MIZORAM PUBLIC SERVICE COMMISSION

DEPARTMENTAL EXAMINATIONS FOR JUNIOR GRADE OF M.E.S. (AE/SDO) UNDER IRRIGATION & WATER RESOURCES DEPARTMENT, GOVERNMENT OF MIZORAM, JUNE, 2024.

ENGINEERING PAPER – I

(Common for Civil and Agricultural Engineers)

Time Allowed : 3 hours FM : 100 PM : 40

Marks for each question is indicated against it.

Attempt all questions.(Scientific Calculator allowed)

PART – A (50 MARKS)

1. Choose the correct answer: **(10×1 =10)**

(i) What type of foundation is preferred for stability in weir construction?

(a) Permeable (b) Impermeable

(c) Porous (d) Semi-permeable

(ii) Which shape of weir provides a smooth flow transition and minimal turbulence?

(a) Broad-crested (b) Sharp-crested

(c) Ogee (d) V-notch

(iii) Which of the following factors influences the hydraulic performance of an irrigation well?

(a) Soil type at the surface (b) Well screen color

(c) Pumping rate (d) Temperature of the well casing

(iv) Why is proper well development important after construction?

(a) To increase construction costs (b) To improve water yield and quality

(c) To decrease pump efficiency (d) To increase sediment entry into the well

(v) An irrigation channel is to be designed to carry a flow of 30 cum/s with a velocity of 1.5 m/s. The area (sq.m) of the flow section shall be:

(a) 20 (b) 25

(c) 30 (d) 400

(vi) For a circulatory watershed, the circularity ratio is.....

(a) 0 (b) π

(c) ∞ (d) 1

(vii) The drainage coefficient for an irrigated area can be estimated as.....

(a) (Deep percolation + seepage loss) irrigation depth/irrigation intervals

(b) (Hydraulic gradient x Area x Velocity)

(c) Hydraulic connectivity x Hydraulic gradient

(d) None of these above option

(viii) .....is the depth in centimeters of water drained off from a given area in 24 hours

(a) Specific storage (b) Hydraulic conductivity

(c) Drainage coefficient (d) storage coefficient

(ix) Available water in a soil refers to the water that is

(a) Drained (b) Conserved

(c) used by plants (d) lost due to percolation

(x) Darcy's law is valid only when.....

(a) flow is laminar (b) flow is turbulent

(c) flow is transitional (d) flow has Reynolds number>4000

Direction for Question No. 2 - 11: Answer the following: **(10×3=30)**

2. Define a Submersible Pump and state its advantages and disadvantages.

3. A channel is to be designed for irrigation 5000 hectares in Kharif crop and 4000 hectares in Rabi crop. The water requirement for Kharif and Rabi are 60 cm and 25 cm, respectively. The Kor period for Kharif is 3 weeks and for Rabi is 4 weeks. Determine the discharge of the channel for which it is to be designed.

4. Water Horse Power (WHP), Shaft Horse Power (SHP) and Head capacity curve.

5. The effect of change of speed and impeller diameter on pump performance (for Flow rate and Head).

6. The root zone of a certain soil has a field capacity of 180 mm and a wilting point of 100 mm. The consumptive used of crops in July is 6 mm/day. Assuming no rainfall, how often ought a farmer to irrigate? How much water should be applied at each irrigation if there is to be no deep percolation?

7. Methods used to estimate depths and spacing of a drainage.

8. Factors affecting Irrigation Intervals.

9. Why is the moisture content at which a crop permanently wilts a function of consumptive used rate as well as a soil texture? Give one point for each.

10. Three methods and mechanisms for energy dissipation.

11. Water table, water logging and its relationship.

Direction for Question No. 12 & 13: Answer the following: ***(2×5 = 10)***

12. Design an irrigation channel (trapezoidal section) in a non-erodible material to carry a discharge of 15 cumecs when the maximum permissible velocity is 0.8 m/s. Assume the bed slope of 1 in 4000, side slope = 1:1 and manning's n = 0.025.

13. A stream of 150 l/sec was diverted from a canal and 120 l/sec were delivered to the field. An area of 2 hectares was irrigated in 9 hours. The effective depth of root zone was 2 m. The runoff loss in the field was 450 m3. The depth of water penetration varied linearly from 2 metre at the head end of the field to 1.4 metre at the tail end. Available moisture holding capacity of the soil is 220 mm/m depth of the soil. Determine the water conveyance efficiency, water application efficiency, and water storage efficiency. Irrigation was started at moisture extraction level of 50% of the available water.

PART – B (50 MARKS)

14. Choose the correct answer: **(10×1=10)**

(i) A doubly reinforced beam is generally used when:

(a) The beam dimensions are not restricted (b) The beam is subjected to small moments

(c) The beam is subjected to high moments (d) The beam is purely under compression

(ii) The primary purpose of providing steel reinforcement in the tension zone of a beam is to:

(a) Resist compressive stresses (b) Increase the weight of the beam

(c) Resist tensile stresses (d) Improve the aesthetics of the beam

(iii) What type of lime is commonly used for soil stabilization in construction?

(a) Quicklime (b) Slaked lime

(c) Hydraulic lime (d) Fat lime

(iv) Which type of cement is best suited for marine construction due to its resistance to sulfate attack?

(a) Ordinary Portland Cement (OPC) (b) Portland Pozzolana Cement (PPC)

(c) Rapid Hardening Cement (d) Low Heat Cement

(v) Which component in mortar increases its workability and bonding properties?

(a) Cement (b) Lime

(c) Sand (d) Water

(vi) Which document is essential for preparing an accurate cost estimate based on SOR?

(a) Project timeline (b) Bill of Quantities (BOQ)

(c) Site survey report (d) Environmental impact assessment

(vii) Which of the following is NOT a method for estimating cut and fill volumes?

(a) Grid method (b) Cross-sectional method

(c) Volumetric method (d) Hydraulic method

(viii) For a reservoir project, the estimation of which of the following is most critical for waterproofing?

(a) Concrete (b) Lining materials

(c) Reinforcement steel (d) Excavation

(ix) In silo design, which factor is crucial for ensuring the flow of stored materials?

(a) Color of the silo (b) Internal pressure

(c) Hopper angle (d) Silo height

(x) Which of the following tests is used to determine the expansion of cement due to hydration of free lime and magnesia?

(a) Vicat apparatus method (b) Sieve analysis method

(c) Le-chatelier method (d) Blaine air permeability method

Direction for Question No. 15 - 24: Write short notes on: **(10×2=20)**

15. Why is it important to consider the seismic design when constructing a water tank?

16. What are the key items to be estimated in the construction of a reservoir?

17. Describe the main types of silos used for storage in agriculture and industry.

18. Why is compression reinforcement used in doubly reinforced beams?

19. What is mortar and what are its main components?

20. Explain the difference between item rate contracts and lump sum contracts.

21. What methods are commonly used for estimating cut and fill volumes?

22. List two main types of cement and their uses.

23. What factors influence the shear capacity of a concrete section?

24. 4 steps out of 12 steps for improved DPR preparation on Irrigation Scheme development.

Direction for Question No. 25 - 29: Answer the following: **(5×3=15)**

25. What is a farmstead? What factors governs the location of the farmstead on the farm?

26. Define Concrete. Calculate the quantities of cement, sand, and gravel required to prepare 81 cu.ft of concrete having 1:3:4 as the proportion of the aggregates. Use Fuller's formula

$$C = \frac{42}{(c+s+r)}$$

27. What is the Limit State Method in structural engineering? Explain the two main types of limit states considered in the Limit State Method?

28. How does the Limit State Method differ from the Working Stress Method?

29. (a) List out the general methods for computation of earthwork & explain.

    (b) Explain about Lead and lift

Direction for Question No. 30-31: Answer <u>any one (1)</u> the following: **(1×5=5)**

30. Evaluate the cost of the following items of work.
    (a) Brick Masonry in super structure with CM 1:6.
    (b) Plastering with CM (1:4) of 12 mm thick.

    (*Assuming the density of cement is 1440 kg/m³, price /cost of material as per prevailing market rate (approx.) and others as per requirement*)

31. The formation width of a road embankment is 9.0 m. The side slopes are 2.5:1. The depths along the center line of road at 50.0 m intervals are 1.2, 1.1, 1.4, 1.2, 0.9, 1.5 and 1.0 m. It is required to calculate the quantity of earthwork by:
    (i) Prismoidal rule
    (ii) Trapezoidal rule

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