

# MIZORAM PUBLIC SERVICE COMMISSION

## COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF M.E.S. (AE/SDO (CIVIL)) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT, MARCH, 2017.

### 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.*

- The rocks formed by gradual deposition, are called
  - Sedimentary rocks
  - Metamorphic rocks
  - Igneous rocks
  - None of the above
- Stones used for retaining walls must be
  - Soft
  - Hard
  - Light
  - Heavy
- The standard size of masonry bricks, is
  - 18 cm × 8 cm × 8 cm
  - 19 cm × 9 cm × 9 cm
  - 20 cm × 10 cm × 10 cm
  - 21 cm × 11 cm × 11 cm
- A 1<sup>st</sup> class brick immersed in water for 24 hours, should not absorb water (by weight) more than
  - 10 %
  - 15 %
  - 20 %
  - 25 %
- A well seasoned timber may contain moisture upto
  - 4 to 6 %
  - 6 to 8 %
  - 8 to 10 %
  - 10 to 12 %
- Crushing strength of good building stone should be more than
  - 50 MPa
  - 100 MPa
  - 150 MPa
  - 200 MPa
- The types of bond in a brick masonry containing alternate courses of stretchers and headers, is called
  - English bond
  - Flemish bond
  - Russian bond
  - Mixed bond
- A wall constructed to resist the pressure of an earth filling is called
  - Retaining wall
  - Breast wall
  - Buttress wall
  - Parapet wall
- If the height of first storey of a building is 3.25 m and riser is 13 cm, the number of tread required is
  - 20
  - 23
  - 24
  - 25

10. In ordinary residential and public buildings, the damp proof course is generally provided at
- (a) Ground level
  - (b) Plinth level
  - (c) Water table level
  - (d) Midway between ground level and water table
11. According to IS 456 the maximum reinforcement in column is
- (a) 2 %
  - (b) 4 %
  - (c) 6 %
  - (d) 8 %
12. An R.C.C column is treated as long if its slenderness ratio is greater than
- (a) 30
  - (b) 35
  - (c) 40
  - (d) 50
13. For M150 mix concrete, according to I.S specifications, local bond stress, is
- (a) 5 kg/cm<sup>2</sup>
  - (b) 10 kg/cm<sup>2</sup>
  - (c) 15 kg/cm<sup>2</sup>
  - (d) 20 kg/cm<sup>2</sup>
14. Finer grinding of cement
- (a) Affects the early development strength
  - (b) Affects the ultimate strength
  - (c) Both (a) and (b)
  - (d) Does not affect the strength
15. Spacing of stirrup in rectangular beam is
- (a) Kept constant throughout the length
  - (b) Decreased towards the centre of the beam
  - (c) Increased at the ends
  - (d) Increased at the centre of the beam
16. The maximum ratio of span to depth of a slab simply supported and spanning in two directions, is
- (a) 25
  - (b) 30
  - (c) 35
  - (d) 40
17. The aspect ratio is defined as the ratio of
- (a) Length to breadth of a state
  - (b) Effective width of flange and effective depth of the beam
  - (c) Width of well and depth of flange
  - (d) None of these
18. The compression stress in concrete at the level of centroid of compression steel is equal to
- (a) 0.416  $F_{ck}$
  - (b) 0.446  $F_{ck}$
  - (c) 0.36  $F_{ck}$
  - (d) 0.57  $F_{ck}$
19. The maximum strain in the tension reinforcement in the section of flexural member shall not be less than
- (a)  $\frac{f_y}{E_s} + 0.002$
  - (b)  $\frac{f_y}{1.15} E_s + 0.002$
  - (c)  $1.15 \frac{f_y}{E_s} + 0.002$
  - (d) None of these

Where  $f_y$  is the characteristic strength of steel and  $E_s$  is the modulus of elasticity.

20. As per IS : 800, the maximum deflection in a beam of span L should not exceed
- (a)  $L/180$  (b)  $L/250$   
(c)  $L/325$  (d)  $L/360$
21. The most critical consideration in the design of rolled steel columns carrying axial loads is the
- (a) percent elongation at yield and the net cross-sectional areas  
(b) critical bending strength and axial yield strength of the material  
(c) buckling strength based on the net area of the section and percent elongation at ultimate load  
(d) compressive strength based on the slenderness ratio and cross-sectional area of the member
22. Shear buckling of web in plate girder is provided to safeguard against
- (a) Vertical intermediate stiffener  
(b) Horizontal stiffener at neutral axis  
(c) Bearing stiffener  
(d) None of the above
23. The heaviest I-section for same depth is
- (a) ISMB (b) ISLB  
(c) ISHB (d) ISWB
24. Minimum pitch of the rivets shall not be less than
- (a)  $1.5 d$  (b)  $2.0 d$   
(c)  $2.5 d$  (d)  $3.0 d$
25. Bolts are most suitable to carry
- (a) Shear (b) Bending  
(c) Axial tension (d) Shear and bending
26. If a number of forces are acting at a point, their resultant will be inclined at an angle  $\theta$  with the horizontal, such that
- (a)  $\tan \theta = \Sigma H / \Sigma V$  (b)  $\tan \theta = \Sigma V / \Sigma H$   
(c)  $\tan \theta = \Sigma H \times \Sigma V$  (d)  $\tan \theta = \sqrt{\Sigma H / \Sigma V}$
27. The moment of inertia of rectangular section having a width (b) and depth (d) about an axis passing through C.G and parallel to width (b) is
- (a)  $\frac{db^3}{12}$  (b)  $\frac{bd^3}{12}$   
(c)  $\frac{db^3}{36}$  (d)  $\frac{bd^3}{36}$
28. The moment of inertia of a circular section about its diameter (d) is
- (a)  $\frac{\pi d^3}{16}$  (b)  $\frac{\pi d^3}{32}$   
(c)  $\frac{\pi d^4}{32}$  (d)  $\frac{\pi d^4}{64}$

29. The maximum frictional force which comes into play, when a body just begin to slide over the surface of the other body, is known as
- (a) Static friction (b) Dynamic friction  
(c) Limiting friction (d) Coefficient of friction
30. Which of the following is a scalar quantity?
- (a) Force (b) Speed  
(c) Velocity (d) Acceleration
31. The velocity of a body reaching the ground from a height of  $h$ , is
- (a)  $2\sqrt{gh}$  (b)  $\sqrt{gh}$   
(c)  $\sqrt{2gh}$  (d)  $2g\sqrt{h}$
32. The law which states, “within elastic limits strain produced is proportional to the stress producing it” is known as
- (a) Bernoulli’s law (b) Stress law  
(c) Poisson’s law (d) Hooke’s law
33. If the principal stresses at a point in a strained body are  $p_1$  and  $p_2$  ( $p_1 > p_2$ ), then the resultant stress on a plane carrying the maximum shear stress is equal to
- (a)  $\sqrt{p_1^2 + p_2^2}$  (b)  $\sqrt{\frac{p_1^2 + p_2^2}{2}}$   
(c)  $\sqrt{\frac{p_1^2 - p_2^2}{2}}$  (d)  $\sqrt{p_1^2 - p_2^2}$
34. The shape of the bending moment diagram over the length of a beam carrying a uniformly distributed load is always
- (a) Linear (b) Parabola  
(c) Cubical (d) Circular
35. Struts are load carrying member of a frame, which are subjected to
- (a) Transverse load (b) Axial tensile load  
(c) Axial compressive load (d) Torsional load
36. The shear force diagram of cantilever beam which is subjected to carrying uniformly distributed load over its length, is
- (a) Triangle (b) rectangle  
(c) Parabola (d) Cubic parabola
37. Strain energy is the
- (a) Energy stored in a body when strained within elastic limits  
(b) Energy stored in a body when strained upto the breaking point of a specimen  
(c) Maximum strain energy which can be stored in a body  
(d) Proof resilience per unit volume of a material
38. A bending moment may be defined as,
- (a) Arithmetic sum of the moments of all the forces on either side of the section  
(b) Arithmetic sum of the forces on either side of the section  
(c) Algebraic sum of the moments of all the forces on either side of the section  
(d) None of these

39. Maximum deflection of a cantilever due to pure bending moment at its free end, is

- (a)  $\frac{ML^2}{3EI}$  (b)  $\frac{ML^2}{4EI}$   
(c)  $\frac{ML^2}{6EI}$  (d)  $\frac{ML^2}{2EI}$

40. The moment required to rotate the near end of a prismatic beam through a unit angle without transition, the far end being simply supported, is given by (EI – flexural rigidity and L is the span of beam)

- (a)  $\frac{3EI}{L}$  (b)  $\frac{4EI}{L}$   
(c)  $\frac{2EI}{L}$  (d)  $\frac{EI}{L}$

41. Castigliano's first theorem is applicable when

- (a) For statically determinate structures only  
(b) When the system behave elasticity  
(c) Only when principal of superposition is valid  
(d) None of these

42. In moment distribution method, the sum of distribution factors of all the member meeting at any joint is always

- (a) Zero (b) Less than 1  
(c) 1 (d) Greater than 1

43. A single rolling load of 8 kN rolls along a girder of 15 m span. The absolute maximum bending moment will be

- (a) 8 kN.m (b) 15 kN.m  
(c) 20 kN.m (d) 30 kN.m

44. Which of the following is not displacement method?

- (a) Equilibrium method (b) Column analogy method  
(c) Moment distribution method (d) Kani's method

45. The strain energy of a structure due to bending is given by

- (a)  $\int \frac{M^2 dx}{EI}$  (b)  $\frac{1}{2} \int \frac{M^2 dx}{EI}$   
(c)  $\int \frac{2M^2 dx}{EI}$  (d)  $\frac{1}{3} \int \frac{M^2 dx}{EI}$

46. The carryover factor in a prismatic member whose far end is hinged is

- (a) 0 (b)  $\frac{1}{2}$   
(c)  $\frac{3}{4}$  (d) 1

47. The deformation of a spring produced by a unit load is called

- (a) Stiffness (b) Flexibility  
(c) Influence coefficient (d) Unit strain

48. A fixed beam of uniform section is carrying a point load at its mid-span. If the moment of inertia of the middle half-length is now reduced to half its previous value, then the fixed end moment will
- (a) Increase (b) Decrease  
(c) Remain constant (d) Change their direction
49. The principal of virtual work can be applied to elastic system considering the virtual work of
- (a) Internal forces only (b) External forces only  
(c) Internal and external forces (d) None of these
50. The shape of a suspended cable for a uniformly distributed load over it, is
- (a) Triangle (b) rectangle  
(c) Parabola (d) Cubic parabola

**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.*

51. Why seasoning of timber is required? List out the various methods of timber seasoning.
52. List out the characteristics of good brick? Describe the various factors that govern the thickness of brick wall.
53. Explain how bulking of fine aggregate takes place and how it is taken care in the field.
54. What is meant by the term 'workability of concrete'? List the methods used for measurement of workability in concrete.
55. A rectangular RC beam of concrete grade M20 is 300 mm wide and 550 mm deep (effective depth). It is provided with 4 nos of 20 mm diameter mild steel rods as tension reinforcement. Determine the moment resistance of the beam with the given data:  $\sigma_{cbc} = 7 \text{ N/mm}^2$ ,  $\sigma_{st} = 140 \text{ N/mm}^2$  and  $m = 13$ .
56. State the assumption in the design for limit state of collapse in flexure is based?
57. Briefly explain the terms under-reinforced, balanced and over-reinforced section in the limit state.
58. Explain under-reinforced and over-reinforced failure of a reinforced concrete beam.
59. Draw a free body diagram for (a) spherical body resting on horizontal plane (b) spherical body hang by a thread on vertical plane.
60. State the principle of work and energy.
61. A stone is projected in space at an angle of  $45^\circ$  to horizontal at an initial velocity of 10 m/s. Find the range of projectile.
62. Two forces  $P = 100 \text{ kN}$  and  $Q = 200 \text{ kN}$  act at the origin. P is directed towards a point (-2,3,-5) meters and Q towards (6,-8,-4) meters. What is the result and corresponding unit vector.
63. What are the strength tests prescribed for concrete.
64. What is Mohr's circle of stress? Explain how it is used.
65. The stresses in a flat steel plate in a condition of plane stress are:  $\sigma_x = 10 \text{ kN/mm}^2$ ,  $\sigma_y = 6 \text{ kN/mm}^2$  and  $\tau_{xy} = 8 \text{ kN/mm}^2$ . Find the magnitude of the principal stress in the plane of the plate.

66. Draw the bending moment diagram of a beam from the shear force diagram of the beam fig.1.

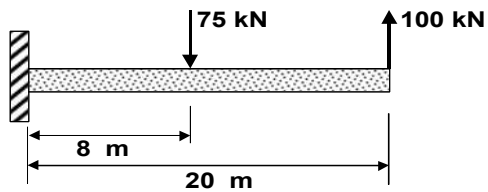


Fig.1

67. Differentiate between statically determinate structures and statically indeterminate structures.
68. Compare force and displacement methods of structural analysis.
69. Derive an expression for strain energy of simply supported beam with centrally loaded concentrated load (W).
70. Define any two terms from the following:
- |                    |                   |
|--------------------|-------------------|
| (a) Plastic Moment | (b) Plastic hinge |
| (c) Shape factor   | (d) Load factor   |

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