*Appendix to the working program*

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

**BANK OF ASSESSMENT TOOLS FOR DISCIPLINE**

# IMMUNOLOGY-CLINICAL IMMUNOLOGY

Training program (specialty): **31.05.03 DENTISTRY**

Department: **EPIDEMIOLOGY, MICROBIOLOGY AND EVIDENCE-BASED MEDICINE**

Mode of study: **FULL-TIME**

Nizhniy Novgorod
2021

**1. Bank of assessment tools for the current monitoring of academic performance, mid-term assessment of students in the discipline / practice**

This Bank of Assessment Tools (BAT) for the discipline " **IMMUNOLOGY-CLINICAL IMMUNOLOGY**" is an integral appendix to the working program of the discipline " **IMMUNOLOGY-CLINICAL IMMUNOLOGY**". All the details of the approval submitted in the WPD for this discipline apply to this BAT.

*(Banks of assessment tools allow us to evaluate the achievement of the planned results stated in the educational program.*

*Assessment tools are a bank of control tasks, as well as a description of forms and procedures designed to determine the quality of mastering study material by students.)*

**2. List of assessment tools**

The following assessment tools are used to determine the quality of mastering the academic material by students in the discipline/ practice:

| No. | Assessment tool | Brief description of the assessment tool | Presentation of the assessment tool in the BAT |
|---|---|---|---|
| **1** | Test №1 | A system of standardized tasks that allows you to automate the procedure of measuring the level of knowledge and skills of a student | Bank of test tasks |
| **2** | Test №2 | | |
| 3 | Abstract | The product of the student's independent work, which is a summary in writing of the results of the theoretical analysis of a certain scientific (educational and research) topic, where the author reveals the essence of the problem under study, provides various points of view, as well as his /her own views on it. | List of abstract topics |
| 4 | Situational tasks | A method of control that allows you to assess the criticality of thinking and the degree of the material comprehension, the ability to apply theoretical knowledge in practice. | List of tasks |

**3. A list of competencies indicating the stages of their formation in the process of mastering the educational program and the types of evaluation tools**

| Code and formulation of competence* | Stage of competence formation | Controlled sections of the discipline | Assessment tools |
|---|---|---|---|
| UC–1, UC-8, GPC-5, GPC-9, PC-6 | Current | **Section** 1. General immunology. Immunity of the oral cavity<br>**Section** 2. Clinical immunology | Test<br>Abstract<br>Situational tasks |
| UC–1, UC-8, GPC-5, GPC-9, PC-6 | Mid-term | **Section** 1. General immunology. Immunity of the oral cavity | Credit |

| | | | |
|---|---|---|---|
| | | **Section** 2. Clinical immunology | |

**4. The content of the assessment tools of entry, current control**

Entry /current control is carried out by the discipline teacher when conducting classes in the form of: test, abstract, situational tasks

Assessment tools for current control.

1. test
2. abstract
3. situational tasks

4.1. Tests for the assessment of competence " UC–1, UC-8, GPC-5, GPC-9, PC-61. Basic ideas in immunology

**1. Inductors of immune responses:**

1. Antigens. 2. Antibodies. 3. B lymphocytes 4. T lymphocytes. 5. Antigen-presenting cells.

**2. Adaptive immunity:**

1.Acquired 2. Specific. 3. Having memory. 4. Limited by antibody production. 5. Unique mechanism of infection resistance. 6. Antigen-dependent

**3. Positions true for innate immunity:**

1. Specificity. 2. Antigen-induced 3. Depends on lymphocyte reactions. 4. Includes factors and mechanisms of the "first line" of infection defence 5. Memory

**4. Position true for of the inductive phase of immune response:**

1.Antibody production 2. T effectors production 3. Phagocyte activation 4. Immune memory development 5. Clonal selection of lymphocytes.

**5. The basic mechanism of the inductive phase of immune response:**

1. B lymphocyte cloning 2. T lymphocyte cloning 3. Activation of antigen-sensitive lymphocyte clones. 4. Activation of phagocytes. 5. Opsonic cooperation.

**6. Immune system cells recognizing antigens (epitopes):**

1. Macrophages. 2. Dendritic cells. 3. T lymphocytes. 4. B -lymphocytes. 5. Eosinophils. 6. Neutrophils. 7. Mast cells.

**7. Specific effectors of the cell-mediated immunity:**

1. Macrophages. 2. Dendritic cells. 3. T lymphocytes. 4. B- lymphocytes
5. Neutrophils.

**8. Specific effectors of the humoral immunity:**

1. Antigens. 2. Complement. 3. Antibodies. 4. Cytokines. 5. Lysozyme

**9. Clonal specificy of lymphocytes is based upon:**

1. Ability of each clone to interact with the unique antigen. 2. Ability of each clone to interact with several antigens. 3. Specificity of the lymphocyte antigen receptors 4. CD-phenotype specificity. 5. MHC-phenotype.

**10. Central (primary) organs of immune system ( in *Mammalia* ):**

1. Mucosal lymph tissues 2. Bone marrow 3. Lymphiod nodes. 4. Thymus 5. Spleen

**11. Peripheral (secondary) organs of immune system:**

1. Mucosal lymphoid tissues 2. Bone marrow 3. Lymph nodes. 4. Thymus 5. Spleen.

**12. Immunological events happening in thymus:**

1. Differentiation of the basic functional variants of T lymphocytes (CD4+, CD8+). 2. T lymphocyte cloning. 3. Negative selection of clones. 4. Positive selection of clones. 5. Antigen-dependent differentiation of lymphocytes. 6. B lymphocyte cloning.

**13. Positions true for antigen-independent differentiation of lymphocytes:**

1.Develops in central organs of immune system. 2. Develops in peripheral lymphoid

tissue. 3. Results in lymphocyte cloning 4. Results in the immune to self-antigens tolerance ( autotolerance ). 5. Results in lymphocyte maturation.

**14. The concept "immunogenesis" reflects the following processes:**

1. Antigen-dependent lymphocyte differentiation in the peripheral lymphoid tissue. 2. Immunity effector production 3. Memory cell maturation 4. Induction phase of immune response. 5. Effector phase of immune response.

**2. Antigens**

**1. Antigen sources for humans:**

1. Microorganisms. 2. Animals. 3. Plants. 4. Synthetic products. 5. Other people. 6. Autologic (self) tissues.

**2. Factors determining immunogenicity of antigens:**

1. Structural foreigness 2. Molecular weight. 3. Chemical nature. 4. Injection route 5. Dosage.

**3. Functions of antigenic epitopes:**

1. Immunogenicity. 2. Specificity. 3. Interaction of a antigenic determinant with the lymphocyte clone-specific receptor. 4. Adjuvant activity. 5. Specific interaction with antigen-presenting cells.

**4. Carrier-dependent functions of antigens:**

1. Specificity ( humoral immunity). 2. Immunogenicity. 3. Interaction with antigen-presenting cells. 4. Source of T-epitops. 5. Adjuvant activity.

**5. Haptens are non-immunogenic owing to:**

1. Non-foreigness 2. Absence of epitopes 3. Absence of carrier. 4. Low molecular weight 5. Immune tolerance.

**6. Properties of haptens:**

1. Immunogenicity 2. Foreigness. 3. Epitope specificity. 4. Ability to interact with preformed antibodies. 5. Ability to interact with B lymphocyte receptors

**7. Positions true for B-epitopes:**

1. Conformational sites of molecules. 2. Functional similarity with haptens 3.Polyclonal specificity. 4. Produced by antigen processing in antigen-presenting cells. 5. Direct interaction with B-lymphocyte receptors.

**8. Positions true for T-epitopes:**

1. Elements of primary structure of protein antigens (sequential epitopes). 2. Conformational elements of molecule (conformational epitopes). 3. Produced by antigen processing in antigen-presenting cells. 4. Direct interaction with lymphocyte receptors 5. MHC (HLA)-dependent presentation

**9. Conformational epitopes:**

1.T-epitopes. 2. B- epitopes. 3. Basis for antigen-specific interaction with antibodies. 4. Presented by MHC/HLA. 5. Produced in antigen-presenting cells (processing).

**10. Sequential epitopes:**

1. T-epitopes. 2. B- epitopes. 3. May participate in interaction with antibodies. 4. Are presented by MHC/HLA. 5. Produced in antigen-presenting cells (processing).

**11. Possible basis and patterns of antigen polyvalence:**

1. Presence of several identical epitopes. 2. Presence of epitopes with different specificity. 3. Adjuvant activity of a carrier. 4. Ability to bind antibodies of the same specificity. 5. Ability to bind antibodies of different specificity.

**12. Alloantigens:**

1. Basis for intraspecies antigenic differences. 2. Induce xenograft rejection 3. Induce autoimmune reactions. 4 Induce allograft rejection. 5. A basis for blood group subdivision.

**3. Immunoglobulins. Antibodies.**

**1. Antibody producing cells:**

1. B lymphocytes. 2. T lymphocytes. 3. Plasmocytes. 4. Macrophages. 5. Neutrophils. 6. Eosinophiles. 7. Mast cells. 8. Monocytes.

**2. Main structural subunits of the immunoglobulin molecule:**

1.Two identical L-chains 2. Two identical H-chains. 3. Two non-identical L-chains 4. Two non-identical H-chains. 5. Single L- and H-chains.

**3. Papain fragments of the immunoglobulin molecule:**

1. L 2. H 3. Fc 4. Fab 5. S. 6. J

**4. Variable domains (V) are subunits of the following parts of immunoglobulins:**

1. H-chains only. 2. L-chain. only 3. H- and L-chains. 4. Fab-fragments 5. Fc- fragments.

**5. L- and H-chains include:**

1. V- and C-fragment. 2. V- or C-fragment. 3. Several V- and C-fragments. 4. J- component 5. S-component

**6. Specificity (antigen-binding activity) is determined by the following components of the antibody molecule:**

1. Framework regions (FRs) of V-domain.s 2. Hypervariable regions of V-domains 3. Fab-fragments . 4. Fc-fragment 5. Constant domains of L- and H- chains.

**7. Antigen-binding site (paratope) of antibodies:**

1. Combination of $V_L$- and $V_H$ hypervariable regions 2. Combination of variable (V) and constant (C) domains of L- and H-chains. 3. Is included in Fab-fragments. 4. Is included in Fc-fragment. 5. Contains hypervariable regions of H-chains ($V_H$) only.

**8. Effector (secondary) functions of antibodies:**

1. Complement activation. 2. Interaction with Fc-receptors of cells. 3.Ttransplacental transfer. 4.Interaction with Fab-receptors of cells. 5. Antigen binding.

**9. Effector (secondary) functions of antibodies are determined by**

1. C-fragment of L-chain. 2. C-fragment of H-chain. 3. Fc-fragment 4. Fab-fragment 5. Hypervariable regions of V-domains.

**10. Classes of immunoglobulins differ in:**

1. Constant domains of H-chains. 2. Constant domain of L-chains 3.Variable domain of H-chains. 4. Variable domain of L-chains 5. Fab-fragment. 6. Fc-fragment

**11. H-isotypes of immunoglobulins:**

1. Differ in Fc-fragment. 2. Differ in Fab-fragment 3. Synonym for immunoglobulin classes 4. Differ in effector (secondary) functions. 5. Synonym for idiotypes.

**12. Subdivision of immunoglobulins into classes is based on the following ideas:**

1. L-isotypes 2. Allotypes. 3. H-isotypes. 4. Idiotypes. 5. Reactivity to antigens.

**13. Individual (intraspecies ) differences are connected with the following immunoglobulin variants:**

1. Classes 2. Isotypes. 3. Subclasses. 4 . Allotypes. 5. Idiotypes.

**14. Arrange the immunoglobulin classes according to their serum concentration:**

1. IgA. 2. IgD. 3. IgE. 4. IgG. 5. IgM.

**15. Immunoglobulins penetrating placenta:**

1.IgG. 2. IgM. 3. IgE. 4. IgD. 5. IgA.

**16. Immunoglobulins (antibodies) passively protecting newborns:**

1. IgA. 2. IgM. 3. IgG. 4. IgE. 5. IgD.

**17. Immunoglobulins (antibodies) activating complement:**

1. IgG. 2. IgA. 3. IgE. 4. IgM. 5. IgD.

**18. Immunoglobulins (antibodies) being the most important in allergic reactions:**

1. IgG. 2. IgD. 3. IgE. 4. IgM. 5. IgA.

**19. Immunoglobulins (antibodies) being the most important in mucosal immunity:**

1.IgG. 2. IgE. 3. IgD. 4. IgA. 5. IgM.

**20. Immunoglobulins (antibodies) with direct opsonic function:**

1. IgA. 2. IgD. 3. IgE. 4. IgG. 5. IgM.

**21. Pentameric structure is typical for:**

1.IgA. 2. IgD. 3. IgE. 4. IgG. 5. IgM.

**22. Unique subunit of polymeric IgM- and IgA is:**

1. Fc. 2. H. 3. L. 4. Fab. 5. J. 6. S. 7. CDR

**23. Initial and secondary (anamnestic, revaccinal ) immune responses differ in the following:**

1. Kinetics of antibody production 2. Class of antibodies. 3. Intensity of antibody production. 4. Antibody affinity 5. Allotype of antibodies.

**24. The first antibodies in primary immune response (at the first antigen exposure) belong to:**

1. IgA. 2. IgD. 3. IgE. 4. IgG. 5. IgM.

**25. B-lymphocytes cloning means:**

1. Ability to synthesize antibodies of one immunoglobulin class. 2. Ability to synthesize antibodies of the unique (one-epitope) specificity. 3. Ability to produce antibodies of definite allotype. 4. Selective reception of cytokines. 5. Selective reception of antigen epitopes.

**26. Properties of B lymphocyte clones:**

1. Production of various immunoglobulin classes 2. Production of immunoglobulin allotypes. 3. Production of various immunoglobulin idiotypes. 4. Production of antibodies with unique antigen ( epitope ) specificity. 5. Production of antibodies reacting with different antigens.

**27. Antigen-dependent selection of B lymphocyte clones means:**

1. Synthesis of antibodies with single specificity. 2. Synthesis of one class of antibodies 3. Synthesis of antibodies with a unique idiotype. 4.Synthesis of immunoglobulins with identical $V_L$ and $V_{H.}$ 5. Dependence on sensitivity to antigens.

**28. Monoclonal antibodies:**

1. Belong to one idiotype. 2. Interact with the unique epitope. 3. Interact with different epitopes. 4. Produced by B-hybridomas. 5. Produced by T-hybridomas.

**29. Components necessary for hybridoma development:**

1. Naive B- lymphocytes 2. Antigen-activated B- lymphocytes 3. Macrophages. 4. Myeloma cells. 5. Dendritic cells. 6. T- lymphocytes.

## 4. Antigen recognition. Receptors of lymphocytes. Major Histocompatibility Complex (MHC /HLA). MHC /HLA- restriction of immune response.

**1. Antigen-recognizing receptors of naive B-lymphocytes (BCR):**

1.IgA. 2. CD 3. IgG. 4. mIgM. 5. HLA-II.

**2. Positions true for BCR of naive B-lymphocytes:**

1. Includes different classes of immunoglobulins. 2. Restricted by MHC. 3. Antigen-dependent clone specificity 4. CD antigens. 5. Has a secretory form.

**3. Positions true for T lymphocyte receptor (TCR):**

1. Consists of alpha and beta-chains 2. Clone specificity 3. Interaction with free antigens. 4. Interact with MHC-presented peptides 5. Functionally dependent on CD3

**4. Elements of T helper (Th) receptor complex :**

1. MHC-I. 2. CD3. 3. CD4. 4. CD8. 5. MHC-II. 6. TCR.

**5. Elements of T killer (CTL) receptor complex :**

1. MHC-I. 2. CD3. 3. CD4. 4. CD8. 5. MHC-II. 6. TCR.

**6. Positions true for TCR:**

1. Cloned by variable domains. 2. Cloned by constant domains . 3. Interaction with free antigens. 4. Associated with costimulatory molecules. 5. TCR-complex reaction is restricted by MHC

**7. Positions true for both TCR and BCR:**

1. Double recognition of antigens. 2. Absence of a secretory form. 3. Clonal specificity 4.Antigen-induced immunoglobulin class switching. 5.Functional dependence on CD3.

**8. The Human Major Histocompatibility Complex designation ( acronym ) :**

1. MHC. 2. CD4. 3. CD8. 4. HLA. 5. BCR. 6. TCR.

**9. HLA-I subclasses :**

1. A. 2. B. 3. C. 4. DR. 5. DP. 6. DQ.

**10. HLA-II subclasses:**

1.A. 2. B. 3. C. 4. DR. 5. DP. 6. DQ.

**11. Positions true for MHC phenotype:**

1. Determined by MHC-I polymorphism 2. Determined by MHC-II polymorphism. 3. Result of the coexpression of two haplotypes . 4. Result of the expression of one haplotype. 5. Clonal specificity

**12. MHC (HLA)- phenotype:**

1. Includes different classes of molecules. 2. Identical in close relatives 3. Determined by alloantigens of nucleated cells. 4. Responsible for incompatibility of the allogenic tissues. 5. Participates in the immune response regulation.

**13. Physiological functions of MHC:**

1. Antigen presentation for T lymphocytes 2. Functional cooperation of immune system cells 3. Antigen presentation for B lymphocytes. 4. Rejection of the allogenic tissues. 5. Regulation of immune response.

**14. Positions true for MHC (HLA)-I molecules**

1. Presence on all nucleated cells 2. Mainly expressed by professional antigen-presenting cells. 3 Antigen presentation for CD8 T lymphocytes. 4. Antigen presentation for CD4 T lymphocytes. 5. Participation in the T-dependent regulation of antibody production.

**15. Positions true for MHC (HLA) -II molecules:**

1. Expressed by all nucleated cells. 2. Expressed by professional antigen-presenting cells. 3. Antigen presentation for CD8 T lymphocytes. 4. Antigen presentation for CD4 lymphocytes. 5. Participation in T-dependent regulation of antibody production.

**16. Professional antigen-presenting cells:**

1. Dendritic cells. 2. Macrophages. 3. Neutrophils. 4. T lymphocytes. 5. B lymphocytes 6. Plasma cells.

**17. Antigen presentation by antigen-presenting cells includes:**

1. Processing (antigenic peptide forming). 2. Selective interaction of antigenic peptides with MHC molecules. 3. MHC-dependent expression of T-epitopes. 4. MHC-dependent expression of B-epitopes. 5. Interaction with T-receptor complex.

**18. Antigen-presenting molecules:**

1. CD. 2. IgG 3. MHC-I 4. MHC-II 5. BCR 6. TCR.

**19. Cells interacting with antigens presented by MHC (HLA) -I:**

1. B lymphocytes. 2. Macrophages. 3. T helpers. 4. Plasma cells. 5. T killers (cytotoxic T lymphocytes).

**20. Cells interacting with antigens presented by MHC (HLA) -II:**

1. B lymphocytes. 2. Macrophages. 3. T helpers. 4. Plasma cells. 5. T killers (cytotoxic T lymphocytes).

**21. The double antigen recognition means:**

1. Lymphocyte interaction with two epitopes. 2. MHC-dependent presentation of T-epitopes. 3. MHC-restriction of immune response. 4. Interaction of TCR with the MHC-anigenic peptide complex 5. Interaction of BCR with the MHC-antigenic peptide complex.

**22. MHC-restriction of immune response includes:**

1. Double recognition of antigens by B- lymphocytes. 2. MHC-dependent presentation of T-epitopes. 3. Antigen processing by antigen-presenting cells. 4. Complementarity (selective interaction) between antigenic peptides and MHC (HLA) molecules. 5. MHC-dependent cooperation of the immunocompetent cells.

**23. MHC(HLA)- presentation of antigens for T helpers is determined by the following factors and mechanisms:**

1. Selective interaction of antigenic peptides with MHC-II-molecules. 2. Complemen-tarity between MHC-II and CD8. 3. Complementarity between MHC-I and CD8. 4. Recognition of " T-epitope-MHC-II complex " by TCR (double antigen recog-nition) 5. Complementarity between MHC-II and CD4.

**24. Factors and mechanisms determining the MHC-dependent regulation of immune response.**

1. Selective MHC (HLA) interaction with antigenic peptides. 2. Regulation of MHC (HLA) expression on antigen-presenting cells 3. MHC (HLA) polymorphism 4. MHC (HLA)-I - presentation of antigens for CD8 T lymphocytes.

5. MHC (HLA)-II - presentation of antigens for CD4 T lymphocytes.

**Answers :**

1. Basic ideas in immunology.

1 (1), 2 (1,2,3,6), 3(4), 4(1,2,4), 5(3), 6(3,4), 7(3), 8(3), 9(1,3), 10(2,4), 11(1,3,5), 12 (1, 2, 3,4), 13(1,3,4), 14(1,2,3,4).

2. Antigens.

1(1-6), 2(1-5), 3(2,3), 4(2,3,4,5), 5(3,4), 6(2,3,4,5), 7(1,2,5), 8(1,3,5), 9(2,3), 10(1,4,5), 11(1,2,4,5), 12(1,4,5).

3. Immunoglobulins. Antibodies.

1(3), 2(1,2), 3(3,4), 4(3,4), 5(1), 6(2,3), 7(1,3), 8(1,2,3), 9(2,3), 10(1,6), 11(1,3,4), 12(3), 13(4 ), 14(4-1-5-2-3), 15(1), 16(3), 17(1,4), 18(3), 19(4), 20(4), 21(5), 22(5), 23(1,2,3,4), 24(5), 25(2,5), 26(3,4), 27(1,3,4,5), 28(1,2,4), 29(2,4).

4. Antigen recognizing. Receptors of lymphocytes. Major Histocompatibility Complex (MHC /HLA). MHC /HLA- restriction of immune response.

1(4), 2(5), 3(1,2,4,5), 4(2,3,6), 5(2,4,6), 6(1,4,5), 7(3), 8(4), 9(1,2,3), 10(4,5,6), 11(1,2, 3), 12(1,3,4,5),13(1,2,5), 14(1,3), 15(2,4,5), 16(1,2,5), 17(1,2,3,5), 18(3,4), 19(5), 20(3), 21(2,3,4), 22(2-5), 23(1,4,5), 24(1-5).

4.2. Abstracts for the assessment of competence UC–1, UC-8, GPC-5, GPC-9, PC-6

1. Modern immunological methods of examination of the patient
2. Immunogram and its interpretation
3. Equipment used in a modern diagnostic laboratory
4. Immunological status of the patient and its significance in clinical practice

4.3. Tasks (assessment tools) for the exam/credit **:** UC–1, UC-8, GPC-5, GPC-9, PC-6

1. In a pregnant woman with a period of 11-12 weeks, when examined for a TORCH infection complex, specific Ig M and IgG to toxoplasma were detected.

1. What causes infection of women during pregnancy?
2. Methods of laboratory diagnostics?

2. Negative results of examination of women for TORCH infection during pregnancy planning indicate …… :

1. What additional diagnostic methods should be used to examine this woman?
2. Specific prevention?

3. Is IgM detection dangerous to HSV during pregnancy
1. Is there a threat to the fetus?
2. What additional diagnostic methods should be used to examine this woman?

**5. The content of the assessment tools of mid-term assessment**

Mid-term assessment is carried out in the form of **a credit**

*The content of the assessment tool*

*https://sdo.pimunn.net/course/index.php?categoryid=743*

5.1 The list of control tasks and other materials necessary for the assessment of knowledge, skills and work experience

5.1.1. Questions for the credit in the discipline "Immunology".

Competence code (according to the WPD) UC–1, UC-8, GPC-5, GPC-9, PC-6

1. The concept of immunity. The basic differences between innate and adaptive immunity. Immunological concept of "specificity". The main factors (cellular and humoral) of specific and nonspecific immunity. The concept of humoral and cellular immunity.
2. A concept scheme of the immune response (from induction to implementation). Immunological memory.
3. Central (primary) organs of the immune system. Results of lymphocyte differentiation in the central immunity organs (functional maturation of lymphocytes, cloning, positive and negative selection). Immunological tolerance.
4. Peripheral (secondary) organs/tissues of the immune system. Results of antigen-dependent activation of lymphocytes in peripheral lymphoid tissue (immunogenesis). Lymphocyte recycling, homing effect.
5. Antigens, definitions. Sources of antigens. Xenoantigens, alloantigens, autoantigens. Submolecular organization of high-grade antigens. Chemical composition. Properties of high-grade antigens. Factors affecting immunogenicity implementation. Polyvalence of "natural" antigens and its manifestations.
6. The concept of B-and T-epitopes in the structure of the antigen. The concept of conformational and sequential (linear) epitopes. Structural and functional features of B-epitopes. Haptens as defective antigens, their properties. B-epitopes as variants of haptens.
7. The concept of B-and T-epitopes in the structure of the antigen. Structural and functional features of T-epitopes. The formation mechanism of T-epitopes. The relationship of antigens with antigen-presenting cells, antigen processing.
8. Antibodies, the concept definition. Cellular nature (origin) of antibodies. The biochemical nature of antibodies. Submolecular organization of a typical immunoglobulin molecule (IgG).
9. Antibodies: structural basis of specificity. Paratopes. Hypervariable regions of immunoglobulin V domains. The concept of papain fragments of antibodies, and their relationship with the "primary" and "secondary" functions of antibodies. Idiotypes and allotypes of antibodies.
10. Isotypes of immunoglobulins. Immunoglobulin classes. Structural features and functions of different classes, quantitative comparison of their presence in human serum.
11. The concept of a secretory immune system (mucosal immunity/mucosal immunity). Secretory IgA (sIgA) formation, structure and function.
12. Dynamics of antibody synthesis during the primary and secondary humoral immune response: qualitative and quantitative seroconversion. The value of B-cells of immunological memory in secondary immune response development. Affinity of antibodies.
13. Cloning of B-lymphocytes. Selective activation of the antigen-sensitive clone as the immune response basis. The polyclonal nature of the immune (antibody-dependent) response to "natural" antigens and its causes. Monoclonal antibodies. B-hybridomas (principles of hybridoma technology).

14. Antigen recognition B-lymphocyte receptors (BCR): basic receptors (isotypes) and their rearrangement in the immune response. The presentation features of antigens to B-lymphocytes. The mechanism of antigenic signal amplification and the participation of CD-molecules (the concept of receptor complexes).
15. CD molecules/antigens (concept, functions). Functional classification of T-lymphocytes. Auxiliary molecules involved in antigen recognition by T and B lymphocytes. The involvement of CD molecules in T-lymphocyte co-stimulation at the induction stage.
16. The main category of T cell antigen recognition receptor (TCR). Structure, similarity and differences with receptors of B-lymphocytes. TCR-complex and its role in antigen signal amplification.
17. The main human histocompatibility complex: genes and their products, the etymology of the acronyms "MHC", "HLA". Genetic basis of HLA polymorphism HLA class I (HLA-I). Subclasses, principle of structure, tissue localization, function. The presentation mechanism of antigens to T-lymphocytes by HLA-1 molecules.
18. HLA Class II. Subclasses, principle of structure, tissue localization, function. "Professional" and "non-professional" antigen presenting cells. The presentation mechanism of antigens to T-lymphocytes by HLA-II molecules.
19. The dual recognition principle of antigens by T-lymphocytes. The concept of HLA-restricted immune response. Features of HLA-I and HLA-II dependent antigen presentation to T lymphocytes.
20. The concept of induction of a (specific) immune response/immunogenesis. Cells related to auxiliary functions during the immune response induction, their participation in the antigen transport and presentation. Co-stimulation principles of B- and T-lymphocytes during induction: mediator (humoral) signals, contact interactions.
21. Cytokines: definition. Cytokine biochemical nature, sources, classification, properties, mechanisms of action. The similarities and differences of cytokines and hormones. The concept of "cytokine network".
22. The main directions and principles of immunogenesis. Antigen-dependent selection of "naive" lymphocytic clones. The result of antigen-dependent activation of "naive" lymphocytes: proliferation and "clone expansion", differentiation into effectors. Formation of immunological memory cells.
23. Induction stages of T-dependent immune response. Activation of CD4 + T-lymphocytes (T-helper cells, Th) during induction: the antigen recognition principle, the molecular basis of intercellular cooperation, the results of anti-induced differentiation. Functional variants of T-helper cells (Th1, Th2), their differences.
24. Activation of CD8 + T-lymphocytes (cTL) during induction of a T-dependent immune response: the antigen recognition principle, the molecular basis of intercellular cooperation, the results of anti-induced differentiation.
25. Activation of B-lymphocytes during the induction of a T-dependent immune response: the antigen recognition principle, the molecular basis of intercellular cooperation, the results of antigen-induced differentiation. The formation of a clone of antibody-producing cells (plasma cells).
26. The concept of T-dependent and T-independent antigens. T-independent antigens: chemical nature, reaction features. Superantigens as non-specific (polyclonal) T-lymphocyte activators.
27. The complement system. Definition, nomenclature, principles of activation (limited proteolysis, the formation of supramolecular complexes, conformational changes in molecules, cascade). The classic pathway of complement activation: inductors and main stages.
28. Alternative pathway of complement activation: inductors and main stages. Effects of complement (membrane-attacking complex, anaphylatoxins, chemoattractants, opsonins), their functions.
29. Professional phagocytes (neutrophils, macrophages), their ontogenesis and functions. Participation in acute and chronic inflammatory response development. Phagocytic reaction stage. Phagocyte biocidal mechanisms. The concept of chemoattractants.
30. Direct and opsonin-dependent (immune) phagocytosis. The concept of non-specific and specific opsonins. The role of a complement and antibodies in opsonophagocytic reactions.

31. Antibodies as immunity effectors. Targets for antibodies, antigen-elimination function of antibodies. The ability of antibodies (immunoglobulins) to cooperate with nonspecific immunity factors (phagocytes, complement, natural killer cells). Antibodies as direct and indirect opsonins.
32. T-lymphocytes as immunity effectors, their targets. Implementation mechanisms of the effector potential of CD8 + T-lymphocytes (cytotoxic T-lymphocytes) and CD4 + T-lymphocytes (T-helper cells). The cooperation mechanism of cellular immunity effectors.
33. Functional cooperation of macrophages and T-lymphocytes with intramacrophagic/intracellular infections.
34. Natural killers (NK-cells): characteristics, targets, mechanisms of cytotoxic effect. The phenomenon of antibody-dependent cellular cytotoxicity.
35. Antigenic targets in antiviral immunity (virions, virus-infected cells). Antibody functions in antiviral immunity: targets and mechanisms of antiviral activity. The functions of T-lymphocytes in antiviral immunity: targets and mechanisms of antiviral activity.
36. Functions of natural killers in antiviral immunity: targets and mechanisms of antiviral activity. Interferons: classification, nature, mediator functions, mechanisms of antiviral activity.
37. Protection levels against infection. Skin as a barrier to an infection. Factors and mechanisms of colonization resistance of mucous membranes. Inflammation as the mobilization and interaction mechanism of immunity effectors. Effectors involved in pathogen neutralization/destruction at an intravascular invasion stage.
38. Types of acquired (specific) anti-infective immunity: natural and artificial, active and passive. Seroprophylaxis and serotherapy. Immune sera and immunoglobulins. An effective agent of serum preparations. Homological and heterologous drugs, the principle of their production.
39. Vaccinal prophylaxis. An effective agent of vaccines. The concept of protective antigens. Types of vaccines (live, killed, subunit). The attenuation principle. Mono-, associated and polyvalent vaccines.
40. Vaccinal prophylaxis. Methods to enhance vaccinal immunogenicity. Immunological adjuvants. Conjugate vaccines: prescription, principles of production. Vaccine administration methods. Mucosal vaccines, their purpose.

## 6. Criteria for evaluating learning outcomes

*For the credit*

| **Learning outcomes** | **Evaluation criteria** | |
|---|---|---|
| | **Not passed** | **Passed** |
| **Completeness of knowledge** | The level of knowledge is below the minimum requirements. There were bad mistakes. | The level of knowledge in the volume corresponding to the training program. Minor mistakes may be made |
| **Availability of skills** | Basic skills are not demonstrated when solving standard tasks. There were bad mistakes. | Basic skills are demonstrated. Typical tasks have been solved, all tasks have been completed. Minor mistakes may be made. |
| **Availability of skills (possession of experience)** | Basic skills are not demonstrated when solving standard tasks. There were bad mistakes. | Basic skills in solving standard tasks are demonstrated. Minor mistakes may be made. |
| **Motivation (personal attitude)** | Educational activity and motivation are poorly expressed, there is no willingness to solve the tasks qualitatively | Educational activity and motivation are manifested, readiness to perform assigned tasks is demonstrated. |

| | | |
|---|---|---|
| **Characteristics of competence formation*** | The competence is not fully formed. The available knowledge and skills are not enough to solve practical (professional) tasks. Repeated training is required | The competence developed meets the requirements. The available knowledge, skills and motivation are generally sufficient to solve practical (professional) tasks. |
| **The level of competence formation*** | Low | Medium/High |

*For testing:*

Mark "5" (Excellent) - points (100-90%)
Mark"4" (Good) - points (89-80%)
Mark "3" (Satisfactory) - points (79-70%)

*Less than 70% – Unsatisfactory – Mark "2"*

The bank of assessment tools for conducting current control and mid-term assessment of students in this discipline is presented on the Educational Portal of the PRMU
*https://sdo.pimunn.net/course/index.php?categoryid=20*

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