**List of questions for the state exam on industrial technology of medicines 2023-2024 for 5th year students of the Pharmaceutical faculty full-time higher education**

1. Goals and objectives of industrial technology of medicines as an academic discipline. The main terms used in the industrial technology of medicines.

2. The system of requirements for the production and quality control of medicines – Good Manufacturing Practice (GMP). The main sections of GMP are: introduction, terminology, personnel, buildings and premises, equipment, production process, functions of the Quality control Department, registration and reporting.

3. Legislative acts of requirements for the quality and conditions of production of medicines in the Republic of Belarus. Technological regulations, State Pharmacopoeia, Pharmacopoeia article of the manufacturer.

4. Differentiation and profiling of pharmaceutical enterprises. The structure of pharmaceutical enterprises. Shop principle of organization of production of medicines.

5. Development of industrial production of medicines in the Republic of Belarus. Expansion of the nomenclature of medicines of industrial production. The state program "Import substitution of medicines".

6. A set of measures for quality assurance, preparation of production, employees, premises, equipment, materials, documentation, rules of production and quality control of medicines.

7. Technological process, its components: stages and operations. Periodic, continuous and combined technological process. Types of technological processes.

8. Material and energy balance. Technical and economic balance. Technological output, expenditure, consumption coefficient and consumption rates.

9. General concepts of machines and apparatuses. The machine as a unity of the engine, transmission and actuating mechanisms.

10. General characteristics of thermal processes. Energy in production processes. Thermal processes in pharmaceutical production. Mechanisms of heat transfer: thermal conductivity, convection, radiation, joint heat transfer.

11. Heating agents and heating methods. Water vapor as the main heat carrier. Wet, dry, saturated and superheated steam. Heat content of water vapor, communication and reduction of water vapor. Heating with sharp and dull steam.

12. Heat exchangers and their classification. Characteristics of heat exchangers: surface, mixing, regenerative and with internal heat dissipation (coil, shell-and-tube, pipe-in-pipe, ribbed, steam jackets, scrubbers, refrigerators, boilers, heaters, etc.).

13. Cooling agents, methods of cooling, condensation and their mechanisms. Characteristics of capacitors: surface and mixing (direct-flow and counter-current). Application of cooling and freezing, cryoprocesses, condensation in industrial technology.

14. The degree of grinding, its dependence on the strength, hardness, elasticity and brittleness of the material.

15. Theoretical foundations of grinding. Surface and volume theory of grinding. Unified theory of shredding Rebinder. Grinding methods: crushing, splitting, impact, abrasion, etc.

16. Grinding machines, principle and mode of operation. Dismembrators, disintegrators, excelsior mills, hammer mills, ball mills, vibrating mills, jet mills.

17. The basic rule of grinding. Features of grinding plant materials. Purpose and use of grinding in industrial technology.

18. Classification of solid materials. Fundamentals of air and hydraulic classification of crushed material. Mechanical classification (sieving). Sieves and sieve analysis. Materials and types of nets (braided, stamped, grate). Standards and numbering of sieves.

19. The device and the principle of operation of mechanized sieves: swinging, rotating, vibrating. Safety precautions when sifting.

20. Mixing in the industrial production of medicines. Production of powdered mixtures. Factors affecting the uniformity of mixtures in the process of obtaining, transporting and storing powders. Mixers of solid, liquid and pasty materials

21. Characteristics of powders for external and oral use: effervescent, nasal powders, for the preparation of oral solutions, suspensions, syrups.

22. Technological and hardware schemes of powder production in the conditions of pharmaceutical production. Dosing, packing and packaging of powders in industrial production conditions.

23. Terms and conditions of powder storage. Tests for powders: uniformity of content, uniformity of dosed units, uniformity of mass, uniformity of dose mass in multi-dose containers, etc.

24. Characteristics of industrial production fees. Technological scheme for the production of fees in industrial conditions.

25. Characteristics, types and nomenclature of tablets for oral, external, sublingual, implantation and parenteral use. Tablets without a shell and coated, tablets "effervescent", soluble, dispersible, intestinal-soluble and with modified release, lyophilizate tablets.

26. Theoretical foundations of tableting: mechanical, capillary theory, fusion under pressure. Manifestation of cohesion and adhesion forces during pressing.

27. Characteristics and operating principle of crank and rotary tablet machines. The main elements of tablet machines: matrices and punches. Feeders of tablet machines: frame, agitator, vacuum, vibration. Tablet machines of double pressing.

28. Characteristics of technological and physico-chemical properties of pharmaceutical substances and excipients: flowability, compressibility, granulometric composition, bulk density and density after shrinkage, relative density, etc.

29. Auxiliary substances used in the production of tablets (fillers, loosening, sliding, gluing, antifriction, dyes, corrigents, prolongators), their characteristics and nomenclature.

30. Characteristics of the stages and operations of the technological process of tablet production.

31. Technological schemes for the production of tablets: direct pressing and the use of granulation in the production of tablets.

32. Production of trituration tablets by molding method. Production of lyophilizate tablets.

33. Methods of granulation in the production of tablet masses: wet and granulation by pressing or rolling. Classification and characteristics of wet granulation: punching and structural.

34. Structural granulation by draining, in a fluidized bed, spray drying, moisture-activated granulation.

35. Drying of the granulate. Fluidized bed dryers DG-30, DG-60, DG-100, etc.

36. Coating of tablets with shells, purposes and methods of coating. Assortment and characteristics of auxiliary substances for coating tablets: sugar, sugar syrup, basic magnesium carbonate, dyes, glossers, film-forming agents, plasticizers.

37. Technology of shell extension (coating): running-in, testing, grinding, glossing.

38. Characteristics and classification of film coatings of tablets, nomenclature of film-forming agents for film coatings.

39. Methods of applying film coatings to tablets.

40. Technology of tablet coatings by pressing. Production of granulate for pressed coatings.

41. Characteristics of multilayer tablets and extended-acting retard tablets.

42. Tests for tablets: uniformity of metered units, uniformity of content, uniformity of mass, dissolution, disintegration, talc and aerosil.

43. The "Dissolution" test for solid dosage forms. Devices and methods for conducting the "Dissolution" test: a device with a basket, with a stirrer blade, with a piston cylinder and with a flow cuvette.

44. Characteristics of the "Disintegration of tablets" test, devices and methods of the test, interpretation of the results for different types of tablets.

45. Characteristics and classification of granules: "effervescent", coated, with modified release and intestinal soluble.

46. Technological scheme of pellet production. The nomenclature of pellets of industrial production. Packaging, labeling, storage of pellets.

47. Characteristics of dragees. Production of dragees by the method of building up in draining boilers (obductors).

48. Medicines for parenteral use, their characteristics and classification.

49. Characteristics of injectable drugs. Infusion drugs, characteristics and classification. Concentrates for the preparation of injectable medicines and infusion medicines.

50. Tests of medicines for parenteral use: uniformity of dosage units, uniformity of content, uniformity of mass, bacterial endotoxins – pyrogenicity.

51. Glass and polymer containers for sterile medicines, requirements and classes of glass. Quality control of glass containers. Testing for hydrolytic and thermal stability, fixability of closures and their tightness.

52. The system of air preparation of pharmaceutical enterprises organized according to GMP. Particle pollution levels for different zones in "equipped" and "operated" condition.

53. The concept of installations for obtaining water for injection. Water treatment system at pharmaceutical enterprises.

54. Ampoule production: preparation of glass, its calibration, washing. Manufacture of ampoules on semi-automatic machines, annealing.

55. Preparation of ampoules for filling. Opening of ampoules, external and internal washing of ampoules. Vacuum, syringe and vapor-condensation internal washing of ampoules. Drying and sterilization of ampoules.

56. Methods of filling ampoules with solutions: vacuum, syringe and vapor condensation.

57. Sealing of ampoules. Semi-automatic machines for sealing ampoules. Sealing of ampoules with gas protection.

58. Sterilization of injection solutions. Pharmacopoeial sterilization methods: thermal, chemical, radiation, filtration sterilization.

59. Air sterilizers. Modes of thermal sterilization depending on the properties of objects and their quantity. Control of the reliability of sterilization. Safety precautions for various sterilization methods.

60. Marking of ampulated solutions. Evaluation of the quality of solutions for injection in ampoules: transparency, color, volume, sterility, toxicity, bacterial endotoxins-pyrogens, testing for mechanical inclusions.

61. Ways to stabilize injection solutions. The range of stabilizers: acids, alkalis, antioxidants, anti-catalysts, etc. The use of gas protection in the production of injection solutions. Characteristics and nomenclature of preservatives.

62. Features of industrial production of injectable solutions of glucose, novocaine, caffeine-sodium benzoate, calcium chloride, magnesium sulfate, calcium gluconate, ascorbic acid, etc.

63. Features of the production of infusion solutions in industrial conditions. Types of infusion solutions: plasma-substituting, water-salt balance regulators, for parenteral nutrition, oxygen carriers and multifunctional. Requirements of isotony, isohydria, isoion and isoviscosity for infusion solutions.

64. Industrial production of salt, plasma-substituting and detoxification solutions. Nomenclature of infusion solutions of industrial production.

65. Features of industrial technology of injection solutions of thermolabile drugs.

66. Sterile suspensions and emulsions of industrial production. Suspensions of insulin, corticosteroids, etc., their production.

67. Preparation of emulsions for parenteral nutrition, the use of ultrasonic devices in their production.

68. Industrial production of powders for sterile solutions: technology features and lyophilization of powders. Packaging of powders in vials and ampoules.

69. Physical, chemical, biological processes occurring in medicines for injection. Stability of medicines. Factors affecting the stability of medicines.

70. Methods of drug stabilization: physical and chemical. The basic principle of drug stabilization. Shelf life of the finished drug.

71. Characteristics of eye medicines: eye drops, inserts, lotions. Requirements for stability, absence of extraneous mechanical impurities, pH values, comfort, etc. for eye drops and lotions.

72. Industrial production of eye drops. Stages and operations of the technological process of the production of eye drops.

73. Stabilization and preservation of eye drops, characteristics of preservatives. The use of buffer solvents in the production of eye drops. Prolongation of the action of eye drops with methylcellulose, polyvinyl alcohol, polyacrylamide, etc.

74. Eye soft medicines. Requirements for eye ointments and the basics for eye ointments. Sterility, stability of eye ointments.

75. Technological scheme for the production of eye ointments under aseptic conditions. Standardization of eye ointments: particle size, homogeneity, structural and rheological properties, viscosity, pH, etc.

76. Characteristics of eye inserts, film-forming agents in the production of eye inserts.

77. Definition, characteristics, classification of medical and skin patches. Tests of plasters for sterility, dissolution. The range of auxiliary substances for the production of plasters.

78. Equipment for the production of plasters, smearing and drying of plasters (reactors, installation-USPL-1, chamber-loop dryer, etc.).

79. Nomenclature of plasters: adhesive plaster, bactericidal, pepper, corn. Liquid plasters: cleol, collodion, etc. Aerosol patches.

80. Production of mustard plasters. Packaging, labeling, storage of patches.

81. Characteristics of hydrogel plates. Production of hydrogel plates. Tests of hydrogel plates for sterility, dissolution. Packaging, labeling, storage of hydrogel plates.

82. Characteristics of the inhalation route of drug administration. Medicines for inhalation, their characteristics and classification.

83. Liquid medicines for inhalation: medicines that are converted into a vaporous state; liquid medicines for spraying; metered-dose medicines for inhalation under pressure. Tests for inhalation drugs: uniformity of the released dose, particle size, number of doses in the inhaler.

84. Powders for inhalation, their tests: particle size, number of doses in a multi-dose inhaler.

85. Characteristics of medicines under pressure.

86. Characteristics and classification of aerosols. Requirements for medicines under pressure: particle size, the dose obtained by pressing the dosing valve, etc.

87. Auxiliary substances used in the production of aerosols: propellants, solvents, solubilizers, surfactants, film-forming agents, etc.

88. Technological scheme of aerosol production. Characteristics of aerosol cans, valve-spray systems. Methods of filling aerosol cans. Evaluation of the quality of aerosol packaging.

89. Solutions, emulsions, suspensions, drops for internal use, their characteristics. Powders and granules for the preparation of solutions, emulsions, suspensions for internal use.

90. Tests for liquid medicines for internal use: uniformity of metered units, uniformity of content, uniformity of mass, dose and uniformity of dosing of drops for internal use, uniformity of mass of doses in multi-dose containers.

91. Medical solutions, characteristics, classification of solutions depending on the nature of the solvent, concentration and method of preparation (by chemical interaction or dissolution): aqueous solutions, alcohol, oil, glycerine liquids. Requirements for medical solutions.

92. Production of solutions for internal and external use in various ways at pharmaceutical enterprises.

93. Dissolution as a diffusion-kinetic process. Intensification of the dissolution process. Temperature and hydrodynamic conditions in the production of medical solutions.

94. General characteristics of hydrodynamic processes. Fundamentals of hydraulics. The concept of real and ideal liquids. Hydrostatics and fluid hydrodynamics.

95. Technological schemes for the production of solutions for indoor and outdoor use. General and specific rules for the production of aqueous and non-aqueous solutions.

96. The use of mechanical mixing in the production of medical solutions. Stirrer designs, their characteristics.

97. Pneumatic mixing with compressed gas, air, hot steam, bubbling, circulation mixing.

98. Gravitational and pulsational mixing. The use of rotary pulsating devices to intensify the dissolution process.

99. Theoretical foundations and use of ultrasound for dispersion and mixing of medical solutions. Electrostrictive and magnetostrictive ultrasound generators, their characteristics and device.

100. Separation of heterogeneous systems. Separation of liquid and solid phases by settling method. Siphon devices for separation of solid and liquid phases.

101. Separation by gravity. Deposition and settling. The speed of settling. Factors affecting the settling rate. The device of settling tanks of periodic and semi-continuous action.

102. Separation of solid and liquid phases under the influence of pressure difference. Filtering, filtering methods, filtering equation. Types of filters: nutch and druk filters, filter presses, cartridge, drum, disc filters. Filters for cleaning gases from mechanical impurities. Characteristics of filter materials.

103. Separation of solid and liquid phases in the field of centrifugal forces. Centrifugation, separation factor, filter and settling centrifuges, periodic and continuous action, supercentrifuges.

104. Production of medical solutions: basic acetic-aluminum salt, basic lead acetic acid, alcohol and aqueous solutions of iodine, iodinol, iodonate, alcohol solution of methylene blue, diamond green, etc.

105. Production of medical solutions: methylene blue alcohol solution, diamond green, etc. Assessment of the quality of solutions for external and internal use. Packaging, labeling, storage of medical solutions.

106. Methods of obtaining suspensions and emulsions at pharmaceutical enterprises: mechanical mixing, breaking in a liquid medium, dispersion by ultrasound.

107. Characteristics of equipment for industrial production of suspensions and emulsions: rotary pulsating apparatus, colloidal mills, dispersants, homogenizers.

108. Soft drugs, characteristics, classification. Ointments, creams, gels, pastes, poultices, liniments, their characteristics. Tests for soft drugs: uniformity of dosed units, sterility.

109. Classification of ointments. Ointments are hydrophobic, hydrophilic and water-based.

110. Characteristics and classification of ointment bases. Quality control of ointments: structural and mechanical properties of ointments (rheology).

111. Lipophilic and hydrophilic creams. Characteristics of lipophilic and hydrophilic gels. Nomenclature of gelling agents. Characteristics of pastes and poultices.

112. Features of the production of ointments and pastes at pharmaceutical enterprises. Technological schemes for the production of ointments.

113. Medicines for rectal use, characteristics, classification. Suppositories, rectal capsules, foams, tampons. Rectal solutions, suspensions, emulsions. Powders and tablets for the preparation of rectal solutions and suspensions. Soft drugs for rectal use.

114. Medicinal products for vaginal use, characteristics, classification. Pessaries, vaginal tablets and capsules, foams, tampons, solutions, emulsions and suspensions. Tablets for the preparation of vaginal solutions and suspensions. Soft drugs for vaginal use.

115. Characteristics of suppositories of industrial production. Characteristics of suppository bases.

116. Technological equipment for the production and packaging of suppositories.

117. Syrups, characteristics, classification: flavoring and medicinal. The importance of syrups in drug therapy. The use of new excipients of sorbitol, fructose, synthetic sweeteners for the production of syrups with high biological availability.

118. Technological schemes for the production of syrups at pharmaceutical enterprises. Evaluation of the quality of syrups. Nomenclature: sugar syrup, aloe with iron, altea, rosehip fruit, etc.

119. Powders and granules for the preparation of syrups, tests for them: uniformity of metered units, uniformity of content, uniformity of mass. Packaging, labeling, storage of syrups.

120. Aromatic waters, characteristics, classification. Technological scheme for the production of aromatic water solutions and distilled aromatic waters.

121. Capsules, characteristics, classification. Capsules are hard and soft, intestinal-soluble and with modified release of active substances, wafers.

122. Technological scheme of gelatin capsules production. Preparation of gelatin mass, capsule forming by immersion, pressing and drip method.

123. Filling capsules with contents. Equipment for the production and filling of capsules.

124. Tests for capsules: uniformity of metered units, uniformity of content, uniformity of mass, dissolution, disintegration for hard and soft capsules. Packaging, labeling, storage of capsules.

125. Methods of microcapsulation: physical, physico-chemical, chemical. Characteristics of excipients for microcapsulation.

126. Extraction of plant, animal, microbiological raw materials and tissue culture in the "solid – liquid" system, as one of the types of mass transfer processes.

127. Technological characteristics of the phases: the content of active, extractive substances and moisture in the raw materials; the quality of the raw materials, the rate and magnitude of swelling of the raw materials, the absorbability of the extractant raw materials, density, volume the mass and bulk mass of raw materials, porosity and porosity of raw materials, the grinding of raw materials, the surface of the particles of raw materials, the coefficient of leaching, internal diffusion, swelling and absorption.

128. Characteristics of extractants. Requirements for extractants: solubility, selectivity, polarity, viscosity, surface tension, reaction of the medium.

129. Classification and modern assortment of extractants: water, ethyl alcohol, chloroform, ether, acetone, etc. The use of liquefied gases in the production of extraction medicines.

130. Regularities of extraction of capillary-porous raw materials with cellular structure, extraction stages: penetration of the extractant into the raw material, dissolution and desorption, internal molecular diffusion, external molecular and convective diffusion.

131. Diffusion equations (the first and second equations of Fick and convective diffusion). Coefficients of internal, molecular and convective diffusion.

132. Maceration, remaceration, percolation, repercolation, fast-flowing repercolation, continuous extraction, circulation.

133. Extractors, classification, device and principle of operation of spray, rotary-disk, pulsation, centrifugal and mixing-settling extractors.

134. Stages of development of production of medicinal products from plant raw materials and their classification. Characteristics of total (native) or galenic and total purified (novogalenic) medicines.

135. Medicinal products from individual substances isolated from plants and complex. Technical and economic features of the production of medicines from plant raw materials. The State Pharmacopoeia of the Republic of Belarus, Good Manufacturing Practice (GMP) in the production of medicines from plant raw materials.

136. Tinctures, characteristics, classification. Obtaining tinctures by dissolving thick and dry extracts.

137. Methods of obtaining extracts in the production of tinctures: maceration and its modifications, 4-fold maceration, turbo extraction, percolation.

138. Tests for tinctures: relative density, ethanol content, methanol and 2-propanol, dry residue, heavy metals, quantitative determination. Determination of alcohol concentration in tinctures.

139. Extracts, classification by consistency and extractant used. Liquid extracts, characteristics. Technological scheme of production of liquid extracts.

140. Methods of obtaining extracts in the production of liquid extracts: percolation, repercolation with a completed and unfinished cycle.

141. Cleaning of hoods from ballast substances. Tests for liquid extracts: relative density, ethanol content, methanol and 2-propanol, dry residue, heavy metals, quantitative determination.

142. Evaporation, evaporation methods: under vacuum, atmospheric pressure and high pressure. The device of evaporation plants: evaporators, receivers, vacuum pumps, refrigerators, receivers.

143. Drying in the industrial production of medicines. Forms of connection of moisture with the material. Static and kinetics of drying. Drying methods: contact and convective drying. Freeze-drying (freeze-drying).

144. Thick and dry extracts, characteristics, classification. Technological scheme of production of thick and dry extracts.

145. Methods of obtaining extracts in the production of thick and dry extracts: bismaceration, percolation, repercolation, countercurrent extraction, circulation extraction. Cleaning of water and alcohol extracts from ballast substances. Evaporation and drying of extracts.

146. Tests for thick and dry extracts: dry residue; solvents; heavy metals; water, weight loss during drying; quantitative determination.

147. Liquid (1:2) and dry extracts-concentrates for the preparation of water extracts. The nomenclature of liquid extracts-concentrates 1:2 (valerian) and dry extracts-concentrates (goricolor, althea root, thermopsis).

148. Technological schemes for the production of liquid and dry extracts-concentrates. Tests for liquid and dry extracts-concentrates. Packaging, labeling, storage of liquid and dry extracts-concentrates.

149. Brief historical background of the creation of maximally purified medicinal products from medicinal plant raw materials. Technological scheme of production of maximally purified medicinal products from medicinal plant raw materials.

150. Methods of obtaining primary extract in the production of maximally purified medicines, characteristics of the extractants used. Purification of extracts from ballast and related substances: fractional precipitation, solvent change, liquid extraction, chromatography, etc.

151. Private technology of maximally purified medicinal products from medicinal plant raw materials. Production of adoniside.

152. Tests of maximally purified medicinal products from medicinal plant raw materials: quantitative determination of biologically active substances. Packaging, labeling, storage of maximally purified medicinal products from medicinal plant raw materials.

153. Medicinal products from animal raw materials, characteristics and a brief historical background of the creation. Classification of medicinal products from animal raw materials by medical use, nature of active substances and methods of preparation.

154. Features of the use of animal raw materials in the production of medicines. Technological scheme for the production of medicines from dried and fat-free animal organs for internal and injectable use.

155. Classification of medicines according to the duration of action and the nature of the distribution of active substances in the human body. Methods of prolongation of the effect of drugs: reducing the rate of excretion from the body, slowing down biotransformation, inhibition and duration of absorption.

156. Therapeutic systems: matrix (biodegradable and non-biodegradable), membrane, osmotic, targeted delivery systems of active substances.

157. Transdermal therapeutic systems (TTS). Classification of TTS according to the technological and pharmacokinetic principle.

158. Targeted medicinal products. The Ringsdorf model and its components: polymer carrier, solubilizer, drug, vector (targeting device). Modern nomenclature of delivery systems: monoclonal antibodies, glycoproteins, erythrocytes, liposomes.

Head chair of pharmaceutical

technologies with course of FCE and SR

doctor of pharmaceutical sciences, professor Khishova O.M.