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-II

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. Probable Maximum Precipitation (PMP) is -
   (a) the average precipitation over a year
   (b) the maximum precipitation expected for a given return period
   (c) the theoretically greatest depth of precipitation for a given duration under optimal meteorological conditions
   (d) none of the above
2. Which of the following is not a direct method of distance measurement?
   (a) Pacing
   (b) Tacheometry
   (c) Odometer
   (d) EDM (Electronic Distance Measurement)
3. The contour interval is -
   (a) the vertical distance between two consecutive contour lines
   (b) the horizontal distance between two points
   (c) the difference in elevation between the highest and lowest points
   (d) the area enclosed between two contour lines
4. The Universal Soil Loss Equation (USLE) estimates:
   (a) Sediment deposition
   (b) Soil erosion by water
   (c) Soil erosion by wind
   (d) Evapotranspiration
5. Gully control structures are used to -
   (a) increase the flow of water
   (b) prevent soil erosion in large, deeply eroded channels
   (c) measure rainfall intensity
   (d) facilitate irrigation
6. Which of the following is the correct expression for the continuity equation in hydrology?
   (a) $\Delta S = P + I - E$
   (b) $\Delta S = P - Q - E$
   (c) $\Delta S = P - I - E$
   (d) $\Delta S = P + Q + E$

7. The Double Mass Curve method is used to -
   (a) measure precipitation
   (b) analyze and correct inconsistencies in hydrological data
   (c) estimate infiltration rates
   (d) determine the evaporation losses

8. When considering frequency analysis of point rainfall, the return period is -
   (a) the average number of years between occurrences of a certain rainfall event
   (b) the maximum number of years in which a certain rainfall event can occur
   (c) the time taken for rainwater to infiltrate the soil
   (d) the average duration of a rainfall event

9. Which of the following is a characteristic of a synthetic unit hydrograph?
   (a) Derived from actual streamflow records
   (b) Developed using empirical relationships
   (c) Not dependent on watershed characteristics
   (d) Represents multiple storm events

10. Horton's infiltration equation is given by:
   (a) $f = f_c + (f_0 - f_c)e^{-kt}$
   (b) $f = f_c - (f_0 + f_c)e^{-kt}$
   (c) $f = f_0 + (f_c - f_0)e^{-kt}$
   (d) $f = f_0 - (f_c + f_0)e^{-kt}$

11. The principle of surveying that states "work from whole to part" means:
   (a) Starting with large-scale surveys and moving to small-scale surveys
   (b) Starting with detailed surveys and then generalizing
   (c) Conducting surveys without any predefined order
   (d) None of the above

12. Which of the following errors is not associated with a prismatic compass?
   (a) Instrumental error
   (b) Personal error
   (c) Magnetic declination
   (d) Parallax error

13. When performing tacheometric surveying, the "stadia interval" refers to:
   (a) The vertical distance between the stadia hairs
   (b) The horizontal distance measured
   (c) The difference in readings of the upper and lower stadia hairs
   (d) The focal length of the instrument

14. The process of rectifying aerial photographs involves:
   (a) Enhancing image quality
   (b) Correcting geometric distortions
   (c) Interpreting features from the photograph
   (d) Merging multiple photographs

15. The Rational Method for estimating peak runoff involves the use of -
   (a) rainfall intensity, area, and runoff coefficient
   (b) rainfall duration, area, and infiltration rate
   (c) evaporation rate, soil moisture, and area
   (d) rainfall frequency, area, and groundwater level

16. The "phi-index" is used in hydrology to represent:
   (a) The rate of infiltration during a storm event
   (b) The rate of evaporation from a water body
   (c) The slope of a catchment area
   (d) The peak flow rate of a river

17. In hydrology, "antecedent moisture condition" (AMC) refers to:

(a) Soil moisture content after a rainfall event (b) Soil moisture content before a rainfall event

(c) Average soil moisture content over a month (d) Maximum soil moisture content

18. The unit used to measure evaporation is -

(a) millimeters per day (mm/day) (b) cubic meters per second (m^3/s)

(c) meters per second (m/s) (d) liters per hectare (L/ha)

19. The concept of "resection" in surveying refers to -

(a) determining the elevation of a point (b) establishing a new survey control point

(c) measuring the distance between two points (d) calculating the area of a land parcel

20. The purpose of riparian buffers is to -

(a) increase water evaporation (b) filter pollutants from runoff

(c) store floodwater (d) channelize stream flow

21. What is the mean precipitation over an area using the Thiessen polygon method. If the precipitation data are as follows: Station A: 10 mm, Station B: 20 mm, Station C: 30 mm, with areas of 40%, 30%, and 30% respectively.

(a) 20 mm (b) 23 mm

(c) 18 mm (d) 25 mm

22. The frequency of point rainfall if a particular rainfall event of 100 mm has a return period of 10 years.

(a) 0.01 (b) 0.1

(c) 0.5 (d) 1.0

23. A stream has a flow rate of 20 m^3/s and a cross-sectional area of 5 m^2. The average velocity of the stream is -

(a) 2 m/s (b) 4 m/s

(c) 5 m/s (d) 10 m/s

24. What is the distance between two points if the prismatic compass reading is 120° and the measured distance along the baseline is 200 m?

(a) 346.41 m (b) 173.21 m

(c) 200 m (d) 100 m

25. Calculate the reduced level (RL) at a point if the height of the instrument is 105.0 m and the staff reading at that point is 2.5 m.

(a) 102.5 m (b) 107.5 m

(c) 100.0 m (d) 105.0 m

26. The area of a triangular plot of land with base 50 m and height 30 m is -

(a) 750 m^2 (b) 1000 m^2

(c) 1500 m^2 (d) 2000 m^2

27. If a soil sample has a bulk density of 1.6 g/cm^3 and a moisture content of 20%, the dry density of the soil is -

(a) 1.2 g/cm^3 (b) 1.3 g/cm^3

(c) 1.4 g/cm^3 (d) 1.6 g/cm^3

28. What is the soil erosion rate using the Universal Soil Loss Equation (USLE) with the following factors: R = 100, K = 0.2, LS = 0.5, C = 0.3, P = 0.6.

(a) 1.8 tons/ha/year (b) 1.5 tons/ha/year

(c) 1.2 tons/ha/year (d) 2.0 tons/ha/year

29. If a contour trench has a length of 100 m, width of 1 m, and depth of 0.5 m, the total volume of soil excavated is -

(a) 25 m^3 (b) 50 m^3

(c) 75 m^3 (d) 100 m^3

30. Calculate the sediment yield from a watershed area of 200 ha, with a soil erosion rate of 5 tons/ha/year and a sediment delivery ratio of 0.3.

(a) 200 tons/year (b) 300 tons/year

(c) 500 tons/year (d) 600 tons/year

31. In the context of erosion control, "gully plugging" involves:

(a) Removing sediment from gullies

(b) Constructing barriers to stabilize the gully and prevent further erosion

(c) Planting vegetation in gullies

(d) Redirecting water flow away from gullies

32. The concept of "safe yield" of a reservoir refers to:

(a) the maximum amount of water that can be stored

(b) the average amount of water available annually

(c) the maximum amount of water that can be withdrawn annually without depleting the reservoir

(d) the total capacity of the reservoir

33. Using remote sensing, if the spatial resolution of an image is 1 m and the image covers an area of 10 km^2, what is the total number of pixels?

(a) 10000 (b) 100000

(c) 1000000 (d) 10000000

34. The average annual precipitation is _____ if monthly precipitation data are as follows (in mm): Jan: 10, Feb: 15, Mar: 20, Apr: 25, May: 30, Jun: 35, Jul: 40, Aug: 45, Sep: 50, Oct: 55, Nov: 60, Dec: 65.

(a) 450 mm (b) 510 mm

(c) 540 mm (d) 600 mm

35. The term "erosion pavement" refers to:

(a) an impermeable layer that prevents erosion

(b) a natural protective layer of coarse fragments on the soil surface

(c) a man-made surface for water flow

(d) a type of erosion control matting

36. "Hydrologic soil groups" are classified based on:

(a) Soil texture and permeability (b) Soil color and structure

(c) Soil organic matter content (d) Soil chemical composition

37. What is the primary factor affecting evaporation?

(a) Soil type (b) Air temperature

(c) Vegetation (d) Topography

38. What is the significance of flood routing in reservoir management?

(a) To estimate the sediment load in the reservoir

(b) To determine the optimal location for a new dam

(c) To predict the inflow and outflow hydrographs

(d) To calculate the evaporation rates from the reservoir

39. The most economical section of grass water way is -
(a) Parabolic
(b) Rectangular
(c) Triangular
(d) Trapezoidal

40. An erosion is considered to be insignificant, when the erosion intensity is -
(a) $> 0.5\ m^3/ha/year$
(b) $< 0.5\ m^3/ha/year$
(c) $= 1.0\ m^3/ha/year$
(d) $< 5.0\ m^3/ha/year$

41. The minimum wind velocity required to indicate movement of soil particle is known as -
(a) Critical Velocity
(b) Intrinsic Velocity
(c) Threshold Velocity
(d) Dynamic threshold Velocity

42. Which term is used for the surface to which elevations are referred?
(a) Benchmark
(b) Level line
(c) Horizontal Plane
(d) Datum

43. Which of the following combinations for a channel is most suitable to achieve best results in flood management?
(a) Increasing width and roughness
(b) Increasing width and decreasing roughness
(c) Decreasing width and increasing roughness
(d) Decreasing width and roughness

44. What is the probability of non-occurrence of 100 mm rainfall in a year if its return period is 15 years?
(a) 0.933
(b) 0.088
(c) 0.067
(d) 0.885

45. Which hydrological method is commonly used for estimating peak flood in ungauged watershed?
(a) Rational Method
(b) SCS Curve Number Method
(c) HEC-RAS Modelling
(d) Unit Hydrograph Method

46. Based on Weibull's formula, what is the mathematical expression for return period?
(a) $T = (N + 1)/m$
(b) $T = N + 1$
(c) $T = m/N$
(d) $T = m/(N + 1)$

47. Revised Universal Soil Loss Equation estimates:
(a) Average sediment yield
(b) Average annual sediment yield
(c) Average annual soil erosion
(d) All of the above

48. The shape of the watershed is described by the formula:
(a) $S_w = L / A$
(b) $S_w = L^2 / A$
(c) Both (a) & (b)
(d) None of these

49. The purpose of cut-off walls in drop structure is to -
(a) Spill the flow safely
(b) Provide structural strength against sliding
(c) Dissipate Kinetic Flow
(d) Support gully walls

50. What is the height of a chute spillway if the design head is 1.5 m and the coefficient of discharge is 2.0?
(a) 1.5 m
(b) 2.0 m
(c) 2.5 m
(d) 3.0 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. Estimate the cut and fill volumes required for leveling a plot of land with irregular topography. The area covers 5 hectares, and the desired final ground level is 2 meters below the existing ground level at some points and 3 meters above at others. Use the grid method for volume calculation and discuss its advantages in earthwork estimation.
2. Calculate the storage capacity of a reservoir with a dam height of 30 meters, a length of 500 meters, and a top width of 10 meters. Use the trapezoidal rule for cross-sectional area calculation and determine the volume-storage relationship.
3. Derive the rational formula for peak flow calculation and explain its components.
4. Derive the formula for the unit hydrograph of a watershed from given rainfall data. Discuss the assumptions and limitations of the unit hydrograph theory.
5. Describe the procedure for leveling a given area using a dumpy level. Include the equipment setup, leveling process, and recording of readings.
6. Explain the Universal Soil Loss Equation (USLE) in detail. Discuss each factor involved and provide an example calculation for estimating soil erosion in a given watershed.
7. Describe the procedure for establishing a control network in a new survey area using triangulation. Discuss the steps involved in the reconnaissance, measurement, and adjustment of the network.
8. Discuss the principles and methods of land grading for agricultural purposes. Provide detailed steps and calculations for designing a land grading plan to improve irrigation efficiency and soil conservation.
9. Calculate the mean annual precipitation for a watershed covering 100 km^2 using data from 5 rain gauges spread across the area. Assume the rainfall data for each gauge over 5 years. Discuss the methodology for computing the mean precipitation and its significance in hydrological studies.
10. What are the methods to calculate mean precipitation? Describe any one method in details.
11. Explain the four stages of gully development.
12. Describe the components of the hydrological cycle and explain the role of each component in the movement of water on Earth's surface.
13. Evaluate different moisture conservation techniques suitable for a semi-arid region experiencing erratic rainfall patterns. Compare and contrast methods such as mulching, contour bunding, and cover cropping in terms of effectiveness in conserving soil moisture and improving crop productivity.
14. Discuss the concepts and applications of remote sensing in surveying. Explain how satellite imagery and aerial photography are used in topographic mapping and land use planning.
15. Describe the process and significance of flood frequency analysis.
16. Differentiate between Passive and Active Remote Sensing.
17. Describe the design principles and components of Chute Spillway.
18. The peak runoff of a flood hydrograph due to 4-hr effective storm is 400 m^3/s. The mean depth of the rainfall is 5.9 cm. Assuming an average infiltration loss of 0.35 cm/hr and a constant base flow of 25 m^3/s, estimate the peak of a 4-hr unit hydrograph.
19. Define hydrology and explain the hydrologic cycle with a neat sketch with its various phases.
20. Differentiate between evaporation, transpiration and evapotranspiration. Describe briefly one method used for measuring evaporation.

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