MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED) UNDER VARIOUS DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-2024

AGRICULTURAL ENGINEERING
PAPER-III

Time Allowed : 3 hours   FM : 200

SECTION - A *(Multiple Choice questions) (100 Marks)*
All questions carry equal mark of 2 each. Attempt all questions.

This Section should be answered only on the __OMR Response Sheet__ provided.

1. Which unit operation involves the removal of undesirable foreign materials from agricultural produce?
   - (a) Grading
   - (b) Cleaning
   - (c) Size reduction
   - (d) Packaging

2. Filtration is commonly used in post harvest technology for -
   - (a) drying of agricultural produce
   - (b) separation of solid particles from liquids
   - (c) size reduction of agricultural produce
   - (d) mixing agricultural ingredients

3. The utilization of rice husk as a by-product includes:
   - (a) Conversion into biofuel
   - (b) Direct use as animal feed
   - (c) Utilization in building materials
   - (d) All of the above

4. The primary source of farm power in mechanized agriculture includes:
   - (a) Wind and solar energy
   - (b) Animal and electro-mechanical sources
   - (c) Geothermal and tidal energy
   - (d) Hydroelectric power

5. Operation and maintenance of farm machinery for primary tillage includes:
   - (a) Harvesting and threshing
   - (b) Land preparation and seedbed preparation
   - (c) Irrigation and drainage
   - (d) Crop storage and preservation

6. The theory of singly reinforced beams and slabs includes:
   - (a) Providing additional reinforcement at the bottom
   - (b) Using beams without any reinforcement
   - (c) Exceeding the load-carrying capacity
   - (d) Eliminating compression

7. Aqueduct design focuses on:
   - (a) Water conservation
   - (b) Efficient water distribution
   - (c) Soil erosion control
   - (d) Crop rotation

8. Freezing is particularly beneficial for which type of agricultural produce?
   - (a) Leafy vegetables
   - (b) Root crops
   - (c) Berries and fruits
   - (d) Nuts and seeds

9. The moisture content of paddy (at the time of milling) should be in the range of -
   - (a) 9 to 10%
   - (b) 11 to 12%
   - (c) 13 to 14%
   - (d) 16 to 18%

10. Difference between a pasteurizer and a sterilizer is only in -
    - (a) heating agent used
    - (b) temperature attained
    - (c) design of equipment
    - (d) % of fat used

11. The average firing interval for 6 cylinder, 4 cycle engine is -
    - (a) 120°
    - (b) 180°
    - (c) 240°
    - (d) 360°

12. In attrition mill, the size of the food grain is reduced by -
    - (a) impact
    - (b) impact and shear
    - (c) impact and cutting
    - (d) shear and crushing

13. Constant rate of drying of agriculture produce is dependent of -
    - (a) Air velocity
    - (b) Thickness of bed
    - (c) Air humidity
    - (d) Air temperature

14. Compression ratio of diesel engine is -
    - (a) 50:1
    - (b) 100:1
    - (c) 1:15
    - (d) 80:1

15. The most common fertilizer metering device used in seed-cum-fertilizer drill is -
    - (a) revolving bottom plate
    - (b) star wheel
    - (c) vertical rotor with grooves
    - (d) adjustable opening with agitator disc

16. The dimension of strain is -
    - (a) LT^{-2}
    - (b) N/m^2
    - (c) N
    - (d) Dimensionless

17. Which law is also called as the elasticity law?
    - (a) Bernoulli's law
    - (b) Stress law
    - (c) Hooke's law
    - (d) Poisson's law

18. What is the bending moment of a cantilever beam subjected to Uniformly Distributed Load? Assume length of beam = L; load = w per unit length.
    - (a) wL
    - (b) wL / 2
    - (c) $wL^2 / 2$
    - (d) $wL^2 / 4$

19. The design of water tanks includes considerations for:
    - (a) Structural stability and water pressure
    - (b) Increasing storage capacity
    - (c) Enhancing water evaporation
    - (d) Reducing material costs

20. Slump test for concrete is carried out to determine:
    - (a) Durability
    - (b) Workability
    - (c) Strength
    - (d) Water content

21. What is the weight of rice bran obtained from 5000 kg of paddy with a bran recovery rate of 10%?
    (a) 500 kg
    (b) 100 kg
    (c) 50 kg
    (d) 5 kg

22. A centrifugal concentrator reduces the volume of orange juice from 1000 liters to 200 liters. What is the concentration ratio achieved?
    (a) 2 : 1
    (b) 4 : 1
    (c) 3 : 1
    (d) 5 : 1

23. How many 25 kg bags can be filled from 5 metric tons of groundnut kernels, assuming a packing efficiency of 95%?
    (a) 200
    (b) 190
    (c) 210
    (d) 180

24. Calculate the power output (in horsepower) of a diesel engine running at 1500 rpm with a torque of 500 Nm.
    (a) 50 hp
    (b) 75 hp
    (c) 100 hp
    (d) 125 hp

25. Calculate the power requirement (in kW) for a tractor to pull a plow with a resistance force of 4000 N at a speed of 4 km/h.
    (a) 8 kW
    (b) 10 kW
    (c) 12 kW
    (d) 14 kW

26. Determine the cross-sectional area (in cm²) of a circular steel rod with a diameter of 25 mm.
    (a) 392.7 cm²
    (b) 490.9 cm²
    (c) 589.0 cm²
    (d) 706.9 cm²

27. Filtration is commonly used in post harvest technology for -
    (a) drying of agricultural produce
    (b) separation of solid particles from liquids
    (c) size reduction of agricultural produce
    (d) mixing agricultural ingredients

28. Size reduction of agricultural produce is essential for -
    (a) increasing bulk density
    (b) eeducing shelf life
    (c) reducing transportation costs
    (d) enhancing flavor

29. What does the term "ground drive" refer to in farm machinery?
    (a) Driving on uneven terrain
    (b) Power transmission to wheels
    (c) Mechanical operation without PTO
    (d) Preventing soil erosion

30. Which farm operation is associated with the use of a rotary tiller?
    (a) Planting
    (b) Harvesting
    (c) Plowing
    (d) Weeding

31. Which farm machinery is used for land leveling and earthmoving operations?
    (a) Disc harrow
    (b) Cultivator
    (c) Bulldozer
    (d) Reaper-binder

32. What is the primary purpose of designing farm structures using the working stress method?
    (a) To minimize cost
    (b) To increase safety factor
    (c) To optimize material use
    (d) To ensure structural stability

33. Calculate the theoretical stress concentration factor for a steel plate with a circular hole, where the hole diameter is 20 mm and plate thickness is 10 mm.

    (a) 2.0   (b) 2.5

    (c) 3.0   (d) 3.5

34. A spraying machine operates at a pressure of 3 bar and delivers 50 liters of pesticide solution per minute. What is the power required by the spraying pump (assuming 90% efficiency)?

    (a) 1.5 kW   (b) 2.0 kW

    (c) 2.5 kW   (d) 3.0 kW

35. Why is site selection critical for constructing farmsteads?

    (a) To maximize land use   (b) To minimize environmental impact

    (c) To optimize resource availability   (d) To ensure accessibility

36. What is the primary advantage of using greenhouses in agriculture?

    (a) Increased pest control   (b) Extended growing season

    (c) Reduced water requirement   (d) Enhanced soil fertility

37. Which material property of timber makes it suitable for constructing farm buildings?

    (a) Thermal conductivity   (b) Water absorption

    (c) Fire resistance   (d) Termite resistance

38. Which type of stress is predominant in structural members subjected to bending loads?

    (a) Torsional stress   (b) Compressive stress

    (c) Shear stress   (d) Bending stress

39. Calculate the total load (in kN) that can be supported by a wooden beam of 4 meters span, if the safe load carrying capacity is 10 kN/m.

    (a) 20 kN   (b) 30 kN

    (c) 40 kN   (d) 50 kN

40. For a good building stone, how much is the required crushing strength?

    (a) Less than 50 N/mm^2 (b) Greater than 100 N/mm^2

    (c) 155 N/mm^2 (d) 10 N/mm^2

41. Determine the compressive stress (in MPa) in a concrete column of 400 mm × 400 mm cross-section subjected to a compressive load of 1000 kN.

    (a) 6.25 MPa   (b) 12.5 MPa

    (c) 18.75 MPa   (d) 25.0 MPa

42. A tractor operates at a speed of 5 km/h and plows a field of 2 hectares in 8 hours. What is the field efficiency of the tractor in percentage?

    (a) 80%   (b) 75%

    (c) 60%   (d) 50%

43. A drying unit reduces the moisture content of 2000 kg of coffee beans from 60% to 10%. How many kilograms of water were removed during the drying process?

    (a) 1000 kg   (b) 1200 kg

    (c) 1400 kg   (d) 1600 kg

44. In deep litter system, how many birds can 2.4 x 2.4 m accommodate?

    (a) 12   (b) 14

    (c) 16   (d) 18

45. The highest stress that a material can withstand for a specified length of time without excessive deformation is called -
    (a) Fatigue strength
    (b) Endurance strength
    (c) Creep strength
    (d) Creep rupture strength

46. The relationship between Young's modulus (E), Bulk Modulus (K) and Poisson's ratio (μ) is given by-
    (a) $E = 3 K (1 - \mu)$
    (b) $E = 3 K (1 - 2 \mu)$
    (c) $K = 3 E (1 - 2 \mu)$
    (d) $K = 3 E (1 - \mu)$

47. What is the maximum percentage of silt allowed in sand to be used in concrete?
    (a) 5%
    (b) 10%
    (c) 8%
    (d) 2%

48. A fruit juice processing plant receives 10,000 kg of oranges with an average juice content of 50%. How many liters of juice can be extracted from these oranges?
    (a) 5000 L
    (b) 4000 L
    (c) 4500 L
    (d) 5500 L

49. Calculate the weight of coir pith obtained from processing 5000 coconut husks, assuming each husk yields 200 grams of coir pith.
    (a) 1000 kg
    (b) 500 kg
    (c) 2000 kg
    (d) 1500 kg

50. The process of detaching grains from the ear heads or from the plants is known as -
    (a) Threshing
    (b) Weeding
    (c) Blowing
    (d) Harvesting

SECTION - B *(Short answer type question) (100 Marks)*
All questions carry equal marks of 5 each.
*This Section should be answered only on the **Answer Sheet** provided.*

1. Determine the traction force required for a crawler-type bulldozer to pull a loaded trailer weighing 20,000 kg up a 30° slope with a coefficient of friction of 0.6 between the bulldozer's tracks and the ground. The gravitational acceleration is 9.81 m/s².

2. Differentiate Working stress method and Limit State method.

3. Explain the different components of a mould board plough with a neat diagram.

4. Explain with the help of a neat sketch the working principle of a 4-stroke cycle diesel engine.

5. Discuss the factors influencing traction efficiency in farm machinery.

6. What are the different types of cement and their uses? List two types of aggregates used in concrete.

7. Calculate the volume of a cylindrical silo with a height of 10 meters and a diameter of 4 meters. Discuss the factors influencing the design of silos for storing maize grains, including the angle of repose and material flow properties.

8. Discuss the process and significance of drying/dehydration in post harvest technology. Explain the methods used and factors influencing the efficiency of drying.

9. Discuss the challenges and solutions involved in the densification of agricultural products. Explain the methods used and the benefits of densification in storage and transportation.

10. Discuss how IoT (Internet of Things) and automation can revolutionize post harvest technology. Provide examples of smart sensors and devices used in monitoring and controlling storage conditions of agricultural produce.

11. Explain the principles of traction and factors affecting tractive performance. Derive the equation for calculating drawbar pull based on soil properties, implement characteristics, and tractor parameters.

12. Analyze a case study of a farmstead construction project. Discuss the challenges faced during site selection, design, and construction phases. Evaluate the success factors and lessons learned for future farm infrastructure projects.

13. Discuss the design criteria and considerations for circular and rectangular water tanks used in agricultural applications. Calculate the required wall thickness for a cylindrical water tank subjected to hydrostatic pressure.

14. Compare the design considerations for singly reinforced beams with doubly reinforced beams. Discuss situations where each type of beam design is preferred.

15. Compare the properties and applications of stones, bricks, and concrete blocks in farm construction. Discuss factors influencing the selection of building materials based on cost, durability, and environmental impact.

16. Provide a detailed procedure for the maintenance of a disc plow used in primary tillage. Discuss the common issues faced during operation and the preventive measures to enhance equipment longevity.

17. Diameter and stroke length of the piston of a 4-stroke 4-cylinder diesel engine are 10 cm and 12 cm respectively and speed of the crankshaft is 2000 rpm. Calculate the Brake power (BP). Assume frictional power = 25 kW and mean effective pressure = 7×10^5 N/m^2.

18. What is meant by curing of concrete? What are its purposes and explain its method.

19. What is meant by parboiling of paddy? Describe one method of paddy parboiling.

20. What is a silo? Describe the differences between a Silo used for grain storage and one used for silage.

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