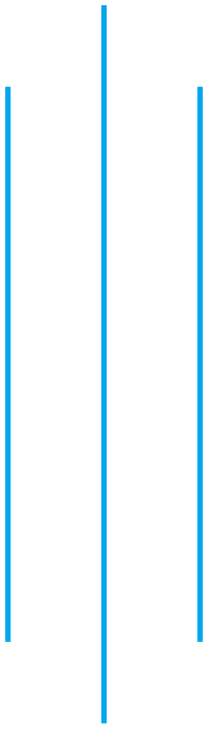
Syllabus For Licensing Examination of B.Sc. Cardiac Technology 2023



Nepal Health Professional Council

Bansbari, Kathmandu

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1. Anatomy & Physiology

Anatomy

1. The human body as a whole

Definition Sub divisions of anatomy Terms of location and positions

Fundamental planes, Vertebrate structure of man Organization of body cells and tissues

2. Locomotion and Support

The Skeletal System Types of bones

Structure and growth of bones Divisions of the skeleton Appendicular skeleton, Axial skeleton Name of all the bones and their parts

Joints: Classification, Types of movements with examples

Muscles: Structure, classification, muscles of abdominal wall, muscles of Respiration, pelvic diaphragm, muscles of head and neck

3. Anatomy of nervous system

Introduction and divisions of nervous system

Central nervous system: Spinal cord, Anatomy, and functions, Reflex arc

The Brain:

Location, gross features, parts, functional areas Hindbrain, Midbrain, fore brain

Coverings of brain and peripheral nervous system anatomy of cerebral blood supply& coverings

Spinal cord –gross features, extent, blood supply and coverings Injuries to spinal cord and brain

Peripheral nervous system – organization& structure of a typical spinal nerve

4. Anatomy of Cardiovascular system

Gross anatomy & Structural features of the Heart and Great vessels: Heart

Location, size, surface features, pericardium & valves Right Atrium: - structural features

Venous area, Septum and atrial appendage

Right Ventricle : - structural features, inflow & Out flow characteristics

Left Atrium-:

- structural features, venous area, Septum and appendage Left ventricle
- structural features, inflow & out flow characteristics Valves
- valve apparatus, location

Structure & functions of each valve

Blood Supply of heart: - coronary arteries, cardiac cycle Innervations: - sympathetic and parasympathetic sensory Pulmonary circuit-names of the arteries and veins & positions

Lymphatic drainage of the Heart

Great Vessels

Structure of blood vessels and its organization Aorta

Pulmonary artery & pulmonary vein General plan of systemic circulation Pulmonary circulation

5. Anatomy of the Respiratory system

Organs of Respiratory System:

Conducting portion, respiratory portion (Nose –nasal cavity, paranasal air sinuses Larynx, trachea, bronchial tree)

Muscles of Respiration

Cross structure and the interior features of nose & nasal cavity Para nasal air sinuses

Cross structure and interior features of the pharynx and larynx

Cross structures and interior features of the trachea and bronchial tree Gross structure, histology, position and coverings of the lungs

Pulmonary circulation – pulmonary arteries pulmonary veins & bronchial arteries Nerve supply to the respiratory system

6. Anatomy of the digestive system

Components of the digestive system Alimentary tube Mouth, tongue, tooth

Salivary gland, liver, biliary apparatus and its secretion, pancreas and pancreatic Secretion, movements of intestine defecation, GI hormones & malabsorption

7. Anatomy of excretory system & Reproductive system

Organization of the renal system

Kidneys: location, gross features, structure, blood supply and nerve supply Excretory ducts, ureters, urinary bladder, urethra location gross features and structure

Male reproductive system:

Testis, Duct system, Prostate

Female Reproductive system:

Ovaries, duct system, accessory organs

8. Anatomy of endocrine system

Name of all endocrine glands and their positions Hormones and their functions

PHYSIOLOGY

1. Introduction to physiology and general physiology

2. Muscle and Nerve

- Neurons and glial cells - Structure, function, Types, electrical property, degeneration and regeneration.
- Muscle- Structure & Functions of skeletal muscle & smooth muscle
- Neuromuscular transmission – Functional anatomy, Transmission & Clinical importance.

3. Haematology

- Fluid compartments, Composition & functions of blood, Plasma protein – names, functions.
- Erythrocyte - Morphology, Count, Function, Erythropoiesis, Factors affecting erythropoiesis, Structure of Haemoglobin, Erythrocyte Sedimentation rate, Anaemia, Polycythemia, Fate of RBC, Jaundice.
- Leucocytes - Morphology, Types, Properties & Functions, variations in count.
- Thrombocytes- Morphology, Count, Function, Variations.
- Hemostasis. Coagulation and its disorders.
- Blood groups and its importance, Blood transfusion.
- Tissue fluid and Lymph
- Immunity.

4. Cardovascular System

- Organisation of CVS, Properties of Cardiac Muscle, Origin and spread of
- cardiac impulse
- Cardiac Cycle – Electrical (ECG)and mechanical events,
- Cardiac output, Measurement, (Fick's Principle) regulation
- Blood pressure, measurement & variation, determinants, regulation, Shock.
- Regional circulation. (Salient features only)-coronary, Pulmonary, Cerebral, Cutaneous

5. Respiratory System

- Introduction. Functional anatomy, Mechanics of ventilation, Pressure changes, volume changes, Surfactant, Compliance, Airway resistance.
- Alveolar ventilation, Dead space, Ventilation perfusion ratio and its
- significance,
- Spirogram

- Diffusion of gases, O_2 transport, CO_2 transport.
- Regulation of respiration – Voluntary, Neural, Chemical.
- Abnormalities of respiration Hypoxia, Cyanosis, Dyspnea, Asphyxia, High
- altitude,
- Dysbarism.

6. Digestive System

- Functional anatomy of GI tract,
- Secretions - Salivary secretion & its regulation, Gastric secretion and its
- regulation,
- Peptic ulcer, Pancreatic secretion and its regulation, Functions of liver. Bile – storage and functions. Intestinal juice
- Movements - Mastication, Deglutition, Movements of stomach, Small
- intestine, Large intestine. vomiting, Defeacation.
- GI Hormones,
- Digestion & Absorption of carbohydrates, Proteins, Fat & vitamins

7. Excretory system

- Functional anatomy of kidney, Structure and function of kidney and nephron
- Renal blood flow, Glomerular filtration rate, Definition, Measurement and factors
- affecting Tubular functions – Reabsorption, Secretion, Acidification, concentration and abnormalities.
- Micturition – Bladder innervation, Micturition reflex.
- Functions of skin

8. Endocrinology

- Introduction to endocrinology (Different glands, hormones)
- Pituitary gland (Anterior and posterior glands, actions and applied aspects.
- Thyroid gland (Actions and applied aspects)
- Calcium homeostasis (Parathyroid, Vitamin D, Calcitonin, actions and applied aspects
- Pancreas (Endocrine part – insulin, glucagon – actions and applied aspects
- Adrenal cortex and medulla (Actions and applied aspects)

9. Reproductive System

- Male Reproductive System- Different parts, spermatogenesis, hormones
- Female reproductive system – Different parts, Sexual cycles – Menstrual cycles – Ovarian, endometrium
- Lactation, Pregnancy & Contraception

10. Central Nervous System

- Organization of Nervous system.
- Synapse, Properties & Function
- Reflexes, Reflex action, Property, Function.
- Sensory system – Receptor, Ascending sensory pathway (basics only), Thalamus, sensory cortex

- Motor System – Spinal control of Motor activity, Motor areas in Cerebral Cortex,
- Pyramidal & extra pyramidal tracts
- Basal ganglia & Cerebellum.
- Hypothalamus
- Autonomous nervous system
- Cerebro-spinal fluid- formation and functions.

11. Special Senses

- Audition
- Vision

2. Microbiology, Biochemistry, Pathology and Pharmacology

Microbiology

- Introduction to medical microbiology
- Morphology and physiology of bacteria Sterilization and disinfection Normal Microbial flora of the human body
- Infection
- Antibiotics
- Hospital infections and prevention
- Immunity
- Antigen, Antibody, Antigen-antibody reactions
- Immune response
- Hypersensitivity
- Immunoprophylaxis
- Tuberculosis
- Typhoid
- Virus infections
- HIV/AIDS
- Hepatitis viruses
- Medical Mycology
- Medical Parasitology
- Malaria
- Urinary Tract Infections
- Respiratory Tract Infections
- Gastrointestinal Infections
- Sexually Transmitted Disease
- Infections of the nervous system

Biochemistry

- Cell strucure & functions
  - Mitochondria
  - Endoplasmic reticulum, lysosomes
  - Fluid mosaic model for membrane structure
- Digestion and absorption of nutrients
  - Digestion of carbohydrates
  - Fats
  - Enzymes in digestion of proteins
- Enzymes
  - Normal serum range and diagnostic importance of serum AST, ALP, ALT,CK,GGT and amylase.
- Proteins
  - Essential amino acids
  - Plasma proteins
  - Immunoglobulins
- Carbohydrates
  - Diabetes mellitus- symptoms and complications
  - Glucose tolerance test
  - Action of insulin and glucagon on carbohydrate metabolism
- Vitamins
  - Deficiency manifestations of vitamin A, C, D, E, K
  - Vit B complex
- Minerals
  - Factors maintaining serum calcium level and important functions of calcium
  - Importance of trace elements
- Hemoglobin
  - Hemoglobin metabolism
- Liver function tests
  - Jaundice and types of jaundice
  - Enzymes in liver disease
- Renal function tests
  - Serum creatinine
- Specialized laboratory investigation
  Principle and applications of
  - Radioimmunoassay (RIA)
  - Elisa
  - Colorimetry
- Lipids
  - Essential fatty acids (EFA)
  - Poly unsaturated fatty acids (PUFA)
  - Phospholipids
- Metabolism
  - TCA cycle (steps only)

- Maintenance of homeostasis
  - Plasma buffers
  - Renal mechanisms in pH regulation
  - Anion gap
  - Metabolic acidosis,
- Nucleic acid
  - DNA and RNA
  - Purine and pyrimidine bases,
- Cancer
  - Chemical and physical carcinogens
  - Tumor markers.

Pathology

- Introduction to Pathology
  - Histopathology- Methods and techniques
  - Cytology-FNAC, advantages and limitations of cytology
  - Hematology-Sample collection.
  - Immunohistochemistry, Immunofluorescence, Electron microscopy, Flow cytometry
- Cell injury & adaptations
  - Etiology
  - Reversible & - Irreversible cell injury
  - Necrosis & Apoptosis
  - Gangrene - Dry – Wet
  - Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Dysplasia. Fatty change
- Inflammation & Repair
  - What is inflammation
  - Signs of inflammation, Acute and chronic inflammation, Types of inflammation, Giant cells, Macrophages, Ulcer, abscess, Acute inflammation, Systemic effects of acute inflammation
  - Factors affecting healing- Complications of healing
- Hemodynamic Disorders
  - Definition of edema and causes of edema
  - Exudate and transudate

    Shock – Definition and types of shock Thrombosis

    Embolism- Definition and types of emboli, - Pulmonary thromboembolism
- Neoplasia
  - Definition
  - Difference between benign and malignant cells, Nomenclature of tumors
  - Routes of metastasis of tumours,- Staging of tumour,- Etiology of cancers - Diagnosis of cancer, including tumour markers
- CVS
  - Definition of Ischaemia, Infarction, Aneurysm
  - Rheumatic heart disease, Infective endocarditis, Atherosclerosis
  - Myocardial infarction, Hypertension and pericardial effusion

- Respiratory system
  - Tuberculosis, Pleural effusion, Pneumonia, COPD and tumours
- GIT
  - Peptic ulcer, - Carcinoma of oesophagus, Stomach & Colon,
  - Inflammatory bowel disease (UC & Crohns)
- Liver and GB
  - Hepatitis. Cirrhosis, Tumours of liver
  - Cholecystitis and GB calculi
- Renal
  - Glomerulonephritis & Pyelonephritis
  - Renal calculi -Nephrotic syndrome, Renal tumors, Polycystic renal diseases

Pharmacology

- General Pharmacology
- Evaluation of drugs in man, drug prescribing and drug interactions
- Sedatives, hypnotics and pharmacotherapy of insomnia
- Drugs effective in convulsive disorders
- Opioid analgesics
- Analgesic – antipyretics and non-steroidal anti-inflammatory drugs
- Psychopharmacology
- Drug therapy of parksinsonism and other degenerative disorders of the brain
- Local anesthetics
- Adrenergic and adrenergic blocking drugs
- Histamine and anti histamic drugs
- Pharmacotherapy of cough
- Pharmacotherapy of bronchial asthma and rhinitis
- Digitalis and pharmacotherapy of cardiac failure
- Vasodilator drugs and pharmacotherapy of angina pectoris
- Pharmacotherapy of hypertension
- Drugs and blood coagulation
- Drugs effective in iron deficiency and other related anemias
- Diuretics
- Emetics, drug therapy of vomiting, vertigo and diarrhea
- Pharmacotherapy of constipation
- Pharmacotherapy of peptic ulcer
- Sulfonamides, Trimethoprim, cortimoxazole, nitrofurans and quinolones
- Penicillins and antibiotics effective mainly against gram positive organisms
- Amonoglycosides and other antibiotics effective mainly against gram negative organisms
- Antibiotics effective against both gram positive and gram negative organisms
- General principles of chemotherapy of infections
- Chemotherapy of urinary tract infections
- Antiseptics, disinfectants and insecticides
- Thyroid and antithyroid drugs
- Insulin and ant diabetic drugs
- Adrenal cortical steroids

- Vitamins and antitoxidants
- Drugs, pregnancy and the newborn

3. Introduction to Cardiac Care Technology

Cardiac Anatomy and Physiology

Cardiac anatomy

Anatomy of Heart:

- Surface anatomy,
- Gross anatomy, cardiac chambers, septa, valves,
- Pericardium

Arteries, Veins, Lymphatics

- Aorta and branches
- Venous drainage
- Pulmonary vessels and circulation
- Coronary circulation and coronary venous drainage, Conduction System of Heart

Cardiac Physiology:

- Normal Cardiac Cycle
- Pulse
- Heart rate
- Blood pressure
- Cardiac output
- Heart Sounds, Murmurs
- Measurement of Blood Pressure: Technique: Sphygmomanometer
- ECG and Cardiac Cycle
- Physiology of Arrhythmias
- Chambers: Pressures, Wave Forms
- Arterial, Venous Pressures and Wave Forms
- Oxygen Saturations: Physiology of Oxygen Transport
- Blood Gases – Technique and Various parameters
- Various Gas laws
- Flow, pressure and resistance
- Physics of Cardiac Perfusion
- Cardiac Cycle, Circulation, Tissue Perfusion – Unified Concept

Radiation Physics and Application, Medical Electronics

- Two dimensional X-ray technique
- Fluoroscopy
- X-ray tube
- Absorption and scattering
- X-ray spectrum and extra filtering

- Image enhancement
- Flat panel technology
- Room shielding
- Radiation protection in fluoroscopy
- Symptoms of Radiation Toxicity

Cardiac Pathology and Pharmacology

- Coronary artery disease and myocardial infarction
- Rheumatic Fever
- Valvular Heart Disease
  - Mitral stenosis
  - Mitral regurgitation
  - Aortic stenosis
  - Aortic regurgitation
  - Tricuspid valve disease
  - Combined valve diseases
  - Microbiology of Valvular Heart Disease
- Pericardial, Myocardial Diseases including End myocardial Diseases
- Hypertension
- Pulmonary Hypertension
- Congenital Heart Disease:
  - Acyanotic
  - Cyanotic
- Shunts
  - Left to Right Shunts
  - Right to Left Shunts
- Heart Failure
- Invasive Monitoring, CVP, Intra Arterial BP, PA Wedge Pressure, Cardiac Output

Pharmacology

- Modes / routes of Drug Administration (Rationale)
- Intra Venous Fluids: Crystalloids, Colloids
- Common Cardiac Drugs – PART-I: Digoxin, Diuretics, Vasodilators, Nitrates
- Common Cardiac Drugs – PART-II: Beta Blockers, Calcium Blockers, ACE

inhibitor

- Common Cardiac Drugs – PART-III: Antiarrhythmic drugs, Positive inotropic drugs
- Drugs for Cardiac Resuscitation
- Drugs for all Cardiac and Medical Emergencies
- Contrast Media
- Adverse Reactions to Contrast Media
- Heparin, Protamine
- Identification of Anaphyaxis and Immediate Management
- Drug reactions, Drug interaction (Basics)

4. Electrocardiography & Echocardiography technology

Electrocardiography

- Basics and Principle
- Electrode / Lead Placements
- Normal ECG: Wave Form
- Normal ECG: Intervals
- ECG Machines: Functions, Frequency Response, Recording Speed, Sensitivity, Standardization, Stylus Lag (Heat Stylus)
- ECG and Chamber Hypertrophy
- ECG and Arrhythmia
- ECG in Myocardial Infraction, Myocardial Ischemia
- ECG in Miscellaneous Conditions: Metabolic, electrolyte changes
- ECG for Technician: Summary

Exercise ECG

- Equipments / Types of Exercise ECG
- Indication / Contradiction
- Lead Placement – Rationale, Limitation
- Monitoring during Ex. ECG: Clinical / ECG / Parameters
- Exercise ECG Protocol: Indications / Advantage and Disadvantage
- Exercise Physiology
- Exercise ECG:
  - Preparation of Patient / Equipment / Defibrillators, Emergency Drugs
  - Detection of Various Arrhythmais, Ischemia, and Plan of action
- Endpoints: Recognition and Action
  - Post Exercise ECG: Observation, Instructions

Echocardiography

- Principle of Echocardiography
- Transducers
- Anatomical Planes for Viewing in Echocardiography
- Normal M-Mode Echo Study: Anatomy / Function: Measurements
- Normal 2D Echo Study: Anatomy / Function: Measurements.
- Echo for Cardiac Function- systolic and diastolic
- Echo in Heart Disease: Acquired
- Echo in Heart Disease: Congenital
- Contrast Echocardiography: Technique and Indications
- Transesophageal echocardiography
- 3D Echocardiography
- Echo Cardiography: Technician's Role:
- Disposables
  - Archiving
  - Record Keeping
  - Stock-Indents, Stock Maintenance, Stock Verification

Principle of Doppler

- Measurement of Flows and Gradients
  - Assessment of gradients, shunts, valve areas, cardiac output
  - Assessment of valve regurgitations

Utility of Doppler in Assessment of Cardiac Disease

- Tissue Doppler

Stress Echocardiography: Protocols, 2D Echo Views, Analysis Trans -esophageal Echo

- Indication / Contraindication
- Patient Preparation
- Transducer: Maintenance, Sterilization, Handling etc.
- Monitoring
- Emergency Drugs
- Utility

Intra Vascular Ultrasound, Intracoronary Doppler wire

Holter Recording

- Principles of Holter
- Utility and indications
- Analysis of Holter

5. Cardiac Catheterization, Pacing and Electrophysiology

Cardiac Catheterization Part I

- Cardiac Catheterization: Laboratory Setup / Types of Procedures
- Sterile Techniques in Cath Lab / Sterile Areas, Sterile Procedure, sterile
- trolley setting, Scrubbing, gowns and Gloves, scrubbing and draping Patients, handling sterile disposables etc.
- Sterilization and re-use of hardware
- Equipment: Cath-Lab Equipment
  - Defibrillator / Pacemaker / IABP / BOYLE's Apparatus / Suction Ma- chine/ oxygen
  - Infusion Pumps / Programmed Stimulators, Pacing System Analyzers
- Equipment in Cath-Lab
  - Hemodynamic Recorders (Physiological Records)
  - Transducers
  - Recording of Pressure Wave Form:
- Range / Gain / Speed / Systolic / Diastolic And Mean Pressures In Chambers And Vessels
- Hazard Management
  - Radiation Protection
  - Infection Prevention
  - Injury Prevention: Electrical /Mechanical
- Wastes Management
  - Plastics

  - Biological Wastes
  - Glass / Needle / Syringes
  - Metallic Waste
- Technician's Role
  - Patient monitoring
  - Procedure Related: Data collection
  - Acquisition and entry of Data, Procedure Books,
  - Handling of Equipment
- Log Books, Registers etc.
  - Stock of all disposables Eg: Catheters etc.
  - Stores (Disposable Items)
  - Accounting (Used Items)
- Equipment Maintenance
- Cine Angiography: Cine Filming, Cine Film Processing and Cine Film Viewing , cine film library
- Contrast Media

Cardiac Catheterization – Part-II

- Cardiac Catheterization Procedure: Diagnostic Studies
- Cardiac Catheterization Procedure: Therapeutic / Interventional Procedures
- Acquisition of Cath Data: Cardiac Output / Oximetry and Shunts
- Acquisition of Cath Data: Pressures and Wave Forms; Recording Technique, Analysis
- Angiography: Technique / Views / Contrast Media
- Cardiac Catheterization
- Application of Echocardiography
- Hardware: Catheters / Connections / Sheaths / Stopcocks / Wires /
- Angioplasty Catheters
- Complication of Cardiac Catheterization: Recognition and management
- Cardiopulmonary Resuscitation
- Special Procedures:
  - Pericardial Tap
  - Atrial Septostomy
  - Endomyocardial Biopsy
  - Balloon Angioplasty (Valve)
  - Coronary Angioplasty
- Case Study of Simple Cardiac Disease
  - ASD, MS, Tetralogy of Fallot
- Hardware of Cardiac Catheterization And Interventions
- Venous and Arterial Check Flow Sheaths, Manifolds, 3-Way Stock Cocks etc.
- Guide Wires and Dilators
- Puncture Needles (Vascular Access Needles)
- Woven Dacron Catheters: GL, NIH, Lehman, Woven Dacron Electrode
- Catheters
- Flow Directed Catheters (Swan Ganz Type) Balloon Angio Catheters
- Polyurethane Catheters: Pig Tail, Judkins, Coronary, Amplatz Coronary, Brachial

Coronary, Sones Catheters

- Guide Wires: Short, Normal Length, Exchange Length 'J' Tipped Movable Core, Tips, Deflectable Types
- Valvuloplasty Catheters, Atrial Septostomy Catheters
- Coronary Angioplasty: Guide Catheters, Guide Wire, Balloon Dilatation Catheters, Indiflators, Y Connectors
  - Stents: Bare Stents, Mounted Stents, Other Types of Stents

Pacing and Electrophysiology

- Arrhythmias: Brady and Tachy Arrhythmias
- Indication for Temporary / Permanent Pacing Technique: Temporary Pacing
- Permanent Pacing: VVI, AAI Pacing (Single Chamber Pacing)
- Permanent Pacing: DDD, other Modes of Pacing
- Septal defect Closure materials
- Pacemaker Clinic: Management of Pacemaker Patients, programmers
- Intracardiac Electrogram – Technique
- Intracardiac Electrogram – Analysis, Intervals etc.
- Electrophysiological Studies
- Radio Frequency Ablation for Arrhythmia's
- Implantable Cardioverter Defibrillator
- Cardiac Arrest
- Cardio Respirator Resuscitation
- Hypotension / Hypertensive Crisis
- Cardiac tamponade
- Cardiac Trauma
- Anaphylaxis
- Emergency Drugs
- Intra-aortic Balloon Pump
- Records Keeping: Indents, Stocks, Log Books, Procedure Books etc.
- Applications of ECMO (Extracorporeal Membraneous Oxygenation)