Questions for the offset/exam for the discipline "FUNDAMENTALS OF MECHANICS AND DESIGN OF PRODUCTS MADE OF LAYERED COMPOSITE MATERIALS (CM)"

1. The concept of composite materials. Advantages and disadvantages of CM . Prospects for the use of CM in the aircraft industry.
2. CM components . Purpose of CM components . Basic materials used as CM components .
3. Classification of CM by type of matrices. Features of CM on various matrices.
4. Classification of CM according to the shape of filler particles. Features of CM with filler particles of different shapes.
5. Concepts of isotropic, anisotropic and quasi-isotropic CM. Features of the practical implementation of these composite structures.
6. The concept of hybrid composites. Purpose, advantages and disadvantages of hybrid CMs . Types of hybridity .
7. Technological requirements for matrices to obtain a high-quality product made of CM .
8. The concept of finishing agents (sizings). Prescription of finishing agents. Use of finishing agents to reduce the level of residual technological stresses.
9. Basic matrix materials and their properties. The feasibility of using certain matrix materials depending on operating conditions.
10. Classification of reinforcing fabrics is plain, satin and twill weave. Scope of use.
11. Basic reinforcing materials and their properties. The feasibility of using certain reinforcing materials depending on operating conditions.
12. Fundamentals of technology for producing reinforcing fibers. Technology for producing glass fibers.
13. Methods for producing carbon fibers : from PAN fiber , from pitches, from cellulose hydrate.
14. Methods for obtaining organic fibers .
15. Technology for producing boron fibers.
16. Ceramic fibers. Prospects and scope of ceramics use in relation to the aircraft industry. Problems of ceramics.
17. The concept of prepregs . Purpose of prepregs . Technological advantages and disadvantages of prepregs .
18. Micromechanics of CM . Purposes and objectives of micromechanics. Basic models of CM micromechanics .
19. Concept of orthotropy . Anisotropy diagrams for isotropic, orthotropic and anisotropic bodies.
20. Elastic characteristics of a unidirectional composite: elastic modulus, shear modulus, Poisson's ratio. The concept of reinforcement coefficient.

21. Influence of reinforcement coefficient on the mechanical characteristics of a unidirectional layer. Restrictions on the upper and lower limits of the reinforcement coefficient.

22. Analysis of the formula for determining the longitudinal modulus of elasticity of a unidirectional layer: factors influencing this characteristic, methods for increasing it.

23. Analysis of the formula for determining the transverse modulus of elasticity of a unidirectional layer: factors influencing this characteristic, methods for increasing it.

24. Analysis of the formula for determining the longitudinal-transverse Poisson's ratio of a unidirectional layer: factors influencing this characteristic. The orthotropic condition and its application to determine the transverse-longitudinal Poisson's ratio.

25. Analysis of the formula for determining the intralayer shear modulus of a unidirectional layer: factors influencing this characteristic, methods for increasing it.

26. Classification of types of destruction of a unidirectional CM layer . Five strength characteristics of unidirectional composite.

27. Types of destruction of CM : failure in longitudinal tension, longitudinal compression - the influence of intercomponent adhesion and reinforcement coefficient on the mechanism of destruction.

28. Types of destruction of CM : failure in transverse tension, transverse compression and shear - the influence of intercomponent adhesion and reinforcement coefficient on the mechanism of destruction.

29. Analysis of formulas for determining the tensile strength of a unidirectional layer under longitudinal tension and compression: factors influencing these characteristics, methods for increasing them.

30. The concept of stress concentration. Stress distribution near the concentrator. Examples of stress concentrators. Methods for reducing stress concentration in products.

31. Analysis of formulas for determining the tensile strength of a unidirectional layer under transverse tension and compression and intralayer shear: factors influencing these characteristics, methods for increasing them.

32. CM deformation diagrams . Purpose. General form. Inflection point. Comparison of diagrams in coordinates $F(\Delta l)$ and $\sigma(\varepsilon)$.

33. Strength criteria for a unidirectional layer. Maximum stress criterion. Criterion of the greatest deformations. The concept of a strength surface and its use in predicting the strength of a unidirectional layer.

34. Layer-by-layer analysis of CM strength . Justification of the need for layer-by-layer analysis of the strength for composites. Hill criterion. Advantages and disadvantages.

35. The concept of safety factor. Relationship between the Hill criterion and the inverse safety factor. Determination of the failure mechanism using the Hill criterion.

36. Analysis of the formula for determining the coefficients of linear thermal expansion of a unidirectional layer along and across the fibers: factors influencing these characteristics, methods for increasing them.

37. Hooke's law. Purpose of Hooke's law. Using Hooke's law to experimentally determine the elastic and strength characteristics of a unidirectional layer.

38. Analysis of the generalized Hooke's law for an isotropic body.

39. Analysis of the generalized Hooke's law for an orthotropic body.

40. Analysis of the generalized Hooke's law for an anisotropic body.

41. Changes in elastic and thermoelastic characteristics at an angle to the main elasticity axes of a unidirectional layer.

42. The concept of the structure of layered composites. Symmetrical, balanced and unbalanced structures. The influence of structure (technological and operational factors) on the stress state and deformation behavior (warping) of products made of CM .