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-I

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. The discharge through Cipolleti Weir is computed by the formula -
   (a) $Q = 0.0018\ LH^{3/2}$ (b) $Q = 0.0018\ LH^{5/2}$
   (c) $Q = 0.0186\ LH^{3/2}$ (d) $Q = 0.0184\ LH^{3/2}$
2. The total mass of water required for the growth of a plant is 285 kgs and the mass of the marketed crop is 19 kgs. Find the transpiration ratio.
   (a) 12 (b) 16
   (c) 25 (d) 15
3. In drip Irrigation design, the design criteria are generally based on an emitter-flow variation of -
   (a) $< 20\%$ (b) $> 20\%$
   (c) $< 5\%$ (d) $< 10\%$
4. Given that a particular irrigation field has CCA of 200 ha, out of which 150 ha of land is cultivated for Rabi season and 100 ha of land is cultivated for Kharif Season. What is the intensity of irrigation for each season?
   (a) 50%, 100% (b) 120%, 605
   (c) 75%, 50% (d) 150%, 75%
5. The ratio of the volume of water added or removed directly from the saturated aquifer to the resulting change in the volume of the aquifer below the water table is called -
   (a) Apparent specific yield (b) Specific yield
   (c) Storage Coefficient (d) Specific storage
6. What is the minimum value of freeboard for Main and branched lined canals if the discharge is more than 10 cumec as specified by BIS Code?
   (a) 0.60 m (b) 0.65 m
   (c) 0.75 m (d) 0.50 m
7. The relation between Transmissibility (T) and Permeability (K) for an aquifer of depth 'd' is -
   (a) $K = Td$ (b) $T = Kd$
   (c) $T = K \log d$ (d) $T = \ln(Kd)$

8. The discharge per unit drawdown at a well is known as -
   (a) specific yield
   (b) specific retention
   (c) specific capacity
   (d) specific storage

9. The specific capacity of a well if it yields 0.0023148 m^3/s and drawdown of 5 m is -
   (a) 20 m^3/day/m
   (b) 40 m^3/day/m
   (c) 60 m^3/day/m
   (d) 80 m^3/day/m

10. If the hydraulic conductivity of a soil is $5x10^{-5}$ m/s, the rate of flow through a soil column of 1 m^2 cross sectional area under hydraulic gradient of 0.2 is -
   (a) 1×10^{-5} m^3/s
   (b) 5×10^{-6} m^3/s
   (c) 1×10^{-6} m^3/s
   (d) 2×10^{-5} m^3/s

11. A drainage system is designed to remove 0.02 m^3/s of water from a field. If the field area is 5 ha, what is the drainage rate in mm/day?
   (a) 34.6 mm/day
   (b) 17.3 mm/day
   (c) 10.4 mm/day
   (d) 6.9 mm/day

12. The water level in a confined aquifer
   (a) Increases with an increase in atmospheric pressure
   (b) Decreases with an increase in atmospheric pressure
   (c) Does not undergo any change with change in the atmospheric pressure
   (d) All of the above are possible

13. The primary reason for using gypsum in soil reclamation is to -
   (a) increase in soil pH
   (b) improve soil drainage
   (c) replace sodium ions with calcium ions
   (d) increase soil organic matter

14. The critical depth in an open channel flow corresponds to -
   (a) maximum velocity point
   (b) minimum energy point
   (c) maximum energy point
   (d) minimum velocity point

15. Relay cropping is best defined as -
   (a) growing multiple crops in sequential seasons
   (b) growing two or more crops simultaneously on the same field
   (c) sowing the next crop before the previous one is harvested
   (d) rotating crops every alternate year

16. The Bernoulli's equation is based on the principle of -
   (a) Conservation of Energy
   (b) Conservation of Momentum
   (c) Conservation of Mass
   (d) Conservation of Pressure

17. If Δ is the depth of water in meter, b is the number of days of base period and D is the duty in hectare/cumec, the relationship which holds good is -
   (a) $D = \Delta(8.64/B)$
   (b) $B = \Delta(8.64/D)$
   (c) $D = (8.6\ \Delta/B)$
   (d) $\Delta = (8.64\ B/D)$

18. Moody chart:
   (a) Empirical chart used for determining friction factors
   (b) Ratio of inertial forces to viscous forces
   (c) Describes the relationship between head loss and flow rate
   (d) Flow regime characterized by smooth, constant fluid motion

19. Irrigation scheduling is primarily based on -

(a) soil type and structure

(b) crop water requirements and evapotranspiration rates

(c) the type of irrigation system used

(d) the availability of water resources

20. What is the runoff coefficient if a storm produces 50 mm of rainfall and the resulting runoff is 15 mm for a particular area?

(a) 0.1 (b) 0.2

(c) 0.3 (d) 0.4

21. The critical shear stress concept is used in the design of -

(a) Reservoirs (b) Sediment transport systems

(c) Pressurized pipelines (d) Crop irrigation schedules

22. In crop production, the term "growing degree days" (GDD) is used to:

(a) measure soil temperature (b) predict pest outbreaks

(c) estimate crop growth duration (d) calculate irrigation requirements

23. The significance of the socio-economic survey in agricultural extension is to -

(a) assess the water quality

(b) evaluate the success of crop varieties

(c) understand the farmers' needs and constraints

(d) measure soil fertility

24. Crop water requirement can be most accurately determined using:

(a) Blaney-Criddle method (b) Hargreaves method

(c) Penman-Monteith equation (d) Thornthwaite method

25. In the context of agricultural extension, the term "adoption" refers to -

(a) rejecting new agricultural practices

(b) accepting and implementing new practices

(c) temporary use of traditional methods

(d) avoiding extension services

26. A field requires 6 cm of irrigation water every week. If the field area is 10 hectares, what is the total volume of water needed in one week?

(a) 600 m^3 (b) 6000 m^3

(c) 60,000 m^3 (d) 600,000 m^3

27. The term "water table" refers to:

(a) the surface of a flowing river

(b) the boundary between saturated and unsaturated zones

(c) the upper surface of a confined aquifer

(d) the depth of water in a well

28. Bored tube-wells in rocky consolidated formations are usually drilled by -

(a) rotary drill rigs (b) percussion drill rigs

(c) down the hole (DTH) hammer rigs (c) impact drill rigs

29. What is the pump discharge (in m^3/s) if the power supplied to the pump is 10 kW, the head is 15 m, and the efficiency is 75%?

(a) 0.067 m^3/s (b) 0.087 m^3/s

(c) 0.107 m^3/s (d) 0.127 m^3/s

30. The term "sprinkler irrigation" refers to:

(a) Applying water directly to the soil surface

(b) Delivering water to crops through emitters at the root zone

(c) Simulating rainfall by distributing water through overhead nozzles

(d) Subsurface application of water

31. A centrifugal pump has a flow rate of 30 *l/s* and a head of 20 m. What is the power required by the pump if the efficiency is 70%?

(a) 4.2 kW (b) 5.2 kW

(c) 6.2 kW (d) 7.2 kW

32. The head loss in a pipe of 100 m length, 0.1 m diameter, and flow velocity of 1 m/s, using Darcy-Weisbach equation with a friction factor of 0.02 is -

(a) 1 m (b) 2 m

(c) 3 m (d) 4 m

33. Which crop is typically not grown during the Kharif season in India?

(a) Rice (b) Maize

(c) Wheat (d) Cotton

34. Kor-watering is the irrigation water supplied to a crop:

(a) before sowing (b) just before harvesting

(c) about 3 weeks after sowing (d) about 3 weeks before harvesting

35. Which type of pump is most suitable for low discharge and high head?

(a) Centrifugal pump (b) Submersible pump

(c) Turbine pump (d) Reciprocating pump

36. A rectangular weir has a width of 2 m and a discharge coefficient of 1.8. What is the discharge over the weir when the head over the weir is 0.4 m?

(a) 0.288 m^3/s (b) 0.576 m^3/s

(c) 0.864 m^3/s (d) 1.152 m^3/s

37. A canal has a trapezoidal cross-section with a bottom width of 5 m, a side slope of 1:1 (horizontal to vertical), and a depth of 2 m. The wetted perimeter is -

(a) 9 m (b) 10 m

(c) 11 m (d) 12 m

38. The line joining the static water levels in several well, excavated through a confined aquifer, is known as -

(a) cone of depression (b) piezometric surface

(c) perched water table (d) hypsometric curve

39. Which factor is most critical in determining the design of an irrigation system?

(a) The type of crops being grown (b) The color of the soil

(c) The altitude of the field (d) The availability of fertilizers

40. Saline soils are primarily characterized by:

(a) High calcium content
(b) High sodium content
(c) Low pH
(d) High organic matter

41. Lacey's regime theory is applicable for:

(a) Flow through pipes
(b) Rigid boundary canals
(c) Alluvial channels
(d) Sediment transport in pipelines

42. Hydraulic resistance (for groundwater flow) typically has dimensions related to:

(a) Time/length
(b) Length/time
(c) Length^2/time
(d) Time

43. Which type of flow occurs when the velocity of a fluid changes over time or location?

(a) Steady flow
(b) Uniform flow
(c) Transient flow
(d) Laminar flow

44. A diversion box in irrigation systems is used to:

(a) measure soil moisture
(b) control water flow to different areas
(c) increase water pressure
(d) filter irrigation water

45. Which one of the following is the dimension of the specific gravity of a liquid?

(a) $[M^1 L^{-3} T^0]$
(b) $[M^1 L^0 T^0]$
(c) $[M^0 L^{-3} T^0]$
(d) $[M^0 L^0 T^0]$

46. An irrigation project is classified as a major project when the CCA involved in the project is more than -

(a) 2500 ha
(b) 10000 ha
(c) 2000 ha
(d) 5000 ha

47. The significance of the socio-economic survey in agricultural extension is to:

(a) assess the water quality
(b) evaluate the success of crop varieties
(c) understand the farmers' needs and constraints
(d) measure soil fertility

48. The main advantage of multiple cropping systems is:

(a) increased use of synthetic fertilizers
(b) higher susceptibility to pests and diseases
(c) enhanced crop yield and resource use efficiency
(d) reduced biodiversity

49. The principle of sediment transport in irrigation canals mainly involves:

(a) Drag and lift forces
(b) Buoyancy and capillary action
(c) Cohesion and adhesion forces
(d) Gravitational and frictional forces

50. Calculate the hydraulic radius for a rectangular channel with a width of 4 m and a water depth of 1.5 m.

(a) 0.5 m
(b) 0.75 m
(c) 1.0 m
(d) 1.25 m

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. Derive the continuity equation for fluid flow and explain in details its application in irrigation canal design.
2. Derive the expression for the hydraulic conductivity using Darcy's law and the application in soil and groundwater studies.
3. Design a tail-water rating curve for a canal with a constant slope and variable discharge, considering the Manning's equation and continuity principles.
4. Derive the formula for the efficiency of a hydraulic pump and calculate it given a pump input power of 10 kW and output hydraulic power of 7.5 kW.
5. What is an observation well? What are the points to be considered for the design and installation of an observation well?
6. Explain and derive the fundamental Bernoulli equation for fluid flow in open channels.
7. Explain the concept of irrigation water use efficiency and calculate it for a field that uses 2000 m^3 of water to produce 4 tons of crop yield.
8. Design the most economical trapezoidal section of a channel to carry a discharge of 10 m^3/s in a bed slope of 1:3000. For stability, the side slope is 1.5:1 and the value of manning's 'n' is 0.025.
9. Explain the role of extension services in enhancing farm mechanization and calculate the potential increase in yield if mechanization improves efficiency by 20%.
10. The gross command area for a distributaries is 6000 ha, 80% of which is culturable irrigable. The intensity of irrigation for Rabi season is 50% and that for Kharif is 25%. If the average duty at the head of the distributary is 2000 ha/cumec for Rabi season and 900 ha/cumec for Kharif season, find out the discharge required at the head of the distributary from average demand consideration.
11. Derive a relationship between a duty and delta for a given base period. In irrigation planning, why is it important to consider both the duty and delta values?
12. Design a surface drainage system for a field of 5 hectares with an excess rainfall of 20 mm and a drainage efficiency of 85%. Calculate the required drainage capacity.
13. Calculate the pump power required to lift water from a well to a height of 15 meters at a flow rate of 0.02 m^3/s with an efficiency of 65%.
14. Calculate the irrigation water requirement for a field of 5 hectares (ha) growing maize during the growing season, assuming a crop coefficient (K_c) of 1.2 and an evapotranspiration rate (ET_o) of 5 mm/day.
15. A groundwater well is pumping at a rate of 50 l/s. Calculate the drawdown in the aquifer at a radial distance of 100 meters from the well after 24 hours of continuous pumping. Assume an initial groundwater level of 10 meters and a transmissivity (T) of 500 m^2/day.
16. Calculate the total hydraulic head required at the inlet of an irrigation pipe system to deliver water at a flow rate of 2 m^3/s over a distance of 1000 meters. Assume a friction loss coefficient (f) of 0.02 and neglect minor losses.
17. Derive the equation for the energy gradient line (EGL) and hydraulic gradient line (HGL) in open channel flow. Explain how these lines are used in the design and analysis of irrigation canals.

18. Explain the concept of crop water requirement and the methods used for estimating evapotranspiration. Discuss the components in the Penman-Monteith equation for estimating reference crop evapotranspiration.

19. Explain the principle behind Lacey's theory for estimating the mean velocity of flow in an open channel. Derive the Lacey's velocity formula and discuss its assumptions and limitations.

20. Discuss the principles, components, advantages, challenges and issues in Warabandi system.

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