

# MIZORAM PUBLIC SERVICE COMMISSION

## DEPARTMENTAL EXAMINATIONS FOR JUNIOR GRADE OF M.E.S. (AE/SDO) UNDER POWER & ELECTRICITY DEPARTMENT, SEPTEMBER, 2018.

### CIVIL ENGINEERING PAPER – I

Time Allowed : 3 hours

FM : 100 PM : 40

*The figures in the margin indicate full marks for the questions.  
Attempt all questions.*

1. Answer any 10 (ten) of the following (10×5=50)
- (a) Define Darcy's Law. Derive the expression for discharge through soil per unit time for soil sample of length 'L', area of cross section 'A', Darcy's coefficient 'k', and differential height of 'h<sub>2</sub>' and 'h<sub>1</sub>' (h<sub>2</sub>>h<sub>1</sub>).
  - (b) Define Optimum Moisture Content in compaction of soil. What are the different factors affecting the compaction of soil?
  - (c) Compute the intensities of active and passive earth pressures at a depth of 6m in dry cohesionless sand with angle of internal friction  $\phi = 30$  degree and unit weight  $\gamma = 18$  kN/cu.m. What will be the intensities of active and passive pressures if the water level rises to the ground level? Take saturated unit weight of sand  $\gamma_{sat} = 21$  kN/cu.m and unit weight of water  $\gamma_w = 10$  kN/cu.m [  $K_a = (1 - \sin\phi)/(1 + \sin\phi)$  ]
  - (d) What is the expression for minimum depth of foundation based on Rankine's theory? A soil is having intensity of loading 200kN/m<sup>2</sup>, density ( $\gamma$ ) of 18 kN/cu.m and angle of shearing ( $\phi$ ) 30 degree. Find out the minimum depth of footing required based on Rankine's theory?
  - (e) What are the conditions under which the stability of slopes of an earth dam is tested? An earthen dam of slope 30 degree to the horizontal is to be constructed with soil having  $c = 15.0$  kN/m<sup>2</sup>,  $\phi = 22.5$  degree and  $\gamma = 19.0$  kN/m<sup>3</sup>. Determine the safe height of slope at a factor of safety of 1.50.
  - (f) Determine the minimum effective depth required and the corresponding steel reinforcements area for a rectangular beam having a width of 200mm to resist an ultimate moment of 200 kN-m using M20 grade concrete and Fe 415 steel.
  - (g) Determine the depth of slab required for a cantilever slab of 1.00m using M20 grade concrete and Fe 415 bars. Live load to be considered is 3 kN/sq.m .
  - (h) A short RCC column 300mmx600mm is to carry a factored load of 2000 kN having a minimum eccentricity of  $< 0.05 D$  ( D being smaller size of column). Design the column using M20 grade concrete and HYSD bars. The diameter and spacing of lateral ties as per IS 456:2000 should also be mentioned. Sketch of the final design shall be clearly shown in a diagram.

- (i) Prepare Analysis of Rates for 1 cu.m of “1 : 2:4 cement concrete( 1 cement: 2 fine sand: 4 coarse aggregate)”

Coefficients to be used in the analysis are :

- |  |                                       |
|--|---------------------------------------|
| i) Cement - 0.32 tonne                 | ii) 20mm coarse aggregate – 0.57 cu.m |
| iii) 10mm coarse aggregate - 0.28 cu.m | iv) fine aggregate – 0.425 cu.m       |
| v) Ist class mason – 0.17              | vi) Semi skilled – 0.90               |
| vii) Unskilled – 2.                    |                                       |

The market rates to be adopted are:

- |   |  |
|---|--|
| i) Cement – Rs. 9000/ tonne                 | ii) 20mm coarse aggregate – Rs. 2200/ cu.m |
| iii) 10mm coarse aggregate - Rs. 2300/ cu.m | iv) Fine aggregate – Rs.1900/ cu.m         |
| v) Ist class mason – Rs. 700/day            | vi) Semi skilled – Rs. 600/day             |
| vii) Unskilled – Rs. 400/day                |  |

- (j) The following are the sieve analysis result of 20mm and 10mm aggregates. Find out by which ratio the two sizes of aggregates must be mixed in order to get the desired all-in-aggregates grading for a project.

S/No	IS Sieve Size	Cumulative % passing by weight		Range required for all- in -aggregate grading
1	26.50mm	20mm	10mm	100
2	19.00mm	60	90	90 -100
3	13.20mm	52	60	56-88
4	4.75mm	40	53	16 – 36
5	2.36mm	10	20	4 – 19
6	0.30mm	5	7	02-Oct
7	0.075mm	1	0	0-5

- (k) What are the statutory clearances mandatory for a hydel project? What are the factors involved for environmental impact assessment to be submitted to the competent authority?
- (l) A plate girder has flange plate of 440x25mm which is subjected to a tension of 1150 kN. Design a butt weld. ( $f_y = 250 \text{ N/mm}^2$ , allowable tension in the weld = 0.60  $f_y$  and effective thickness of a single V butt weld = 0.75 plate thickness)

2. Give short answers to the following -

(10×2=20)

- What is segregation in concrete undesirable?
- What is the effect of fire on concrete especially on columns?
- What is the difference between work cube and laboratory cubes in mix design of concrete?
- What is the minimum percentage of steel in RCC foundations? Where is the distance from the column two-way shear is checked?
- What is the limit of slenderness ratio for short column? How much is the load capacity of a circular column increased if helical reinforcements is used?
- What is the minimum percentage of steel in RCC slab ? What is the minimum thickness of slab to be adopted?

- (g) What is the range of factor of safety usually adopted for in determining the bearing capacity of soil?
- (h) What is meant by Atterberg's limits?
- (i) What is passive pressure in retaining wall design?
- (j) What is the main difference between compaction and consolidation?

3. Choose the correct answer:

(15×2=30)

- (a) Reinforcement bars in column should not have diameter less than
  - (i) 16mm
  - (ii) 12mm
  - (iii) 10mm
  - (iv) 8mm
- (b) The index that is used to indicate the consistency of undisturbed soils in the field is:-
  - (i) Plasticity
  - (ii) Liquidity index
  - (iii) Toughness Index
  - (iv) Sensitivity
- (c) The minimum percentage of steel in RCC column is
  - (i) 1%
  - (ii) 0.80%
  - (iii) 0.85%
  - (iv) 0.90 %
- (d) Permeability soil is the rate at which water flows through it under the action of hydraulic
  - (i) Pressure
  - (ii) Flow
  - (iii) Gradient
  - (iv) Impact
- (e) Under passive earth pressure, backfill behind the retaining wall is in the state of
  - (i) Compression
  - (ii) Tension
  - (iii) At rest
  - (iv) Compression and tension alternatively
- (f) Which IS Sieve size differentiate coarse and fine aggregate?
  - (i) Aggregate passing 2.36mm
  - (ii) Aggregate passing 4.75mm
  - (iii) Aggregate passing 1.18mm
  - (iv) Aggregate passing 10mm
- (g) While casting concrete, concrete should not be dropped from a height greater than
  - (i) 1.00m
  - (ii) 1.20m
  - (iii) 1.50m
  - (iv) 1.25 m
- (h) The characteristic load is defined as the load that has a \_\_\_\_\_ % probability of not being exceeded during the life of the structure
  - (i) 90%
  - (ii) 92%
  - (iii) 100%
  - (iv) 95%
- (i) If  $f_{ck}$  is the characteristic strength of the concrete, the strength of concrete in the actual structure shall be taken as
  - (i)  $0.87 f_{ck}$
  - (ii)  $0.67 f_{ck}$
  - (iii)  $0.75 f_{ck}$
  - (iv)  $0.80 f_{ck}$
- (j) The failure of slopes slope takes place mainly due to
  - (i) The action of gravitational forces
  - (ii) The seepage forces within the soil
  - (iii) Due to excessive cutting below the slope
  - (iv) Due to overburden pressure on the slope
- (k) In stability computations of slope, the curve representing the real surface of sliding is usually represented by
  - (i) Parabola
  - (ii) Arc of circle
  - (iii) Cubic parabola
  - (iv) None of these

- (l) The main factor to be considered while preparing a detailed estimate is
- (i) Quantity of materials
  - (ii) Availability of materials
  - (iii) Transportation of materials
  - (iv) All of these
- (m) The most economical section for a steel column is
- (i) Rectangular section
  - (ii) Tubular section
  - (iii) Solid round section
  - (iv) I- Section
- (n) Maximum slenderness ratio ( $l/r$ ) of compression member carrying dead loads and superimposed load shall not exceed
- (i) 180
  - (ii) 250
  - (iii) 200
  - (iv) 350
- (o) The minimum pitch to be used for rivet is
- (i) 2.2 times diameter of rivet
  - (ii) 2.5 times diameter of rivet
  - (iii) 2.0 times diameter of rivet
  - (iv) 1.75 times diameter of rivet

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