

MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF INSPECTOR OF FACTORIES UNDER LABOUR, EMPLOYMENT, SKILL DEVELOPMENT & ENTREPRENEURSHIP DEPARTMENT, GOVERNMENT OF MIZORAM, 2019

MECHANICAL ENGINEERING PAPER - II

Time Allowed : 2 hours

Full Marks : 200

All questions carry equal marks of 2 each.

Attempt all questions.

- In a reciprocating steam engine, which of the following forms a kinematic link?
 - cylinder and piston
 - piston rod and connecting rod
 - crank shaft and flywheel
 - flywheel and engine frame
- The motion of a piston in the cylinder of a steam engine is an example of -
 - completely constrained motion
 - incompletely constrained motion
 - successfully constrained motion
 - none of these
- In a kinematic chain, a quaternary joint is equivalent to -
 - one binary joint
 - two binary joints
 - three binary joints
 - four binary joints
- The Grubler's criterion for determining the degrees of freedom (n) of a mechanism having plane motion is -
 - (a) $n = (l - 1) - j$
 - (b) $n = 2(l - 1) - 2j$
 - (c) $n = 3(l - 1) - 2j$
 - (d) $n = 4(l - 1) - 3j$Where l = Number of links, and j = Number of binary joints.
- In a four bar chain or quadric cycle chain -
 - each of the four pairs is a turning pair
 - one is a turning pair and three are sliding pairs
 - three are turning pairs and one is sliding pair
 - each of the four pairs is a sliding pair
- The size of a cam depends upon -
 - base circle
 - pitch circle
 - prime circle
 - pitch curve
- The angle between the direction of the follower motion and a normal to the pitch curve is called -
 - pitch angle
 - prime angle
 - base angle
 - pressure angle
- The cam follower generally used in automobile engines is -
 - knife edge follower
 - flat faced follower
 - spherical faced follower
 - roller follower
- The cam follower extensively used in air-craft engines is -
 - knife edge follower
 - flat faced follower
 - spherical faced follower
 - roller follower

10. Which of the following displacement diagrams should be chosen for better dynamic performance of a cam-follower mechanism?
- (a) simple harmonic motion (b) parabolic motion
(c) cycloidal motion (d) none of these
11. The two parallel and coplanar shafts are connected by gears having teeth parallel to the axis of the shaft. This arrangement is called -
- (a) spur gearing (b) helical gearing
(c) bevel gearing (d) spiral gearing
12. An imaginary circle which by pure rolling action, gives the same motion as the actual gear, is called-
- (a) addendum circle (b) dedendum circle
(c) pitch circle (d) clearance circle
13. The size of a gear is usually specified by -
- (a) pressure angle (b) circular pitch
(c) diametral pitch (d) pitch circle diameter
14. The module is the reciprocal of -
- (a) diametral pitch (b) circular pitch
(c) pitch diameter (d) none of these
15. Mitre gears are used for -
- (a) great speed reduction (b) equal speed
(c) minimum axial thrust (d) minimum backlash
16. The contact ratio for gears is -
- (a) zero (b) less than one
(c) greater than one (d) infinity
17. Involute profile is preferred to cycloidal because -
- (a) the profile is easy to cut
(b) only one curve is required to cut
(c) the rack has straight line profile and hence can be cut accurately
(d) none of these
18. The product of the diametral pitch and circular pitch is equal to -
- (a) 1 (b) $1/p$
(c) p (d) $2p$
19. Which is the incorrect relationship of gears?
- (a) Circular pitch \times Diametral pitch = p (b) Module = P.C.D/No. of teeth
(c) Dedendum = 1.157 module (d) Addendum = 2.157 module
20. For a speed ratio of 100, smallest gear box is obtained by using -
- (a) a pair of spur gears
(b) a pair of helical and a pair of spur gear compounded
(c) a pair of bevel and a pair of spur gear compounded
(d) a pair of helical and a pair of worm gear compounded
21. The train value of a gear train is -
- (a) equal to velocity ratio of a gear train (b) reciprocal of velocity ratio of a gear train
(c) always greater than unity (d) always less than unity

22. When the axes of first and last gear are co-axial, then gear train is known as -
(a) simple gear train (b) compound gear train
(c) reverted gear train (d) epicyclic gear train
23. In a clock mechanism, the gear train used to connect minute hand to hour hand, is -
(a) epicyclic gear train (b) reverted gear train
(c) compound gear train (d) simple gear train
24. A differential gear in an automobile is a -
(a) simple gear train (b) epicyclic gear train
(c) compound gear train (d) none of these
25. A differential gear in automobiles is used to -
(a) reduce speed (b) assist in changing speed
(c) provide jerk-free movement of vehicle (d) help in turning
26. The maximum fluctuation of energy is the -
(a) sum of maximum and minimum energies
(b) difference between the maximum and minimum energies
(c) ratio of the maximum energy and minimum energy
(d) ratio of the mean resisting torque to the work done per cycle
27. In a turning moment diagram, the variations of energy above and below the mean resisting torque line is called -
(a) fluctuation of energy (b) maximum fluctuation of energy
(c) coefficient of fluctuation of energy (d) none of these
28. The ratio of the maximum fluctuation of speed to the mean speed is called -
(a) fluctuation of speed (b) maximum fluctuation of speed
(c) coefficient of fluctuation of speed (d) none of these
29. The height of a Watt's governor (in metres) is equal to -
(a) $8.95/N^2$ (b) $89.5/N^2$
(c) $895/N^2$ (d) $8950/N^2$
30. A Hartnell governor is a -
(a) pendulum type governor (b) spring loaded governor
(c) dead weight governor (d) inertia governor
31. A governor is said to be hunting, if the speed of the engine -
(a) remains constant at the mean speed
(b) is above the mean speed
(c) is below the mean speed
(d) fluctuates continuously above and below the mean speed
32. Isochronism in a governor is desirable when -
(a) the engine operates at low speeds (b) the engine operates at high speeds
(c) the engine operates at variable speeds (d) one speed is desired under one load
33. The balancing of rotating and reciprocating parts of an engine is necessary when it runs at -
(a) slow speed (b) medium speed
(c) high speed (d) none of these

34. In order to have a complete balance of the several revolving masses in different planes -
(a) the resultant force must be zero
(b) the resultant couple must be zero
(c) both the resultant force and couple must be zero
(d) none of these
35. The wheels of a moving car possess -
(a) potential energy only
(b) kinetic energy of translation only
(c) kinetic energy of rotation only
(d) kinetic energy of translation and rotation both
36. When a particle moves along a straight path, then the particle has -
(a) tangential acceleration only
(b) centripetal acceleration only
(c) both tangential and centripetal acceleration
(d) none of these
37. According to Aronhold Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a -
(a) straight line
(b) parabolic curve
(c) ellipse
(d) none of these
38. The instantaneous centres which vary with the configuration of the mechanism, are called -
(a) permanent instantaneous centres
(b) fixed instantaneous centres
(c) neither fixed nor permanent instantaneous centres
(d) none of these
39. The direction of linear velocity of any point on a link with respect to another point on the same link is -
(a) parallel to the link joining the points
(b) perpendicular to the link joining the points
(c) at 45° to the link joining the points
(d) none of these
40. The coriolis component of acceleration is taken into account for -
(a) slider crank mechanism
(b) four bar chain mechanism
(c) quick return motion mechanism
(d) none of these
41. In a gib and cotter joint, the gib and cotter are subjected to -
(a) single shear only
(b) double shear only
(c) single shear and crushing
(d) double shear and crushing
42. Match List I (Items in joints) with List II (Type of failure) and select the correct answer using the codes given below the Lists:
- | <u>List I</u> | <u>List II</u> |
|--|----------------------------|
| A. Bolts in bolted joints of engine cylinder cover plate | 1. Double transverse shear |
| B. Cotters in cotter joint | 2. Torsional shear |
| C. Rivets in lap joints | 3. Single transverse shear |
| D. Bolts holding two flanges in a flange coupling | 4. Tension |
- (a) 4 1 3 2
(b) 4 2 3 1
(c) 3 1 4 2
(d) 3 2 4 1
43. In a cotter joint, the width of the cotter at the centre is 50 mm and its thickness is 12 mm. The load acting on the cotter is 60 kN. What is the shearing stress developed in the cotter?
(a) 120 N/mm^2
(b) 100 N/mm^2
(c) 75 N/mm^2
(d) 50 N/mm^2
44. In the assembly design of shaft, pulley and key, the weakest member is -
(a) pulley
(b) key
(c) shaft
(d) none

45. A spur gear transmitting power is connected to the shaft with a key of rectangular section. The type (s) of stresses developed in the key is/are.
- (a) shear stress alone (b) bearing stress alone
(c) both shear and bearing stresses (d) shearing, bearing and bending stresses

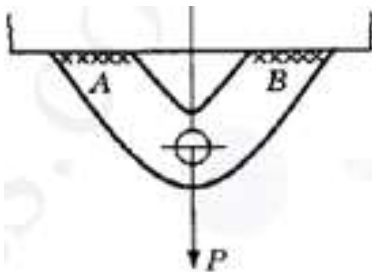
46. Consider the following statements:

A splined shaft is used for

1. transmitting power
2. holding a flywheel rigidly in position
3. moving axially the gear wheels mounted on it
4. mounting V-belt pulleys on it.

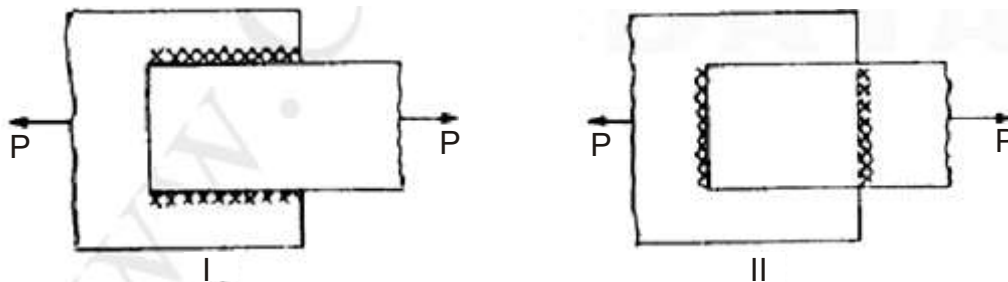
- Of these statements
- (a) 2 and 3 are correct (b) 1 and 4 are correct
(c) 2 and 4 are correct (d) 1 and 3 are correct

47. In the welded joint shown in the given figure, if the weld at B has thicker fillets than that at A then the load carrying capacity P , of the joint will -



- (a) increase (b) decrease
(c) remain unaffected (d) exactly get doubled

48. The following two figures show welded joints (x x x x indicates welds), for the same load and same dimensions of plate and weld. The joint shown in -



- (a) fig. I is better because the weld is in shear and the principal stress in the weld is not in line with P
(b) fig. I is better because the load transfer from the tie bar to the plate is not direct
(c) fig. II is better because the weld is in tension and safe stress of weld in tension is greater than that in shear
(d) fig. II is better because it has less stress concentration

49. The bolts in a rigid flanged coupling connecting two shafts transmitting power are subjected to

- (a) shear force and bending moment (b) axial force
(c) torsion (d) torsion and bending moment

50. The creep in a belt drive is due to the -

- (a) material of the pulleys
(b) material of the belt
(c) unequal size of the pulleys
(d) unequal tension on tight and slack sides of the belt

51. In flat belt drive, if the slip between the driver and the belt is 1%, that between belt and follower is 3% and driver and follower pulley diameters are equal, then the velocity ratio of the drive will be -
(a) 0.99 (b) 0.98
(c) 0.97 (d) 0.96
52. A pulley and belt in a belt drive form a -
(a) cylindrical pair (b) turning pair
(c) rolling pair (d) sliding pair
53. Centrifugal tension in belts is -
(a) useful because it maintains some tension even when no power is transmitted
(b) not harmful because it does not take part in power transmission
(c) harmful because it increases belt tension and reduces the power transmitted
(d) a hypothetical phenomenon and does not actually exist in belts
54. What is the efficiency of a self-locking power screw?
(a) 70% (b) 60%
(c) 55% (d) < 50 %
55. To ensure self-locking in a screw jack it is essential that helix angle is -
(a) larger than friction angle (b) smaller than friction angle
(c) equal to friction angle (d) such as to give maximum efficiency in lifting
56. The velocity ratio between pinion and gear in a gear drive is 2.3, the module of teeth is 2.0 mm and sum of number of teeth on pinion and gear is 99. What is the centre distance between pinion and the gear?
(a) 49.5 mm (b) 99 mm
(c) 148.5 mm (d) 198 mm
57. The working surface above the pitch surface of the gear tooth is termed as -
(a) addendum (b) dedendum
(c) flank (d) face
58. Match List I (Terms) with List II (Definition) and select the correct answer using the codes given below the lists:

List I

- A. Module
B. Addendum
C. Circular pitch

List II

1. Radial distance of a tooth from the pitch circle to the top of the tooth
2. Radial distance of a tooth from the pitch circle to the bottom of the tooth
3. Distance on the circumference of the pitch circle from a point of one tooth to the corresponding point on the next tooth
4. Ratio of a pitch circle diameter in mm to the number of teeth

<u>Code :</u>	A	B	C
(a)	4	1	3
(b)	4	2	3
(c)	3	1	2
(d)	3	2	4

59. If one gear is fixed while the other gear has motion of two types i.e. rotary about its own axis and rotation about axis of fixed gear, then the gear train is _____
- (a) Epicyclic gear train (b) Reverted gear train
(c) Kepler gear train (d) None of these
60. Which one of the following pairs is not correctly matched?
- (a) Positive drive ----- Belt drive
(b) High velocity ratio ----- Worm gearing
(c) To connect non-parallel and non- intersecting shafts ----- Spiral gearing
(d) Diminished noise and smooth operation ----- Helical gears
61. Which among the following is the condition for maximum acceleration in Hooke's joint?
- (a) $\cos 2\theta \approx (2 \sin 2\alpha / 2 + \sin 2\alpha)$ (b) $\cos \theta \approx (2 \sin 2\alpha / 2 - \sin 2\alpha)$
(c) $\cos 2\theta \approx (2 \sin 2\alpha / 2 - \sin 2\alpha)$ (d) $\cos 2\theta \approx (\sin 2\alpha / 2 - \sin 2\alpha)$
62. For high speed engines, the cam follower should move with.
- (a) uniform velocity (b) simple harmonic motion
(c) uniform acceleration and retardation (d) cycloidal motion
63. In a coupling rod of a locomotive, each of the four pairs is a _____ pair.
- (a) Sliding (b) Turning
(c) Rolling (d) Screw
64. If w/w_n is very high for a body vibrating under steady state vibrations, the phase angle for all values of damping factors, will tend to approach -
- (a) 0° (b) 90°
(c) 180° (d) 360°
65. In a circular arc cam with roller follower, the acceleration in any position of the lift will depend only upon -
- (a) total lift, total angle of lift, minimum radius of cam and cam speed
(b) radius of circular arc, cam speed, location of centre of circular arc and roller diameter
(c) mass of cam follower linkage, spring stiffness and cam speed
(d) total lift, centre of gravity of the cam and cam speed
66. The pair is known as a higher pair, when the relative motion between the elements is -
- (a) turning only (b) sliding only
(c) rolling only (d) partly turning and partly sliding
67. In vibration isolation system, the transmissibility will be equal to unity, for all values of damping factor, if w/w_n is
- (a) equal to one (b) equal to square root 2
(c) less than square root 2 (d) greater than square root 2
68. A disturbing mass m_1 attached to the rotating shaft may be balanced by a single mass m_2 attached in the same plane of rotation as that of m_1 , such that (where r_1 and r_2 are the radii of rotation of m_1 and m_2 respectively)
- (a) $m_1 r_2 = m_2 r_1$ (b) $m_1 r_1 = m_2 r_2$
(c) $m_1 m_2 = r_1 r_2$ (d) none of these

69. Scotch yoke mechanism is the inversion of
- (a) Single slider kinematic chain
 - (b) Double slider kinematic chain
 - (c) Four bar chain
 - (d) None of these
70. Watt's mechanism is based on
- (a) inversions of single slider chain mechanism
 - (b) inversions of double slider chain mechanism
 - (c) inversions of four bar chain mechanism
 - (d) inversions of five bar chain mechanism
71. A material with identical properties in all directions is known as -
- (a) homogeneous
 - (b) isotropic
 - (c) elastic
 - (d) none of these
72. Poisson's ratio is defined as ratio of -
- (a) axial strain to transverse strain
 - (b) transverse strain to axial strain
 - (c) shear strain to axial strain
 - (d) axial strain to shear strain
73. The limit up to which the stress is linearly proportional to strain is _____ limit.
- (a) elastic
 - (b) plastic
 - (c) ultimate
 - (d) rupture
74. The stress at which elongation of a material is quite large as compared to the increase in load is known as -
- (a) ultimate point
 - (b) yield point
 - (c) elastic limit
 - (d) rupture point
75. The bulk modulus of a material having $E = 200$ GPa and $G = 80$ GPa is -
- (a) 233.3 GPa
 - (b) 133.3 GPa
 - (c) 250 GPa
 - (d) 160 GPa
76. Deformation of a bar under its own weight is _____ the deformation due to a direct load equal to the weight of the body applied at the lower end.
- (a) double
 - (b) four times
 - (c) half
 - (d) equal to
77. The ratio of linear stress to linear strain is known as -
- (a) bulk modulus
 - (b) modulus of rigidity
 - (c) Young's modulus
 - (d) Poission's ratio
78. Factor of safety is defined as ratio of -
- (a) ultimate stress to allowable stress
 - (b) ultimate stress to yield stress
 - (c) allowable stress to ultimate stress
 - (d) allowable stress to yield stress
79. In case of biaxial stresses, the maximum value of shear stress is -
- (a) difference of normal stresses
 - (b) half the difference of normal stresses
 - (c) sum of normal stresses
 - (d) half the sum of normal stresses
80. In a Mohr's circle, the radius gives the value of -
- (a) minimum shear stress
 - (b) maximum normal stress
 - (c) minimum normal stress
 - (d) maximum shear stress

81. Modulus of resilience is -
(a) percentage of elongation of an elastic body
(b) strain energy stored in the elastic body
(c) strain energy per unit volume of the elastic body
(d) None of these
82. Strain energy stored in a body due to suddenly applied load compared to when applied slowly is -
(a) twice (b) four times
(c) eight times (d) half
83. The point of contraflexure lies where -
(a) shear force changes sign (b) bending moment is zero or changes sign
(c) shear force is zero (d) bending moment is maximum
84. The variation of shear force due to a uniformly distributed load is by -
(a) cubic law (b) parabolic law
(c) linear law (d) uniform law
85. A simply supported beam carries a couple at a point on its span, the shear force -
(a) varies by cubic law (b) varies by parabolic law
(c) varies linearly (d) is uniform throughout
86. At the point of application of a point load on a beam there is -
(a) maximum bending moment
(b) sudden change of shape of bending moment diagram
(c) maximum deflection
(d) point of contraflexure
87. In a transversally loaded beam, the maximum tensile stress occurs at the -
(a) top edge (b) bottom edge
(c) neutral axis (d) none of these
88. A beam is said to be loaded in pure bending if -
(a) shear force and bending moment are uniform throughout
(b) shear force is zero and bending moment is uniform throughout
(c) shear force can vary but bending moment is uniform throughout
(d) None of these
89. Shear centre is the point in or outside a section through which the shear force applied produces _____ in the beam
(a) only twisting (b) only bending
(c) twisting and bending (d) no twisting and bending
90. The nature of shear stress distribution in a rectangular beam is -
(a) uniform (b) linear
(c) parabolic (d) elliptic
91. The flexural rigidity of a beam is -
(a) E/I (b) EI
(c) I/E (d) E^2I

92. Three-moment theorem for continuous beams was forwarded by -
(a) Bernoulli (b) Clapeyron
(c) Castigliano (d) Maxwell
93. For a beam having a point load at the midspan, the ratio of the deflection when the two ends are simply supported to when they are fixed is -
(a) 2 (b) 3
(c) 4 (d) 5
94. The variation of bending stress in a curved beam is -
(a) linear (b) parabolic
(c) hyperbolic (d) cubic
95. Magnitude of shear stress induced in a shaft due to applied torque varies from -
(a) maximum at centre to zero at circumference
(b) maximum at centre to minimum (not-zero) at circumference
(c) zero at centre to maximum at circumference
(d) Minimum (not zero) at centre to maximum at circumference
96. A solid shaft of same cross-sectional area and of same material as that of a hollow shaft can resist -
(a) less torque (b) more torque
(c) equal torque (d) none of these
97. Leaf springs are subjected to -
(a) tensile stress (b) compressive stress
(c) shear stress (d) bending stress
98. Widely used springs in automobile industry are -
(a) flat spiral springs (b) leaf springs
(c) closely-coiled helical springs (d) open-coiled helical springs
99. Rankine's formula is applicable to -
(a) long columns (b) short columns
(c) both of these (d) none of these
100. The buckling load for a given material depends upon -
(a) Poisson's ratio and slenderness ratio (b) Poisson's ratio and modulus of elasticity
(c) Slenderness ratio and cross-sectional area (d) Slenderness ratio and modulus of elasticity

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