MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (M.E.S.) UNDER PUBLIC WORKS DEPARTMENT, GOVERNMENT OF MIZORAM, MARCH, 2020

CIVIL ENGINEERING PAPER - I

Time Allowed : 3 hours   Full Marks : 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. The Le Chatelier apparatus is used to determine
   (a) soundness of cement
   (b) fineness of cement
   (c) setting time of cement
   (d) compressive strength of cement

2. For mass concrete work such as a dam, the recommended type of cement is
   (a) Ordinary Portland cement
   (b) Quick setting cement
   (c) Low-heat Portland cement
   (d) Portland Pozzolona cement

3. What will be the weight of fine aggregates for the particular concrete mix design given below?

	Weight	Specific gravity
Cement	400 kg/m^3	3.2
Fine aggregates	-	2.5
Coarse aggregates	1040 kg/m^3	2.6
Water	200 kg/m^3	1

   (a) 528 kg/m^3
   (b) 688 kg/m^3
   (c) 570 kg/m^3
   (d) 1000 kg/m^3

4. For limit state of collapse, the partial safety factors recommended by IS 456:2000 for estimating the design strength of concrete and reinforcing steel are respectively
   (a) 1.15 and 1.5
   (b) 1.0 and 1.0
   (c) 1.5 and 1.15
   (d) 1.5 and 1.0

5. The deformation in concrete due to sustained loading is
   (a) creep
   (b) hydration
   (c) segregation
   (d) shrinkage

6. The effective length of a column of actual length L, effectively held in position and restrained in direction at one end, but is free at the other end is
   (a) 2L
   (b) L
   (c) 0.67L
   (d) 1.5L

7. Match List-I with List-II and select the correct answer using the codes given below the lists:

	List-I		**List-II**
A.	Serviceability	1.	Sliding
B.	Shear key	2.	Deflection
C.	Shrinkage	3.	Cracking
D.	Concrete spalling	4.	Corrosion

Codes:

	A	B	C	D
(a)	1	3	4	2
(b)	2	1	3	4
(c)	1	3	2	4
(d)	2	1	4	3

8. Which one of the following is a long term pre-stress loss in a pre-stressed member?
   - (a) Loss due to elastic shortening
   - (b) Loss due to friction
   - (c) Loss due to relaxation of strands
   - (d) Loss due to anchorage slip

9. The material that exhibits the same elastic properties in all directions at a point is said to be
   - (a) homogeneous
   - (b) orthotropic
   - (c) viscoelastic
   - (d) isotropic

10. For an isotropic material, the relationship between Young's modulus (E), shear modulus (G) and Poisson's ratio (v) is given by
    - (a) $G = \dfrac{E}{2(1+v)}$
    - (b) $E = \dfrac{G}{2(1+v)}$
    - (c) $G = \dfrac{E}{(1+2v)}$
    - (d) $G = \dfrac{E}{2(1-2v)}$

11. For a given shear force across a symmetrical I section, the intensity of shear stress is maximum at
    - (a) extreme fibres
    - (b) centroid of the section
    - (c) at the junction of the flange and the web but on the web
    - (d) at the junction of the flange and the web but on the flange

12. A long shaft of diameter 'd' is subjected to twisting moment T at its ends. The maximum normal stress at its cross-section is
    - (a) Zero
    - (b) $\dfrac{16T}{\pi d^3}$
    - (c) $\dfrac{32T}{\pi d^3}$
    - (d) $\dfrac{64T}{\pi d^3}$

13. The radius of Mohr's circle is zero when the state of stress is such that
    - (a) shear stress is zero
    - (b) there is pure shear
    - (c) there is no shear stress but identical direct stresses in two mutually perpendicular directions
    - (d) there is no shear stress but equal direct stresses, opposite in nature, in two mutually perpendicular directions

14. A thin hollow cylinder of diameter 'd', length 'L' and thickness 't' is subjected to an internal pressure 'p'. The hoop stress in the cylinder is

(a) $\dfrac{pd}{8t}$

(b) $\dfrac{pd}{4t}$

(c) $\dfrac{pd}{2t}$

(d) $\dfrac{pd}{t}$

15. Influence line for redundant structures can be obtained by

(a) Castigliano's theorem

(b) Muller Breslau principle

(c) Unit load theorem

(d) Maxwell-Betti's theorem

16. Match List-I with List-II and select the correct answer using the codes given below the lists:

	List-I		List-II
A.	Slope deflection method	1.	Force method
B.	Moment distribution method	2.	Displacement method
C.	Method of three moments		
D.	Castigliano's second theorem		

Codes:

	A	B	C	D
(a)	1	2	1	2
(b)	1	1	2	2
(c)	2	2	1	1
(d)	2	1	2	1

17. For the truss shown in the Figure, the force in the member QR is
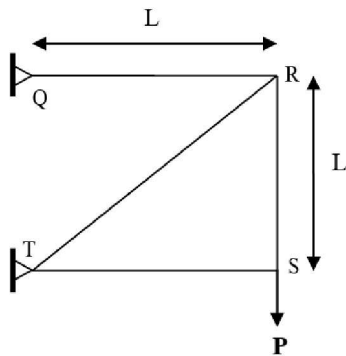
(a) zero

(b) $P/\sqrt{2}$

(c) P

(c) $\sqrt{2P}$

18. Choose the correct statement for the frame given below.
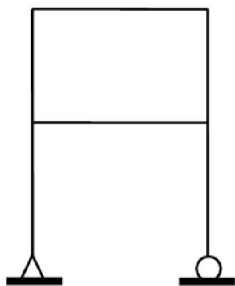
(a) stable and statically determinate

(b) unstable and statically determinate

(c) stable and statically indeterminate

(d) unstable and statically indeterminate

19. The unit of moment of inertia of an area is

    (a) $kg\text{-}m^2$ (b) $kg\text{-}m\text{-}s^2$

    (c) kg/m^2 (d) m^4

20. The linear velocity of a body rotating at v rad/s along a circular path of radius 'r' is given by

    (a) v/r (b) vr

    (c) v^2/r (d) v^2r

21. The velocity of a body on reaching the ground from a height 'h' is

    (a) $2\sqrt{gh}$ (b) $\sqrt{gh}$

    (c) $\sqrt{2gh}$ (d) $2g\sqrt{h}$

22. When a bar is subjected to a change of temperature and its deformation is prevented, the stress induced in the bar is

    (a) tensile stress   (b) compressive stress

    (c) shear stress   (d) thermal stress

23. The shear stress at the outermost fibres of a circular shaft under torsion is

    (a) zero   (b) minimum

    (c) maximum   (d) infinity

24. A simply supported beam of span *l* carries over its full span a load varying linearly from zero at both ends to *w*/unit length at midspan, then maximum bending moment is equal to

    (a) $\dfrac{wl^2}{8}$ (b) $\dfrac{wl^2}{4}$

    (c) $\dfrac{wl^2}{12}$ (d) $\dfrac{wl^2}{10}$

25. The bending moment for a certain portion of the beam is constant. For that section, shear force would be

    (a) zero   (b) increasing

    (c) decreasing   (d) constant

26. Number of unknowns to be determined in the stiffness method is equal to

    (a) static indeterminacy   (b) kinematic indeterminacy

    (c) sum of (a) and (b)   (d) none of these

27. The shape of cable under horizontal uniformly distributed load is

    (a) parabolic   (b) catenary

    (c) circular   (d) triangular

28. In the limit state design of pre-stressed concrete structures, strain distribution is assumed to be

    (a) linear   (b) non-linear

    (c) parabolic   (d) cubic parabolic

29. For a reinforced concrete section, the shape of shear stress diagram is

    (a) wholly rectangular   (b) wholly parabolic

    (c) wholly linear   (d) rectangular and parabolic

30. If s_{cbc} is the permissible compressive stress in flexure, the modular ratio is of the order of

    (a) $\dfrac{280}{3\sigma_{cbc}}$ (b) $\dfrac{200}{3\sigma_{cbc}}$

    (c) 1   (d) 10

31. Which of the following concepts is the basis principle of structural design based?

    (a) Weak column and strong beam   (b) Equally strong column-beam

    (c) Strong column and weak beam   (d) None of these

32. Shear span is defined as the zone where

    (a) bending moment is zero   (b) shear force is zero

    (c) bending moment is constant   (d) shear force is constant

33. The maximum strain in concrete at the outermost compression fibre in the limit state design of flexural member is

    (a) 0.0020   (b) 0.0035

    (c) 0.0050   (d) 0.0065

34. Ratio of plastic section modulus to elastic section modulus for rectangular section of width b and depth d

    (a) 1   (b) 2

    (c) 1.5   (d) 2.5

35. Shape factor is the property which depends on

    (a) ultimate stress of material   (b) yield stress of material

    (c) geometry of the section   (d) All of these

36. The most efficient and economical section used as a steel beam is

    (a) I section   (b) Circular section

    (c) H section   (d) Rectangular section

37. Bearing stiffeners are provided at the

    (a) support   (b) point of application of concentrated load

    (c) both (a) & (b)   (d) none of these

38. To minimise the total cost of a roof truss, the ratio of cost of truss to cost of purlins should be

    (a) 1   (b) 2

    (c) 3   (d) 4

39. Some steels do not show yield plateau and show continuous curve. For such steels, the yield strength can be obtained by drawing

    (a) initial secant modulus   (b) 0.2% offset of strain

    (c) 0.1% offset of strain   (d) none of these

40. For the analysis of thick cylinders, the theory applicable is

    (a) Lame's theory   (b) Courbon's theory

    (c) Rankine's theory   (d) Poisson's theory

41. For complete hydration of cement the w/c ratio needed is

    (a) less than 0.25   (b) between 0.25 and 0.35

   (c) between 0.35 and 0.45   (d) between 0.45 and 0.60

42. Which one of the following aggregate gives the maximum strength in concrete?

    (a) Rounded aggregate   (b) Elongated aggregate

    (c) Flaky aggregate   (d) Cubical aggregate

43. Vibrators are used for

    (a) compacting concrete   (b) proper mixing of concrete

    (c) Removing excess water from concrete   (d) Obtaining smooth surface

44. In a concrete mix, if the maximum size of coarse aggregate is increased, the proportion of fine to coarse aggregate should be

    (a) increased   (b) decreased

    (c) kept the same   (d) not dependent on size of aggregates

45. The crushing strength of a good building stone should be at least

    (a) 50 MPa   (b) 100 MPa

    (c) 150 MPa   (d) 200 MPa

46. The number of bricks required per cubic metre of brick masonry is

    (a) 400   (b) 450

    (c) 500   (d) 550

47. The strength of timber is maximum in a direction

    (a) parallel to grains   (b) perpendicular to grains

    (c) 45 degrees to grains   (d) 30 degrees to grains

48. 'The resultant force of a system is zero, the vector sum of impulses of all the external forces is zero, and the momentum of the system remains constant'. This principle is called the

    (a) principle of conservation of energy   (b) d'Alembert principle

    (c) work-energy principle   (d) principle of conservation of momentum

49. A large force acting over a short period of time is called

    (a) moment   (b) impulse

    (c) momentum   (d) power

50. Resilience is

    (a) recoverable strain energy   (b) shear strain energy

    (c) total potential energy   (d) maximum strain energy

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. Explain the difference in the behaviour of one-way slabs and two-way slabs.

2. What is the purpose of a retaining wall? What are the different types of concrete retaining walls?

3. What are the different components of a roof truss? Name three types of roof truss.

4. Draw bending moment diagram of the beam shown below:
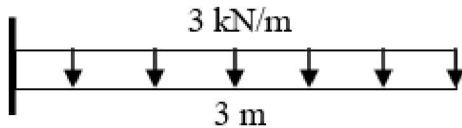
5. List some of the common defects associated with welds.

6. Describe main factors which affect permeability of concrete.

7. State five common defects in timber.

8. Define principal stress. Determine principal stress in an axially loaded circular bar of diameter 50 cm, with 5 kN axial force.

9. Discuss the stress strain characteristic of a ductile material.

10. Explain field testing of cement.

11. Explain the factors affecting good orientation of a building.

12. Determine the reaction forces at A and B on the pin-connected structure as shown in Figure. Note B is pin-connected.
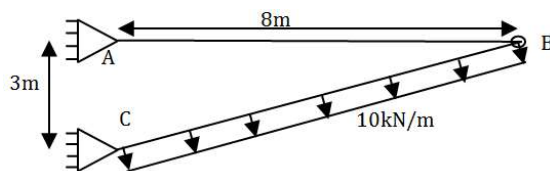
Figure

13. Determine the deflection at C using moment area method as shown in Figure. Take EI = constant.
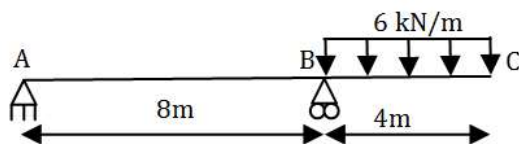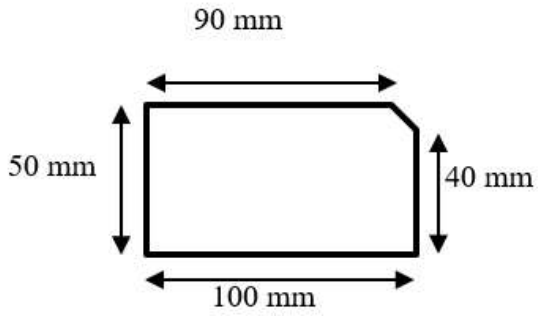

Figure

14. Calculate the principal stress for the state of stress given below:

$$\sigma_{ij} = \begin{bmatrix} 0 & -75 & -55 \\ -75 & 0 & 65 \\ -55 & 65 & 0 \end{bmatrix}$$

15. Explain the difference between bearing and friction type bolts.

**16.** Locate the centroid of the section shown in Figure.

Figure

17. Construct influence line on a simply supported beam of span 10m taking regular interval of 2.5m for shear at 2.5m from left support of a beam.

18. Explain briefly bulking of fine aggregates with proper graph to justify your answer.

19. Define kinematic indeterminacy. Calculate the kinematic indeterminacy for a truss shown in Figure.
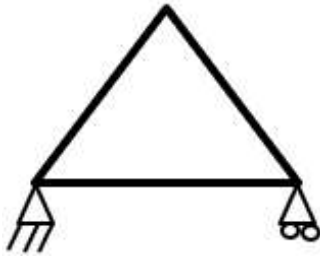
Figure

20. List out the assumptions in the limit state design for reinforced concrete.

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