

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)

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 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 and CO ₂ 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 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		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 <ul style="list-style-type: none"> • Epithelium of the respiratory system • Trachea • Bronchi • Bronchioles • Alveoli