

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-I

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.

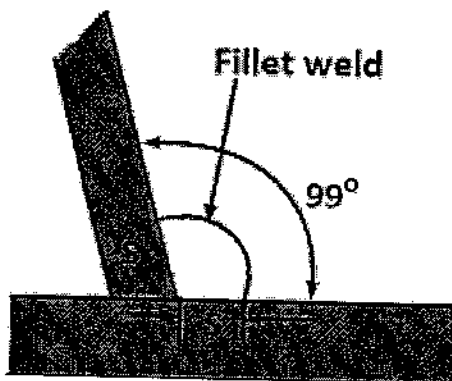
1. Attrition test on stone is done to find out
 - (a) Compressive strength
 - (b) Hardness
 - (c) Rate of wear
 - (d) Toughness
2. A cement bag contains 0.035 cubic meter of cement by volume. How many bags will one tonne of cement comprise?
 - (a) 16
 - (b) 17
 - (c) 18
 - (d) 20
3. What is the treatment for making timber fire-resistant?
 - (a) ASCU treatment
 - (b) Abel's process
 - (c) Creosoting
 - (d) Tarring
4. In air-conditioned buildings, a door has to serve both purposes of opening and closing and the most suitable type of door is
 - (a) Swinging door
 - (b) Sliding door
 - (c) Rolling shutter door
 - (d) Revolving door
5. Direction: The item consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the correct answer.

Statement (I) : Wood is essentially an organic substance, made up of a skeleton of cellulose impregnated with lignin.

Statement (II) : The organic substances are not susceptible to attack by both bacteria and fungi.

 - (a) Both Statement (I) and Statement (II) are individually true, and Statement (II) is the correct explanation of Statement (I)
 - (b) Both Statement (I) and Statement (II) are individually true, but Statement (II) is not the correct explanation of Statement (I)
 - (c) Statement (I) is true, but Statement (II) is false.
 - (d) Statement (I) is false, but Statement (II) is true.

6. Sapwood consists of—
- (a) Innermost annular rings around the pith
 - (b) Portion of timber between heartwood and cambium layer
 - (c) Thin layers below the bark
 - (d) Thin fibre which extends from the pith outwards and holds the annular rings together
7. The percentage of alumina in a good brick earth lies between
- (a) 5 to 10%
 - (b) 20 to 30%
 - (c) 50 to 60%
 - (d) 70 to 80%
8. Quick lime is
- (a) calcium carbonate
 - (b) calcium hypochlorite
 - (c) calcium oxide
 - (d) calcium hydroxide
9. Le Chatelier's device is used for determining the
- (a) soundness of cement
 - (b) setting time of cement
 - (c) tensile strength of cement
 - (d) compressive strength of cement
10. The amount of water used for one kg of distemper is
- (a) 0.2 L
 - (b) 0.4 L
 - (c) 0.6 L
 - (d) 0.8 L
11. The permissible stress in axial tension in steel member on the net effective area of the section shall not exceed the following value (f_y is the yield stress)
- (a) $0.85 f_y$
 - (b) $0.80 f_y$
 - (c) $0.70 f_y$
 - (d) $0.60 f_y$
12. For the fillet weld of size 'S' shown in the following figure, the effective throat thickness is

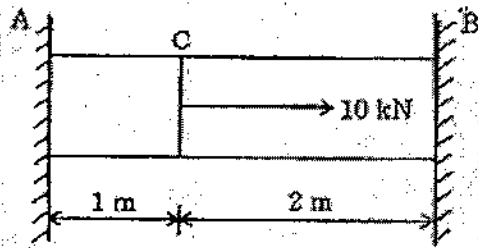


- (a) 0.60 S
 - (b) 0.65 S
 - (c) 0.70 S
 - (d) 0.75 S
13. A continuous beam of constant M_p has three equal spans and carries total uniformly distributed load 'w' on each span. The value of collapse load for the beam will be
- (a) $14.756 L/M_p$
 - (b) $11.656 M_p/L$
 - (c) $71.559 M_p/L$
 - (d) $41.251 L/M_p$
14. Generally the maximum deflection/span ratio of a steel member should be not exceed
- (a) $\frac{1}{750}$
 - (b) $\frac{1}{500}$
 - (c) $\frac{1}{325}$
 - (d) $\frac{1}{250}$

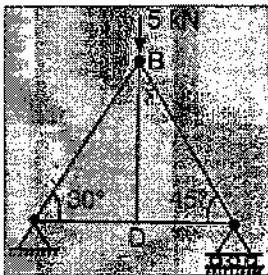
15. The lighter sections of structural members subjected to transverse loading are called as
(a) struts (b) tie
(c) joists (d) stancions
16. A simply supported RCC one-way slab for an office floor has clear dimensions of 4 m × 10 m with 230 mm walls all-around. What is the effective length of the slab? (Take the effective depth of the slab as 160 mm)
(a) 2.23 m (b) 4.16 m
(c) 6.84 m (d) 10.23 m
17. The main reinforcement of an RC slab consists of 10 mm bars at 10 cm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then the spacing of 12 mm bars should be
(a) 10.2 cm (b) 12.6 cm
(c) 14.4 cm (d) 16.8 cm
18. The minimum eccentricity to be considered for an axially loaded RCC column of size 400 mm × 400 mm with unsupported length of 5 m is:
(a) 20.5 mm (b) 23.3 mm
(c) 25.6 mm (d) 30.7 mm
19. Which one of the following is categorized as a long-term loss of prestress in a prestressed concrete 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
20. For M20 Grade of concrete, modular ratio would be:
(a) 13.33 (b) 15.54
(c) 16.66 (d) 12.89
21. Force polygon method is applicable for
(a) any coplanar force system (b) concurrent coplanar force system
(c) a system of parallel forces only (d) Non-concurrent coplanar force system
22. If 'm' is the total mass of a uniform thin rod of length 'l' then its moment of inertia about the middle axis perpendicular to the length will be
(a) $\frac{3ml^3}{7}$ (b) $\frac{2ml^2}{11}$
(c) $\frac{ml^2}{12}$ (d) $\frac{4ml^2}{42}$
23. When two concurrent forces 20 kg and 15 kg act at right angles on a particle, then their resultant will be equal to
(a) 35 kg (b) 25 kg
(c) 5 kg (d) $20\sqrt{15}$ kg
24. The dimensions of power are
(a) ML^2T^{-3} (b) ML^3T^{-2}
(c) ML^3T^2 (d) MLT^{-3}
25. A particle of mass 5 gm executes a simple harmonic motion making 35 oscillations in 11 seconds. if its maximum velocity is 60 cm/s, then the amplitude of vibration will be
(a) 9.0 cm (b) 6.0 cm
(c) 4.5 cm (d) 3.0 cm

26. Calculate the velocity of a body having a mass of 9 kg and linear momentum of 63 kg m/s.
- (a) 5 m/s
(b) 6 m/s
(c) 7 m/s
(d) 8 m/s
27. A glass marble drops from a height of 3 m upon a horizontal floor. If the co-efficient of restitution is 0.9, what is the height to which it rises after impact?
- (a) 1.43 m
(b) 2.43 m
(c) 3.43 m
(d) 4.43 m
28. A bullet of mass 0.01 kg is fired from a gun weighing 5.0 kg. If the initial speed of the bullet is 250 m/sec along the positive x-axis, calculate the velocity with which the gun recoils.
- (a) -0.05
(b) -0.5
(c) 0.05
(d) 0.5
29. A 5 m long ladder is resting on a smooth vertical wall with its lower end 3 m from the wall. What should be the coefficient of friction between the ladder and the floor for equilibrium?
- (a) 1/2
(b) 3/4
(c) 3/8
(d) 3/5
30. A thin disc and a thin ring, both have mass M and radius R . Both rotate about axes through their centre of mass and are perpendicular to their surfaces at the same angular velocity. Which of the following is true?
- (a) The ring has higher kinetic energy
(b) The disc has higher kinetic energy
(c) The ring and the disc have the same kinetic energy
(d) Kinetic energies of both the bodies are zero since they are not in linear motion
31. When two unequal like Principal stresses ' P_1 ' and ' P_2 ' act, then the radius of Mohr's circle will be
- (a) $\frac{P_1 - P_2}{2}$
(b) $\frac{P_1 + P_2}{2}$
(c) $\frac{P_1}{2}$
(d) $\frac{P_2}{2}$
32. If the value of Young's modulus of elasticity for a material is zero, it implies that the material is
- (a) compressible
(b) highly elastic
(c) incompressible
(d) plastic
33. The Poisson's ratio is defined as
- (a) $\frac{\text{axial stress}}{\text{lateral stress}}$
(b) $\frac{\text{axial strain}}{\text{lateral strain}}$
(c) $\frac{\text{lateral stress}}{\text{axial stress}}$
(d) $\frac{\text{lateral strain}}{\text{axial strain}}$
34. Which one of the following is NOT the assumption of Euler's column theory?
- (a) The direct stress is very small compared to the bending stress.
(b) The self-weight of the column is considerable.
(c) The cross-section of the column is uniform throughout.
(d) The column will fail by buckling only.

35. A simply supported beam is subjected to a uniformly distributed load. Which one of the following statements is true?
- Maximum or minimum shear force occurs where the curvature is zero.
 - Maximum or minimum bending moment occurs where the curvature is zero.
 - Maximum or minimum bending moment occurs where the shear force is zero.
 - Maximum bending moment and maximum shear force occur at the same section.
36. A long shaft of diameter d is subjected to twisting moment T at its ends. The maximum normal stress acting at its cross-section is equal to
- 0
 - 1
 - $\frac{16T}{\pi d^3}$
 - $\frac{32T}{\pi d^3}$
37. A thin cylinder of unit length, thickness 't' and radius 'r' is subjected to internal pressure 'p'. What is circumferential stress?
- $pr/2Et$
 - $pr/2t$
 - pr/t
 - $2pr/t$
38. A tensile test is performed on a round bar. After fracture, it has been found that the diameter remains approximately same at fracture. The material under test was
- Mild steel
 - Cast iron
 - Copper
 - Aluminium
39. The reactions at the rigid supports at A and B for the bar loaded as shown in the figure are respectively:



- $20/3$ kN, $10/3$ kN
 - $10/3$ kN, $20/3$ kN
 - 5 kN, 5 kN
 - 5 kN, 0 kN
40. Maximum energy that a given component can absorb without undergoing any permanent deformation up to elastic limit is known as:
- Resilience
 - Proof Resilience
 - Hardness
 - Toughness
41. What is the magnitude of the force the member BD in the figure given below ?



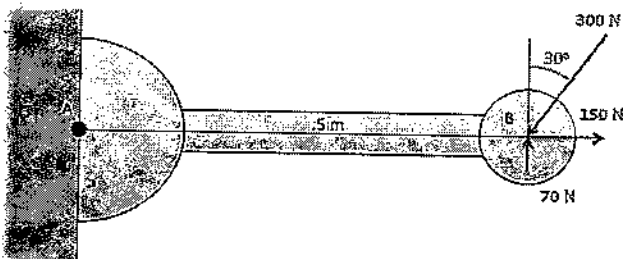
- 5 kN
- 7 kN (Approx)
- $4\sqrt{2}$ kN
- Zero

SECTION - B (Short answer type question) (100 Marks)

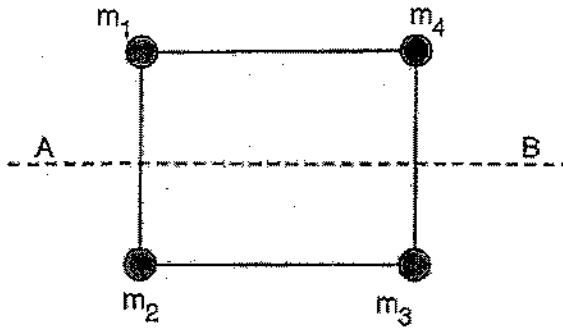
All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

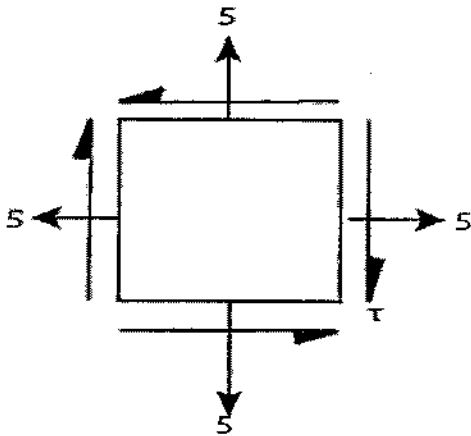
1. What is damp proofing? Explain various damp proofing methods used in building construction.
2. What is energy efficient buildings? Explain the design concepts of energy efficient buildings.
3. Briefly explain the building components and their functions.
4. How the seasoning and preservation of timber takes place ?
5. Explain briefly the methods and systems of prestressing. Also explain the losses in prestress.
6. What is the percentage of reinforcement of an axially loaded short square column of 400 mm side to support a factored load of 1600 kN? (Use M20 concrete and Fe415 steel)
7. Design a rectangular RC beam in flexure and shear when it is simply supported on masonry walls 300 mm thick and 5 m apart (center to center support) to support a distributed a Live load of 8 kN/m and a dead load of 6 kN/m in addition to its own weight. Materials used are M20 grade concrete and HYSD bars. Adopt Working Stress method of design. Make necessary sketches.
8. A steel column of ISHB 350 @72.4 kg/m is subjected to a factored axial compressive load of 2000 kN. The load is transferred to a concrete pedestal of grade M20 through square base plate. Consider the bearing strength of concrete as $0.45 f_{ck}$, where f_{ck} is the characteristic strength of concrete. Using the limit state method and neglecting the self-weight of base plate and steel column, calculate the length of a side of the base plate to be provided. Make necessary sketches.
9. A particle moves in a straight line. Its position is defined by the equation $x = 6t^2 - t^3$ where, 't' is in seconds and 'x' is in metres. Find out the maximum velocity of the particle during its motion.
10. Differentiate between momentum and impulse.
11. A lever is attached to a wall at one end, and three different forces are applied to the lever's free end, 0.5 m from the base's point of contact with the wall (point A) as shown in figure below. Use Varignon's Theorem to find the moment that the forces exert about point A.



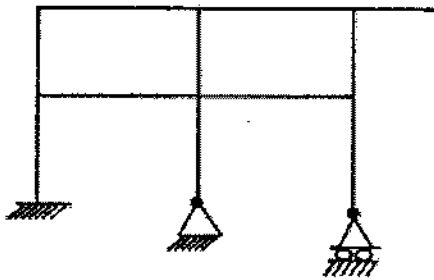
12. The mass of each ball is 200 grams, and they are connected by cord as shown in the figure below. The length of the cord is 80 cm, and the width of the cord is 40 cm. What is the moment of inertia of the balls about the axis of rotation (Ignore cord's mass)?



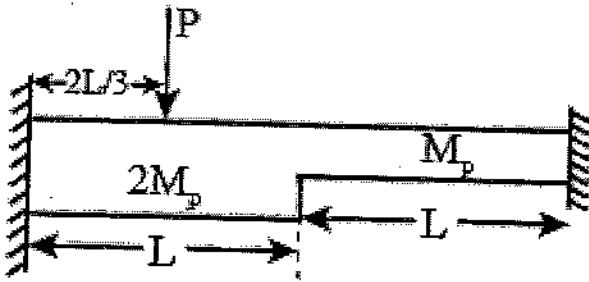
13. A thin-walled cylindrical pressure vessel having a radius of 0.5 m and wall thickness of 25 mm is subjected to an internal pressure of 700 kPa. Calculate the hoop stress developed.
14. A mild steel specimen is under uniaxial tensile stress. Young's modulus and yield stress for mild steel are 2×10^5 MPa and 250 MPa, respectively. Calculate the maximum amount of strain energy per unit volume that can be stored in this specimen without a permanent set.
15. For the stress state (in MPa) shown in the figure below, the major principal stress is 10 MPa. Calculate the shear stress τ .



16. Explain Mohr's moment area method theory.
17. For the plane frame with an overhang as shown in the figure below, assuming negligible axial deformation, calculate the degree of static indeterminacy, d , and the degree of kinematic indeterminacy, k .



18. A fixed-end beam is subjected to a concentrated load (P) as shown in the figure below. The beam has two different segments having different plastic moment capacities M_p and $2M_p$ as shown. Calculate the minimum value of load (P) at which the beam would collapse (ultimate load).



19. A cantilever beam of length L is subjected to a concentrated load P at a distance of $L/3$ from the free end. Derive the expression for deflection of the free end of the beam using necessary sketches.
20. Analyse the frame shown in figure below by moment distribution method. Draw the BMD. The second moment of inertia are indicated in the figure below.

