Department of Physiology
Sikkim Manipal Institute of Medical Sciences
SYLLABUS FOR PhD INTERENCE EXAMINATION

BLOOD

1. General introduction to blood and circulatory system, function, components, blood as a part of body fluids, functions of individual components of blood in brief, production and life span of cells, defense function of WBC, immune functions, importance of blood clotting, pH of blood, concept of haemostasis.
2. Development of red cells: bone marrow stages, necessary factors, hypoxic regulation.
3. Red cell destruction: bilirubin metabolism, jaundice.
4. Anaemia: brief account of iron metabolism, iron deficiency states, Vitamin $B_{12,}$ folic acid deficiency anaemia.
5. Concept of blood groups, blood transfusion, hazards.
6. Phagocytic function of leucocytes.
7. Immunity, role of lymphocytes.
8. Thrombocytes and haemostasis.
9. Blood coagulation, fibrinolysis, disorders, anti-coagulants.
10. Macrophage system, lymph, lymphatics.
11. Blood volume, principle of determination, regulation (in brief), blood buffers.

NERVE-MUSCLE PHYSIOLOGY

1. OVERVIEW:
   Importance of nervous system in regulation, neurons as building blocks of nervous system, location, central and peripheral nervous system, somatic and autonomic nervous system, 'Reflex' as the simplest example of nervous integration, sensory and motor neurons of a typical (multipolar) neuron on brief.
2. Properties of neurons-excitability, RMP, basis of RMP, action potential generation.
3. Properties of action potential propagation.
4. Velocity of conduction in nerve fibres, properties of nerve trunk, compound action potential.
5. Nerve injury and regeneration of nerve fibres.
6. Muscle Physiology: Muscle as generators of contractile force, types, structural organisation.
7. Contractile filaments of skeletal muscle fibres and role in contraction.
8. Excitation-contraction coupling, energy sources.
9. Types of skeletal muscles fibres, smooth muscle types.
10. Properties of visceral smooth muscles.
11. Nerve muscle transmission, special features (compare with synapse), neuro-muscular blockers

CARDIO-VASCULAR SYSTEM

1. **Introduction and Overview:**
   Importance of circulation, heart as a mechanical pump; design of systemic and pulmonary circulation, pressure, flow, resistance in circulation, types of blood vessels and functions.
2. **Cardiac Properties:**
   Review of histological Features and significance, automatic rhythmicity and basis Pacemaker potential.
3. Sequential conduction of cardiac action potential, role of specialized conducting system.
4. Action potentials of working cardiac muscles, ionic basis, refractory period and significance, E-C coupling in cardiac muscles fibres.
5. Length-tension relationship in cardiac muscle. Frank-Starling law, factors influencing the force of cardiac muscle contraction.
6. Heart as a pump-cardiac cycle, haemodynamic events.
7. Recording of pressure, volume changes during a cycle, heart sounds.
8. Principle of echocardiography, waves, leads uses.
9. Innervation of heart and blood vessels, neural control of cardiac activity and vasomotor tone.
10. Cardiac output, variations, determinants, regulation.
11. Regulation of cardiac output contd., principles of measurement.
12. Biophysical aspects of circulation, Poiseuille's principle velocity of blood, laminar and turbulent flow, circulation time.
13. Arterial blood pressure: variations, determinants, neural control, role of baroreceptors.
14. Long term control of mean arterial pressure, role of kidney.
15. Venous circulation, venous pressure, capillary circulation, local regulation of blood flow ti tissues.
16. Coronary circulation.
17. Cerebral, pulmonary, cutaneous, splanchnic & foetal circulation.
18. Cardio-vascular adjustments during exercise.
19. Pathophysiology of shock and review of cardio-vascular function.

RESPTRATORY SYSTEM

1. Organisation of respiratory system, internal and external respiration, major processes involved, respiratory passage ways and functions, respiratory membrane.
2. Ventilation: relationship between lungs and pleura, concept of intrapleural pressure, mechanism of quiet inspiration and expiration, muscles of respiration and their actions.
3. Lung volumes and capacities, principles of measurement, alveolar ventilation, dead space, pulmonary circulation-salient feature.
4. Lung compliance, elastic behaviour of lungs, role of surfactant.
5. Gaseous exchange.
6. Transport of oxygen and delivery to tissue.
7. Transport of carbon dioxide, Haldane effect.
8. Regulation of respiration: mechanism of automatic breathing, respiratory centres and their role.
9. Feedback regulation of respiration –chemical feedback, respiratory chemoreceptors and their role.
10. Hypoxia, types, causes, features.
11. Hypoxia of high attitude, acclimatization.

DIGESTIVE SYSTEM

1. Introduction and overview, autonomous control of gastro intestinal secretion and motility by enteric nervous system, its location, review of properties of visceral smooth muscles.
2. Salivary secretion and regulation.
3. Deglutition.
4. Gastric secretion: Composition, cellular mechanism of acid secretion, phases of secretion.
5. Regulation of gastric secretion, neural and hormonal.
6. Gastric motility and its regulation.
7. Pancreatic secretion and hormonal regulation, biliary secretion, functions of gall bladder.
8. Intestinal secretions, digestion and absorption of food.
9. Small intestinal movements, regulation, functions of ileo-caecal junction.
10. Large intestinal functions, defaecation

KIDNEY
(INCLUDING SKIN, THRMOREGULATION)

1. Overview of Renal Function

- Highlighting major homeostatic functions of kidney, major processes taking places in Kidney, parts of nephron, histological features relating to function (in brief).

2. **Dynamics of Filtration**

-Glomerular capillaries**, afferent** and efferent arterioles

- Glomerular blood –flow, special features and autoregulation.

-Filtration barrier-its special features, forces involved in filtration, effective filtration Pressure, filtration fraction.

-Filtration rate and autoregulation.

-Determination of GFR, RBF

3. -Tubular Function:

-Reabsorption of substances in PCT: Glucose, sodium, water reabsorption

-Clearance concept, tubular maximum concept and their application

4. Modification of Filtrate along Loop of Distal Nephron:

Counter current system and its important, establishment and maintenance of medullary osmotic gradient.

5. Role of Kidney in Regulation of Plasma Osmolality:

-Role of ADH; concentrating/diluting ability of kidney, diuretics

Na balance by kidney: Role of Aldosterone and ANP

6. **Acid Base Balance by Kidney:**

H+ secretion and acidification mechanism.

7. Micturition: Filling bladder (Cystometrogram)

-Reflex emptying of bladder and voluntary control.

-Initiation, continuation and cessation of act of micturition-Automatic bladder.

8. **Temperature Regulation:**

-Need for regulation, core and shell temperature, heat by body, heat loss mechanisms, rile of skin-(Cutaneous circulation and sweat glands and their regulation) – thermostat-heat regulating central mechanisms, thermos-regulatory reflexes-fever, hyper and hypothermia.

ENDOCRINE PHYSIOLOGY

1. **Introduction:**
   Methods of study,
   Mechanism of hormonal action
   Various mechanisms of regulation of hormonal secretion and action
   Role of hypothalamus
2. **Anterior Pituitary hormones:**
   Function and regulation of secretion of growth hormone, Factors influencing growth
   (Function of other hormone photographs/case history
3. **Posterior pituitary**
   Actions of ADH and oxytocin
   Regulation of ADH and Oxytocin secretion
   Diabetes insipidus
4. **Thyroid**

Histology and steps of synthesis of thyroid hormones-drugs affecting synthesis of hormones. Action and regulation of secretion of thyroid hormones
Thyroid function tests, Disorders

5. **Parathyroid**

Importance of Ca^{2}+PO_4^{2}(Calcium, phosphate Actions of parathormone, 1,25 DHCC & calcitonin, Regulation of secretion of hormones.
Disorders

6. **Adrenal Medulla**
   Actions of adrenaline and noradrenaline
   Regulation of adrenaline, nor-adrenalines secretion
7. **Adrenal Cortex**

Action of cortical hormones, regulation of secretion.
Disorders

8. **Endocrine Pancreas, Cell Types**
   Actions of insulin
   Actions of Glucagon
   Regulation of secretion of hormones
   Glucose homeostasis
   Diabetes mellitus

REPRODUCTION

1. Sexual differentiation.
2. Male reproductive system: Primary and accessory organs of sex, functions of testis, spermatogenesis-different stages, factors influencing, normal sperm count.
3. Endocrine functions of testis: Testicular hormones, actions on reproductive system, others.
4. Control of testicular function, cryptorchidism.
5. Female reproductive system: Primary and Secondary organs of sex, ovarian functions – gametogenesis, development of corpus lutetium, ovulation.
6. Endocrine functions of ovary: Hormones, action on reproductive system and others.
7. Menstrual cycle different changes –ovarian , uterine ,cervical, vaginal .Hormonal control of menstrual cycle – Role of gonado –trophines (FSH and LH), ovarian hormones , Tests for fertility in males (seminal analysis , sperm count)and females (tests of ovulation)

   Principle diagnostic tests for pregnancy
8. Functions of placenta – endocrine, excretory, respiratory.
9. Methods of contraception in males and females (both temporary and permanent) and the physiological basis of their use.

CENTRAL NERVOUS SYSTEM (C.N.S.)

1. Synaptic transmission in central nervous system
2. Functional systems of C.N.S.
3. Sensory Systems of the Brain: Sensation and perception
   a) Coding and processing of sensory information, receptors, types, properties
   b) Sensory Pathways:
      -Anterolateral
      -Dorsolemmiscal
      -Functions and modulation

4. **Motors Systems of the Brain:**
   Reflex and voluntary control of movement
   a) Overview-control of movement
   b) Spinal reflex, muscle receptor, spinal stretch reflex, location, stimuli, central control, role in muscle tone.
   c) Spinal mechanism of motor control.
5. Effects of spinal cord transection-completed and hemisection
6. Posture and Equilibrium: definition, brain stem and spinal mechanism-role of vestibular apparatus and neck reflexes-Decerebrate Rigidity.
7. Control of voluntary movements
   a) Role of cerebral cortex-motor areas, corticospinal tract.
   b) Cerebellum connection functions, disorders.
   c) Basal ganglia-connection, function, disorders.
8. Reticular formation: distribution, function
9. Hypothalamus and limbic system, motivation, emotion, behaviour
10. Autonomic nervous system
11. EEG, sleep, dream
12. Higher function: Pre frontal lobe-speech, conditioned reflex. Learning, and memory
13. Cerebro-spinal fluid, formation, circulation, function, applied physiology
14. Thalamus-connection and functions-Thalamic syndrome

SPECIAL SENSES

VISION:

1. Brief outline of functions of Cornea, Sclera, Choroid and Retina.

Cornea: factors influencing corneal transparency applied aspect, corneal opacity, corneal graft, function of sclera

2. Functions of Iris-Innervation

-Ciliary body
-Choroid
-Aqueous humour: formation, circulation, function.

3. Dioptric mechanism of the eye-physiological optics, “reduced eye’, nodal point, Dioptric power, Definition, calculation mechanism, pathway, refractive errors and their correction.
4. Accommodation: Definition, mechanism, pathway, refractive errors and their correction.
5. Retinal functions: Histology of retina, photoreceptors, types, distribution, duplicity theory of vision.
6. Photo transduction, dark adaptation visual pathway and effects of its lesion at various levels.

HEARING

1. Functional anatomy of the ear.
2. The elementary acoustics, role of external ear and middle ear.
3. The role of cochlea in pitch and intensity discrimination of sound, theories of hearing
4. **Taste:** Location of receptors, taste pathways, abnormalities

5. **Eye:** Visual acuity, colour vision, colour blindness, visual reflexes, field of vision.
6. **Ear**: Auditory pathway and tests for hearing.
7. **Olfaction**: Location of receptors, olfactory pathway, odour types
   Functional importance abnormalities.