

MIZORAM PUBLIC SERVICE COMMISSION

**TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY
UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM
NOVEMBER, 2023**

MECHANICAL ENGINEERING PAPER-II

Time Allowed : 2 hours

Full Marks : 200

All questions carry equal marks of 2 each.

Attempt all questions.

1. What type of mechanical component is commonly used for fastening two parts together, preventing relative axial motion?
(a) Cotter (b) Key
(c) Spline (d) Welded joint
2. Which of the following mechanical components is primarily used for transmitting torque between a rotating shaft and a hub?
(a) Key (b) Cotter
(c) Spline (d) Welded joint
3. Splines are often used in mechanical designs to:
(a) Prevent axial movement between parts (b) Transmit torque and axial loads
(c) Allow for easy disassembly (d) Enhance weld strength
4. What type of joint is created by permanently fusing two pieces of metal together through the application of heat?
(a) Cotter joint (b) Key joint
(c) Spline joint (d) Welded joint
5. Threaded fasteners, such as bolts and screws, are commonly used to create which type of joint?
(a) Cotter joint (b) Key joint
(c) Spline joint (d) Bolted joint
6. When designing a threaded fastener joint, what is the term for the force that resists the tendency of the joint to rotate?
(a) Tensile force (b) Shear force
(c) Torque (d) Axial load
7. What type of interference fit joint involves pressing two mating parts together with a force to achieve a desired interference between them?
(a) Cotter fit (b) Key fit
(c) Spline fit (d) Press fit
8. In a cotter joint, the cotter pin is used to:
(a) Transmit torque (b) Prevent axial movement
(c) Secure two parts together radially (d) Create a press fit

9. Which type of joint is typically used for connecting two shafts that are slightly misaligned and require flexibility?
 - (a) Cotter joint
 - (b) Key joint
 - (c) Spline joint
 - (d) Flexible joint
10. When designing a threaded fastener joint, what is the primary purpose of the washer under the nut or bolt head?
 - (a) To increase axial load capacity
 - (b) To prevent corrosion
 - (c) To distribute the load over a larger area
 - (d) To make the joint easier to disassemble
11. What is the primary purpose of a coupling in a mechanical system?
 - (a) To transmit power between two shafts at a constant speed
 - (b) To allow for misalignment between two shafts
 - (c) To control the engagement and disengagement of power transmission
 - (d) To increase the efficiency of a belt drive
12. A clutch in a vehicle is an example of what type of device in a friction drive system?
 - (a) Coupling
 - (b) Belt drive
 - (c) Chain drive
 - (d) Power screw
13. In a belt drive system, what is the role of the belt?
 - (a) To transmit power by meshing with gears
 - (b) To transfer torque through friction between the belt and pulleys
 - (c) To maintain shaft alignment
 - (d) To provide a rigid connection between two shafts
14. Which of the following is NOT a common type of belt used in belt drive systems?
 - (a) V-belt
 - (b) Flat belt
 - (c) Roller chain
 - (d) Timing belt
15. In a chain drive system, what is responsible for transferring power from one sprocket to another?
 - (a) Chain links
 - (b) Belt tension
 - (c) Chain lubrication
 - (d) Chain tensioner
16. What is the primary function of a power screw in mechanical systems?
 - (a) To control the tension in a belt drive
 - (b) To provide mechanical advantage for lifting heavy loads
 - (c) To prevent misalignment in a clutch
 - (d) To reduce the friction between two rotating shafts
17. When designing a clutch, what is the term for the mechanism that allows the clutch to engage and disengage?
 - (a) Torsion spring
 - (b) Actuator
 - (c) Friction lining
 - (d) Housing
18. Which type of belt drive is known for its high efficiency and is commonly used in automotive engines?
 - (a) Flat belt drive
 - (b) V-belt drive
 - (c) Serpentine belt drive
 - (d) Timing belt drive
19. What is the primary advantage of a chain drive over a belt drive?
 - (a) Lower cost
 - (b) Higher efficiency
 - (c) Smoother operation
 - (d) Easier maintenance

20. When designing a power screw, which parameter determines how much axial force can be applied to the screw without causing it to fail?
- (a) Thread pitch
 - (b) Screw diameter
 - (c) Lead angle
 - (d) Thread strength
21. What is the primary purpose of gears in a power transmission system?
- (a) To support the weight of rotating equipment
 - (b) To transmit power between parallel or intersecting shafts
 - (c) To provide flexibility in shaft alignment
 - (d) To reduce friction between moving parts
22. Which type of gear is known for its ability to change the direction of rotation between two shafts at right angles to each other?
- (a) Spur gear
 - (b) Helical gear
 - (c) Bevel gear
 - (d) Worm gear
23. In a gear drive system, what is the term for the ratio of the number of teeth on the driven gear to the number of teeth on the driving gear?
- (a) Gear modulus
 - (b) Gear pitch
 - (c) Gear ratio
 - (d) Gear engagement
24. What is the primary function of a shaft in a power transmission system?
- (a) To provide mechanical advantage
 - (b) To change the direction of rotation
 - (c) To support and transmit torque between components
 - (d) To reduce friction in the system
25. When selecting a material for a high-torque shaft, which property is most important to consider?
- (a) Density
 - (b) Elastic modulus
 - (c) Thermal conductivity
 - (d) Yield strength
26. Wire ropes are commonly used in applications that require:
- (a) Low tensile strength
 - (b) Flexibility and resistance to bending
 - (c) Low weight-bearing capacity
 - (d) High speed transmission
27. In wire rope design, what is the term for the number of wires bundled together to form a strand?
- (a) Strand diameter
 - (b) Wire pitch
 - (c) Lay length
 - (d) Wire gauge
28. Which type of wire rope construction is characterized by a central core surrounded by multiple layers of helically wound wires in alternating directions?
- (a) Fiber core
 - (b) Seale construction
 - (c) Warrington construction
 - (d) Filler wire construction
29. In gear design, what type of gear is known for its curved teeth, resulting in smoother and quieter operation compared to spur gears?
- (a) Helical gear
 - (b) Spur gear
 - (c) Bevel gear
 - (d) Worm gear
30. What is the primary advantage of using a worm gear in a power transmission system?
- (a) High efficiency
 - (b) Bidirectional rotation capability
 - (c) Self-locking property
 - (d) Low cost

31. What type of bearing relies on a thin film of lubricating fluid to separate moving parts and reduce friction?
- (a) Rolling element bearing (b) Hydrodynamic bearing
(c) Thrust bearing (d) Sleeve bearing
32. Which of the following is a common material used for rolling elements in rolling element bearings?
- (a) Brass (b) Rubber
(c) Steel (d) Aluminium
33. In a hydrodynamic bearing, what is the primary factor that generates the fluid film between the bearing surfaces?
- (a) Lubricant viscosity (b) Rolling elements
(c) Magnetic forces (d) Heat conduction
34. Which type of bearing is often used in applications requiring high radial load capacity, such as in car wheel hubs?
- (a) Thrust bearing (b) Angular contact bearing
(c) Needle roller bearing (d) Deep groove ball bearing
35. What is the primary advantage of a rolling element bearing over a hydrodynamic bearing?
- (a) Higher load capacity (b) Self-lubricating properties
(c) Lower cost (d) Greater speed capability
36. In the context of planar mechanisms, what does kinematic analysis primarily deal with?
- (a) Forces and torques (b) Motion and geometry
(c) Material properties (d) Electrical circuits
37. Which of the following represents a kinematic constraint in a planar mechanism?
- (a) The force required to move a link
(b) The maximum torque applied to a joint
(c) The relationship between velocities and positions of components
(d) The material strength of a component
38. When performing kinematic analysis of a planar mechanism, what does the term "degrees of freedom" refer to?
- (a) The number of joints in the mechanism
(b) The number of links in the mechanism
(c) The number of independent variables needed to define its position
(d) The range of motion of each joint
39. What is the primary objective of dynamic analysis in planar mechanisms?
- (a) To study the geometry of linkages
(b) To determine the kinematic constraints
(c) To analyse the forces and torques involved during motion
(d) To study the material properties of components
40. Which law or principle is commonly used in dynamic analysis to relate the motion of a planar mechanism to the forces acting on it?
- (a) Ohm's Law (b) Newton's Second Law of Motion
(c) Boyle's Law (d) Kepler's Third Law of Planetary Motion

41. Which type of gear has teeth that are parallel to the axis of rotation and is known for transmitting motion smoothly and quietly?
- (a) Spur gear (b) Helical gear
(c) Bevel gear (d) Worm gear
42. When two gears of different sizes mesh together, what effect does it have on the speed of the driven gear compared to the driving gear?
- (a) The speed increases (b) The speed decreases
(c) The speed remains constant (d) The speed reverses direction
43. What is the primary purpose of a flywheel in a machine?
- (a) To control the engagement of gears
(b) To store and release energy to maintain a constant speed
(c) To convert rotary motion into reciprocating motion
(d) To regulate the flow of fluids in a system
44. Governors are commonly used in engines and machines to:
- (a) Control the flow of electricity (b) Regulate the temperature of a system
(c) Maintain a constant speed under varying loads (d) Convert rotary motion into linear motion
45. Which type of cam has a shape that results in a continuous and smooth motion for the follower?
- (a) Plate cam (b) Groove cam
(c) Offset cam (d) Disc cam
46. In a gear train, what is the term for the gear that receives power from the input source (driving gear)?
- (a) Driver gear (b) Idler gear
(c) Intermediate gear (d) Driven gear
47. What is the gear ratio of a gear train consisting of a driver gear with 20 teeth and a driven gear with 40 teeth?
- (a) 1:2 (b) 2:1
(c) 20:40 (d) 40:20
48. Which type of governor uses rotating weights to control the speed of an engine?
- (a) Centrifugal governor (b) Flyball governor
(c) Hydraulic governor (d) Pneumatic governor
49. Flywheels are crucial in machines that require a steady output of power because they:
- (a) Increase the overall weight of the machine
(b) Store kinetic energy and release it during fluctuations in power demand
(c) Convert mechanical energy into electrical energy
(d) Regulate the flow of fluids in the system
50. What is the primary function of a cam in a mechanical system?
- (a) To transmit power between shafts
(b) To convert rotary motion into reciprocating motion or vice versa
(c) To store energy for later use
(d) To regulate the speed of a machine

51. What is the primary goal of balancing rigid rotors in machinery?
- (a) To increase the speed of rotation
 - (b) To reduce vibration and ensure smooth operation
 - (c) To add weight to the rotor for stability
 - (d) To decrease the energy consumption
52. In field balancing, why is it important to correct unbalance in rotating machinery?
- (a) To increase energy efficiency
 - (b) To simplify maintenance procedures
 - (c) To prevent excessive wear and damage to components
 - (d) To improve sound quality
53. When balancing a single-cylinder engine, where is the correction mass typically added to achieve balance?
- (a) Cylinder head
 - (b) Flywheel
 - (c) Crankshaft
 - (d) Exhaust system
54. In a multi-cylinder engine, what is the purpose of the firing order?
- (a) To optimize fuel consumption
 - (b) To control the engine's speed
 - (c) To balance the forces and reduce vibrations
 - (d) To regulate exhaust emissions
55. Linear vibration analysis in mechanical systems primarily deals with:
- (a) Rotary motion
 - (b) Oscillatory motion along a straight line
 - (c) Circular motion
 - (d) Irregular, unpredictable motion
56. What is the significance of identifying critical speeds in a rotating shaft system?
- (a) To determine the shaft's length
 - (b) To ensure the shaft operates at its maximum speed
 - (c) To avoid resonant vibrations that can lead to failure
 - (d) To increase the torque applied to the shaft
57. Whirling of shafts occurs when:
- (a) The shaft is perfectly balanced
 - (b) The shaft is subjected to high temperatures
 - (c) The shaft rotates at a critical speed
 - (d) The shaft is lubricated improperly
58. In automatic control systems, what is the primary function of a controller?
- (a) To sense the system's output
 - (b) To compare the actual output to the desired setpoint
 - (c) To supply power to the system
 - (d) To monitor system temperature
59. Which type of controller continuously adjusts the system's input based on the error signal to maintain a setpoint?
- (a) Proportional controller
 - (b) Integral controller
 - (c) Derivative controller
 - (d) Proportional-Integral-Derivative (PID) controller
60. In vibration analysis, what is resonance?
- (a) The point at which vibrations are minimal
 - (b) A state where the system's natural frequency matches the excitation frequency
 - (c) A condition where vibrations are completely eliminated
 - (d) The point where the system reaches maximum speed

61. Which component of a multi-cylinder engine experiences the most severe dynamic forces and vibrations?
(a) Cylinder head (b) Piston
(c) Crankshaft (d) Camshaft
62. What type of automatic control system has an open-loop configuration?
(a) A system that relies on feedback
(b) A system that does not adjust its output based on the input
(c) A system that continuously adjusts its output
(d) A system that requires manual intervention
63. In field balancing, what is the primary tool used to detect unbalance in a rotating machine?
(a) Microscope (b) Stethoscope
(c) Vibration analyser (d) Thermometer
64. Critical speed in rotating machinery is associated with:
(a) The point at which the machine should be turned off
(b) The point at which vibrations become negligible
(c) The point at which resonance occurs
(d) The point at which maximum power output is achieved
65. What is the primary role of a governor in an engine?
(a) To balance the engine's components (b) To control fuel injection
(c) To regulate engine speed or output (d) To improve fuel efficiency
66. What is the primary focus of two-dimensional stress analysis?
(a) Determining thermal stresses
(b) Analysing stresses in two different materials
(c) Evaluating stresses in two perpendicular directions
(d) Studying stress in three dimensions
67. Principal stresses represent:
(a) The maximum shear stress in a material
(b) The maximum and minimum normal stresses in a material
(c) The stresses that cause material failure
(d) The average stress in a material
68. What graphical method is used to determine principal stresses and visualize stress transformations?
(a) Hooke's Law (b) Mohr's Circle
(c) Pascal's Triangle (d) Euler's Formula
69. In linear elastic materials, what is the relationship between stress and strain?
(a) Stress is proportional to strain (b) Stress is inversely proportional to strain
(c) Stress is independent of strain (d) Stress is equal to strain
70. Anisotropic materials exhibit different mechanical properties in:
(a) Different temperatures (b) Different directions
(c) Different pressure conditions (d) Different stress states
71. What is the relationship between the elastic modulus (Young's modulus) and the material's stiffness?
(a) They are inversely proportional (b) They are directly proportional
(c) They are unrelated (d) It depends on the material

72. When a material undergoes uniaxial loading, what type of stress is it subjected to?
(a) Tensile stress (b) Compressive stress
(c) Shear stress (d) Biaxial stress
73. Thermal stresses arise due to:
(a) Mechanical loading (b) Material density
(c) Temperature differences (d) Elastic deformation
74. In the context of beams, what is a bending moment diagram used to represent?
(a) Shear forces along the length of the beam
(b) Bending stresses within the beam
(c) The variation of bending moment along the beam's length
(d) The beam's deflection
75. What is the primary function of a beam's shear force diagram?
(a) To determine the beam's deflection
(b) To show the distribution of bending stresses
(c) To represent the internal shear forces along the beam
(d) To display the beam's temperature distribution
76. What causes bending stresses in a beam?
(a) Shear forces (b) Torsional forces
(c) Temperature variations (d) Bending moments
77. When a beam is loaded, where is the maximum bending stress typically located?
(a) At the midpoint of the beam (b) At the fixed end of the beam
(c) At the free end of the beam (d) At the supports or points of attachment
78. In beams, what is the primary function of the shear stress distribution?
(a) To determine the bending moment (b) To prevent buckling
(c) To resist transverse forces (d) To calculate deflection
79. Torsion of shafts refers to:
(a) Axial loading of a shaft (b) Twisting deformation along the length of a shaft
(c) Bending deformation of a shaft (d) Tension and compression of a shaft
80. What is the primary purpose of helical springs in mechanical systems?
(a) To transmit power (b) To store and release energy
(c) To reduce friction (d) To dampen vibrations
81. Combined stresses occur when a material is subjected to:
(a) Multiple simultaneous loads (b) High temperatures
(c) Only axial loads (d) Only shear stresses
82. In the context of pressure vessels, what is the primary difference between thick-walled and thin-walled vessels?
(a) Thickness of the vessel's walls (b) Material composition
(c) Geometric shape (d) Operating temperature
83. In columns and struts, what is the critical load or critical stress associated with?
(a) Buckling or instability (b) Maximum axial loading
(c) Yield strength (d) Torsional deformation

84. Which theory of failure takes into account both normal and shear stresses in a material?
(a) Maximum principal stress theory (b) Maximum shear stress theory
(c) Tresca's theory (d) Coulomb's theory
85. What is the primary focus of the strain energy concept in materials science?
(a) Analysing stress-strain relations (b) Evaluating material stiffness
(c) Studying material fatigue (d) Predicting material failure
86. In the context of strain energy, what does the term "stored energy" refer to?
(a) The energy consumed during deformation
(b) The energy required to cause deformation
(c) The energy released when a material breaks
(d) The energy stored within a material during deformation
87. Which failure theory is often used for brittle materials like ceramics?
(a) Maximum principal stress theory (b) Maximum shear stress theory
(c) Tresca's theory (d) Mohr's theory
88. Which of the following is an example of a material that exhibits isotropic behaviour?
(a) Wood (b) Rubber
(c) Steel (d) Mica
89. What is the key property of anisotropic materials?
(a) They have the same properties in all directions. (b) They have a random orientation of atoms.
(c) Their properties vary with direction. (d) They are transparent to electromagnetic waves.
90. The elastic modulus is a measure of a material's:
(a) Density (b) Stiffness
(c) Thermal conductivity (d) Tensile strength
91. What type of stress is experienced by a material subjected to equal and opposite forces acting along the same line?
(a) Tensile stress (b) Compressive stress
(c) Shear stress (d) Torsional stress
92. What is the primary purpose of analysing thermal stresses in engineering design?
(a) To determine the material's melting point
(b) To prevent material deformation due to temperature changes
(c) To increase thermal conductivity
(d) To reduce material stiffness
93. In the context of beams, what does the bending moment represent?
(a) The applied external forces (b) The rate of change of shear force
(c) The internal resistance to bending (d) The maximum deformation of the beam
94. When analysing beams, what is the relationship between the bending moment and the curvature of the beam?
(a) They are inversely proportional. (b) They are directly proportional.
(c) They are unrelated. (d) It depends on the material.
95. In a beam subjected to a bending moment, where is the maximum bending stress typically located?
(a) At the midpoint of the beam (b) At the fixed end of the beam
(c) At the free end of the beam (d) At the neutral axis of the beam

96. In the context of torsion, what is the torsional shear stress?
- (a) The maximum shear stress at the surface of the shaft
 - (b) The average shear stress along the length of the shaft
 - (c) The shear stress that occurs in beams
 - (d) The maximum tensile stress in the shaft
97. What type of spring stores mechanical energy in the form of potential energy?
- (a) Torsion spring
 - (b) Compression spring
 - (c) Helical spring
 - (d) Leaf spring
98. In combined stress analysis, what is the result of combining tensile and compressive stresses in a material?
- (a) Bending stress
 - (b) Shear stress
 - (c) Torsional stress
 - (d) Hydrostatic stress
99. When analysing the stresses in a thick-walled pressure vessel, what parameter is often used to differentiate between thin-walled and thick-walled vessels?
- (a) Diameter of the vessel
 - (b) Wall thickness of the vessel
 - (c) Operating pressure of the vessel
 - (d) Material of the vessel
100. What is the primary purpose of a strut or column in structural engineering?
- (a) To resist compressive forces
 - (b) To transmit torque
 - (c) To prevent bending
 - (d) To reduce vibrations

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