

DIPLOMA IN MEDICAL LAB. TECHNOLOGY – DMLT12

Eligibility	:	Senior Secondary Level Examination
Program Duration	:	2 Years
Program Objectives	:	Medical Laboratory Technology, also known as Clinical laboratory science, is an allied health/paramedical profession, which is concerned with the diagnosis, treatment and prevention of disease through the use of clinical laboratory tests. Doctors rely on laboratory technologies to detect, diagnose and treat diseases. The programme covers the basics of preclinical subjects such as Biochemistry, Pathology, Microbiology and Blood Banking. Medical Laboratory Technologists (MLT) do these tests by analyzing body fluids, tissues, blood typing, microorganism screening, chemical analyses, Cell counts of human body etc.
Job Prospects	:	<p>After the completion of DMLT, you will find a challenging career in a hospital, minor emergency centers, private laboratory, blood donor centers, doctor's office or clinics. A technician can become a technologist through further education and work experience.</p> <p>Common job profiles of students after completing DMLT include: Technician in Blood Banks, Hospitals, Nursing Homes and Diagnostic Labs</p>

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ANT12203	Human Anatomy and Physiology - I	70	30	4
MBL12202	Medical Microbiology	70	30	4
BCH12202	Biochemistry	70	30	4
PAT12201	Pathology and Hematology	70	30	3
HHM12201	General Principles of Hospital Practice and Patient Care	70	30	3
ANT12203P	Human Anatomy and Physiology – I (P)	35	15	3
MBL12202P	Medical Microbiology (P)	35	15	3
BCH12202P	Biochemistry (P)	35	15	3
PAT12201P	Pathology and Hematology (P)	35	15	3
Total		700		30

YEAR II

Course Code	Course Title	Theory/Prac tical	Continuous Assessment (Internals)	Credits
ANT12302	Human Anatomy and Physiology - II	70	30	4
MBL12302	Systemic Microbiology	70	30	4
BCH12302	Clinical Biochemistry	70	30	4
PAT12302	Clinical Pathology, Histopathology and Blood Banking	70	30	4
MLT12301	Advanced Techniques and Future Trends in Laboratory Science	70	30	4
ANT12302P	Human Anatomy and Physiology – II (P)	35	15	2
MBL12302P	Systemic Microbiology (P)	35	15	2
BCH12302P	Clinical Biochemistry (P)	35	15	2
PAT12302P	Clinical Pathology, Histopathology and Blood Banking (P)	35	15	2
TRN12301	Hospital Training	100		2
Total		800		30

DETAILED SYLLABUS

INSTRUCTIONAL METHOD: Personal contact program Lectures (virtual and in-person), Assignments, Labs and Discussions, Learning projects, Industrial Training Program and Dissertation.

YEAR I

HUMAN ANATOMY AND PHYSIOLOGY –I – ANT12203

UNIT	CONTENT
1	General Anatomy: Organization of Organisms; Cell-Structure and Function; Tissue - Classification and Function; Human Anatomy - Introduction; Subdivisions of anatomy; Anatomical nomenclature - Terms of position, location and fundamental planes, Clinical terms; General Histology - Definition and meaning; Slide preparation – Fixing, Chemical fixation with formaldehyde or other chemicals; Processing - Dehydration, clearing, and infiltration; Embedding; Sectioning; Staining; Common laboratory stains.
2	Skin and Connective Tissue: Skin - Definition of Skin; Layers of skin; Types of skin; Functions; Dermatome; Connective tissue - Definition; Brief discussion on Types: Connective tissue proper (general and Specific), General Definition - Bone, Cartilage and Blood, Embryonic connective tissue - a) Mesenchyme & b) Mucous or mucoid.
3	The Skeletal System: Brief discussion over skeletal system; Classification of skeleton- axial and Appendicular; brief discussion over bone structure, bone cells, bone marrow, bone growth, ossification, parts of a long bone; Major components of skeleton system: a) Bone- definition, synonym, Composition, Special features & Function, Classification, features of a long bone, Bone marrow; b) Cartilage-definition; Components and classification - Overview of Osteology of bones of: i) Upper limb - Clavicle, Scapula, Humerus, Radius & Ulna and carpals; ii) Lower limb - Femur, Patella, Tibia & Fibula and tarsals; iii) Thorax (sternum & ribs); iv) Abdomen-Pelvis; v) Skull bones- Cranial bones (Frontal, Parietal, Temporal, Occipital); Facial bones- (Maxilla and Mandible) - their position, orientation, side determination & ligaments attached – Joints - Definition of Joints, Functions, Classification of Joints based on – Structure and Function.
4	The Muscular System: Brief introduction of muscular system; muscle tissue types; General review of skeletal muscles - Brief knowledge of Appendicular muscles & Axial muscles.
5	The Circulatory System: Brief discussion about basics of circulatory system; The Heart - General features of Heart, Shape and Size of Heart, Position of heart, General overview on mediastinum and relations of heart, Pericardium, Layers of heart - epicardium, myocardium and endocardium, Cardiac muscles, Chambers of heart and associated blood vessels, Valves of heart, Blood supply of Heart, vessels related to heart, Conduction system of heart, Functions of heart; Lymphatic system - Introduction to lymphatic system, brief overview of lymph nodes & lymphatic organs.
6	The Respiratory System: General discussion of respiratory system - Cellular respiration, Brief knowledge of classification of respiratory system; upper conducting part & lower respiratory part; Brief discussion over anatomy of – Larynx, trachea and bronchial tree; Lungs - Anatomical position, relations, lobes, fissures, broncho-pulmonary segments, Pleura - Layers of pleura and Pleural cavities; Microscopic anatomy of Trachea & Lungs.
7	General Physiology: Introduction to Physiology –Meaning, Homeostasis, Cell, Body fluid, Transport through cell membrane - Passive Processes; The Principle of Diffusion; Simple diffusion; Facilitated diffusion Osmosis; Active Processes - Active Transport; Transport in Vesicles; The Primary Tissue; Organs and systems.

8	Blood: Red blood cells – Erythropoiesis, stages, differentiation, Functions, Blood cells count, variations; Hemoglobin – Structure, function, concentration, physiological variation, Methods of estimation of Hb; White blood cell – Production, function, life span, count, differential count; Platelets – Origin, normal count, morphology, functions, Coagulation, Coagulants & anti-coagulants; Blood groups - A, B, O system, Blood grouping and typing, Cross-matching, Rh system, Rh factor, Rh in cross matching; Blood transfusion – indication, universal donor and recipient concept; Selection criteria of blood donor; Disorders of white blood cells, Platelets and Clotting.
9	Gastrointestinal System: Physiological anatomy of GIT; Digestion of food in the mouth (mastication), stomach, and intestine; Absorption of nutrients from digested food; Role of bile in the digestive process.
10	Respiratory System: Respiratory system physiology; Introduction; measurements of respiratory rates and volumes; gas laws; gas exchange; oxygen and carbon dioxide transport in the blood.
11	Nerve muscle Physiology: Resting membrane potential; Action Potential - Physiology of nerves and neuromuscular junction, Neuro muscular transmission; Overview of muscular system - Muscle Physiology, Muscle fiber, Muscle contraction, the sliding filament model of muscle contraction; Involuntary muscles - Cardiac and smooth muscles.
12	Cardiovascular and Lymphatic System: Introduction; Cardiac muscle; the cardiac conducting system; The electrocardiogram - ECG and applied physiology; Cardiac output; Blood pressure - Control, fluid volume and blood pressure; Coronary circulation and applied physiology; Introduction to the lymphatic system - lymph, lymphatic circulation, and functions of lymph.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Tortora, G & Anagnostakos, N. (1990) Principles of Anatomy and Physiology. 6th ed. USA; Harper Collins Publishers.
- B. Beashel, P. & Taylor, J. (1997) The World of Sport Examined. UK: Thomas Nelson & Sons Ltd.
- C. Guyton, Arthur and Hall, John (2000). Guyton Textbook of Medical Physiology (10 Ed.). ISBN 052165655X.

WEB LINKS:

- A. <http://www.doestoc.com/docs/76871349/Histology-lectures-notes-Part-2>.
- B. <http://www.biologicalelectronmicroscopy.com/fixation.html>
- C. <http://www.oandp.com/news/jmcorner/library/uclamanual/UCLA-01.pdf>.

HUMAN ANATOMY AND PHYSIOLOGY –I (P) – ANT12203P

1. Histology
 - a) Histotechniques
 - b) Microscope
 - c) Histology of Skeletal muscle
 - d) Histology of Cardiac muscle
 - e) Histology of Smooth muscle
 - f) Histology of Bone

- g) Histology of Hyaline cartilage
 - h) Histology of Elastic cartilage
 - i) Histology of Fibrocartilage
 - j) Histology of artery
 - k) Histology of Vein
 - l) Histology of Lung
 - m) Histology of Trachea
2. Osteology
 - a) Appendicular skeleton
 - b) Axial skeleton
 3. Specimen
 - a) Heart
 - b) Lungs
 - c) Larynx
 - d) Skin
 4. Study and care of microscope.
 5. Collection of blood samples.
 6. Hemocytometer.
 7. Determination of Erythrocyte Sedimentation Rate (ESR) and Packed Cell Volume (PCV).
 8. Estimation of Hemoglobin concentration.
 9. Total RBC count.
 10. Determination of red blood cell indices.
 11. Total Leukocyte count.
 12. Preparation and examination of blood smear & Differential Leukocyte Count (DLC).

MEDICAL MICROBIOLOGY – MBL12202

UNIT	CONTENT
1	Introduction and Brief History of Microbiology: General Introduction & terms used in Microbiology; Classification, morphology and physiology of bacteria; Historical aspect and Branches of Microbiology; Prokaryotic organisms- Prokaryote Vs Eukaryote- cell wall, structures external to cell wall, structures internal to cell wall; Eukaryotic organisms- structure of eukaryotes, characteristics of eukaryotes.
2	Growth, Nutrition & Multiplication of Bacteria : Classification of bacteria on the basis of Nutrition; Structure & definition of a bacterial cell wall; Growth requirements of microorganism- Chemical requirements, Physical requirements; Bacterial classification based on shapes; Bacterial classification based on staining methods; Classification based on Oxygen requirement (Aerobic & Anaerobic bacteria); Autotrophic & Heterotrophic bacteria; Bacterial Classification based on environment; Growth & Multiplication of bacteria, Bacterial growth

	curve, Bacterial cell division, Generation time; Environmental factors affecting growth- Oxygen requirements, pH, Temperature, Carbon dioxide, Osmotic pressure.
3	Microscopy: Introduction to microscopy; Purpose of microscopy; Definition of Microscope; Principles, importance & parts of Microscope; Types of Microscope.
4	Sterilization and Disinfection: Introduction to Sterilization & Disinfection; Definition of Sterilization, Disinfection; Physical & Chemical methods to destroy or reduce microbes; Physical methods- Sunlight, Drying, Heat, Filtration, Radiation; Chemical methods- Use of Alcohols, Aldehydes, Dyes, Halogens, phenols, Gases, Surface-Active agents, Metallic salts.
5	Staining of Bacteria: Definition of Bacterial Staining; Principle & purpose of staining; Types of microbiological stain: Basic stains, Acidic stains, Neutral stains; Types of staining methods: Simple staining method, Differential staining method, Special staining method, Spore staining method, Capsule staining method; Principle & procedure of Gram stain & Ziehl-Neelsen stain; Result interpretation and application of Gram staining & Ziehl-Neelsen staining.
6	Biochemical Identification of Bacteria: Brief introduction to biochemical test to identify bacteria; Principle, procedure, result interpretation and application of Catalase, Oxidase, Coagulase, Indole, Citrate, Urease, Triple sugar iron.
7	Bacterial Culture Media & Culture Methods: Introduction and definition of culture media; Common ingredients of culture media; A brief note on agar; Importance of culture media; Types of culture media (solid, liquid, simple, complex, defined & semi-defined media); Types of special media. Culture Methods: Introduction to bacterial culture; Purpose of bacterial culture; Methods to isolate the bacteria- Streak culture, Stroke culture, Stab culture, Pour plate culture, Liquid culture; Special methods of Anaerobic culture-McIntosh-Fildes anaerobic jar, Gaspac, Anaerobic chamber.
8	Antibiotic Sensitivity Test: Introduction & use of antibiotic sensitivity test; Role of antibiotic sensitivity test; Components of antibiotic sensitivity test; Types of antibiotic sensitivity test (Diffusion and Dilution method of antibiotic susceptibility testing).
9	Introduction to Medical Parasitology: Brief introduction into concepts & terminology of parasitology (Symbiosis, Commensalism, Mutualism, Parasitism); Definition of Parasite & type of parasites; Host & common type of host; Lifecycle & types of life cycle; Relationship between parasite & host; The basic factors of transmission of parasitic diseases; The preventive measures of parasitic diseases.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Ryan K.J and Ray C.G. SHerris, "Medical Microbiology", 4th ed. McGraw Hill.
- B. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Microbiology: An Introduction, Eight Edition, Hardcover: 944 pages, Publisher: Benjamin Cummings.
- C. Prescott, Harley and Klein's Microbiology 7th Ed. Author: Joanne M Wiley, Christopher J Woolverton, Linda M Sherwood.

WEB LINKS:

- A. <http://www.microbeworld.org/history-of-microbiology>
- B. <http://www.britannica.com/EBchecked/topic/48203/bacteria/39334/Diversity-of-structure-of-bacteria>.
- C. <http://www.textbookofbacteriology.net/themicrobialworld/control.html>.

MEDICAL MICROBIOLOGY (P) – MBL12202P

1. The microscope.
2. Sterilization.
3. Illustration of Staining Techniques.
4. Identification of organism by biochemical reactions.
5. Solid and liquid culture media.

BIOCHEMISTRY – BCH12202

UNIT	CONTENT
1	Introduction to Biochemistry: Biophysical aspects of biochemistry; General introduction and role of biochemist, ethics, responsibility, safety measures and first aid; Cleaning and care of general laboratory glassware and equipment; Distilled water-types of distilled water plants, preparation & storage.
2	Carbohydrates, Proteins & Lipids: Carbohydrates - Chemical structure, function, classification, monosaccharides, disaccharides-polysaccharides, homopolysaccharides, heteropolysaccharides, glycoproteins; Proteins - Amino acids, classification, structure of protein, determination of protein structure, properties of proteins, denaturation, classification of proteins, antigen, antibody types of plasma proteins, blood clotting; Lipids - Chemical structure, functions, classification-fatty acids, triacylglycerols, phospholipids, glycoproteins, lipoproteins, steroids, amphipathic lipids.
3	Vitamins, Minerals & Nucleic Acids: Fat soluble vitamins (A, D, E, and K); Water soluble vitamins; B-complex vitamins - principal elements (Calcium, phosphorus, magnesium, potassium, chlorine and sulphur), trace elements; Nucleic acid - Definition of DNA, structure of DNA, Watson & Crick model of DNA, Types of RNA; Calorific value of foods - basal metabolic rate (BMR), respiratory quotient (RQ) specific dynamic action (SDA); Balanced diet Marasmus and Kwashiorkor
4	Enzymes & Co-enzyme: Enzyme definition – nomenclature, classification; Factors affecting enzyme activity- active site, co-enzyme, mechanism of enzyme action, enzyme pattern in diseases.
5	Hormones: Classification; Mechanism of action; Role of biologically important hormones; Pituitary; Anterior; Posterior; Thyroid; Adrenal cortex, Adrenal medulla; GI hormones; Gonadal hormones.
6	Acids & Bases: Definition - pH, Buffers, Indicators, Normality, Molarity, Molality; Renal control of acid base balances; Respiratory acidosis, alkalosis and metabolic acidosis, alkalosis.
7	Analytical Balance & Standard Solutions: Introduction to analytical chemistry; Definition and principle of analytical balance; Working and maintenance; Preparation of reagents; formulation and preparation; vented balanced safety enclosure; various standard solutions used their preparation; storage of chemicals; quality control.
8	Clinical Biochemistry: Collection and recording of biochemical specimen; separation of serum/plasma preservation and disposal of biological material; Chemical examination of urine- Qualitative, sugar, protein, bile salt, bile pigment, ketone bodies; Chemical examination of stool - occult blood; Chemical examination of other body fluids; CSF, Plural fluid, ascitic fluid; Laboratory management and maintenance of records.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Guidelines for Good Clinical Laboratory Practices (GCLP) Indian Council of Medical Research, New Delhi.
- B. Voet&Voet: Text Book of Biochemistry: Wiley 3rd Ed.
- C. Lehninger, Principles of Biochemistry: Nelson and Cox 4th Ed.

WEB LINKS:

- A. http://www.aceglass.com/dpro/kb_article.php?ref=8386-IPSF-3037.
- B. <http://www.ilo.org/legacy/english/protection/safework/ghs/ghsfinal/ghsc10.pdf>.
- C. <http://www.phy.bris.ac.uk/chemical/cleaning%20glassware.pdf>

BIOCHEMISTRY (P) – BCH12202P

1. Collection of blood.
2. Separation of serum from blood.
3. Separation of plasma from blood.
4. Demonstration of Vacutainers.
5. Qualitative determination of glucose in urine.
6. Qualitative determination of albumin in urine.
7. Determination of bile salt in urine.
8. Determination of bile pigment in urine.
9. Determination of ketone bodies in urine.
10. Examination of stool - occult blood.
11. Preparation of 2/3N Sulfuric acid.
12. Preparation of Normal Saline (Quantity 1 Lt).

PATHOLOGY AND HEMATOLOGY – PAT12201

UNIT	CONTENT
1	Introduction to Pathology: Introduction to general pathology - the cell in health and disease; Inflammation- acute and chronic, derangement of body fluids and electrolytes- types of shocks, Ischaemia, Infection, Infectious diseases, Disease of infancy and childhood, Neoplasia- Etiology and Pathogenesis; Different branches of Pathology.
2	Cell in Health & Disease: Cellular structure & metabolism, cell injury- etiology, pathogenesis & morphology; cell death, types autolysis, necrosis, apoptosis & gangrene; cellular adaptation, atrophy, hypertrophy, hyperplasia, dysplasia.
3	Inflammation & Healing: Definition, types, acute inflammation- vascular event, cellular event, inflammatory cells; Chronic inflammation- general features; Healing, Regeneration, repair, wound healing.

4	Derangement of Homeostasis & Haemodynamic Disorders: Brief discussion over oedema, dehydration, overhydration, hyperemia, congestion, haemorrhage, shock, circulatory disturbances, thrombosis, disturbance of electrolyte, ischaemia & infarction.
5	Neoplasia & Genetic Diseases: Classification of tumours, etiology & pathogenesis; Brief introduction & classification of genetic diseases.
6	Haematology: Introduction to haematology, blood, components, formation & function of blood, classification of anaemia- morphology & etiology; Leukemia- introduction & classification, hemophilia, thalassemia.
7	Maintenance of Equipments in the Hematology Laboratory: Introduction to microscope- parts of microscope, principle, working & maintenance of centrifuge, automated cell counter, urine analyzer, coagulometer.
8	Collection of Blood Samples: Specimen collection; methods- venipuncture, cleansing the venipuncture site; sample collection- collect, receive and conduct preanalytical processing of clinical laboratory specimens.
9	Coagulation Studies: Hemostasis- definition, basic concept & principle, basic steps involve in hemostasis; Coagulation- basic physiology, coagulation factor, mechanism of blood coagulation; Regulators of blood coagulation.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Introduction to General Pathology (Paperback) by Walter Graham Spector.
- B. Macfarlane, Reid, Callander, Illustrated Pathology, Churchill Livingstone, 5th ed., 2000.
- C. William Boyd; Textbook of Pathology, Structure and Function in Disease, Philadelphia, 8th ed. 1987.

WEB LINKS:

- A. www.cumc.columbia.edu/
- B. www.siklucv-ustav-patologie.cz/vyuka/Cell-injury-death.doc.
- C. <http://www2.mozcom.com/~emcdvm/path05.html>.

PATHOLOGY AND HEMATOLOGY (P) – PAT12201P

1. The Microscope.
2. A Peripheral Blood Smears Preparation.
3. Slide Staining with Romanowsky Stain.
4. Performing a Manual Differential and Assessing RBC Morphology.
5. Sickle Cell.
6. Automated Haematology Cell Counters.
7. Special Stains for Classification of Leukemia.

GENERAL PRINCIPLES OF HOSPITAL PRACTICE AND PATIENT CARE – HHM12201

UNIT	CONTENT
1	Hospital Structure and Organization: Overview of hospital structure, hospital procedure, professional qualities; Communication and relational skills –development of appropriate communication skills with patients, verbal and non verbal communication, appearance and behavior; Professional attitude of the technologist to patients and other members of the staff; Records and reports – records relating to patients and departmental statistics; Minimizing waiting time out- patient and follow-up clinics, stock-taking and stock keeping; Administrative policies and disciplinary procedures; Importance of reporting.
2	Care of Patient: Contact with the patient and family members in the respective department; Communication with the patient and family members; Patient transfer technique; Restraint techniques – consideration to be taken for the geriatric, paediatric, trauma, emotionally disturbed, and anaesthetized patients; Specific patient conditions – essentials of care of patients on ventilator, tracheostomy, tubes and catheters, nasogastric tubes, chest tubes, intravenous lines, oxygen & casts; Basics on hygiene and maintenance of hygiene; Essential care of patient with a colostomy, providing bed pans and urinals; Basics of nursing care – measurement of vital signs – sterile dressing.
3	First Aid and Basic Life Support: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. shock; insensibility; asphyxia; convulsion; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; haemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons. Introduction to BLS, indications for BLS, and the process of BLS. Recovery position.
4	Infection Control Practices: Definition – introduction to the types of microorganisms – Bacteria – their nature and appearance – spread of infections – auto-infection or cross infection; asepsis and antisepsis; Infection pathogens; Communicable diseases cross infection and prevention, patient hygiene, personal hygiene, departmental hygiene, handling of infectious patients in the department; Application of asepsis, inflammation and infection process; Hospital acquired infection; Universal precautions and biomedical waste management.
5	Principle of Asepsis: Sterilization – methods of sterilization; use of central sterile supply department of instruments, surgical dressing in common use including filamented swabs, elementary operating theatre procedure, general abdominal preparation, clothing of a patient.
6	Maintenance of Medications in the Department: Storage: classification; labeling and checking, regulations regarding dangerous and other drugs; units of measurements, special drugs, anti-depressive, anti-hypertensive etc.
7	Specialized Investigations: Care of patients - patients care during investigation; GI tract, renal tract, biliary tract, respiratory tract, gynecology, cardiovascular, lymphatic system, CNS.
8	Medico – Legal Issues: Medico – Legal considerations – clinical and ethical responsibilities, ethical law and professional etiquettes applied to members of profession associated with medicine, misconduct and malpractice; Handling female patients, practice in pregnancy – decision making.
9	Nursing, Handling and Care of Patients: Hospital and developmental procedure; Hospital staffing and organization, records and departmental statistics, appoints, stock taking and stock keeping, reception, elementary hygiene.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Francis (2000). Hospital Administration, 3rd Ed. Jaypee, New Delhi.
- B. Malhotra, A.K. (2009). Hospital Management: An Evaluation. Global India Publication, New Delhi.
- C. Dr. Sanjeev K. Singh, Dr. Shakti Kumar Gupta, Col. Dr. Sunil Kant, Hospital Infection Control Guidelines-Principles and Practices, Jaypee Brothers, New Delhi.

WEB LINKS:

- A. <http://smallbusiness.chron.com/organizational-structure-hospitals-3811.html>.
- B. <http://www.healthit.gov/providers-professionals/electronic-medical-records-emr>.
- C. <http://meded.ucsd.edu/clinicalmed/clinic.htm>.



YEAR II

HUMAN ANATOMY AND PHYSIOLOGY - II – ANT12302

UNIT	CONTENT
SECTION A (HUMAN ANATOMY)	
1	The Digestive System: The Digestive system – Overview of digestive system, functions of digestive system; The alimentary canal or GI tract (gastrointestinal tract) - Mouth, Pharynx, Esophagus, Stomach, Small intestine, Large intestine & Rectum and Anus; Accessory digestive organs – Tongue, Teeth, Salivary glands, Liver, Gallbladder, and Pancreas; Histology - Esophagus, Liver, and Pancreas.
2	The Uro-Genital System: Kidney - Nephron, histology of kidney; Ureters; Urinary bladder, urethra; The Genital System – brief discussion and anatomy; Male reproductive system – primary reproductive organs, secondary or accessory reproductive organs; Female reproductive system – primary reproductive organs, secondary or accessory reproductive organs; Histology – Testis, and Ovary.
3	The Nervous System: Broad classification of nervous system; neurons and glial cells; central nervous system – brain, spinal cord; Peripheral nervous system – cranial nerves, spinal nerves; Histology – spinal cord, and cerebrum.
4	The Endocrine System: Anatomy of pituitary gland – hormones of the pituitary gland; Anatomy of thyroid – Hormones of thyroid; Parathyroid gland – parathyroid hormone; Adrenal gland – hormones of the adrenal glands.
5	The Special Senses: Overview of special senses; chemical senses – olfaction, taste; physical senses – vision, ear; Anatomical overview of sense organs – eye, ear, nose, and tongue.
6	Radiological Anatomy: Properties of X-rays; Radiographic views and procedures – Fluoroscopy, CT scanning, Ultrasound, and MRI (Magnetic Resonance Imaging); X-rays of skeleton; Drugs used in radiology; Radiographic Examination - Alimentary tract, kidney and gall bladder.
SECTION B (PHYSIOLOGY)	
7	Excretory System: Body fluid compartments - Intracellular fluids, Extracellular fluids, interstitial fluid and edema; Urine formation by the kidney - Renal blood flow, Tubular processing; Diuretics and kidney diseases; Micturition – Cystometrogram; Excretory functions of skin.
8	Fluids, Electrolytes and Acid-base Balance: Regulation of ECF osmolarity and sodium concentration; Renal regulation of ECF and blood volume; Renal regulation of potassium, calcium, phosphate, and magnesium – Regulation of potassium balance, Regulation of calcium balance, regulation of phosphate, regulation of magnesium; Acid base balance – Proximal tubular mechanism, and distal tubular mechanism.
9	Endocrine System: Endocrine glands and their mechanism of hormonal function; The hypothalamus; Pituitary gland; Adrenal glands; Thyroid gland; Parathyroid gland; Pancreas; Testis and Ovary.
10	Reproductive System: Physiology of male reproductive system – Seminal fluid, spermatogenesis; Physiology of female reproductive system; Oogenesis; The ovarian cycle and the menstrual cycle; Gestation – Pregnancy tests and contraceptives; Lactation – composition of milk, advantages of breast feeding.
11	Nervous System: Functional anatomy of nervous system - neurons, neuroglia, nerves, and flows of information from neuron to neuron; Cerebrospinal fluid (CSF) – functions of CSF, formation and flow of CSF, significance of CSF analysis; Physiology of spinal cord – Reflexes; Functions of brain; functions of autonomic nervous system.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Graaff, Kent Van de and et al, Schaum's Outline of Human Anatomy and Physiology: Fourth Edition, (2013), McGraw-Hill Education.
- B. Shier David and et al, (2012) Hole's Human Anatomy and Physiology, McGraw Hill Education.
- C. Clark, Robert K., (2005) Anatomy and Physiology: Understanding the Human Body, Jones and Bartlett Publishers.

WEB LINKS:

- A. <http://www.colorado.edu/intphys/iphy3415/histology/>
- B. http://ocw.mit.edu/courses/biological-engineering/20-450-molecular-and-cellular-pathophysiology-be-450-spring2005/lecture-notes/liver_anat.pdf.
- C. <http://www.histol.chuvashia.com/atlas-en/male-010en.htm>.

HUMAN ANATOMY AND PHYSIOLOGY - II (P) – ANT12302P

1. Histology

- a) Histology of Esophagus
- b) Histology of Stomach (Fundus)
- c) Histology of Duodenum
- d) Histology of Ileum
- e) Histology of Appendix
- f) Histology of Pancreas
- g) Histology of Testis
- h) Histology of Ovary
- i) Histology of Cerebrum
- j) Histology of Cerebellum
- k) Histology of Spinal cord
- l) Histology of Kidney
- m) Histology of Thyroid gland
- n) Histology of Cornea

2. Specimen

- a) Stomach
- b) Liver
- c) Pancreas

- d) Tongue
- e) Kidney
- f) Brain
- g) Eye

3. Radiological Anatomy

- a) Chest X-ray
- b) KUB
- c) X-ray of Shoulder joint
- d) X-ray of Knee joint

4. Perimetry (Charting the Field of Vision).

5. Examination of Visual Acuity.

6. Examination of Color Vision.

7. Tuning-Fork Tests of Hearing.

8. Determination of sensation of Taste.

9. Determination of sensation of Smell.

10. EEG.

11. Electroneurodiagnostic Tests.

SYSTEMIC MICROBIOLOGY – MBL12302

UNIT	CONTENT
1	Introduction to Immunology & Immune System: Definition of Immunology - Immune system; Origin of cells of the immune system - Principle function of Immune system; Organs involved in immune system – The primary lymphoid organs, secondary lymphoid organs; Cells involved in immune responses – Hematopoiesis, phagocytic cells and their killing mechanisms; Defence Mechanisms - Innate Immune system and Adaptive Immune system; Nature of antigens & antibody – Antigen vs immunogen, haptens; Structure and functions of Immunoglobulin's; General idea on Hypersensitivity – classification and types of hypersensitivity reaction, immunodeficiency disorders; Autoimmune diseases.
2	Immunity and Immune Response: Introduction; Immunity - immune response; Types of immune response; Types of immunity – Innate immune system: properties and mechanism, non-specific defence mechanism, and adaptive immune system: properties and mechanism; Vaccines – Types of Vaccines; Immunological tolerance.
3	Introduction to Serology: Introduction; Techniques of serology – Principle of serological techniques; Various serological test - WIDAL, VDRL, CRP, RF, ASO, Weil- Felix, Pregnancy rapid card test.
4	General Bacteriology: Introduction; Principles in identifying an unknown organism - Principle; Methods; Elementary knowledge of common pathogens; Technique oriented examination of specimens - pus, urine, stool, sputum, throat swab.
5	Emerging and Re-emerging Infections: Introduction; Emerging and re-emerging infections – The factors contributing to emergence of infectious diseases, Microbes that cause infectious diseases, occurrence of infectious diseases; Host Defenses against infectious diseases – Public

	health measures to prevent infectious diseases, Public health organizations; Emerging and re-emerging infectious diseases – Example of an emerging and non-emerging disease; Factors affecting emergence.
6	Nosocomial Infection: Introduction; Nosocomial infections - Definition; Transmission; Epidemiology – causes of nosocomial infections; Bacteriology surveillance of Nosocomial infections.
7	Systemic Bacteriology: Introduction to systemic bacteriology; Gram positive cocci: Staphylococcus aureus - Streptococcus, Micrococci, Pneumococcus; Neisseria - Corynebacterium, Bacillus, Clostridium; Nonsporing Anaerobes – Enterobacteriaceae; Mycobacterium Tuberculosis; Spirochates -Mycoplasma.
8	Introduction to Virology: Virus – General Properties of virus, Viral structure; Classification of viruses - viral life cycle, host virus interaction; Morphology, pathogenesis, clinical syndromes, lab diagnosis of a few viruses - Poliovirus, Herpes virus; Hepatitis B virus; Human Immunodeficiency virus (HIV); Structure and significance of bacteriophage.
9	Introduction to Mycology: Fungi – Overview of fungal systematic and taxonomy, general properties; Parasitic fungi - Moulds, Yeasts, Dimorphic Mycotic agents; Classification of fungal diseases - Superficial Mycoses, Subcutaneous Mycoses; Systemic Mycoses - Opportunistic Mycoses, Laboratory diagnosis & prevention of fungal diseases.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Really Essential Medical Immunology Arthur Rabson, Iwan. M. Roit, Peter. J. Delves Second Edition.
- B. Immunology at a Glance JML Playfair and B.M. Chain Seventh Edition.
- C. Introduction to Medical Immunology edited by Gabriele Varella Medical University of South Carolina Charleston, South Carolina.

WEB LINKS:

- A. <http://www.uth.tmc.edu/pathology/medic/immunology/Immuno/ImmunoTimeline.pdf>.
- B. <http://en.wikipedia.org/wiki/Lymphaticsystem>.
- C. <https://mlinjawi.kau.edu.sa/Files/0001735/files/18899LECTURE%2018%20Antigen%20and%20immunogen.pdf>.

SYSTEMIC MICROBIOLOGY (P) – MBL12302P

1. Widal Test.
2. VDRL Test.
3. Determination of CRP.
4. RA Test.
5. ASO Test.
6. Pregnancy Rapid Card Test.
7. Rapid Detection of Hepatitis B Surface Antigen (HbsAg).
8. Qualitative Determination of HIV 1/2 Antibody.
9. Examination of Sputum for TB.

CLINICAL BIOCHEMISTRY – BCH12302

UNIT	CONTENT
1	Introduction to Clinical Biochemistry: The scope of biochemistry; Chemical organization of the cell; Organic and inorganic components of the cell; Marker enzymes of the cell; Hydrogen ion concentration and buffers: pH, blood buffers, regulation of blood pH; Acid base metabolism; Carbohydrates - Dietary Sources, digestion, absorption, basic metabolism, regulation of blood glucose & its importance, glucosetolerance test, glucocylatedHb, other parameters and related disorders.
2	The Biochemistry of Disease: Review of clinical aspects of carbohydrates; Lipids; Proteins and Amino acids metabolism; Enzymes integration of metabolism; Genetic metabolism; Diabetes and other carbohydrate disorder- diabetes mellitus, glucose challenge test and other diagnostics test; Tests of diabetes control and disease progression; Hypertension & Microalbuminuria, GlycalatedHaemoglobin; Hypoglycemia; Glycogen Storage Disorders; Fructosuria; Galactosemia; Additional Testing to Aid Interpretation of Carbohydrate disorders.
3	Assessment of Renal Functions: Basic renal functions - Creatinine metabolism, Glomerular nephritis, Nephrotic syndrome; Types & aspects of renal failure; Calculation of fractional excretion of sodium; Renal control of acid- base balance; The role of electrolytes, sodium, potassium, chloride, bicarbonate; Renal tubular acidosis; Electrolyte analysis - Calculation of anion gap, use of anion gap, electrolyte critical values, abnormal sodium levels, abnormal potassium levels; Renal impact on water and electrolytes; Physiology hormonal and renal control of electrolytes and minerals; Kidney stones.
4	Assessment of Liver Functions: Tests for liver function; Bilirubin metabolism; Hyperbilirubinemia; Obstructive jaundice; Hepatitis; Neonatal hyperbilirubinemia: Physiological Jaundice of the newborn; Pathophysiology of liver enzymes; Analytical aspects of liver enzymes; Interpretation of alkaline phosphatase results; Liver function of the elderly or pediatric patient; Clinical significance of alkaline phosphatase Laboratory Test Results that correspond with Liver Disorders- Proteins and Amino Acids; Interpretation of Total Serum Protein Levels; Cerebrospinal Fluid Proteins; Interpretation of Serum Albumin Levels; Other Serum Proteins; Nephelometry; Cirrhosis and Hepatitis; Ammonia metabolism; hepatic Encephalopathy.
5	Testing for Thyroid Disorders: Thyroid Function Testing; Enzyme-Multiplied Immunoassay Technique (EMIT); Historical Methods of Thyroid Testing; Hyperthyroidism; Disorders of water balance; Mineral metabolism; Pre-analytical variations in hormone testing.
6	Organ Profiles: Liver function test; Kidney function test; Thyroid function test; Cardiac function test; Pancreas function test; Hypertension profile; Diabetic profile; Gastric function test.
7	Therapeutic Drug Monitoring: Barbiturate Phenobarbital, Phenytoine, lithium, lead, salicylate, mercury, digitalist; Regulation of blood pH, Henderson Hasselbach equation, renal, respiratory and buffer system importance of arterial blood gases.
8	Radioactivity: Radioactivity- types of radioactive decay with examples; Radioactive half-life; Units of radioactivity; Application of radioisotope in clinical chemistry.
9	Detection of Drugs & Toxic Substances: Principles of Chromatography; paper & thin layer Chromatography, their application in detection of drugs & toxic substances.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Allan Graw, Michael J. Murphy, Rajeev Srivastava, Robert A. Cowan, Denis St. J. O'Reilly, Clinical Biochemistry: An Illustrated Colour Text, 2013.

B. Nanda Maheshwari. Clinical Biochemistry 2008.

C. Geoffrey Beckett, Peter Rai, Lecture Notes: Clinical Biochemistry, 2010.

WEB LINKS:

A. http://books.google.co.in/books?id=RjUvZEKTbQYC&printsec=frontcover&dq=clinical+biochemistry&hl=en&sa=X&ei=vFnbU-OFF4_HuASG4IHwAw&ved=0CBoQ6AEwAA#v=onepage&q=clinical%20biochemnistry&f=false.

B. <http://www.nlm.nih.gov/medlineplus/ency/article/003591.htm>.

C. <http://www.foodmatters.tv/articles-1/7-foods-to-naturally-cleanse-your-liver>.

CLINICAL BIOCHEMISTRY (P) – BCH12302P

1. Determination of blood glucose.
2. Glucose tolerance test.
3. Determination of total Protein in blood.
4. Determination of Albumin in blood.
5. Estimation of Urea in urine.
6. Determination of Urea.
7. Estimation of Creatinine in urine.
8. Estimation of Creatinine in blood.
9. Estimation of sodium, potassium & chloride.
10. Determination of bilirubin.
11. Determination of SGOT.
12. Determination SGPT.
13. Determination of Alkaline phosphatase.
14. Determination of Cholesterol.
15. Estimation of LDH Enzyme.

CLINICAL PATHOLOGY, HISTOPATHOLOGY AND BLOOD BANKING – PAT12302

UNIT	CONTENT
1	Clinical Pathology: Reception of patients - Phlebotomy and aftercare of patients; Microscope – different parts of microscope, types of microscope, methods of cleaning & care of microscope; Transportation of different clinical materials to distant laboratories.
2	Examination of Urine: Urine examination – Indication, Collection, Container of urine sample, Transport, Preservation of urine; Physical examination and its significance; Chemical examination and its significance - Microscopic examination and its significance.
3	Examination of Stool: Stool examination -Indication, Collection, Container of stool sample, Transport and Preservation of fecal matter; Physical examination and its significance; Chemical

	examination and its significance - Microscopic examination and its significance.
4	Examination of Sputum: Sputum examination - Indication, Collection, Container of sputum sample, Transport and Preservation of sputum; Physical examination and its significance; Chemical examination and its significance - Microscopic examination and its significance.
5	Semen Analysis: Semen examination –Semen analysis and Indication, Collection, Container of semen sample, Transport of semen, Preservation of semen; Physical examination and its significance; Chemical examination and its significance - Microscopic examination and its significance.
6	Examination of Cerebrospinal Fluid (CSF): Examination of CSF and Other Body Fluids - Indication, Collection, Container of body fluids, Transport of sample, Preservation for CSF; Fluid analysis- Physical examination and its significance; Chemical examination and its significance; Microscopic examination and its significance.
7	Cytological Techniques: Cytological Techniques - Cytopathology, fixation, pap staining, cytological processing of fluids; Fine needle aspiration technology (FNAC) – May-Grunwald-Giemsa staining; Cytochemistry & immunohistochemistry.
8	Histopathology: Mammalian tissues and their histological structure – Epithelial tissues, connective tissues, muscle, and nerves; Human organs and histological structure – Kidney, urinary bladder, heart, lungs, liver, stomach and skin; Receiving of biopsy specimens at laboratory – Fixation of tissues, classification of fixing agents and mechanism of fixation, decalcification; Processing of tissues – Automated tissue processing, manual tissue processing, paraffin embedding, and different techniques for embedding; Frozen section/cryostat - Use of Microtomes, selection and maintenance of knife, technique of section cutting & mounting on slide, Staining of section slide; Preservation of specimens and mounting of museum specimens.
9	Blood Banking: Blood Group (ABO & Rh) – ABO blood group system, Rh blood group system, Blood grouping, reverse grouping; Blood banking – Collection of blood, anticoagulants, cross matching; Screening test for incomplete antibodies – antiglobulin test, Coomb's test; Preparation of different blood components – Requisition of blood, preparation of red cell suspension; Blood transfusion & hazards – Hazards, Detect the time when to discard blood in Blood Bank; Computerized record keeping of Blood Bank.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Guidelines for Good Clinical Laboratory Practices (GCLP) – 2009 – Indian Council of Medical Research.
- B. Carson F, Hladik C. (2009): Histotechnology: A Self-instructional Text. (3rd Ed.)
- C. Daneils G. Human Blood Groups. Blackwell Science Ltd. Oxford (1995).

WEB LINKS:

- A. http://www.dehs.umn.edu/bio_pracprin_std_ship_guide.htm.
- B. http://www.ucdmc.ucdavis.edu/pathology/services/clinical/clinical_pathology/clinical_laboratory/p_hlebotomy.html.
- C. http://histologylab.cnmtl.columbia.edu/histological_techniques/

CLINICAL PATHOLOGY, HISTOPATHOLOGY AND BLOOD BANKING (P) – PAT12302P

1. Microscope.
2. Preparation of buffer solution.
3. Determination of BT, CT, Whole blood clotting time.
4. Determination of ESR.
5. Differential count of white blood cells.
6. Red blood cell count.
7. Measurement of blood pressure.
8. Determination of blood group ABO and RH system.
9. Automated Haematology Cell Counters.

ADVANCED TECHNIQUES AND FUTURE TRENDS IN LABORATORY SCIENCE – MLT12301

UNIT	CONTENT
1	Essentials in Laboratories: Types of laboratory; Laboratory management; Laboratory Safety: First aid and kit, prevention of transmission of pathogens; Role technician; laboratory mathematics; Glassware and Lab ware: Composition of glass, general and volumetric glassware, cleaning, & storage of glassware; Chemicals: Different grade of chemicals, preparation of solution and reagent, Buffer, preparation of buffer, storage of chemicals.
2	Laboratory Instruments: Basic knowledge about the working principles, uses and care of laboratory Instruments; Balance; pH Meter; Centrifuge; Cyclo-mixer; Magnetic stirrers; Spectrophotometer; Microscopes Electron-microscopy:- Transmission & Scanning; Fluorescence microscopy and its modification; Phase contrast microscopy and its modification; Distillation plant; Flame Photometer; Laminar flow; Autoclave.
3	Laboratory Techniques: Electrophoresis; fluorescence spectrophotometer; Densitometry; Chromatography; Blot techniques; Immunological Methods; Radio-isotopic Technique; Automation in Bio-chemistry – wet and dry chemistry, Rapid diagnostic technique: Glucometer, Cholesterol strip.
4	Immuno Techniques: Gel immuno electrophoretic technique; Hospital infection and it's laboratory investigation; Laboratory investigation of immune compromised host and HIV Patient.
5	Body Fluid Analysis: Rapid test in urine analysis – Dip stick / Multi stick; Rapid test of urine culture – Dip slide culture etc.; Rapid test for stool analysis – Occult blood etc.; Rapid test for stool culture – Rota virus etc.; Rapid test for semen analysis – Total count etc.
6	Automation in Haematology: Brief discussion over- Automatic venipuncture and evacuated tubes; Cell counter and coagulometer; Cell separation and cell component; Plasmapheresis.
7	Automatic Tissue Processor: Automatic Stainer and Screener; Flow Cytometry; Immuno Chemistry Technique; Chemiluminescent assay; Rate Nephelometry.
8	Molecular Diagnostic Technique & Tele Pathology: Polymerase Chain Reaction (PCR); Southern Hybridization Analysis; Dot Blot Hybridization Analysis.
9	Computerized Medical Application for Data and Image Acquisition: Brief discussion about Future of laboratory medicine; Top Medical Lab Software Products.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. P.B. Godkar, Text Book of Medial Laboratory Technology, Bhalani Publication.
- B. Billings P.R. and Brown M.P. The future of clinical laboratory genomics. MLO Med. Lab. Obs. 36: 8 – 10, 12 – 17, 2004.
- C. Biosafety Manual for Laboratories WHO, Geneva WHO Publication, Geneva.

WEB LINKS:

- A. <http://www.cityofpalaolto.org/civicax/filebank/documents/3703>.
- B. www.jkirkbrown.com/pdfs/biotechmath.pdf.
- C. <http://chemistry.about.com/od/labtechniques>.

HOSPITAL TRAINING – TRN12301