Thematic plan of seminar-type classes
in discipline «Molecular regulation of metabolism and cell cycle»
for students of 2023 year of admission
under the educational programme
33.05.01. Pharmacy,
specialisation (profile) Pharmacy
(Specialist's),
form of study full-time
for the 2025-2026 academic year

№	Thematic blocks	Hours (academic) [3]
	5 term	
1.	Introduction to the molecular biology of cells and intercellular interactions.[1] Rafts in the structure of biological membranes. Raft theory. Structure and functions of rafts. Cytoskeleton (filaments) and intracellular transport. Ion channels. Classification of ion channels, selectivity. Molecular mechanisms of ion channel regulation. Model of a voltage-gated ion channel. The role of lipid rafts in the membrane localization of channels[2]	2
2.	Receptors, main characteristics[1] Receptors and their ligands. Agonists (model one receptor, one ligand one effect). Affinity, Kd, intrinsic activity (α). Antagonists, partial agonists/antagonists. Mechanisms of downregulation (addiction, tolerance to opiates) and upregulation of the number of receptors and their sensitivity. Regulated exocytosis and receptor-mediated endocytosis.[2]	2
3.	Types of G proteins, structure and functions.[1] G protein - structure, cycle of functioning, families of subunits, effectors. Variants of Gα subunit. β-arrestin pathway. α and β adrenoreceptors, M-cholinergic receptor. Mechanisms of action of cholera and pertussis toxins, phorbol esters.[2]	2
4.	Protein kinases: structure, classification, properties and biological role.[1] Protein kinase A – regulation of glycogen and CRE metabolism. Protein kinase C, Protein kinase G. Regulation of smooth muscle contraction. Other protein kinases PKB/AKT, AMPK, PI3-kinase.[2]	2
5.	Ca2+ signaling.[1] Protein kinase C. Carcinogenesis, phorbol esters. Dynamics, homeostasis, remodeling. Diseases as a result of abnormal remodeling of Ca2+ signaling. Muscle contraction. Lipophilic hormones.[2]	2
6.	Receptor and cytoplasmic tyrosine kinases.[1] The src kinase family, ZAP70/Syk and JAKs, FAKs. Intracellular effects of insulin, SH2/SH3 domains, Ras/Raf/MAPK pathway. PI3K pathway, tyrosine phosphatases. Rho, Rac and Rab proteins.[2]	2
7.	Signal transmission induced via signalosomes[1] Signalosomes, structure, function and dysfunction. Main signalosomes (WNT, COP9, RIP1/RIP3 necrosome). AIM2 and NLRP3 inflamosomes).[2]	2
8.	The role of small molecules in the regulation of metabolism.[1] Lactate as a signaling molecule, GPRC81 receptor. ROS as signaling molecules. HIP1α as an essential transcription factor. The role of prolyl hydroxylase-2 in oxygen reception.[2]	2

9.	The cell cycle.[1] Interphase G0. Mitosis, meiosis. Cyclins and cyclin-dependent kinases. Cyclin-dependent kinase inhibitors. INK4 - a family of cyclin-dependent kinase inhibitors (CKI). The role of CDKN1A or P21. Tissue regenerative capacity. Cell cycle regulation. ATM-Chk2 and ATR-Chk1 pathways; PAK1 pathway; Map kinase signaling cascade.[2]	2
10.	Cell cycle regulation, cell death[1]. Cyclins and CDK (cyclin-dependent protein kinases). Metabolic intermediates as regulators of metabolism. Phases of the cell cycle. Checkpoints of the cell cycle. Signaling pathways regulating the cell cycle. Extrinsic and intrinsic pathways of apoptosis activation. Apoptosis and necrosis. Mechanism of apoptosis. Receptor-dependent signaling pathway. Mitochondrial signaling pathway.[2]	2
11.	Apoptosis, activation pathways.[1] Apoptosis receptors - CD95 (Apo-1 or Fas) and TNF-R (tumor necrosis factor) protein families. Caspase cascades. Bcl2 protein family. Role of BH3/BH4 domains. P-53 protein system.[2]	2
12.	Molecular bases of afferent signal transmission.[1] The concept of threshold potential, inhibitory postsynaptic potential. Nociceptors and pain signal transmission. Structure and functioning of TRP channels.[2]	2
13.	Nitric oxide is a unique messenger.[1] Synthesis, localization, processes regulated by it. Signaling pathways involved in the transmission of nitric oxide signal outside vascular endothelial cells.[2]	2
14.	Molecular mechanisms of diabetes mellitus development[1]. Diabetes mellitus, definition of the concept, types. Molecular mechanisms of development. Insulin resistance: pre-receptor, receptor and post-receptor levels in impaired insulin sensitivity[2].	2
15.	Intercellular interactions through integrin receptors.[1] Adhesion and aggregation of platelets. Transmission of a mechanical signal through src kinases. WNT and NOTCH signaling Protease-dependent signaling.[2]	2
16.	Molecular mechanisms of carcinogenesis.[1] Kinase cascades. Immunological features of oncological processes. Stages of tumor formation.[2]	2
17.	The effect of a tumor on the body.[1] Inhibitors of kinase cascades in the treatment of malignant melanoma, as means of targeted therapy [2]	2
18.	The effect of a tumor on the body.[1] Inhibitors of kinase cascades in the treatment of malignant melanoma, as means of targeted therapy [2]	2
	Total	36

[1] – topic
[2] – essential content
[3] – one thematic block includes several classes, the duration of one class is 45 minutes, with a break between classes of at least 5 minutes

Considered at the department meeting fundamental and clinical biochemistry, protocol of «29» may 2025 y., № 12.

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