

Respiration Module

First Professional Year MBBS

4 Weeks

Themes of the module

1- Chest wall injury- 1 week

2- Cough and Hemoptysis-1 week

3- Breathlessness- 2 weeks

GENERAL LEARNING OUTCOMES

By the end of this module the students will be able to;

- 1- Describe the anatomy and abnormalities of thoracic cage
- 2- Describe the development and gross anatomy of the diaphragm
- 3- Describe the contents of mediastinum and their relations
- 4- Describe the anatomy of pleura and its reflections
- 5- Describe the gross and microscopic structure, development, nerve supply and blood supply of trachea, bronchi and lungs
- 6- Describe the epithelia and connective tissues lining the respiratory passageways.
- 7- Describe pulmonary ventilation

- 8- Discuss the mechanisms of gaseous exchange between alveoli, and blood and blood and tissues
- 9- Elaborate the transport of gases in the blood
- 10- Describe the mechanisms of regulation of respiration
- 11- Define hypoxia, and cyanosis
- 12- Describe the effect of aging on respiratory system
- 13- Describe glycolysis
- 14- Describe the processes of Krebs's cycle
- 15- Describe the mechanisms of biologic oxidation
- 16- Describe the mechanisms of energy production in the body
- 17- Describe the mechanisms of O₂ and CO₂ transport in the blood
- 18- Classify anti-asthmatic and anti-tuberculous drugs
- 19- Describe the types and signs of asphyxia
- 20- Enlist the causes and signs of pneumonias, bronchial asthma, tuberculosis, Acute Respiratory Distress Syndrome (ARDS), and pulmonary edema
- 21- Describe the parameters of Pulmonary Function Tests (PFTs)
- 22- Describe basic statistical terms and its significance
- 23- Understand personality development and personal development plans

Specific learning objectives (theme based)

| Theme-1: Chest wall injuries | | | |
|------------------------------|-------------------------|-------|---|
| Subject | Topic | S. No | Learning objectives |
| Anatomy | Gross anatomy of thorax | 1 | Describe main features of thoracic wall |
| | | 2 | Describe the location and shape of the sternum |
| | | 3 | Describe the parts of the sternum |
| | | 4 | Describe the articulations and muscle attachments |
| | | 5 | Describe the gross features of the thoracic vertebrae a. Vertebral body b. Intervertebral disc c. Laminae d. Pedicles e. Intervertebral foramina f. Processes g. Ligaments |
| | | 6 | Differentiate between typical and atypical ribs. |
| | | 7 | Describe different joints of thorax |
| | | 8 | Discuss Intercostal muscles |

| | | | |
|------------|--------------------------------|----|--|
| | | 9 | Discuss the contents of intercostal spaces |
| | | 10 | Describe the origin of intercostal arteries |
| | | 11 | Describe the origin, course and distribution of intercostal nerves |
| | | 12 | Discuss branches and course of internal thoracic artery |
| | Abnormalities of thoracic wall | 13 | Describe thoracic wall abnormalities and its clinical correlation |
| | Diaphragm | 14 | Describe the origin and insertion of the diaphragm |
| | | 15 | Describe the openings of the diaphragm |
| | | 16 | Describe the nerve supply of diaphragm and its clinical significance |
| | Mediastinum | 17 | Describe the contents of the superior mediastinum |
| | | 18 | Describe the contents of the Anterior & Posterior Mediastinum |
| | | 19 | Describe the relations of different contents in mediastinum |
| | | 20 | Identify various anatomical landmarks on chest X-Rays, CT and MRI |
| Embryology | Development of Diaphragm | 21 | Describe development of diaphragm |
| | | 22 | Describe diaphragmatic hernias and clinical significance |

| | | | |
|------------|-----------------------------|----|--|
| | Development of Ribs | 23 | Describe the development of ribs from costal elements of primitive vertebrae |
| Physiology | Mechanics of Respiration | 24 | Describe the mechanics of respiration |
| | | 25 | Describe the pressures that cause the movements of the air in and out of the lungs |
| | Lung compliance | 26 | Define compliance of the lung and elastic recoil |
| | | 27 | Identify two common clinical conditions in which lung compliance is higher or lower than normal. |
| | Lung volumes and capacities | 28 | Describe changes in the lung volume, alveolar pressure, pleural pressure, and trans-pulmonary pressure during normal breathing |
| | | 29 | Draw a normal pulmonary pressure-volume (compliance) curve (starting from residual volume to total lung capacity and back to residual volume), labeling the inflation and deflation limbs. Explain the cause and significance of the hysteresis in the curves. |
| | | 30 | Draw the pressure-volume (compliance) curves for the lungs, chest wall, and respiratory system on the same set of axes. Show and explain the significance of the resting positions for each of these three structures. |
| Surgery | | 31 | Describe pneumothorax |

| | | | |
|--------------------------------------|-----------------------------------|----|--|
| | | 32 | Define Hydropneumothorax |
| Theme-2: Cough and Hemoptysis | | | |
| Anatomy | Introduction | 33 | Describe the major components of the (upper and lower) respiratory system and describe their functions |
| | Trachea, bronchi and lungs | 34 | Describe trachea and bronchi with relations plus subdivisions |
| | | 35 | Describe the neurovascular supply of trachea and bronchi |
| | | 36 | Describe the surfaces anatomy of trachea and bronchi |
| | | 37 | Describe the lungs with their lobes and fissures, relations with surroundings and surfaces and compare between right and left lungs. |
| | | 38 | Describe Broncho-pulmonary segments and their clinical importance |
| | | 39 | Describe innervations, blood supply and lymphatic drainage of the lungs. |
| Embryology | Development of Respiratory system | 40 | Describe development of trachea, bronchial tree, pleura, lungs |
| | | 41 | Recognize the cephalo-caudal and transverse folding of embryonic disc |
| | | 42 | Describe the extent of intra embryonic coelom after folding and its divisions into three serous cavities |

| | | | |
|--------------|---|----|---|
| | | 43 | State the derivatives of visceral and parietal layers of mesoderm |
| | | 44 | State the pericardio-peritoneal canals and their final fate |
| | | 45 | Discuss the formation of Lung Bud |
| Histology | Respiratory epithelium and connective tissues | 46 | Classify the types of epithelia lining the various parts of respiratory system |
| | | 47 | Differentiate between the histological differences among various parts of respiratory system |
| | | 48 | Describe the structure of trachea and its layer |
| | | 49 | Discuss the microscopic picture of respiratory bronchiole, alveolar ducts, alveolar sacs and alveoli. |
| | | 50 | Describe the different types of cells found in alveoli |
| Physiology | Functions of respiratory passageways | 51 | Describe the respiratory and non-respiratory functions of the respiratory passageways |
| | | 52 | Identify the mechanism by which particles are cleared from the airways. |
| Pharmacology | Anti-Aashtmatic drugs | 53 | Enlist Anti-asthmatic drugs |
| | Anti-Tuberculous | 54 | Classify Anti-tuberculous drugs |

| | | | |
|--------------------|-------------------------------------|----|---|
| | drugs | | |
| Pathology | Pneumonias | 55 | Define pneumonia and enlist the causative pathogens of pneumonia |
| | Pulmonary Tuberculosis | 56 | Define primary and secondary Tuberculosis and state its etiology |
| | Bronchial Asthma | 57 | Describe the etiology, pathogenesis and clinical features of asthma |
| | Pulmonary Edema | 58 | Define pulmonary edema and classify it according to underlying causes |
| Community Medicine | Prevention of Respiratory disorders | 59 | Discuss preventive strategies of different problems related to respiratory system |
| | | 60 | Discuss the relationship of smoking with lung Diseases |
| | | 61 | Describe preventive strategies for smoking |

Theme-3: Breathlessness

| | | | |
|------------|--------------------------|----|---|
| Anatomy | Mechanics of respiration | 62 | Describe briefly mechanics of respiration |
| | Pleura | 63 | Describe the gross features of pleura |
| | | 64 | Describe the pleural cavity and the pleural reflections |
| | | 65 | Describe the surface anatomy related to pleural reflections |
| Embryology | | 66 | Describe the development of pleural cavity |
| Histology | | 67 | Discuss surfactant, alveolar septum, alveolar |

| | | | |
|------------|-----------------------|----|---|
| | | | pores and alveolar macrophages |
| Physiology | Pulmonary ventilation | 68 | Define respiration |
| | | 69 | Compare between the internal and external respiration |
| | | 70 | Enlist the steps of external respiration accomplished by the respiratory system and those carried out by the circulatory system |
| | | 71 | State the functions of Type I alveolar cells, Type II alveolar cells, and alveolar macrophages |
| | | 72 | Describe the forces that keep the alveoli open and those that promote alveolar collapse. |
| | | 73 | Define the following terms: anatomic dead space, physiologic dead space, wasted (dead space) ventilation, total minute ventilation and alveolar minute ventilation. |
| | | 74 | Compare anatomic and physiologic dead space |
| | | 75 | Describe the basic concept of measurement of dead space |
| | | 76 | Enlist the factors that changes the dead space |
| | | 77 | Define the following terms: hypoventilation, hyperventilation, hypercapnea, eupnea, hypopnea, and hyperpnea. |
| | | 78 | Define surface tension, surfactants, |

| | | | |
|--|-----------------------|----|---|
| | | | atelectasis |
| | | 79 | Describe the role of surfactants on the lung compliance. |
| | | 80 | Describe the composition of the pulmonary surfactants and its role |
| | | 81 | Describe the pathophysiology of respiratory distress syndrome of the newborn |
| | | 82 | Discuss the work of breathing |
| | Pulmonary circulation | 83 | Explain the physiologic anatomy of the pulmonary circulatory system |
| | | 84 | Describe the pressures in the pulmonary circulatory system |
| | | 85 | Describe blood volume of the lungs |
| | | 86 | Describe blood flow through the lungs and its distribution |
| | | 87 | Compare the systemic and pulmonary circulations with respect to pressures, resistance to blood flow, and response to hypoxia. |
| | | 88 | Describe the regional differences in pulmonary blood flow in an erect position. |
| | | 89 | Describe the consequence of hypoxic pulmonary vasoconstriction on the distribution of pulmonary blood flow. |
| | | 90 | Describe the pulmonary capillary dynamics |

| | | | |
|--|-----------------------------|-----|--|
| | | 91 | Describe the development of pulmonary edema |
| | Gas exchange | 92 | List the normal airway, alveolar, arterial, and mixed venous PO ₂ and PCO ₂ values. |
| | | 93 | List the normal arterial and mixed venous values for O ₂ saturation, [HCO ₃ ⁻] |
| | | 94 | List the factors that affect diffusive transport of a gas between alveolar gas and pulmonary capillary blood. |
| | | 95 | Describe respiratory unit |
| | | 96 | Describe the physiologic anatomy of the respiratory membrane and its significance |
| | | 97 | Describe the factors that affect the rate of gaseous diffusion through the respiratory membrane |
| | | 98 | Describe the diffusing capacity of respiratory membrane for O ₂ and CO ₂ at rest and exercise. |
| | | 99 | Describe the effect of ventilation/perfusion (V/Q) ratio on alveolar gas concentrations. |
| | | 100 | Identify the average V/Q ratio in a normal lung. |
| | | 101 | Explain the concept of physiologic shunt and physiologic dead space |
| | | 102 | Describe the abnormalities of ventilation perfusion ratio in normal lung and chronic obstructive lung disease. |
| | | 103 | Enlist common causes of hypoxemia |
| | Transport of O ₂ | 104 | Define oxygen partial pressure (tension), |

| | | | |
|--|----------------------------------|-----|---|
| | and CO ₂ in the blood | | oxygen content, and percent hemoglobin saturation as they pertain to blood. |
| | | 105 | Describe Oxyhemoglobin dissociation curve (hemoglobin oxygen equilibrium curve) showing the relationships between oxygen partial pressure, hemoglobin saturation, and blood oxygen content. |
| | | 106 | Describe the relative amounts of O ₂ carried bound to hemoglobin with that carried in the dissolved form. |
| | | 107 | State Henry's Law (the relationship between PO ₂ and dissolved plasma O ₂ content) |
| | | 108 | Describe how the shape of the oxyhemoglobin dissociation curve influences the uptake and delivery of oxygen. |
| | | 109 | Define P ₅₀ . |
| | | 110 | Describe how the oxyhemoglobin dissociation curve is affected by changes in blood temperature, pH, PCO ₂ , and 2,3-DPG. |
| | | 111 | Describe how anemia and carbon monoxide poisoning affect the shape of the oxyhemoglobin dissociation curve, PaO ₂ , and SaO ₂ . |
| | | 112 | List the forms in which carbon dioxide is carried in the blood. |
| | | 113 | Describe the percentage of total CO ₂ transported as each form. |

| | | | |
|--|---------------------------|-----|--|
| | | 114 | Describe the chloride shift and its importance in the transport of CO ₂ by the blood. |
| | | 115 | Describe the enzyme that is essential to normal carbon dioxide transport by the blood and its location. |
| | | 116 | Describe the carbon dioxide dissociation curves for oxy- and deoxyhemoglobin. |
| | | 117 | Describe the interplay between CO ₂ and O ₂ binding on hemoglobin that causes the Haldane effect. |
| | Regulation of Respiration | 118 | Describe the regions in the central nervous system that play important roles in the generation and control of cyclic breathing. |
| | | 119 | Give three examples of reflexes involving pulmonary receptors that influence breathing frequency and tidal volume. Describe the receptors and neural pathways involved. |
| | | 120 | List the anatomical locations of chemoreceptors sensitive to changes in arterial PO ₂ , PCO ₂ , and pH that participate in the control of ventilation. Identify the relative importance of each in sensing alterations in blood gases. |
| | | 121 | Describe how changes in arterial PO ₂ and PCO ₂ alter alveolar ventilation, including the synergistic effects when PO ₂ and PCO ₂ both change. |
| | | 122 | Describe the significance of the feedforward control of ventilation (central command) during |

| | | | |
|--------------|----------------------------------|-----|---|
| | | | exercise, and the effects of exercise on arterial and mixed venous PCO ₂ , PO ₂ , and pH. |
| | | 123 | Describe voluntary control of respiration |
| | | 124 | Describe the effect of irritant receptors, J-receptors, brain edema and anesthesia on breathing. |
| | Common Respiratory abnormalities | 125 | Describe periodic breathing and basic mechanism of Cheyne-Stokes breathing |
| | | 126 | Define sleep apnea |
| | | 127 | Describe the pathophysiology of Obstructive sleep apnea and central sleep apnea. |
| | | 128 | Describe the pathophysiology of specific pulmonary abnormalities: |
| | | 129 | Describe hypoxia |
| | | 130 | Describe cyanosis |
| | | 131 | Describe the effect of aging on lung volumes, lung and chest wall compliance, blood gases, and respiratory control. |
| Biochemistry | Glycolysis | 132 | Explain Aerobic and Anaerobic Respiration |
| | | 133 | Define Glycolysis |
| | | 134 | Enlist different enzymes used in Glycolysis |
| | | 135 | Enlist the intermediate compounds of glycolysis |
| | | 136 | Enlist the reversible and irreversible reactions in |

| | | | |
|--|--------------|-----|---|
| | | | glycolysis |
| | | 137 | Explain production of Energy |
| | | 138 | Explain Regulation of rate limiting enzymes <ul style="list-style-type: none"> • Hexokinase and glucokinase • Phosphofructokinase Pyruvate kinase |
| | | 139 | Explain aerobic regeneration of NAD ⁺ and Disposal of Pyruvate |
| | | 140 | Describe conversion of carbohydrates into fatty acids and cholesterol |
| | | 141 | Explain conversion of Pyruvate into oxaloacetate for citric acid cycle |
| | | 142 | Describe role of Glycolysis in genetic diseases and cancer. |
| | Kreb`s cycle | 143 | Define Kreb cycle |
| | | 144 | Enlist different enzymes used in Kreb`s cycle |
| | | 145 | Enlist the intermediate compounds of Kreb`s cycle |
| | | 146 | Describe Sequence of reactions Kreb`s cycle |
| | | 147 | Explain substrate level phosphorylation |
| | | 148 | Explain production of Energy in Kreb`s cycle |
| | | 149 | Explain the regulation of Kreb`s cycle |
| | | 150 | Describe briefly the major pathways converging into Kreb`s cycle |

| | | | |
|--|--------------------|-----|---|
| | Biologic oxidation | 151 | Define biological oxidation |
| | | 152 | Define redox reactions |
| | | 153 | Describe the structure of Mitochondria |
| | | 154 | Enlist the Functions of Mitochondria |
| | | 155 | Describe Oxidoreductases |
| | | 156 | Describe sources of NADH and FADH ₂ |
| | | 157 | Describe Glycerol 3-phosphate Shuttle |
| | | 158 | Describe Malate Shuttle |
| | | 159 | Enumerate different parts enzymes and co-enzymes that carryout biological oxidation |
| | | 160 | Enlist components of each enzyme involved in Biological Oxidation |
| | | 161 | Describe transfer of electron through each complexes |
| | | 162 | Describe the free radicals involved in BO |
| | | 163 | Explain Chemiosmotic theory. |
| | Formation of ATP | 164 | Describe structure of ATP |
| | | 165 | Describe the mechanism of ATP production by ATP Synthase |
| | | 166 | Describe transfer of protons from Inter mitochondrial membrane to Mitochondrial matrix through ATP Synthase |

| | | | |
|--|--|-----|--|
| | | 167 | Explain P/O ratio |
| | | 168 | Explain coupling |
| | | 169 | Describe uncoupling along with examples |
| | | 170 | Enumerate the Electron transport chain inhibitors |
| | | 171 | Define respiration and Explain steps of respiration. |
| | | 172 | Define partial pressure and explain its role in the transport of gases according to Dalton's law. |
| | | 173 | Explain various modes of oxygen transport and clinical importance of oxygen. |
| | | 174 | Describe the formation of oxyhemoglobin. |
| | | 175 | Explain Respiratory exchange ratio. |
| | O ₂ and CO ₂ transport | 176 | Explain oxygen-dissociation curves with various factors affecting oxygen delivery. |
| | | 177 | Describe Bohr effect and its importance. |
| | | 178 | Describe the modes of carbon dioxide transport |
| | | 179 | Explain various modes of oxygen transport |
| | | 180 | Describe in detail all the events occurring at lung site and tissue site including Haldene effect. |
| | | 181 | Explain the chloride shift and its importance. |
| | | 182 | Explain the factors affecting the transport of |

| | | | |
|--------------------|--|-----|--|
| | | | carbon dioxide transport. |
| | | 183 | Describe the role of Nitrogen in plasma. |
| | | 184 | Explain how free radicals are produced and why oxygen is more prone to produce superoxide radical? |
| | | 185 | Discuss various toxic effects of free radicals. |
| | | 186 | Classify antioxidants. How they are produced and discuss its role in combating free radicals. |
| | | 187 | Describe the respiratory control of acid base balance. |
| | | 188 | Role of dipalmitoyl phosphatidyl inositol in infant respiratory syndrome. |
| Forensic Medicines | Asphyxia | 189 | Define Asphyxia |
| | | 190 | Describe different types of Asphyxia |
| | | 191 | Identify classical signs of asphyxia |
| Medicine | Introduction to Respiratory symptomatology | 192 | Enumerate the various symptoms of respiratory disorders |
| | PFT's | 193 | Interpret the Pulmonary Function Tests |
| | ARDS | 194 | Discuss acute lung injury and its correlation Acute Respiratory Distress Syndrome |
| | | 195 | Describe the causes of Acute Respiratory Distress Syndrome |
| | | 196 | Discuss the morphology of Acute Respiratory Distress Syndrome |

| | | | |
|---|------------|---|--|
| | | | |
| Psychomotor and Affective domain | | | |
| Breathlessness | Physiology | 1 | Draw a normal spirogram, labeling the four lung volumes and four capacities. |
| | | 2 | List the volumes that comprise each of the four capacities. |
| | | 3 | Identify which volume and capacities cannot be measured by spirometry. |
| | | 4 | Define the factors that determine total lung capacity, functional residual capacity, and residual volume. |
| | | 5 | Describe the mechanisms responsible for the changes in those volumes that occur in patients with emphysema and pulmonary fibrosis. |
| | | 6 | Differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category. |
| | | 7 | Examine the chest of the subject |
| | | 8 | Calculate the respiratory rate of the subject |
| | | 9 | Determine the peak expiratory flow (PEF) |

| | | | |
|-----------------------------|-----------|----|---|
| | | | by peak flow meter |
| | | 10 | Describe the use of inhaler |
| | | 11 | Demonstrate the use of inhaler to the subject |
| Cough and Hemoptysis | Histology | | <p>Identify the various microscopic tissue types in the Respiratory system</p> <ul style="list-style-type: none"> z Epithelium of the respiratory system z Trachea z Bronchi z Bronchioles z Alveoli |