

MIZORAM PUBLIC SERVICE COMMISSION
DEPARTMENTAL EXAMINATIONS FOR JUNIOR GRADE OF M.E.S. (AE/SDO)
UNDER IRRIGATION & WATER RESOURCES DEPARTMENT,
GOVERNMENT OF MIZORAM, DECEMBER, 2023.

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:

(25×1=25)

- (1) The most suitable equipment for well drilling in hard rock areas is
 - (a) Cable tool drilling
 - (b) Direct rotary drilling
 - (c) Down-the-hole air rotary drilling
 - (d) Reverse rotary drilling
- (2) When the head against which the positive displacement pump operate is changed, the volume of water displaced by it
 - (a) remains constant
 - (b) varies directly as the head
 - (c) varies as the square of the head
 - (d) varies as the cube of the head
- (3) When the speed of a centrifugal pump is changed, discharge
 - (a) remains constant
 - (b) varies directly as speed
 - (c) varies as the square of the speed
 - (d) varies as the cube of the speed
- (4) The most suitable irrigation pump to lift water from Stream/canal with lift less than 25 m is
 - (a) Jet pump
 - (b) submersible pump
 - (c) centrifugal pump
 - (d) propeller pump
- (5) If the RPM of a pump are increased by 50%, the required BHP will increase by
 - (a) 50 percent
 - (b) 175 times
 - (c) 225 times
 - (d) 338 times
- (6) The main cause for overloading of the motor/engine is
 - (a) High discharge head
 - (b) damaged impeller
 - (c) low discharge head
 - (d) too high suction lift
- (7) The indirect benefits from the irrigation-based projects on wells and pumps include
 - (a) increase in actual crop area
 - (b) increase in value of the crop
 - (c) improving the quality of the crops
 - (d) providing off-season vegetables
- (8) Drain spacing is directly proportional to
 - (a) Type of soil
 - (b) type of Gravel material
 - (c) drain discharge
 - (d) None of the above

- (9) 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
- (10) The construction of drain is always started at the
- (a) out let and progress upstream
 - (b) Upstream and progress out let
 - (c) Last contour of field
 - (d) First contour of field
- (11) Drainage removes only water from the soil
- (a) gravitational
 - (b) held water
 - (c) capillary
 - (d) pressurized water
- (12) The relation between transmissibility (T) and permeability (K) for an aquifer of depth d is
- (a) $K=T d$
 - (b) $T=K d$
 - (c) $T=K \log d$
 - (d) $T=\ln(K d)$
- (13) Available water in a soil refers to the water that is
- (a) Drained
 - (b) Conserved
 - (c) used by plants
 - (d) lost due to percolation
- (14) For a circulatory watershed, the circularity ratio is
- (a) 0
 - (b) p
 - (c) ∞
 - (d) 1
- (15) A rainfall of 15mm over a watershed produced a runoff of 6 mm, the balance 9mm is
- (a) Evaporation loss
 - (b) depression storage
 - (c) Total abstraction
 - (d) interception loss
- (16) The peak of a unit hydrograph is the discharge per unit of
- (a) Total rainfall
 - (b) watershed area
 - (c) rainfall duration
 - (d) rainfall excess
- (17) An aquifer is a geologic formation that
- (a) Contain water but does not transmit
 - (b) does not contain water
 - (c) Contain water and also transmit
 - (d) is a rock outcrop
- (18) The diameter of the intake pipe of a lift scheme flowing partially full is computed using
- (a) Darcy Weisbach formula
 - (b) William Hazel formula
 - (c) Manning's formula
 - (d) Chezy's formula
- (19) The depth of flow over a sharp crested rectangular weir should not be more than about
- (a) Half the crest width
 - (b) two-third of the crest width
 - (c) three-fourth of the crest width
 - (d) the width of the weir
- (20) The most suitable device for measuring large flows in earth channels in a canal water distribution system is
- (a) In-built Parshall flume
 - (b) Supressed rectangular Weir
 - (c) Broad-crested rectangular weir
 - (d) Truncated flume
- (21) The recommended safe limits of land slope in loamy soil range from
- (a) 001 to 005 %
 - (b) 005 to 010 %
 - (c) 010 to 020 %
 - (d) 010 to 050 %

- (22) In ground water flows, Darcy's law is generally applied because
- (a) Ground water flow cannot be estimated correctly by other existing formula
 - (b) Ground water flow, being very slow, thus has very less Reynolds number
 - (c) Ground water flow is very cool
 - (d) Ground water has very high Reynolds number
- (23) 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
- (24) The index of hydraulic gradient in Darcy's equation is
- (a) 1/2
 - (b) 1
 - (c) 2/3
 - (d) 0
- (25) 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

Directions (Questions No. 2 - 6) : Write short notes on:

(5×3=15)

2. Diversion weir, Pickup weir and Permeable weir.
3. Minor, Medium and Major Irrigation Project.
4. Water conveyance efficiency, Water application efficiency and Water distribution efficiency.
5. Centrifugal pump, Submersible pump and Hydraulic Ram.
6. Crop coefficient, Actual evapotranspiration and Potential evapotranspiration.

Direction (Question No. 7 & 8) : Explain in brief (Answer any one) :

(1×10=10)

7. Design a concrete lined trapezoidal channel to carry a discharge of 200 cumecs at a slope of 1 in 5000. The side slopes of the channel are 1:1 and manning's coefficient of rugosity may be taken as 0014. Assume the limiting velocity in the channel as 2 m per second
8. A sandy loam soil holds water at 140 mm/m depth between field capacity and permanent wilting point The root depth of the crop is 30cm and the allowable depletion of water is 35 % The daily water use by the crop is 5 mm/day The area to be irrigated is 60 ha and water can be diverted at 28 lps The surface irrigation application efficiency is 40% There are no rainfall and ground water contribution

Determine

- (a) Allowable depletion depth between irrigations
- (b) Frequency of irrigation
- (c) Net application depth of water
- (d) Volume of water required
- (e) Time to irrigate 4 ha plot

PART – B (50 MARKS)

9. Choose the correct answer:

(20×1=20)

- (1) Granite is mainly composed of
 - (a) quartz and mica
 - (b) felspar and mica
 - (c) quartz and felspar
 - (d) quartz, felspar and mica
- (2) A good building stone is one which does not absorb more than of its weight of water after one day's immersion
 - (a) 5%
 - (b) 10%
 - (c) 15%
 - (d) 25%
- (3) The crushing strength of a stone depend upon its
 - (a) Texture
 - (b) specific gravity
 - (c) workability
 - (d) both (a) and (b)
- (4) A first-class brick should not absorb water more than 20% of its own dry weight after 24 hours immersion in cold water
 - (a) 10%
 - (b) 15%
 - (c) 20%
 - (d) 25%
- (5) A first-class brick should have a minimum crushing strength of
 - (a) 7MN/m²
 - (b) 105 MN/m²
 - (c) 125 MN/m²
 - (d) 14 MN/m²
- (6) The compressive strength of paving bricks should not be less than
 - (a) 20 MN/m²
 - (b) 30 MN/m²
 - (c) 40 MN/m²
 - (d) 50 MN/m²
- (7) The hydraulic lime which resembles very much with Portland cement in its chemical composition is called
 - (a) Feebly hydraulic lime
 - (b) moderately hydraulic lime
 - (c) eminently hydraulic lime
 - (d) none of these
- (8) The ultimate strength of cement is provided by
 - (a) Silica
 - (b) di-calcium silicate
 - (c) tri-calcium silicate
 - (d) tri-calcium aluminate
- (9) Le-chatelier method is used to determine
 - (a) initial setting of cement
 - (b) fineness of cement
 - (c) soundness of cement
 - (d) normal consistency of cement
- (10) A twisted bar has about more yield stress than ordinary mild steel bar
 - (a) 10%
 - (b) 20%
 - (c) 35%
 - (d) 50%
- (11) In a singly reinforced beam, the effective depth is measured from the compression edge to the
 - (a) Tensile edge
 - (b) centre of tensile reinforcement
 - (c) neutral axis of the beam
 - (d) none of these
- (12) In an over-reinforced section,
 - (a) Steel reinforcement is not fully stressed to its permissible value
 - (b) Concrete is not fully stressed to its permissible value
 - (c) Either (a) or (b)
 - (d) Both (a) and (b)

- (13) For M15 grade concrete, the section is to be redesigned if shear stress is more than
(a) 05 N/mm² (b) 1 N/mm²
(c) 15 N/mm² (d) 2 N/mm²
- (14) In doubly reinforced rectangular beam, the allowable stress in compression steel is the permissible stress in tension in steel
(a) equal to (b) less than
(c) greater than
- (15) In a slab, the transverse reinforcement is provided at to the span of the slab
(a) 45° (b) 60°
(c) 75° (d) 90°
- (16) The main factor to be considered while preparing a detailed estimate, is
(a) Quantity of the materials
(b) Availability of the materials
(c) Transportation of materials
(d) Location of site and local labour charges
(e) All of the above
- (17) The volume is measured correct to the nearest
(a) 001 cum (b) 002 cum
(c) 003 cum (d) 004cum
(e) 005 cum
- (18) According to ISI method of measurement, the order of the sequence is
(a) Length, breadth, height (b) Breadth, length, height
(c) Height, length, breadth (d) None of these
- (19) The excavation exceeding 15m in width and 10 sqm in plan area with a depth not exceeding 30 cm, is termed as
(a) Excavation (b) Surface dressing
(c) Cutting (d) Surface excavation
- (20) The following item of earthwork is not measured separately
(a) Setting out of works (b) Site clearance
(c) Dead men (d) Steps in deep excavation
(e) All of the above

Direction (Question 10 - 19) Write short notes on:

(10×2=20)

10. What are admixtures and pH value of water to be used in concrete?
11. Singly reinforced beam and doubly reinforced beam.
12. Limitation of slump test.
13. Water cement ration and its effect on strength of concrete.
14. Types of cement.
15. Dairy barn and cattle-shed.
16. Aqueducts and Canals.
17. Site selection of farm houses and poultry-shed.
18. Classification of aggregates.
19. Estimation and costing.

Direction (Question 20-21) Explain in brief:

(2×5=10)

20. Find out the Economic depth of a channel from the following data :-

Bed width = 5.0m, Full supply level = 501.00m, Bed level = 500.00m, Height of bank above F.S.L. = 0.50m, side slope in cutting = 1 : 1, side slope in banking = 1½ : 1. Top width of bank = 2m

** [for economic depth of excavation, sec area of digging = sec area of banking*

$$Bd + Sd^2 = (b_1 + b_2) h + 2 S_1 h^2$$

where B=bed width of channel, S:1 = side slope in cutting, S₁ : 1 = side slope in filling]

21. Explain briefly the procedure for preparation of Detailed Project Report of Minor Irrigation Project.

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