The Hashemite University

الجامعـــــــة الهاشميـــــــــة

Deanship of Academic Development
and International Outreach

عمادة التطوير الأكاديمي والتواصل الدولي

Syllabus*: General Physiology 111501106

First year–Second Semester 2025–2026

COURSE INFORMATION	
Course Name: General Physiology **Semester**:Second Semester **Department:** Anatomy Physiology and Biochemistry **Faculty:** Medicine	**Course Code: 111501106** **Section: All** **Core Curriculum**: MD program
Day(s) and Time(s):TBD **Classroom: TBD**	**Credit Hours:** 3 **Prerequisites**: None

COURSE DESCRIPTION

This is an introductory course in human physiology that covers the fundamental concepts and principles of human physiology. The course will emphasize the basis of the physiological control systems implicated in the maintenance .of homeostasis. The course will also focus on body fluids compartments and their ionic composition. Examples of body fluid abnormalities along with an outline of IV fluid therapy are also introduced. In addition, the basic principles of membrane transport, the ionic basis of neuromuscular excitability, the molecular mechanisms, and the mechanical properties of muscle contraction will be emphasized. The course will discuss the physiology of the autonomic nervous system, neuronal communication, and signal transduction in both endocrine and nervous systems, as well as the neuronal basis of somatic and autonomic reflexes. The course will introduce l capillary membrane dynamic, Starling forces affecting the movements of fluid across capillary wall to the interstitial space lymph flow and psychophysiology basis of edema Lastly, Energy balance, control of food intake, temperature regulation and pathophysiology of fevere are also introduced

DELIVERY METHODS

The course will be delivered through a combination of active learning strategies. These will include:

- PowerPoint lectures and active classroom-based discussion
- Relevant papers and reading materials.
- E-learning resources: e-reading assignments and practice quizzes through Microsoft Team

FACULTY INFORMATION

Name:	**DR. AMJAD ZUHIER ALROSAN (Coordinator)**
Academic Title:	**Assistant Professor**
Office Location:	**Faculty of Pharmacy**
Telephone Number:	**+962 (05)3903333 ext. 5352**
Email Address:	**amjadz@hu.edu.jo**
Office Hours:	**TBD** **Or by an appointment**

REFERENCES AND LEARNING RESOURCES

Required Textbook

-Guyton and Hall Textbook of Medical Physiology 14th Edition (Elsevier 2020) [eBook ISBN:9780323640039/ Hardcover ISBN:9780323597128].

Additional Resources:

- All lecture slides will be uploaded as PDF files.
- All instructors have open discussions with the students during the office hours to answer any question.

Suggested Additional Resources

-Lauralee Sherwood: Human Physiology: From Cells to Systems 9th Edition, 9th edition (Cengage Learning, 2016) [ISBN 9781305445512, 1305445511].

-LINDA S. COSTANZO: Physiology, Sixth Edition. [ISBN 0323478816, 978-0323478816

STUDENT LEARNING OUTCOMES MATRIX*

TOPICS DETAILS/ STUDENT LEARNING OUTCOMES MATRIX

Course objectives	Topic and subject	Lecture No.	Intended learning outcomes	Assessment method
Biomedical Knowledge Biomedical Knowledge 1. Describe the functional organization of the human body and the control of homeostasis 2. Describe the molecular composition of biological membranes and mechanisms of membrane transport and the movement of substances between intracellular and extracellular environments. 3. Describe the overall regulation of body fluid volume, constituents of the extracellular and	The scope of physiology Homeostasis and body control systems	L1 & L2	• Define physiology • understand the concept of homeostasis and the significance of internal environment • Explain how organ systems. contribute to homeostasis and give • Explain the difference between steady state and equilibrium examples • Describe how homeostatic mechanism monitors a particular aspect of the internal environment. • Define and describe the components of homeostatic control. • Compare and contrast negative and positive feedback and explain the importance of these processes to homeostasis.	**MCQ**

control of fluid exchange between extracellular intracellular compartments and control of plasma pH 4. Define and explain the significance of resting membrane potential. and explain the origin of resting membrane potential. 5.. Describe the different phases of neuronal action potential and explain the ionic fluxes that occur during an action potential as well as self-propagation of neuronal 6. Compare the properties' of neuronal action potential with action potentials generated in skeletal muscles, and cardiac muscles. 7.Explain synaptic transmission, and electrical properties of synaptic potential 8.Recognize various forms of intercellular communication and describe mechanisms of hormonal and neurotransmitter signal transduction . .9. Understand the function of different neuronal circuits and their role in the processing of information. .10. Outline the main component and neuronal circuits of nervous system reflexes			• Define the gain of the control system and its physiological significance. • Describe feed-forward mechanisms and its importance for initiation of responses in anticipation of a change in internal environment.	
	Membrane Transport and movement of substances across the cell membrane	L 3	• Review the fluid mosaic model of membrane structure and describe the organization of the phospholipid bilayer and associated proteins in a biologic membrane. • Understand the physiological importance of the cell membrane selective permeability created by the plasma membrane. • Identify various forms membrane channels, gates and their selective permeability. • List the transport pathways through the cell membrane and the basic mechanisms of transport (Diffusion and active transport) • Define simple diffusion and describe the factors that affect the rate of diffusion of substances across cell membranes, according to Fick's law of diffusion. • Define Carrier mediated transport • Describe facilitated diffusion and give examples of substances that cross the cell membrane through facilitated diffusion. • Compare and contrast facilitated diffusion and simple diffusion.	**MCQ**

and give examples of somatic and autonomic reflexes. 11. List the type of sensory receptors and understand the steps involved in sensory transduction 12. Outline the general organization and functional aspects of the autonomic nervous. 12.Describe the molecular and electrical makeup of skeletal , smooth muscles and the mechanism of excitation contraction in both skeletal and smooth muscles 14.Describe the mechanical properties of skeletal and smooth muscle contraction 15. Define plasma pH , 16. Explain the role of buffers, respiratory and renal system in the regulation of acid base balance and List the major abnormalities of acid base statue 17. Describe the structure of the microcirculation and capillary system, Capillary Fluid Exchange, Interstitial Fluid, Lymph Flow, and edema. Describe the temperature-regulating mechanisms. 19. Explain the homeostasis of energy balance and mechanisms of food intake regulation.			• Explain the characteristics of carrier mediate transport, (specificity, saturation, and competition	
	Membrane Transport II	L 4	• Define and explain primary active transport • Describe the Na+ K+ ATPase and its functions • Describe proton pump as examples of primary active transport. • Discuss the characteristics of primary active transport. • Define and explain the mechanism of secondary active transport and give examples. • Distinguish between symport and antiport. • Explain how glucose is transported across epithelial cells in the kidney and the gut by secondary active transport. • Define vesicular transport, transcellular transport and identify different types of this pattern of transport and their functions.	**MCQ**
	Membrane Transport III	L 5	• Define osmosis and explain how osmosis takes place. • Define osmotic pressure and explain the determinants of osmotic pressure. • Define the reflection coefficient of a selectively permeable membrane.	

			• Understand how to calculate osmotic pressure. • Describe water movement across the plasma membrane and explain the role of water channels	
	Body fluids compartments and its constituents Measurements	L 6	• Describe the volume and percent distribution of body fluids in various compartments in adults and list factors affecting the volume of body water • Describe the Composition of extracellular fluid (ECF) and intracellular fluid compartment (ICF) and the ionic distribution in these compartments. • Explain the Indicator–dilution method and its use for measuring body fluids volumes. • Understand how to determine volumes of specific body fluid compartments using various substances and the volume of distribution of these substances.	
	Plasma osmolarity and its determinants	L 7	• Review basic principles of osmosis and osmotic pressure. • Review the definitions of mole, equivalent, and osmole. • Define the Osmolality and Osmolarity of solutions. • Understand how to calculate the osmolarity of solution. • Compare the concentration of osmotically active substances in ECF and ICF	**MCQ**

			• Know the relative osmolarity of various body fluids compartments and the primary determinants of osmolarity in plasma under normal conditions. • Calculate the plasma osmolarity based on the osmolar concentration of Na ions, glucose, and urea. • Compare and contrast plasma osmolarity and tonicity. • Describe changes in cell volume when exposed to osmotic stress	
	Movements of fluids between various body compartments and osmotic equilibrium	L 8	• Describe the changes in body fluids compartment volume and osmolarity following the intravenous infusion of normal saline. • Calculate changes in body fluids compartment volume and osmolarity following the intravenous infusion of normal saline after osmotic equilibrium. • Describe changes in body fluids volumes and osmolarity following the infusion of hypoosmotic and hyperosmotic solutions.	
	Changes in body fluid compartment volume and osmolarity in	L 9	• Define hypo and hypernatremia.	

	different abnormal states		• List the main causes of hypo and hypernatremia. • Describe and explain the shift of fluids between ECF and ICF in conditions associated with hypernatremia and hyponatremia. • Describe changes in body fluids compartments volume and osmolarity associated with hypernatremia and hyponatremia. • Outline of fluid therapy (glucose and other solutions	
	Changes in body fluid compartment volume and osmolarity in different abnormal states	L 10	• Describe the changes in body fluids compartment volume and osmolarity following the intravenous infusion of normal saline. • Calculate changes in body fluids compartment volume and osmolarity following the intravenous infusion of normal saline after osmotic equilibrium. • Describe changes in body fluids volumes and osmolarity following the infusion of hypoosmotic and hyperosmotic solutions. • Outline of fluid therapy (glucose and other solutions administration.	**Problem set Discussion**
	Excitable tissues: Electrochemical equilibrium and	L11	• Compare the distribution and permeability differences of ions across cell membranes	

	diffusion potentials		• Define diffusion potentials Understand the biophysical basis of establishment of a diffusion across cell membrane. • Define the resting membrane potential of neurons and muscle cells. • Understand the biophysical basis of Nerst equation • Define the equilibrium potential of K and Na sodium and calculate the equilibrium potential of these ions at electrochemical equilibrium using the Nerst equation.	
	Excitable Tissue Resting membrane potential	L 12	• Explain why the resting membrane potential of most cells is close to the Nernst potential for K+. • List the key components of the Goldman equation and explain why this equation gives the value of the membrane potential. • Discuss the contribution of the Na+−K+ Pump to the resting potential. E • Compare and contrast the resting membrane of different excitable tissue and none excitable tissue	
	Excitable Tissue: Neuronal action potential	L 13	• Identify the functional component of a neuron. • Define the action potential of nerve cells.	

			• Draw a graph depicting the changes in membrane potential during depolarization, repolarization, and hyperpolarization as compared to resting membrane. • Understand the function of sodium and potassium voltage-gated channels. • Describe the activation and inactivation of voltage-gated channels during an action potential • Describe ionic fluxes during an action potential. • Describe changes in membrane permeability and ion movement that lead to generation an action potential.	
	Neuronal Action potential characteristics and properties	L 14	• Explain all or none nature of the action potential. • Define the self-propagation of the action potential and explain the mechanism of propagation of a nerve impulse in myelinated (salutatory conduction and contiguous conduction in nonmyelinated axons • List factors affecting the rate of propagation of nerve impulses. • Distinguish between the absolute refractory period and the relative refractory period during the action potential and	

			understand the ionic basis of the refractory period • Distinguishing features of graded potentials and Action Potentials. • Describe action potentials with plateau recorded in cardiac muscles and compare their properties with neuronal and skeletal muscle action potential	
	Synapses and neuronal integration	L 15	• Review the functional anatomy of the neuron. • Define a synapse and distinguish between electrical and chemical synapses. • Describe the functional anatomy of the chemical synapse. • List the sequential steps of neuronal chemical synaptic transmission. • Distinguish between chemically gated and voltage-gated channels. • Explain the action of the transmitter substance on the postsynaptic neuron—Function of "Receptor Proteins. • Compare and contrast excitatory synapses and inhibitory synapses. • Define EPSP and IPSP and explain changes in postsynaptic cell permeability, and ionic fluxes during synaptic potentials.	

			• Explain the generation of action potentials in the Initial segment of the axon by EPSP	
	Synapses and neuronal integration	L 16	• Explain the local graded nature of synaptic potentials. • Explain how temporal and spatial summations cause changes in the amplitude of synaptic potential. • Explain how presynaptic inhibition or facilitation can selectively alter the effectiveness of a presynaptic input to a post-synaptic cell. • Describe the effects of hypoxia acidosis or alkalosis hyperventilation on synaptic transmission. • List various classes of neurotransmitters in the nervous system.	
	Neuronal circuits for processing information	L17	• Describe the basic organization of a neuronal pool. • Described divergence of Signals Passing through neuronal pools and its function • Described divergence of signals passing through neuronal pools and its function • Discuss feedback neuronal circuits and their significance. • Describe the reverberatory (Oscillatory) circuit and its function	
	Neuroendocrine regulation of body	L18	• Describe voltage-gated channels and ligand-gated channels	

	functions and the molecular basis of of chemical signals transduction		and how these channels are opened. ● Describe autocrine, paracrine, and endocrine signaling in the control of cell function. ● Describe how second messengers regulate and amplify signal transduction. ● Describe various mechanisms of signal transduction by neurotransmitters and hormones.	
	Sensory receptors and sensory transduction	L19	● Define sensory neuronal receptors and list different types of receptors based on the modality of sensations. ● Define the modality of sensation and understand the Labeled line principle. ● Explain the transduction of sensory stimuli into nerve impulses and how a stimulus alters the receptor's permeability, leading to a graded receptor potential. ● Explain the relation of the receptor potential to action potentials in primary afferent neurons. ● Define receptor adaptation and differentiate between slowly (tonic) and rapidly (phasic) adapting receptors and indicate its physiological significance.	

	Motor and sensory axis of the nervous system and nervous system reflexes	L20	• Outline the major division of nervous system. • Classify neuronal reflexes based on neuronal circuits. • Compare and contrast somatic and autonomic reflexes • Identify the neuronal circuit of a neuronal reflex using the stretch reflex as an example. • Discuss the clinical significance of reflexes using the stretch reflex as an example.	
	Autonomic nervous system I	L 21	• Describe the functional anatomy of the autonomic nervous system Compare and contrast anatomical features of the sympathetic and parasympathetic systems. • Identify the neurotransmitters released by preganglionic and postganglionic. •Identify various types of autonomic receptors • Distinguish between cholinergic and adrenergic receptors. • Identify various types of cholinergic and adrenergic receptors	

	Autonomic nervous system II	L 22	• Describe the overall and specific functions of sympathetic and parasympathetic. • Describe the effects of the parasympathetic and sympathetic nervous systems on the activity of visceral organs. • Explain how various regions of the central nervous system regulate autonomic nervous system function. • Explain how autonomic reflexes contribute to homeostasis.	
	Review and discussion	L23	•	
	Functions of the adrenal medulla and the alarm response	L 24	• Outline the sympathetic innervation to the adrenal medulla. • List the hormones released by the adrenal medulla. • Explain how the effects of catecholamines differ from those of direct sympathetic stimulation. • Explain the synergistic effects of the sympathetic nervous system and the adrenal medulla. • Define sympathetic and parasympathetic tone and indicate the contribution of adrenal medulla secretion to sympathetic tone. • Explain the alarm or "stress" response of the sympathetic nervous system and list the major physiological changes during the alarm response	
	Skeletal Muscle: Neuromuscular Transmission and Excitation	L 25	• Describe the functional anatomy of the neuromuscular junction (The motor end plate).	

	Contraction Coupling in skeletal muscles		• List the sequence of steps of neuromuscular transmission. • Identify the neurotransmitter released at the neuromuscular junction, its synthesis and degradation. • Define end plate potential and explain permeability changes in muscle cells that cause the generation of end plate potential. • Explain how the end plate potentials lead to generating action potential in muscle cell. • Describe how the sarcolemma and the sarcoplasmic reticulum are involved in excitation–contraction coupling. • Explain the role of the dihydropyridine and the ryanodine receptors in the process of excitation–contraction coupling. • Explain the pathophysiology muscle weakness in myasthenia gravis. • List major drugs and toxin affecting neuromuscular transmission and their mechanism of action.	
	Molecular mechanism of skeletal muscle contraction	L 26	• Describe the functional anatomy of skeletal muscle fiber. • Describe the microscopic anatomy of myofibrils. • Define elements of the sarcomere that underlie striated muscle contraction.	

			• Describe the role of the proteins that are involved in contraction. • Explain the functions of the following: myosin cross bridges, troponin, tropomyosin, sarcomeres, Z lines, neuromuscular junction, transverse tubules, and sarcoplasmic reticulum • Discuss the molecular events during muscle contraction and muscle relaxation. • Understand the walk-along theory of muscle contraction and the sliding filament hypothesis of muscle contraction. • Describe the role of ATP in muscle contraction. • Explain why muscles are stiff during rigor mortis.	
	Skeletal Muscle Mechanics	L 27	• . • Define muscle twitch and relate muscle twitch to the muscle action potential. • Compare the twitch duration in fats and slow. • Explain the relationship between the contractile component and the series-elastic (tendon) component in transmitting muscle tension to the bone. • Define muscle tension and explain the length–tension in relationship in skeletal muscle and its physiological significant	

			• Describe isotonic and isometric contraction. • Understand the relation between velocity muscle and the velocity shortening to load imposed on muscle. • Explain the motor unit. • Explain how whole muscle strength of contraction can be increased by recruitment of motor units. • Explain twitch summation and the effects of high frequency stimulation on muscle tension • Define muscle tetany and explain its physiological basis	
	Excitation contraction coupling in smooth muscles	L28	• Describe the difference between multiunit and unitary smooth muscle. • Define slow wave depolarization, pacemaker potential and understand their ionic basis • Understand various types of action potentials generated in smooth muscle. • Illustrate the pattern of autonomic innervation of smooth muscle and discuss how the autonomic nervous system modifies the	

			activity of Smooth muscle.	
	Mechanism of Smooth muscle contraction and the mechanical properties of smooth muscle contraction	L 29	• Describe the microscopic structure of smooth muscles and the arrangements of thick and thin filaments. • Illustrate the arrangement of thick and thin filaments in a smooth muscle cell in relaxed and contracted states. • Describe the molecular mechanism of smooth muscle contraction • Describe the molecular mechanism of smooth muscle relaxation. • Explain the slow cycling of the myosin Cross-bridges, and the low energy requirement to sustain smooth muscle contraction. • Explain the slowness of the onset of contraction and relaxation of the smooth muscles. • Compare the maximum force of contraction in smooth	

			muscle compared to skeletal muscles. ● Define The “Latch” mechanism and explain how it facilitates prolonged contractions of smooth muscle. ● Define and explain the phenomena of stress relaxation in smooth muscles and its physiological significance	
	Microcirculation and capillary fluid exchange	L30	● Review the structure and the function of systemic capillary. ● List various types of capillaries ● Describe how capillary wall permeability to a solute is related to the size and lipid solubility of the solute. ● List the factors (Starling forces) that influence transcapillary fluid movement and, given data, predict the direction of transcapillary fluid movement at arterial end and the venous	

	Function of lymphatic capillary and lymph, pathophysiology of edema	L 31	• Describe the structure and function of lymphatic vessel system. • Explain the role of lymphatic vessels in preventing fluid accumulation in interstitial space. • Describe the formation of lymph. • know the rate of daily lymph flow under normal conditions. • List factors that determine lymph flow. • Describe the role of the lymphatic system in controlling interstitial fluid protein concentration, volume, and pressure. • Define edema and differentiate between extracellular and intracellular edema . • Illustrates the difference between pitting and non-pitting edema. • Using starling forces, understand and explain the causes of extracellular edema. • Define lymphedema and list its primary causes.	

			• Explain safety factors that normally prevent edema. • discuss edema in potential spaces of the body (effusion)	
	Acid base balance I	L 32	• Define acids, bases, and buffers. • Define fixed and volatile acid • List the major sources of H ions in the body • State the normal ranges of arterial pH, PCO_2, and bicarbonate concentration, • List the buffer systems in the ECF and ICF and outline their function •	
	Acid base balance II	L33	• , • Define alkalosis, acidosis, alkalemia and acidemia • List the primary potential causes of respiratory acidosis and alkalosis and metabolic acidosis and alkalosis. • Discuss the respiratory mechanisms that help	

			compensate for acidosis. and alkalosis. ● Discuss the renal mechanisms that help compensate for acidosis and alkalosis. ● Understand the difference between compensates and none compensated acidosis and alkalosis ● Evaluate blood gas data to determine acid–base status.	
	Energy balance and control of food intake	L 34	● Outline energy Input and output of the body ● Define metabolic rate and basal metabolic rate. ● List factors which affect metabolic rate ● Explain the role of the hypothalamus in the control of food intake and describe the neuronal pathways within the hypothalamus involved in the control of food intake. ● Identify hormones and neurotransmitters that decrease feeding (Anorexigenic) or increase feeding (orexigenic) and their site of secretion.	

	Body temperature regulation	L 35	• List and define the four mechanisms of heat transfer from the skin to the environment. • Know the normal body temperature and its methods of assessment • Define core body temperature and know the normal core temperature • Compare and contrast core body temperature and peripheral body temperature • Explain the feedback control of internal body temperature. • Understand the short-term response to cold (to increase heat production and minimize heat loss) and heat (to decrease heat production and maximize heat loss). • Describe the role of hypothalamus in temperature regulation and understand the concept of temperature set-point • Understand the mechanisms and pathophysiology of fever.	

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ACADEMIC SUPPORT

It is The Hashemite University policy to provide educational opportunities that ensure fair, appropriate and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their Instructor to ensure that their individual needs are met. The University through its Special Need section will exert all efforts to accommodate for individual needs.

Special Needs Section: Student Services and Care Unit
Tel: 053903333 ext. 4132 / 4583 / 5023
Location: Deanship of Students Affairs
Email: **stydent@hu.edu.jo**

COURSE REGULATIONS

Participation

Class participation and attendance are important elements of every student's learning experience at Hashemite University, and the student is expected to attend all classes. A student should not miss more than 15% of the classes during a semester. *Those exceeding this limit of 15% will receive a failing grade regardless of their performance*. It is a student's responsibility to monitor the frequency of their own absences. **Attendance record begins on the first day of class irrespective of the period allotted to drop/add and late registration. It is a student's responsibility to sign in; failure to do so will result in a non-attendance being recorded.**

In exceptional cases, the student, with the instructor's prior permission, could be exempted from attending a class provided that the number of such occasions does not exceed the limit allowed by the University. The instructor will determine the acceptability of an absence for being absent. A student who misses more than 25% of classes and has a valid excuse for being absent will be allowed to withdraw from the course.

Plagiarism

Plagiarism is considered a serious academic offense and can result in your work losing marks or being failed. HU expects its students to adopt and abide by the highest standards of conduct in their interaction with their professors, peers, and the wider University community. As such, a student is expected not to engage in behaviors that compromise his/her integrity as well as that of the Hashemite University.

Plagiarism includes the following examples, and it applies to all student assignments or submitted work:

- **Use of the work, ideas, images, or words of someone else without his/her permission or reference to them.**
- **Use of someone else's wording, name, phrase, sentence, paragraph, or essay without using quotation marks.**
- **Misrepresentation of the sources that were used.**

The instructor has the right to fail the coursework or deduct marks where plagiarism is detected.

Late or Missed exams: In all cases of assessment, students who fail to attend an exam on the scheduled date without prior permission and/or are unable to provide an accepted medical note will automatically receive a fail grade for this part of the assessment.

Student Complaints Policy

Students at The Hashemite University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the students' handbook.

COURSE ASSESSMENT

Course Calendar and Assessment

Students will be graded through the following means of assessment, and their final grade will be calculated from the forms of assessment listed below, with their grade weighting taken into account.

Assessment	Grade Weighting	Assessment Date
Exam 1	50	TBD
Final Exam	50	TBD
Total final grade	100	

Description of Exams

Test questions will predominately come from the material presented in the lectures. Semester exams will be conducted during the regularly scheduled lecture period. Exam will consist of multiple-choice questions for the regular exams and short assay questions for makeup exams (for students with accepted excuses, only documented absences will be considered as per HU guidelines).

Grades are not negotiable and are awarded to *the MD program* according to the following criteria*:

Letter Grade	Description	Grade Points
A+	Excellent	4.00
A		3.75
A-		3.50
B+	Very Good	3.25
B		3.00
B-		2.75
C+	Good	2.50
C		2.25
C-		2.00
D+	Pass	1.75
D	Pass	1.50
F	Fail	0.00
I	Incomplete	-

WEEKLY LECTURE SCHEDULE AND CONTENT DISTRIBUTION

TBD