MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (AE/SDO) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT, GOVERNMENT OF MIZORAM, JANUARY-2024

CIVIL ENGINEERING
PAPER-III

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. Aeolian Soils are —
   - (a) Residual soils
   - (b) Wind deposits
   - (c) Gravity deposits
   - (d) Water deposits

2. When the product of rock weathering is not transported as sediment but remains in place, is called
   - (a) Alluvial soil
   - (b) Residual soil
   - (c) Glacial soil
   - (d) Red soil

3. Which one of the following is the part of assumptions made by Terzaghi while developing the mathematical statement of the consolidation process?
   - (a) The soil is non-homogeneous.
   - (b) The soil particles and water are incompressible.
   - (c) The partial deformation of soil is due to partial change in volume.
   - (d) Co-efficient of permeability is variable during consolidation.

4. If the water content of a fully saturated soil mass is 100%, the void ratio of the sample is
   - (a) Less than specific gravity of the soil
   - (b) Equal to specific gravity of the soil
   - (c) Greater than specific gravity of the soil
   - (d) Independent of specific gravity of the soil

5. A certain soil has the following properties: $Gs = 2.71$, $n = 40\%$ and $w = 20\%$. The degree of saturation of the soil (rounded off to the nearest percent) is —
   - (a) 56
   - (b) 75
   - (c) 81
   - (d) 92

6. A footing $3m \times 1.5m$ in plan transmits a pressure of $160\ kN/m^2$ on a cohesive soil having $E = 8 \times 10^4$ kN/m^2 and $\mu = 0.48$. What is the immediate settlement at the center? assuming the footing to be flexible? (Take influence factor, $I_f = 1.52$).
   - (a) 2.47 mm
   - (b) 3.51 mm
   - (c) 4.62 mm
   - (d) 5.81 mm

7. The factor of safety of an infinite slope in a sand deposit is found to be 1.732. The angle of shearing resistance of sand is 30. The average slope of the sand deposit is given by
   - (a) $\tan^{-1}(0.666)$
   - (b) $\tan^{-1}(0.333)$
   - (c) $\tan^{-1}(0.777)$
   - (d) $\tan^{-1}(0.444)$

8. Unconfined compression test is most suitable for determining the
    1. sensitivity of clays
    2. settlements of embankments
    3. strength of partially saturated clay sample
    4. strength of fully saturated clay sample

    (a) 1, 2, 3. and 4
    (b) 2 and 3 only
    (c) 3 and 4 only
    (d) 1 and 4 only

9. If the uniformity coefficient $C_u = 4$ and coefficient of curvature $C_c = 1$ for a soil, then D_{30}/D_{10} for the soil is

    (a) 4
    (b) 1/4
    (c) 2
    (d) 1/2

10. The mean unconfined compressive strength of a purely cohesive soil was found to be 50 kN/m². The ultimate bearing capacity of a square footing calculated by Terzaghi's concept (bearing capacity factor $N_C = 5.7$).

    (a) 185.25 kN/m²
    (b) 390.5 kN/m²
    (c) 285 kN/m²
    (d) 142.5 kN/m²

11. Which one of the following surveys is used to define the property line?

    (a) City survey
    (b) Cadastral survey
    (c) Compass survey
    (d) Topographical survey

12. The permissible error (E) for the Precise levelling type with distance (D) in kilometre is given by:

    (a) $E = \pm 0.025\sqrt{D}$
    (b) $E = \pm 0.100\sqrt{D}$
    (c) $E = \pm 0.012\sqrt{D}$
    (d) $E = \pm 0.006\sqrt{D}$

13. Convert the direction of a line PQ measured in whole circle bearing system, 75°30', into quadrantal bearing system.

    (a) N 75°30' W
    (b) N 255°30' E
    (c) N 255°30' W
    (d) N 75°30' E

14. What is ∠ABC if FB of line AB is 40° and BB of line BC is 280°?

    (a) 220°
    (b) 120°
    (c) 320°
    (d) 420°

15. A 30 m metric chain is found to be 0.1 m too short throughout the measurement. If the distance measured is recorded as 300 m, then the actual distance will be

    (a) 300.1 m
    (b) 301.0 m
    (c) 299.0 m
    (d) 310.0 m

16. A person of height 1.65 m standing on a cliff of height 20 m above the water level on sea shore can sight a ship at a distance of

    (a) 10 km
    (b) 18 km
    (c) 20 km
    (d) 15 km

17. The curvature of the earth's surface is taken into account only if the extent of survey is more than

    (a) 60 sq km
    (b) 160 sq km
    (c) 260 sq km
    (d) 360 sq km

18. What is the unit of payment in MKS system for Earthwork in banking, cutting in road and irrigation channel?

    (a) Per m
    (b) Per m³
    (c) Per m²
    (d) Tons

19. Which of the following areas is NOT included in the plinth area?
    (a) Sunshades, vertical sun breakers or box louvers projecting out.
    (b) Area of porches other than cantilevered.
    (c) Internal shafts for sanitary installations provided do not exceed 2 m² in area.
    (d) All floors, area of walls at the floor level, excluding plinth offsets, if any

20. What is the quantity of cement (in kg) and of dry sand (in cubic meter) respectively required for preparing 1 cubic meter of wet cement mortar of 1 : 5 proportion?
    (a) 270 and 1.00
    (b) 290 and 1.04
    (c) 290 and 1.00
    (d) 312 and 1.04

21. In which area of airport loading and unloading of cargo and passengers, parking, refueling of an aircraft is carried out?
    (a) Apron
    (b) Taxiways
    (c) Runways
    (d) Hanger

22. The raising of outer rail over inner rail is called
    (a) Cant deficiency
    (b) Cant
    (c) Capacity of the track
    (d) Centre bound sleepers

23. The current total length (in km) of the existing National Highways in India is in the range of
    (a) 25,000 – 75,000
    (b) 75,000 – 100,000
    (c) 100,000 – 125,000
    (d) > 125,000

24. A road is being designed for a speed of 110 km/hr on a horizontal curve with a super elevation of 8%. If the coefficient of side friction is 0.10, the minimum radius of the curve (in m) required for safe vehicular movement is
    (a) 115.0
    (b) 152.3
    (c) 264.3
    (d) 528.5

25. The value of lateral friction or side friction used in the design of horizontal curve as per India Roads Congress guidelines is
    (a) 0.15
    (b) 0.24
    (c) 0.35
    (d) 0.40

26. The length of a transition curve for a circular curve of radius 300 m and for a design speed of 15 m/s when the rate of change of centrifugal acceleration is 0.3 m/s² is
    (a) 47.5 m
    (b) 57.5 m
    (c) 27.5 m
    (d) 37.5 m

27. The impact load of ship while docking is taken up by
    (a) Morning dolphins
    (b) Breasting dolphins
    (c) Bulkhead
    (d) Fixed morning berth

28. Which one of the following binders is recommended for a wet and cold climate?
    (a) 80/100 penetrating asphalt
    (b) tar
    (c) cutback
    (d) emulsion

29. Drift method of tunnelling is used to construct tunnels in
    (a) soft ground
    (b) rocks
    (c) self supporting grounds
    (d) broken grounds

30. Platforms built for ships to come close to the shore are known as
    (a) wharves
    (b) locks
    (c) ports
    (d) none

31. The critical activity has:
    (a) Normal float
    (b) Maximum float
    (c) Minimum float
    (d) Zero float

32. For a construction project. The mean and standard deviation of the completion time are 200 days and 6.1 days, respectively. Assume normal distribution and use the value of standard normal deviate $Z = 1.64$ for the 95% confidence level. The maximum time required (in days) for the completion of the project would be _____.
    (a) 190
    (b) 210
    (c) 250
    (d) 275

33. Which among the following uses probabilistic time estimates for project management?
    (a) CPM
    (b) Grantt chart
    (c) PERT
    (d) Bar chart

34. Bar charts are suitable for
    (a) Minor works
    (b) Major works
    (c) Both minor works and major works
    (d) Nether minor works nor major works

35. Activities A, B, and C are the immediate predecessors for Y activity. If the earliest finishing time A, B, and C are 12, 15, and 10 days, respectively, then what will be the earliest starting time for Y?
    (a) 10
    (b) 12
    (c) 15
    (d) 37

36. Given that the scope of the construction work is well-defined with all its drawings, specifications, quantities and estimates, which one of the following types of contracts would be most preferred?
    (a) EPC contract
    (b) Percentage rate contract
    (c) Item rate contract
    (d) Lump sum contract

37. Which of the following equipment's is not used for hauling
    (a) tractors
    (b) bulldozers
    (c) draglines
    (d) scrapers

38. Which one of the following is not the excavating and movinig type machine?
    (a) Dragline
    (b) Scraper
    (c) Buldozer
    (d) Dump truck

39. The original cost of an equipment Rs 10,000.00. Its salvage value at the end of its total useful life of five years is Rs 1000.00. Its book value at the end of two years of its useful life (as per straight line method of evaluation of depreciation) will be
    (a) Rs 8800.00
    (b) Rs 7600.00
    (c) Rs 6400.00
    (d) Rs 5000.00

40. Slack time in PERT analysis
    (a) can never be greater then zero
    (b) is always zero for critical activities
    (c) can never be less then zero
    (d) is minimum for critical events

41. In PERT analysis, the start and end of event is represented by
    (a) activity
    (b) event
    (c) task
    (d) work

42. As per Indian standards for bricks, minimum acceptable compressive strength of any class of burnt clay bricks in dry state is
   (a) 3.5 MPa
   (b) 5.0 MPa
   (c) 7.5 MPa
   (d) 10 MPa

43. Consider the following statements:
   P. Walls of one brick thick are measured in square meters.
   Q. Walls of one brick thick are measured in cubic meters.
   R. No deduction in the brickwork quantity is made for openings in walls up to 0.1 m² area.
   S. For the measurement of excavation from the borrow pit in a fairly uniform ground, deadmen (stakes or markers) are left at suitable intervals.

   For the above statements, the correct option is
   (a) P – False; Q – True: R – False: S – True
   (b) P – False; Q – True: R – False: S – False
   (c) P – True; Q – False: R – True: S – False
   (d) P – True; Q – False: R – True: S – True

44. The effective height of free-standing non-load bearing wall and column respectively will be
   (a) 1.0H and 1.0H
   (b) 1.5H and 1.5H
   (c) 2.0H and 1.5H
   (d) 2.0H and 2.0H

45. Water retentivity for brick masonry should not be less than
   (a) 50 %
   (b) 60 %
   (c) 70 %
   (d) 80 %

46. Which stone is used for buildings situated in industrial towns?
   (a) Marble slab
   (b) Compact sandstone
   (c) Gneiss
   (d) Slate

47. Select the correct option for the following statements:
   Assertion A : Limiting value of slenderness ratio for a column is less than that of a wall.
   Reason R : A column can buckle around either of the two horizontal axes while a wall can buckle around only one axis.

   Select your answer according to the codes given below:
   (a) Both A and R are true, and R is the correct explanation of A.
   (b) Both A and R are true, but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true.

48. For strengthening a 50 m long and 5 m high straight compound wall built in brick work, which one of the following would be most suitable?
   (a) Providing buttresses at certain intervals
   (b) Providing a deeper foundation
   (c) Using a richer mortar
   (d) Using stronger bricks

49. Which of the below joints is used for masonry in arches?
   (a) Butt
   (b) Table
   (c) Rebated
   (d) Dowel

50. Ashlar masonry uses:
   (a) Dimension stones
   (b) Polygonal stones
   (c) Quarry dressed stones
   (d) Square stones

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. A 300 mm square bearing plate settles by 21 mm in a plate load test on a cohesive soil, when the intensity of loading is 0.2 N/mm². Determine the settlement of a prototype shallow footing 1 m square (1 m × 1 m) under the same intensity of loading (considering both plate and footing are placed at same depth).

2. The water content of a saturated soil and specific gravity of soil solids were found to be 30% and 2.70, respectively. Assuming the unit weight of water to be 10 kN/m³, calculate the saturated unit weight (kN/ m³) and the void ratio of the soil.

3. A cohesive soil yields a maximum dry density of 1.8 g/cc at an OMC of 16% during a standard proctor test. If the value of G is 2.65, what is the degree of saturation? What is the maximum dry density it can be further compacted to?

4. A cylinder of soil fails under a axial vertical stress of 18 t/m², when it is laterally unconfined. The failure plane makes an angle of 55° with the horizontal. Calculate the values of cohesion and the angle of internal friction of soil.

5. Estimate the quantity of brick masonry required for construction of a room of 4 m × 3 m internal dimensions using centre line method. The thickness of the wall should be 250 mm. Two windows of 2 m × 1.5 m and one door of 1.5 m × 2.2 m is to be provided in the room. The height between the top of plinth beam and bottom of slab beam should be 4 m. Make necessary sketches.

6. A brick masonry wall of normal thickness 200 mm carries an axial load of 26 kN/m and another load of 19 kN/m acting at an eccentricity of 45 mm. Determine the resultant eccentricity and eccentricity ratio.

7. A 200 mm thick brick masonry wall made of modular bricks is 5 m long between cross walls and 3.8 m clear height between RCC slabs at top and bottom. Determine the slenderness ratio of the wall.

8. Explain at least 5 types of stone masonry with neat sketch for each type.

9. Explain each of the following earth work instruments in specifying their applications. (i) Excavators, (ii) power shovels, (iii) trailers, (iv) dumpers and (v) rollers.

10. A PERT network has 9 activities on its critical path. The standard deviation of each activity on the critical path is 3. What is the standard deviation of the critical path?

11. With the following data of activities of a project, cast a suitable network for programming by CPM

Activity	A	B	C	D	E	F	G
Predecessors	-	A	B	B	D	C, E	F
Time (days)	5	6	14	8	5	9	6

G is terminal activity. Determine the project completion time, the critical path, the total float for each activity.

12. Write short note on 'Network Techniques'.

13. A transition curve is required for a circular curve of 200 m radius, the gauge being 1.5 m and maximum super elevation restricted to 15 cm. The transition is to be designed for a velocity such that no lateral pressure is imposed on the rails and the rate of gain of radial acceleration is 30 cm/s². Determine the required length of the transition curve AND the design speed.

14. A vehicle traveling on dry, level pavement at 80 kmph had its brakes applied. The vehicle traveled 76.5 m before stopping. What is the coefficient of friction that has developed?

15. If the design speed is 80 kmph, perception reaction time is 3 seconds and coefficient of friction is 0.5, then determine the safe stopping sight distance (SSD).

16. Using a sleeper density of n+5, find out the number of sleepers required for constructing a broad gauge railway track of 0.64 km length.

17. The chainage of the intersection point of two straights is 1060 m, and the angle of intersection is 120°. If the radius of a circular curve to be set out is 570 m, and peg interval is 30 m, calculate the length of the long chord AND the length of the curve.

18. If the bearing of the side AB of a regular hexagon traverse ABCDEFA shown in the figure below is 36°45', determine the bearing of the adjacent side BC of the traverse.
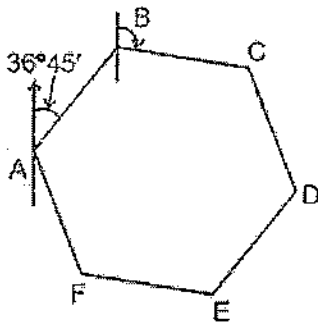
19. The true length of a line is known to be 200 m. When this measured with a 20 m tape, the length is 200.80 m. Find the correct length of 20 m tap.

20. A building fetches a net income of Rs 16000.00 per annum for the next 60 years. What is the value of the property? Assuming that the landlord desires a return of 8% on capital and sinking fund to replace the capital is also to accumulate at 8%.

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