JINNAH SINDH MEDICAL UNIVERSITY

STUDY GUIDE	
PROGRAM	**MBBS**
MODULE TITLE	**URINARY SYSTEM-1**
ACADEMIC YEAR	**2nd Year,2025**
INTRODUCTION	This module introduces the learners to the development, and the grossand microscopic structures of the urinary system. It is connected with and supports the Renal and excretory-2 module. Students learn how the urinary system functions, the processes and causes of its malfunction and some of the drugs which act on the kidneys. The students will gain an understanding of the electrolyte and acid-basedisorders. This module also introduces the young learners to majorclinical aspects of related diseases so that they can relate basic sciences to the applied / Clinical aspects.
RATIONALE	Before students get exposed to complete clinical aspects of diseases related to the urinary system, it is imperative that they achieve a thorough understanding of what the system is about, how it Functions and how diseases may be caused.
OUTCOMES	By the end of the module, students will be able to relate the structure (gross, microscopic and biochemical) and the normal processes with the underlying disease processes and their clinical manifestations
DEPARTMENTS INVOLVED	1. Anatomy 2. Biochemistry 3. Physiology
MODULE OBJECTIVES	By the end of the module, students should be able to:
LECTURES **ANATOMY**	**1. Gross anatomy of kidneys** • Describe the gross structure of kidney, its location and shape • Discuss the coverings, and cortex and medulla, relations and functions of kidneys • Discuss the clinical conditions related to kidneys
	2. Blood supply, nerve supply and lymphatic drainage of kidneys • Describe the structures passing through the hilum of kidneys with

	their sequence • Discuss the blood supply of kidney in detail, with clinical segmentation of kidney according to its blood supply • Discuss the nerve supply and lymphatic drainage of kidney • Discuss the clinical conditions related to blood supply of kidney **3. Gross anatomical features of ureter and urinary bladder & urethra** • Name the parts of urinary system (ureter, urinary bladder and urethra) • Describe the structure, course, anatomical constrictions, and relations of ureter • Explain the location, apex, base, surfaces and relations of urinary bladder • Describe the trigone of the urinary bladder • Explain the support to the urinary bladder • Describe the blood supply, nerve supply and lymphatic drainage of ureter, urinary bladder and urethra **4. Surface anatomy of Urinary system** • Mark the following structures on the surface of a human body/ mannequin: i. Kidney ii. Ureter iii. Urinary bladder **5. Histological of kidney** • Describe the histological features of kidney (cortex & medulla) • Discuss the histological features of a nephron and their types • Describe the filtration barrier and its significance • Describe juxtaglomerular apparatus, its location and significance **6. Histological features of ureter, urinary bladder and urethra** • Describe the arrangement of layers in ureter, urinary bladder and urethra & their microscopic appearance

	7. Development of kidney & urinary bladder • Describe the role of intermediate mesoderm in the formation of kidney • Describe the development and the fate of the three progenitors of urinary system: pronephros, mesonephros and metanephros • Discuss development of the following: i. Nephron, and the steps of its development ii. Collecting system of kidney and ureter iii. Urinary bladder iv. Urethra **8. Anomalies of kidney & urinary bladder** • Describe the congenital anomalies of kidney (polycystic kidney,pelvic kidney, horseshoe kidney) & ureter (Bifid ureter)
	1. Water distribution, regulation & disturbances • Describe the distribution of water in the body • Discuss the hormonal regulations o f water homeostasis and their exchanges • Explain the regulatory mechanism by which the water balance is maintained • Discuss the biochemical consequences of dehydration and overhydration • Discuss the clinical disorders associated with water balance abnormalities and their management **2. pH Disturbances** • Describe the maintenance of normal pH • Discuss the renal mechanism of pH regulation • Discuss the biochemical consequences of respiratory andmetabolic acidosis and alkalosis • Explain the compensatory mechanism in metabolic pHdisturbances

- Explain the Arterial blood gases (ABGs) in metabolic pHdisturbances
- Discuss the ABGs in compensated metabolic pH disturbances

3. Sodium and chloride disturbances

- List the sources of dietary sodium and chloride
- Discuss the normal daily requirement of Sodium and chloride
- Explain the distribution of sodium in extracellular and intracellular compartments
- Describe the biochemical role and metabolism of Sodium and chloride
- Discuss the clinical disorders associated with sodium and chloride disturbances (e.g. Hypertension)
- Discuss the laboratory investigations related with the disturbances of these electrolytes (e.g. dehydration and over-hydration)

4. Renal Function tests

- Discuss the clinical importance of renal disorders
- Discuss the importance of renal function tests for the diagnosis of renal disorders
- List the renal function tests
- Explain the renal function tests
- Interpret clinical conditions correlated with their laboratory investigations

5. Potassium and phosphate disturbances

- List the sources of dietary potassium and phosphate
- Discuss the normal daily requirement of potassium and phosphate
- Explain the distribution of potassium and phosphate inextracellular and intracellular compartments
- Describe the biochemical role and the metabolism of potassiumand phosphate
- Discuss the clinical disorders associated with potassium and

	• phosphate disturbances (e.g. hypokalemia & hyperkalemia) • Discuss the laboratory investigations related with the disturbances of these electrolytes **NUCLEOTIDE METABOLISM** **6. Purine Synthesis** • Discuss the structure and biochemical functions of nucleotides • Name the different types of purines • Describe the sources of carbon and nitrogen atoms in the purine ring • Discuss the process of purine synthesis (Denovo and salvage pathways) • Discuss the biochemical abnormalities related to purine synthesis (e.g. Lesch –Nyhan Syndrome & Von Gierke's Diseases) **7. Purine Degradation** • Describe the fate of dietary nucleoproteins • Discuss the degradation of tissue purine nucleotides • Explain the formation of uric acid • Discuss the clinical significance of purine degradation abnormalities **8. Pyrimidine Metabolism** • Discuss the structure and biochemical functions of pyrimidine nucleotides • Name the different types of pyrimidine • Discuss the process of pyrimidine synthesis and degradation • Discuss the biochemical abnormalities related to pyrimidine synthesis (e.g. Orotic aciduria)
PHYSIOLOGY	**1. General functions of kidneys and excretory system** • List the general functions of kidneys • Describe the structure, functions and types of typical nephron and its blood supply. **2. Glomerular filtration rate (GFR) and its regulating factors** • Define glomerular filtration rate

- Explain the composition of glomerular filtrate
- Discuss the major factors that regulate the GFR (Net filtration pressure, hydrostatic, and colloid osmotic pressures)

3. Auto-regulation of GFR and renal blood flow

- Define tubulo glomerular feedback
- Explain the functions of juxta glomerular apparatus and Macula densa
- Discuss myogenic auto-regulation

4. Tubular reabsorption and secretion-I

- Discuss the transport mechanisms among different segments of renal tubule
- Explain the reabsorption and secretion of substances in proximal convoluted tubule and loop of Henle.

5. Tubular reabsorption and secretion-II

- Elaborate the reabsorption and secretion of substances along distal tubule, colleting tubule and collecting duct.
- Describe glomerulotubular balance in relation to regulation of tubular reabsorption.
- Discuss the hormonal control of tubular reabsorption and secretion

6. Urine Formation

- Explain the renal mechanisms for excreting dilute urine.
- Discuss the role of antidiuretic hormone in formation of concentrated urine.

7. Counter-Current Mechanism

- Explain the counter-current multiplier and exchanger.
- Elaborate the importance of urea absorption in forming concentrated urine.

8. Process of micturition and micturition reflex

- Explain physiology and innervation of bladder
- Explain the mechanism of micturition reflex

9. Buffer systems of kidneys and basis of acid base balance

- Describe the buffer systems of body fluids; bicarbonate buffer system, phosphate buffer system
- Explain the role of proteins as intracellular buffers.

10. Regulation of acid-base balance

- Elaborate the renal control of alkalosis.
- Explain the renal mechanisms for control of acidosis.
- Describe the respiratory regulation of acid-base balance.

11. Regulation of extracellular fluid osmolality and sodium concentration

- Explain the osmoreceptor ADH-feedback system for control of sodium concentration.
- Describe the importance of thirst in regulation of ECF osmolality and sodium concentration.

12. Renal regulation of Potassium, Calcium, Phosphate and Magnesium.

- Explain the major factors that regulate the secretion and excretion of Potassium, Calcium, Phosphate and Magnesium.

13. Interpretation of renal function tests

- Determine renal plasma flow, renal blood, GFR
- List the substances that are used to estimate renal function (PAH, inulin)
- Calculate clearance of PAH and inulin
- Explain creatinine clearance in estimating kidney function.

14. Endocrine functions of kidney & hormones acting on kidney

- Elaborate the process of erythropoietin release from the kidneys.
- Explain the role played by different hormones on kidney function (ADH, Angiotensin, aldosterone)

15. Diuretics and Kidney Diseases

- Explain the significance of Diuretics in renal diseases.

	• Briefly explain the mechanism of action of various diuretics in different segments of nephron. • Discuss the basic principles and indication of Dialysis in kidney diseases.
TUTORIALS **PHYSIOLOGY**	**1. Renal calculi:** • Explain various causes of renal stones. **2. Counter Current mechanism** • Discuss the process of Counter Current Mechanism and its significance in formation of concentrated urine.
PRACTICALS **BIOCHEMISTRY**	**1. Detection of normal and abnormal urine constituents** • List the normal and abnormal urine constituents and itsbiochemical significance • Outline the method for detection of normal and abnormal urine constituents by chemical tests and urine dipstick • Detect the normal and abnormal constituents of urine by chemical tests and urine dipstick • Interpret relevant clinical conditions with their laboratory investigations **2. Urea & Creatinine estimation** • Explain the bio-techniques to estimate Urea and Creatinine in a sample • Explain the principle of detection of Urea and Creatinine by spectrophotometry • Estimate Urea and Creatinine levels by spectrophotometry • Interpret relevant clinicalconditions with their laboratory investigations **3. Uric Acid estimation** • Explain the bio-techniques to estimate Uric acid in a sample • Explain the principle of detection of Uric acid byspectrophotometry • Estimate Uric acid level by spectrophotometry

	• Interpret relevant clinicalconditions with their laboratory investigations
HISTOLOGY	**1. Histological features of kidneys** • Identify renal corpuscle • Differentiate proximal and distal convoluted tubules • Identify medullary rays, collecting tubules and collecting ducts • Describe the histological features of kidneys **2. Histological features of Ureter & Urinary Bladder** • Identify the microscopic appearance and structure of the ureter, urinary bladder & urethra.
INTERNAL ASSESSMENT	• Internal evaluation carries 20% weight in professional examination. The mode of internal assessment may vary from one institution to the next.
ANNUAL EXAMINATION	• MCQs and OSPE (observed + un-observed)
MODULE EVALUATION	• Module evaluation will be obtained through a feedback form which will be posted on the JSMU website