**Respiration Module**

**First Professional Year MBBS**

**4 Weeks**

KMU - Central Curriculum Committee

**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 the biochemical structure and functions of enzymes
14. Describe the mechanisms of O2 and CO2 transport in the blood
15. Classify anti-asthmatic and anti-tuberculous drugs
16. Describe the types and signs of asphyxia
17. Enlist the causes and signs of pneumonias, bronchial asthma, tuberculosis, Acute Respiratory Distress Syndrome (ARDS), and pulmonary edema
18. Describe the parameters of Pulmonary Function Tests (PFTs)

**Specific learning objectives (theme based)**

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| **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 Hydro pneumothorax |
| **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-Asthmatic drugs | 53 | Enlist Anti-asthmatic drugs |
|  | Anti-Tuberculous drugs | 54 | Classify Anti-tuberculous 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 PO2 and PCO2 values. |
|  |  | 93 | List the normal arterial and mixed venous values for O2 saturation, [HCO3-] |
|  |  | 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 O2 and CO2 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 O2 and CO2 in the blood | 104 | Define oxygen partial pressure (tension), 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 O2 carried bound to hemoglobin with that carried in the dissolved form. |
|  |  | 107 | State Henry’s Law (the relationship between PO2 and dissolved plasma O2 content) |
|  |  | 108 | Describe how the shape of the oxyhemoglobin dissociation curve influences the uptake and delivery of oxygen. |
|  |  | 109 | Define P50. |
|  |  | 110 | Describe how the oxyhemoglobin dissociation curve is affected by changes in blood temperature, pH, PCO2, and 2,3-DPG. |
|  |  | 111 | Describe how anemia and carbon monoxide poisoning affect the shape of the oxyhemoglobin dissociation curve, PaO2, and SaO2. |
|  |  | 112 | List the forms in which carbon dioxide is carried in the blood. |
|  |  | 113 | Describe the percentage of total CO2 transported as each form. |
|  |  | 114 | Describe the chloride shift and its importance in the transport of CO2 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 CO2 and O2 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 PO2, PCO2, 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 PO2 and PCO2 alter alveolar ventilation, including the synergistic effects when PO2 and PCO2 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 PCO2, PO2, 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 |  | 132 | Define Enzymes |
|  |  | 133 | Define activation energy |
|  |  | 134 | Define Gibbs Free energy |
|  |  | 135 | Explain the general structure of enzymes |
|  |  | 136 | Define co-factors |
|  |  | 137 | Explain the function of co-factors |
|  |  | 138 | Enlist different types of co-factors |
|  |  | 139 | Define different parts and forms of enzymes |
|  |  | 140 | Describe the factors involved in structure of enzymes |
|  |  | 141 | Describe the mechanism of Enzyme activity |
|  |  | 142 | Define catalysis |
|  |  | 143 | Explain different mechanism of catalysis |
|  |  | 144 | Explain the Principals for Nomenclature of enzymes |
|  |  | 145 | Classify Enzymes on the basis of functions |
|  |  | 146 | Enlist the factors affecting the activity of enzymes |
|  |  | 147 | Describe roles of factors affecting enzyme activity |
|  |  | 148 | Define enzyme kinetics |
|  |  | 149 | Explain different areas of enzyme kinetics |
|  |  | 150 | Describe the role of Km in Enzyme kinetics |
|  |  | 151 | Define Isoenzymes (Isozymes) |
|  |  | 152 | Explain Factors affecting the properties of isozymes |
|  |  | 153 | Explain the role of enzymes as a diagnostic tool |
| Forensic Medicines | Asphyxia | 154 | Define Asphyxia |
|  |  | 155 | Describe different types of Asphyxia |
|  |  | 156 | Identify classical signs of asphyxia |
| Medicine | Introduction to Respiratory symptomatology | 157 | Enumerate the various symptoms of respiratory disorders |
|  | PFT`s | 158 | Interpret the Pulmonary Function Tests |
|  | ARDS | 159 | Discuss acute lung injury and its correlation Acute Respiratory Distress Syndrome |
|  |  | 160 | Describe the causes of Acute Respiratory Distress Syndrome |
|  |  | 161 | Discuss the morphology of Acute Respiratory Distress Syndrome |
| **Psychomotor and Affective domain** | | | |
| **Breathlessness** | Physiology | 162 | Draw a normal spirogram, labeling the four lung volumes and four capacities. |
|  |  | 163 | List the volumes that comprise each of the four capacities. |
|  |  | 164 | Identify which volume and capacities cannot be measured by spirometry. |
|  |  | 165 | Define the factors that determine total lung capacity, functional residual capacity, and residual volume. |
|  |  | 166 | Describe the mechanisms responsible for the changes in those volumes that occur in patients with emphysema and pulmonary fibrosis. |
|  |  | 167 | Differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category. |
|  |  | 168 | Examine the chest of the subject |
|  |  | 169 | Calculate the respiratory rate of the subject |
|  |  | 170 | Determine the peak expiratory flow (PEF) by peak flow meter |
|  |  | 171 | Describe the use of inhaler |
|  |  | 172 | Demonstrate the use of inhaler to the subject |
| **Cough and Hemoptysis** | Histology | 173 | Identify the various microscopic tissue types in the  Respiratory system   * Epithelium of the respiratory system * Trachea * Bronchi * Bronchioles * Alveoli |