

Syllabus for MEDICAL students, academic year 2021-22

The syllabus contains 103 questions, subdivided into following sections:

- I. Biopolymers - structure, synthesis and self-assembly**
- II. Genome - organization and gene expression**
- III. Cell cycle and cell communications**
- IV. Reproduction - mechanisms of fertilization and early embryogenesis**
- V. Methods to study biopolymers and cells - molecular basis**
- VI. Immunity - molecular and cellular basis**
- VII. Evolution and development**
- VIII. Biology of medically important parasites**
- IX. Vertebrate comparative anatomy and evolution**

I. Biopolymers - structure, synthesis and self-assembly

- 1. Origin and evolution of cells.
- 2. Proteins. Protein domains. Protein families.
- 3. Nucleic acids. DNA. RNA
- 4. Recognition and self-assembly of macromolecules. Cytoskeleton.
- 5. Transcription.
- 6. RNA processing.
- 7. Genetic code. Translation.
- 8. Proteins after translation: sorting, folding, modifications, degradation.
- 9. DNA replication.
- 10. RNA replication. Reverse transcription
- 11. DNA repair.

II. Genome organization and gene expression

- 12. Prokaryotic genome and regulation of gene expression.
- 13. Eukaryotic genome and regulation of gene expression.
- 14. Cytoplasmic (extrachromosomal) inheritance in prokaryotes and eukaryotes.
- 15. General (homologous) recombination. Molecular mechanisms of crossing over.
- 16. Site-specific recombination.
- 17. Reproduction of viruses.
- 18. Chromatin. Nucleosomes.
- 19. Human karyotype. Types of chromosomes.
- 20. Gene mutations. Mechanisms and mutagenic factors.
- 21. Chromosomal mutations. Evolution of karyotype.
- 22. Genes and alleles. Dominance and recessivity - mechanisms, medical examples. Penetrance and expressivity.
- 23. Phenotype, genotype and allele frequencies. Hardy – Weinberg law.
- 24. Factors influencing allele frequencies: mutations, migrations, natural selection.
- 25. Effects of isolation: genetic drift, inbreeding.
- 26. Quantitative traits.

III. Cell cycle and cell communications

- 27. Cell cycle. Mitosis. Cell cycle control.

28. Growth factors, protooncogenes, oncogenes, tumor suppressors. Oncogenic viruses
29. Cell senescence. Cell death: apoptosis, necrosis.
30. Cell signaling. Cell receptors.

IV. Reproduction - mechanisms of fertilization and early embryogenesis

31. Meiosis. Origin of germ cells.
32. Spermatogenesis. Mammalian spermatozoa.
33. Oogenesis. Mature mammalian ova.
34. Fertilization. Interaction of maternal and paternal genomes.
35. Assisted reproduction: IVF, ICSI.
36. Embryonic development – early stages (zygote to neurula).
37. Embryonic development – regulative and mosaic. Morphogens and embryonic induction.
38. Preimplantation mammalian embryo.
39. Sex determination and differentiation.

V. Methods to study biopolymers and cells - molecular basis

40. Methods of karyotyping and chromosome analysis.
41. Basic methods in molecular biology – electrophoresis, PCR, blotting, sequencing.
42. Immunological methods. Diagnosis of viral infections.
43. Recombinant DNA technology – restriction endonucleases, DNA vectors, recombinant proteins.
44. Cell micromanipulations.
45. Transgenic animals. Gene therapy.

VI. Immunity - molecular and cellular basis

46. Innate immunity.
47. Structure of antibodies.
48. Functions of antibodies.
49. Molecules of cell-mediated immunity.
50. Cytotoxic and helper T lymphocytes.
51. Genetic basis of antibodies and T-cell receptors.
52. Lymphocyte differentiation in central lymphoid organs.
53. Lymphocyte differentiation in peripheral lymphoid organs. Immune response
54. Immune memory.
55. Immune tolerance. Regulatory T lymphocytes.
56. Transplantation immunity.
57. Antitumor immunity. Evolution of immunity.
58. Blood group alloantigens. ABO and H blood groups.
59. Rhesus blood groups.

VII. Evolution and development

60. Animal evolution before vertebrates.
61. Sequence of evolutionary innovations in vertebrate classes
62. Phylogeny and development of the skull
63. Phylogeny and development of the postcranial skeleton
64. Phylogeny and development of the skin
65. Phylogeny and development of the nervous system (brain and spinal cord)
66. Phylogeny and development of the skin sense organs, taste, and olfactory organs.
67. Phylogeny and development of the organ of balance and hearing.
68. Phylogeny and development of organ of vision.
69. Phylogeny and development of digestive system.

70. Phylogeny and development of circulatory system.
71. Phylogeny and development of respiratory system.
72. Phylogeny and development of excretory system.
73. Phylogeny and development of reproductive system.
74. Mechanisms of evolution. Anagenesis.
75. Speciation (cladogenesis). Macroevolution.
76. Human evolution.
77. Molecular evolution.

VIII. Biology of medically important parasites

78. Protozoa. Phylum Sarcomastigophora. Subphylum Mastigophora (Flagellata). *Trypanosoma brucei gambiense*, *Trypanosoma brucei rhodesiense*. *Trypanosoma cruzi*.
79. *Leishmania donovani*. *Leishmania tropica*. *Leishmania braziliensis*.
80. *Trichomonas vaginalis*. *Trichomonas tenax*. *Giardia lamblia* (*Lamblia intestinalis*).
81. Subphylum Sarcodina. *Entamoeba histolytica*. *Entamoeba dispar*. *Entamoeba gingivalis*.
82. Phylum Apicomplexa. *Toxoplasma gondii*.
83. *Plasmodium vivax*. *Plasmodium malariae*. *Plasmodium falciparum*. Morphological differences in the erythrocyte schizogony of the genus *Plasmodium*.
84. Phylum Ciliophora. *Balantidium coli*.
85. Metazoa: important evolutionary changes associated with the transition to multicellularity. Phylum Cnidaria (Coelenterata). Genus *Hydra*. Genus *Obelia*.
86. Phylum Platyhelminthes: important evolutionary changes. Class Trematoda. *Fasciola hepatica*.
87. *Dicrocoelium dendriticum* (*D. lanceatum*).
88. *Opisthorchis felinus*. Genus *Schistosoma* and its species.
89. Class Cestoda. *Diphyllobothrium latum*.
90. *Taenia saginata*. *Taenia solium*.
91. *Echinococcus granulosus*. *Hymenolepis nana*.
92. Phylum Nematoda. *Ascaris lumbricoides*.
93. *Enterobius vermicularis*. *Trichuris trichiura* (*Trichocephalus trichiurus*).
94. *Trichinella spiralis*.
95. *Ancylostoma duodenale*. *Strongyloides stercoralis*.
96. *Dracunculus medinensis*. Filarial worms: *Wuchereria bancrofti*, *Loa loa*, *Onchocerca volvulus*.
97. Phylum Annelida: important evolutionary changes. *Lumbricus terrestris*. *Hirudo medicinalis*.
98. Phylum Arthropoda: important evolutionary changes. Class Crustacea: general characterization. Class Arachnida. Orders Scorpiones and Araneae.
99. Order Acari. Medical importance of ticks and mites.
100. Class Insecta. The role of insects as vectors and mechanical carriers.
101. *Pediculus humanus*. *Phthirus pubis*. *Cimex lectularius*. *Pulex irritans*.
102. Genus *Culex* and genus *Anopheles*: morphological differences. *Phlebotomus papatasi*.
103. Overview of parasitism.