Questions for the 1st term test

1. Types of mechanical deformation.
2. Stress-Strain Relationship. Hooke's Law. Young's Modulus. Typical engineering stress-strain plot.
3. Biomechanical properties of bones, muscles, blood vessels tissue, cartilage.
4. Elastic, viscous, viscoelastic media and their mechanical properties. Mechanical models of viscoelastic properties of biological tissues
5. Mechanical oscillations. Simple Harmonic Motion
6. Energy in Simple Harmonic motion
7. Damped oscillations. Forced oscillations. Resonance
8. Superposition of Oscillations. Self-oscillations
9. Compound oscillations. Fourier theorem. Harmonic content of compound oscillations
10. Harmonic analysis of medical signals
11. Waves. Types of mechanical waves. Velocity of wave propagation
12. Wave function for a sinusoidal plane wave
13. Energy of wave motion: energy flux, intensity, energy density, Umov–Poynting vector
14. Doppler effect
15. Objective sound wave characteristics (frequency, period, harmonic content) and sound wave species (musical tone: simple tone, compound tone and noise)
16. Intensity of sound wave, level of intensity in decibels, sound pressure. Threshold of hearing, threshold of pain
17. Weber-Fechner law. Subjective sound perception: pitch, loudness, and quality. Their dependence on objective sound characteristics. Equal loudness curves (Fletcher-Munson diagram)
18. Audiometry and phonocardiography
19. Ear and hearing
20. Reflection and refraction of sound wave. Specific acoustic impedance
21. Ultrasonic transducers
22. Interaction of ultrasound and biological tissues
23. Ultrasound-based diagnostic imaging technique
24. Application of ultrasound in therapy and surgery
25. Infrasound and its influence biological objects
26. The basic concepts of hydrodynamics. Ideal fluid. Steady-state fluid flow. The continuity equation, Bernoulli’s law, and their usage to explain some phenomena in cardiovascular system
27. Viscosity. Newton's law of viscosity. Newtonian and non-Newtonian fluids Viscous blood properties. Determinants of blood viscosity. Fahraeus-Lindqvist effect
28. Viscosity measurement: Ostwald viscometer, Stokes' technique, rotational method
29. Work and power of the heart

30. Poiseuille's law. Hydraulic resistance coefficient
31. The elasticity of blood vessels, a pulse wave
32. Measurement of blood pressure and blood flow rate. Blood flow rate and blood pressure distribution along cardiovascular system
33. Molecular structure of liquids. Surface tension
34. Surface curvature and pressure. LaPlace's Law. Gas embolism in the vascular system.
35. Surfactant role in respiration
36. Phenomena of wetting and non-wetting. Phenomenon and physics of capillary action
37. Surface tension measurement
38. Structural organization of cell membrane
39. Physical properties of cell membranes
40. Passive transport. The main kinds of passive transport
41. Nernst–Planck equation. Fick's law
42. Active transport.
43. Membrane potential. Resting potential.
44. Nernst equation. Goldman-Hodgkin-Katz equation
45. Action potential. Stages of action potential
46. Action potential propagation in an unmyelinated axon
47. Action potential propagation in an myelinated axon
48. Electric field and its characteristics
49. Electric dipole. Electric field potential of an electric dipole. Electric dipole in electric field
50. The cardiac dipole and its wanderings
51. The concept of electrography of organs and tissues
52. Physical basics of electrocardiography. Einthoven’s theory. Electrocardiogram standard limb leads (bipolar) and chest leads (unipolar)
53. The waves of ECG and their formation
54. Determination of amplitude and time parameters of the ECG.
55. Amplifiers of biopotential signals
56. Amplitude characteristic of amplifier. Amplitude distortions
57. Frequency characteristic of amplifier. Frequency distortions
58. Amplitude and frequency ranges of biopotential signals
59. Differential amplifier
60. Direct electric current. Ohm’s law. Ohm’s Law in Point (Differential) Form
61. Electrical conductivity of electrolytes
62. Alternating electric current and its characteristics
63. Resistor in an AC circuit
64. Capacitor in an AC circuit
65. Inductor in an AC circuit
66. Impedance and the phase difference between voltage and current in an AC circuit
67. Electrical conductivity of biological tissues. DC influence on body tissues. Galvanization and medicinal electrophoresis

68. AC influence on body tissues, capacitive properties of body tissues. Impedance of biological tissues. Three-element model of tissue impedance
69. Assessment of tissue vitality by means of electrical impedance dispersion
70. Rheography (impedance plethysmography)
71. Electric pulse, pulsed current definition and classification
72. Pulse and pulsed current parameters
73. Electroexcitabilityof biological tissues. Strength-duration curve for stimulus of an excitable tissue.Lapicque's Equation. Rheobase. Chronaxie.
74. Electrical stimulation of the heart
75. Electronic stimulators. The low-frequency physiotherapy electronic equipment