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

MECHANICAL ENGINEERING

PAPER-II

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. Which of the following methods is also known as individual wall method?
   (a) Centre line method (b) Alignment method
   (c) Long wall and short wall method (d) Voluminous method
2. To determine hoop stress, efficiency of _____ is to be considered.
   (a) Construction joint (b) Transverse joint
   (c) Longitudinal joint (d) Rivet joint
3. Hardness is which kind of property?
   (a) Isotropic (b) Anisotropic
   (c) Homogenous (d) Non-homogenous
4. Resilience can also be termed as
   (a) Stress energy (b) Strain energy
   (c) Modulus (d) Tenacity
5. The ductility of a material is _____ to the increase in percentage reduction in an area.
   (a) inversely proportional (b) directly proportional
   (c) equal (d) uniform
6. The longitudinal stress in the shell is
   (a) pd/3t (b) pd/4t
   (c) pd/2t (d) pd/6t
7. The ratio of hoop stress to maximum shear stress is
   (a) 2 (b) 3
   (c) 4 (d) 6
8. Belt slip may occur due to
   (a) Heavy load (b) Loose belt
   (c) Driving pulley too small (d) All of these

9. Aircraft body is usually fabricated by
   (a) Welding
   (b) Precoating
   (c) Riveting
   (d) Casting

10. In V belt drive, the belt touches
   (a) At the bottom
   (b) At sides only
   (c) Could touch anywhere
   (d) None of these

11. The following is not a friction clutch
   (a) Centrifugal clutch
   (b) Cone clutch
   (c) Disc clutch
   (d) Fluid clutch

12. 5-in disc clutch, the clutch disc acts as a
   (a) Driving member
   (b) Driven member
   (c) Neutral member
   (d) All of the above

13. A mechanism where there are no restrictions on the relative motion between the particles, the mechanism is called
   (a) Planar mechanism
   (b) Flexure mechanism
   (c) Spherical mechanism
   (d) Spatial mechanism

14. A higher pair has_____.
   (a) Point contact
   (b) Surface contact
   (c) No contact
   (d) None of these

15. Transmission angle is the angle between
   (a) Input link and coupler
   (b) Input link and fixed link
   (c) Output link and coupler
   (d) Output link and fixed link

16. Which gear is used for connecting two coplanar and intersecting shafts?
   (a) Spur gear
   (b) Helical gear
   (c) Bevel gear
   (d) None of these

17. The governor used in gramophone is of the following type
   (a) Pickering
   (b) Porter
   (c) Hartnell
   (d) Watt

18. The cam follower generally used in automobile engines is
   (a) Knife edge follower
   (b) Flat faced follower
   (c) Spherical faced follower
   (d) Roller follower

19. The advantage of the piston valve over D-slide valve is that in the former case
   (a) Wear is less
   (b) Power absorbed is less
   (c) Both wear and power absorbed are low
   (d) The pressure developed being high provides tight sealing

20. In a four stroke I.C. engine, the turning moment during the compression stroke is
   (a) Negative throughout
   (b) Positive throughout
   (c) Negative during major portion of the stroke
   (d) Positive during major portion of the stroke

21. The balancing of a rigid rotor can be achieved by appropriately placing balancing masses in

(a) A single plane
(b) Two planes
(c) Three planes
(d) Four planes

22. What is the ratio of Youngs modulus E to shear modulus G in terms of Poisson ratio?

(a) $2(1+\mu)$
(b) $2(1-\mu)$
(c) $1/2(1-\mu)$
(d) $1/2(1+\mu)$

23. Deformation per unit length in the direction of force is known as

(a) Strain
(b) Lateral strain
(c) Linear strain
(d) Linear stress

24. Which of the following is a spring-controlled governor?

(a) Hartnell governor
(b) Hartung governor
(c) Wilson-Hartnell governor
(d) All of these

25. The minimum number of links in a single degree-of-freedom planar mechanism with both higher and lower kinematic pairs is

(a) 2
(b) 3
(c) 4
(d) 5

26. In a single slider four-bar linkage, when the slider is fixed, it forms a mechanism of

(a) hand pump
(b) reciprocating engine
(c) quick return
(d) oscillating cylinder

27. When two shafts are neither parallel nor intersecting, power can be transmitted by using

(a) a pair of spur gears
(b) a pair of helical gears
(c) an Oldham's coupling
(d) a pair of spiral gears

28. Maximum angular velocity of the connecting rod with a crank to connecting rod ratio 1:5 for a crank speed of 3000 rpm is around:

(a) 300 rad/s
(b) 60 rad/s
(c) 30 rad/s
(d) 3000 rad/s

29. A fly wheel of moment of inertia 9.8 kgm^2 fluctuates by 30 rpm for a fluctuation in energy of 1936 Joules. The mean speed of the flywheel is (in rpm)

(a) 600
(b) 900
(c) 968
(d) 2940

30. If the length of the cantilever beam is halved, then natural frequency of the mass M at the end of this cantilever beam of negligible mass is increased by a factor of

(a) 2
(b) 4
(c) $\sqrt{8}$
(d) 8

31. If air resistance is neglected, while it is executing small oscillations the acceleration of the bob of a simple pendulum at the mid-point of its swing will be

(a) zero
(b) a minimum but not equal to zero
(c) a maximum
(d) not determinable unless the length of the pendulum and the mass of the bob are known

32. The value of the natural frequency obtained by Rayleigh's method
    (a) is always greater than the actual fundamental frequency
    (b) is always less than the actual fundamental frequency
    (c) depends upon the initial deflection curve chose and may be greater than or less than the actual fundamental frequency
    (d) is independent of the initial deflection curve chosen

33. A reed type tachometer uses the principle of
    (a) torsional vibration
    (b) longitudinal vibration
    (c) transverse vibration
    (d) damped free vibration

34. A test specimen is stressed slightly beyond the yield point and then unloaded. Its yield strength will
    (a) Decrease
    (b) Increase
    (c) Remains same
    (d) Becomes equal to ultimate tensile strength

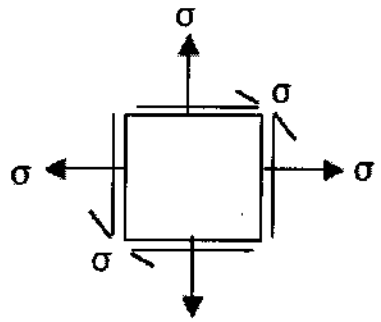
35. Two tapering bars of the same material are subjected to a tensile load P. The lengths of both the bars are the same. The larger diameter of each of the bars is D. The diameter of the bar A at its smaller end is D/2 and that of the bar B is D/3. What is the ratio of elongation of the bar A to that of the bar B?
    (a) 3 : 2
    (b) 2 : 3
    (c) 4 : 9
    (d) 1 : 3

36. During tensile-testing of a specimen using a Universal Testing Machine, the parameters actually measured include
    (a) True stress and true strain
    (b) Poisson's ratio and Young's modulus
    (c) Engineering stress and engineering strain
    (d) Load and elongation

37. A weight falls on a plunger fitted in a container filled with oil thereby producing a pressure of 1.5 N/mm^2 in the oil. The Bulk Modulus of oil is 2800 N/mm^2. Given this situation, the volumetric compressive strain produced in the oil will be:
    (a) 400×10^{-6}
    (b) 800×10^{6}
    (c) 268×10^{6}
    (d) 535×10^{-6}

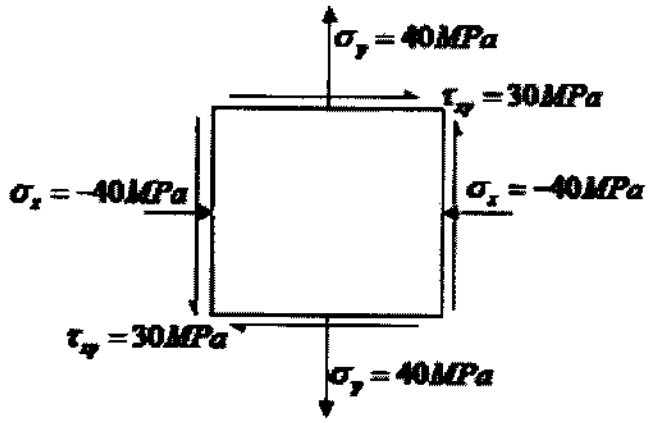
38. A solid circular shaft of diameter 100 mm is subjected to an axial stress of 50 MPa. It is further subjected to a torque of 10 kNm. The maximum principal stress experienced on the shaft is closest to
    (a) 41 MPa
    (b) 82 MPa
    (c) 164 MPa
    (d) 204 MPa

39. The maximum principal stress for the stress state shown in the figure is



    (a) σ
    (b) 2σ
    (c) 3σ
    (d) 1.5σ

40. The state of stress at a point in a loaded member is shown in the figure. The magnitude of maximum shear stress is [1MPa = 10 kg/cm^2]

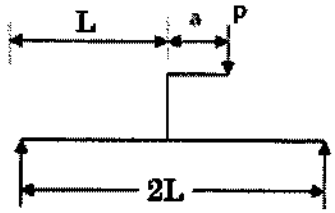


(a) 10 MPa
(b) 30 MPa
(c) 50 MPa
(d) 100 MPa

41. The shapes of the bending moment diagram for a uniform cantilever beam carrying a uniformly distributed load over its length is:

(a) A straight line
(b) A hyperbola
(c) An ellipse
(d) A parabola

42. A simply supported beam carries a load 'P' through a bracket, as shown in Figure. The maximum bending moment in the beam is

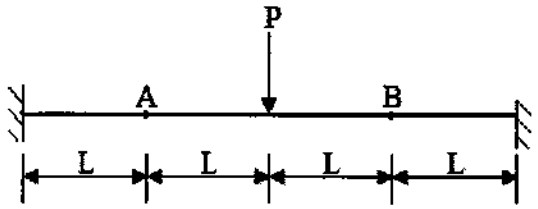


(a) PI/2
(b) PI/2 + aP/2
(c) PI/2 + aP
(d) PI/2 – aP

43. If the shear force acting at every section of a beam is of the same magnitude and of the same direction then it represents a

(a) Simply supported beam with a concentrated load at the centre.
(b) Overhung beam having equal overhang at both supports and carrying equal concentrated loads acting in the same direction at the free ends.
(c) Cantilever subjected to concentrated load at the free end.
(d) Simply supported beam having concentrated loads of equal magnitude and in the same direction acting at equal distances from the supports.

44. A beam AB of length 2 L having a concentrated load P at its mid-span is hinge supported at its two ends A and B on two identical cantilevers as shown in the given figure. The correct value of bending moment at A is



(a) Zero
(b) PL/2
(c) PL
(d) 2 PL

45. A cantilever beam having square cross-section of side a is subjected to an end load. If a is increased by 19%, the tip deflection decreases approximately by

(a) 19%
(b) 29%
(c) 41%
(d) 50%

46. A T-section beam is simply supported and subjected to a uniform distributed load over its whole span. Maximum longitudinal stress at

(a) Top fibre of the flange
(b) The junction of web and flange
(c) The mid-section of the web
(d) The bottom fibre of the web

47. A cotter joint is used when no relative motion is permitted between the rods joined by the cotter. It is capable of transmitting

(a) twisting moment
(b) an axial tensile as well as compressive load
(c) the bending moment
(d) only compressive axial load

48. In the case of an involute toothed gear, involute starts from

(a) addendum circle
(b) dedendum circle
(c) pitch circle
(d) base circle

49. In a journal bearing, the radius of the friction circle increases with the increase in

(a) load
(b) radius of the journal
(c) speed of the journal
(d) viscosity of the lubricant

50. The most suitable bearing for carrying very heavy loads with slow speed is

(a) hydrodynamic bearing
(b) ball bearing
(c) roller bearing
(d) hydrostatic bearing

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 endurance limit? Enumerate different endurance limit modifying factors.
2. How does a porter governor differ from a watt governor, explain with diagram?
3. What is Kinematic link, Kinematic pair and Kinematic chain?
4. Why tensile and compressive stresses are called nominal stresses?
5. What is indicated by percentage elongation and percentage reduction in area for specimen under tensive force?
6. What is addendum and dedendum of cams?
7. Write a short note on anti-friction bearings.
8. Explain the factors influencing the selection of welding processes in the design of mechanical joints.
9. Discuss the advantages and applications of splines in mechanical assemblies.
10. Explain the design considerations for selecting cotter joints in mechanical applications.
11. What is principle of the superposition? Explain its uses.
12. Explain the procedure for finding out the stresses developed in a body due to change of temperature.
13. What do you understand by the term, 'point of contraflexure'?
14. Explain the difference between
    (a) Size of the fillet weld and throat thickness
    (b) Legs of the weld and length of the weld
    (c) Side fillet weld and end fillet weld
15. Show that in the case of a thin cylindrical shell subjected to an internal fluid pressure, the tendency to burst lengthwise is twice as great as in a transverse section.
16. Explain the term 'slenderness ratio' and describe with mathematical expression, how it limits the use of Euler's formula for crippling load.
17. Derive the expression for torque applied by a disc of mass moment of inertia of I when it is spinning about an axis at ω rad/sec and its axis is processing at angular velocity of ω_p.
18. Define the terms 'frequency', periodic time, referred to for Simple Harmonic Motion.
19. Explain the three types of instantaneous centres of rotation and the significance of each type.
20. Explain the pressure angle of the cam and discuss how it is influenced by the base circle of the cam.

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