insipidus, Sickle cell anemia, PKU Eugenics and Genetic counseling

III. MOLECULAR BIOLOGY

1. DNA structure and replication

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

2. DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair:Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

3. Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

4. Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyltRNAsynthetases, Mechanism of initiation, elongation and termination of polypeptide

IV. ENDOCRINOLOGY

1. Introduction

Endocrinology, Endocrine glands. Concept of homeostasis - Glucose and Calcium Homeostasis.

2. Endocrine Hypothalamus

Hypothalamohypophyseal portal system, Hypothalamohypophysealneurosecretary tracts, Hypothalamic nuclei, - Magnocellular and Parvicellular elements. Hypothalamic releasing and inhibitory hormones/factors.

3. Hormones

Chemical messengers, type of chemical messengers. Hormones, types of hormones (proteins and steroids).Hormonal regulation of secretion – Feedback system- long loop, short loop, positive and negative feedback.

4. Hypophysis

Gross anatomy, blood supply, histology of Adenohypophysis- identification of cell types based on staining affinities. Division and nomenclature of hypophysis. Hormones of Adenohypophysis, their functions and effect on target organs, Disorders of growth hormones.Neurohypophysis – Hormones of the neurohypophysis, Biological effects of Oxytocin and Vasopressin, Diabetes insipidus.

5. Thyroid

Structure, blood supply and nerves.Structure of thyroid follicles, principal cells and parafollicular cells. Biochemistry of Thyroid Hormones, Factors affecting thyroid functions. Clinical aspects of thyroid functions (Cretinism, Myxoedema, and Graves‟ disease) Parathyroid – Histology, hormones, Regulation of Blood Calcium level, Parathyroid tetany.

6. Endocrine Pancreas

Histology of Pancreas, Endocrine pancreas- Islets of Langerhans, types of cells (α,β,γ and δ). Effects of Insulin and Glucagon.Regulation of blood glucose level – Diabetes Mellitus (IDDM and NIDM).

7. Adrenal

Anatomy of adrenal gland, Functional morphology of adrenal cortex, Zones of adrenal cortex - Histology. Adrenal steroid hormones - Glucocorticoids, Mineralo corticoids and Adrenal sex steroids. Regulation of Adrenocortical function. Adrenal medulla – Functional morphology of adrenal medulla, Hormones of medulla, Catacholamines and their roles in metabolism. Adrenocortical disorders – Cushing‟s syndrome and Virilism.

8. Gonads as endocrine structures

Testes – endocrine component of testes (Leydig cells and Sertoli cells). Hormones of testes – Androgens and their biological role. Ovary - Endocrine components of ovary (Follicular wall Theca and Granulosa). Corpus luteum and Interstitial cells. Hormones of ovary and their biological function .Placenta –Placenta and its Hormones.

V. MEDICAL MICROBIOLOGY

1. Normal microflora of the human body and host pathogen interaction

Normal microflora of the human body: Importance of normal microflora; normal microflora of skin, throat, gastrointestinal tract, genito - urinary tract

Host pathogen interaction: Pathogen, Invasion, Infection, Pathogenicity, Virulence, Virulence factors (Pili, fimbriae, flagella, capsule, glycocalyx, adhesins, enzymes, chelators (siderophores), endotoxin, exotoxin)

Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiological effects of LPS.

2. Sample collection, transport and diagnosis

Sample types and collection, transport and culturing from clinical samples.

Principle and methodology of different diagnostic techniques - ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes and Microarray.

3. Bacterial diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with mode of transmission, pathogenesis, symptoms, chemotherapy and prophylaxis:

A. Respiratory Diseases: Pneumonia (Streptococcus pneumoniae), Influenza (Haemophilusinfluenzae), Tuberculosis (Mycobacterium tuberculosis).

B. Gastrointestinal Diseases: Bacterial diarrhea (Escherichia coli), typhoid (Salmonella typhi), Cholera (Vibrio cholerae), bacterial dysentery (Shigella dysenteriae). C. Skin infections- Staphylococcus aureus, Vibrio parahaemolyticus

D. Genito-Urinary Tract Infections: Syphilis (Treponema pallidum), UTI(E. coli and Proteus vulgaris)

4. Viral diseases

List of diseases of various organ systems and their causative agents.

The following diseases in detail with mode of transmission, pathogenesis, symptoms, chemotherapy and prophylaxis. Polio, Hepatitis (A, B, C, D and E), Rabies, Dengue, AIDS.

5. Protozoan diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with mode of transmission, pathogenesis, symptoms, chemotherapy and prophylaxis. Malaria, Amoebic dysentery

6. Fungal diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with mode of transmission, pathogenesis, symptoms, chemotherapy and prophylaxis. Cutaneous mycoses: Athlete’s foot (Tinea pedis) Opportunistic mycoses: Candidiasis (Candida albicans)

VI. HAEMATOLOGY AND CLINICAL BIOCHEMISTRY

1. Haematology

Overview of blood circulatory system of humans, Blood, plasma, serum - definition, Blood components and their functions, Buffering system – role of proteins, carbonate system and other ions in buffering, deviations in pH and their impact, Haematopoiesis-erythropoiesis, leukopoiesis and thrombopoeisis.

Structure and function of erythrocytes, Hemoglobin- structure, function, synthesis, metabolism of iron, abnormal erythrocytes andhaemoglobins, types of Hbs and its derivatives (carboxy Hb andmet Hb, sickle cell Hb).

Structure and function of different types of leucocytes.

Structure and function of thrombocytes.

2. Blood counts

Collection of blood - methods, skin puncture and venipuncture; type and use of Anticoagulants, handling and processing of bloodsamples, disposal of samples.

Determination of hemoglobin- significance, principle and method.

Blood cell counts – RBC count and Total leucocyte count byHaemocytometer, differential leucocyte count, total platelet count , determination of haematocrit –micro haematocrit and macrohaematocrit method, Erythrocyte sedimentation rate (ESR) - Westergren's and Wintrobe's method. Overview of automatedmethods of blood analysis.

3. Hemostasis and coagulation

Mechanism of blood coagulation – intrinsic and extrinsic pathways, routine coagulation tests – bleeding time, clottingtime.

4. Hematological diseases

Anaemia - Introduction and etiological classification, types of anaemias – iron deficiency, aplastic anaemia, megalobastic anaemia, sideroblastic anaemia, pernicious anaemia.

Thalassemia – alpha and beta – underlying causes, clinical 21features, diagnosis and treatment

Leukemia - introduction, types of leukemia - Acute myelogenousleukemia (AML), Chronic lymphocytic leukemia (CLL), Acutelymphoblastic leukemia (ALL)

5. Clinical Biochemistry

Carbohydrate metabolism: Clinical aspects of Regulation of Bloodsugar and Diabetes, Diabetic profile test.

Protein metabolism: starvation, and protein energy malnutrition, blood urea.

Lipid metabolism: Clinical aspects of lipid profile- HDL, LDL, VLDL, cholesterol, triglycerides. Atherosclerosis.