

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING) UNDER POWER & ELECTRICITY DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-2023

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.*

- Which formula is used to calculate maximum efficiency of worm gear?
(a) $\tan d / \tan (d + F)$ (b) $(1 - \sin F) / (1 + \sin F)$
(c) $\tan (d + F) / \tan d$ (d) $(1 + \sin F) / (1 - \sin F)$
- What is meant by jump phenomenon in cam and follower system?
(a) Follower loses contact with cam surface when cam rotates beyond particular speed due to inertia forces
(b) Follower loses contact with cam surface when follower rotates beyond particular speed due to gravitational force
(c) Follower loses contact with cam surface when cam rotates beyond particular speed due to gravitational forces
(d) None of the above
- The rotating shafts tend to vibrate violently at whirling speeds because
(a) the system is unbalanced
(b) bearing centre line coincides with the axis
(c) the shafts are rotating at very high speeds
(d) resonance is caused due to the heavy mass of the rotor
- In order to facilitate starting of locomotive in any position, the cranks of a locomotive with two cylinders, are placed at
(a) 45° to each other (b) 90° to each other
(c) 120° to each other (d) 180° to each other
- A system in dynamic balance implies that
(a) the system is critically damped (b) there is no critical speed in the system
(c) the system is also statically balanced (d) there will absolutely no wear of bearings
- Transmission of power from the engine to the rear axle of an automobile is by means of
(a) compound gears (b) worm and wheel method
(c) crown gear (d) bevel gears.

7. Where is the necking region?
- (a) Area between lower yield point and upper yield point
 - (b) Area between plastic limit and elastic limit
 - (c) Area between ultimate point and initial point
 - (d) Area between the ultimate point and rupture
8. Principal planes are those planes on which
- (a) Normal stress is maximum
 - (b) Normal stress is minimum
 - (c) Normal stress is either maximum or minimum
 - (d) Shear stress is maximum
9. Resilience can also be termed as
- (a) Stress energy
 - (b) Strain energy
 - (c) Modulus
 - (d) Tenacity
10. To determine hoop stress, efficiency of _____ is to be considered.
- (a) Construction joint
 - (b) Transverse joint
 - (c) Longitudinal joint
 - (d) Rivet joint
11. Hooke's law holds good up to
- (a) Yield point
 - (b) Limit of proportionality
 - (c) Breaking point
 - (d) Elastic limit
12. Thermal stress(P) is given by
- (a) αTE
 - (b) αT
 - (c) $\frac{\alpha}{T}$
 - (d) $\frac{\alpha}{TE}$
13. Experimental investigations have shown that maximum principle stress theory gives good results for
- (a) Ductile materials
 - (b) Plastic Materials
 - (c) Elastic materials
 - (d) Brittle materials
14. A rod, 120cm long and of diameter 3.0 cm is subjected to an axial pull of 18 kN. The stress in N/mm² is.
- (a) 22.57
 - (b) 23.47
 - (c) 24.57
 - (d) 25.47
15. Slenderness ratio is [l = length of column and k = least radius of gyration of cross section about its axis].
- (a) l/k
 - (b) k/l
 - (c) $l/2k$
 - (d) $k/2l$
16. According to distortion-energy criterion, yielding occurs when
- (a) Distortion energy reaches a critical value
 - (b) Second invariant of the stress deviator exceeded some critical value
 - (c) Octahedral shear stress reaches a critical value
 - (d) All of the above

17. In a reinforced concrete section, shear stress distribution is diagrammatically
- (a) Wholly Parabolic
 - (b) Wholly Rectangular
 - (c) Parabolic above N-A and Rectangular below N-A
 - (d) Rectangular above N-A and Parabolic below N-A
18. Flexural collapse in over-reinforced beams is due to
- (a) Primary compression failure
 - (b) Secondary compression failure
 - (c) Primary tension failure
 - (d) Bond failure
19. A solid circular shaft has a diameter d . Its polar modulus will be
- (a) $\frac{\pi}{16} d^2$
 - (b) $\frac{\pi}{64} d^3$
 - (c) $\frac{\pi}{16} d^3$
 - (d) $\frac{\pi}{32} d^3$
20. Maximum shear stress at any point in a thin cylinder, subjected to internal fluid pressure is given by,
- (a) $pd/2t$
 - (b) $pd/4t$
 - (c) $pd/8t$
 - (d) pd/t
21. The deflection at any point of the given beam =
- (a) Shear force
 - (b) Bending Moment
 - (c) slope
 - (d) both a & b
22. The load cup of a screw jack is made separate from the head of the spindle to
- (a) enhance the load carrying capacity of the jack
 - (b) reduce the effort needed for lifting the working load
 - (c) prevent the rotation of load being lifted
 - (d) reduce the value of frictional torque
23. Which of the following statement is wrong?
- (a) The power transmitted by V-belts is less than flat belts for the same coefficient of friction, arc of contact and allowable tension in the belts
 - (b) The V-belt drive is used with large centre distance
 - (c) The V-belt may be operated in either direction with tight side of the belt at the top or bottom
 - (d) The ratio of driving tensions in V-belt drive is more than flat belt drives
24. The cam follower extensively used in aircraft engines is
- (a) Knife edge follower
 - (b) Flat faced follower
 - (c) Spherical faced follower
 - (d) Roller follower
25. A screw is said to be a self-locking screw, if its efficiency is
- (a) Less than 50%
 - (b) More than 50%
 - (c) Equal to 50%
 - (d) None of these
26. In designing a key, it is assumed that the distribution of forces along the length of key
- (a) Varies linearly
 - (b) Is uniform throughout
 - (c) Varies exponentially, being more at the torque-input end
 - (d) Varies exponentially, being less at the torque-input end

27. Lewis equation is applied
- (a) Only to the pinion
 - (b) Only to the gear
 - (c) To stronger of the pinion or gear
 - (d) To weaker of the pinion or gear
28. A typewriter constitutes a
- (a) machine
 - (b) structure
 - (c) mechanism
 - (d) inversion
29. In kinematic chain, a ternary joint is equivalent to
- (a) two binary joints
 - (b) three binary joints
 - (c) four binary joints
 - (d) single binary joint
30. The type of follower used in automobiles is
- (a) knife edge
 - (b) roller
 - (c) mushroom with flat face
 - (d) mushroom with spherical face
31. The function of a governor is to
- (a) reduce the speed fluctuations during a cycle
 - (b) maintain the prime mover speed within prescribed limits
 - (c) not to influence the speed of the prime mover
 - (d) not to control the variation in load on the prime mover
32. The flywheel influences the
- (a) variation of load demand on prime mover
 - (b) mean speed of the prime mover
 - (c) cyclic variation in speed of the prime mover
 - (d) mean torque developed by the prime mover
33. The surface of the gear tooth below the pitch surface is called
- (a) addendum portion
 - (b) dendendum portion
 - (c) flank
 - (d) face
34. In a gear train, where the axes of gears have motions, is called
- (a) simple gear train
 - (b) compound gear train
 - (c) epicyclic gear train
 - (d) reverted gear train
35. If the axes of first and last gear of a compound gear train are co-axial, the gear train is called
- (a) reverted
 - (b) compound
 - (c) simple
 - (d) epicyclic
36. A cotter joint is used to transmit
- (a) axial tensile load only
 - (b) axial compressive load only
 - (c) combined axial and twisting loads
 - (d) axial tensile or compressive loads
37. In a steam engine, the valve rod is connected to an eccentric by means of a
- (a) knuckle joint
 - (b) universal joint
 - (c) flange coupling
 - (d) cotter joint
38. The type of stresses developed in the key is/are
- (a) both shear and bearing stresses
 - (b) bearing stress alone
 - (c) shear stress alone
 - (d) shearing, bearing and bending stresses
39. Which of the following screw thread is adopted for power transmission in either direction?
- (a) Acme threads
 - (b) Square threads
 - (c) Buttress threads
 - (d) Multiple threads

40. All stresses produced in a belt are
(a) compressive stresses (b) tensile stresses
(c) both tensile and compressive stresses (d) shear stresses
41. Lewis equation in spur gears is used to find the
(a) fatigue stress (b) shear stress
(c) compressive stress in bending (d) tensile stress in bending
42. If a force acts on a body, it sets up some resistance to the deformation. This resistance is known as
(a) stress (b) strain
(c) elasticity (d) modulus of elasticity
43. If a composite bar is cooled, then the nature of stress in the part with high coefficient of thermal expansion will be
(a) tensile (b) zero
(c) compressive (d) none of these
44. The value of Poisson's ratio for steel varies from
(a) 0.20 to 0.25 (b) 0.25 to 0.35
(c) 0.35 to 0.40 (d) 0.40 to 0.55
45. If a cantilever beam is subjected to a point load at its free end, then the shear force under the point load is
(a) zero (b) less than the load
(c) equal to the load (d) more than the load
46. A beam of uniform strength has constant
(a) shear force (b) bending moment
(c) cross-sectional area (d) deflection
47. When a solid shaft is subjected to torsion, the shear stress induced in the shaft at its centre is
(a) zero (b) minimum
(c) maximum (d) average
48. In a thin shell, the ratio of longitudinal stress to the circumferential stress is
(a) $1/2$ (b) $3/4$
(c) 1 (d) 2
49. A thin cylindrical shell of diameter (d), length (l) is subjected to an internal pressure (p). The circumferential stress in the shell is
(a) $2pd/t$ (b) $4pd/t$
(c) $6pd/t$ (d) $8pd/t$
50. A column of length L is hinged at its both ends. Its equivalent length will be equal to
(a) 2L (b) L
(c) 0.5 L (d) 0.707 L

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. Define degrees of freedom of a mechanism. How this is determined?
2. What is the main function of a governor? How does it differ from that of a flywheel?
3. State the law of gearing.
4. What are the methods of preventing loosening of threads between the nut and the screw?
5. What are the advantages of welded joints compared with riveted joints?
6. What are the advantages and disadvantages of saddle key over flat key?
7. Define stress, strain and elasticity. Derive a relation between stress and strain of an elastic body.
8. What do you understand by the term, 'point of contraflexure'?
9. Write the assumptions for finding out the shear stress in a circular shaft, subjected to torsion.
10. Distinguish between circumferential stress and longitudinal stress in a cylindrical shell, when subjected to an internal pressure.
11. Discuss with proper expressions, velocity ratio and slip of a belt drive.
12. With the help of a neat sketch discuss basic terminology of a spur gear.
13. Define: Kinematic link, Kinematic pair, Kinematic chain.
14. Write a short note on anti-friction bearings.
15. Explain the inversions of a double-slider-crank chain.
16. What is quick return mechanism? Where are they used?
17. Why tensile and compressive stresses are called nominal stresses?
18. What is the difference between column and struts?
19. Discuss briefly the various types of belts drive used for the transmission of power
20. Explain the importance of critical speed of a shaft.

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