TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE
UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT, 2014

MECHANICAL ENGINEERING
PAPER - II

Time Allowed : 3 hours   Full Marks : 200

Attempt all questions.

Part A - Objective Type Questions (100 Marks)

All questions carry equal marks of 2 each.

1. Theory of machine which deals with the inertia force due to combined effect of the mass and motion of the various links of the machines is known as
   - (a) kinetics
   - (b) kinematics
   - (c) dynamics
   - (d) statics

2. A shaft with collars at both ends fitted into a circular hole is a popular example of
   - (a) rolling pair
   - (b) turning pair
   - (c) sliding pair
   - (d) spherical pair

3. If the expression of the relation between the number of links (L) and the number of joints (J) is written as $J = \dfrac{3L}{2} - 2,$ it constitutes
   - (a) a kinetic chain
   - (b) a kinematic chain
   - (c) a structure
   - (d) a mechanism

4. A kinematic chain is called a mechanism, if the number of fixed links is
   - (a) at most one
   - (b) at least one
   - (c) more than one
   - (d) none of these

5. Frequency of vibrations is usually expressed in
   - (a) Number of cycles per hour
   - (b) Number of cycles per second
   - (c) Number of cycles per minute
   - (d) Number of cycles per day

6. In a spur gear, the circle on which the involute is generated is called the
   - (a) base circle
   - (b) clearance circle
   - (c) pitch circle
   - (d) addendum circle

7. The power transmitted by a belt drive is maximum when the ratio of maximum tension in the belt to that of centrifugal tension is
   - (a) 2
   - (b) 3
   - (c) 4
   - (d) none of these

8. Which one of the following is a dead weight governor?
    (a) Watt governor
    (b) Hartnell governor
    (c) Porter governor
    (d) Hartung governor

9. The balancing of rotating and reciprocating parts of an engine is necessary when it runs at
    (a) high speed
    (b) low speed
    (c) moderate speed
    (d) all of these

10. When two elements have point or line contact motion, the pair so formed is known as
    (a) higher pair
    (b) lower pair
    (c) closed pair
    (d) screw pair

11. Coriolis component of acceleration is considered in case of
    (a) quick return motion mechanism
    (b) slider crank mechanism
    (c) four bar mechanism
    (d) none of these

12. Train value of a gear train is
    (a) always less than unity
    (b) always greater than unity
    (c) equal to reciprocal of speed ratio
    (d) equal to speed ratio of gear train

13. The product of circular pitch and diameteral pitch is equal to
    (a) module
    (b) unity
    (c) π
    (d) $1/\pi$

14. At node of the shaft, the vibrations are
    (a) minimum
    (b) maximum
    (c) zero
    (d) any value between minimum and maximum

15. Rankine's theory of failure is applicable for which of the following type of materials?
    (a) brittle
    (b) ductile
    (c) elastic
    (d) plastic

16. The rated life of a bearing under a given load (L) is inversely proportional to the
    (a) cube of load
    (b) cubic root of load
    (c) square of load
    (d) square root of load

17. Which one of the following bearings is most suitable for carrying very heavy loads with slow speed?
    (a) hydrodynamic bearing
    (b) ball bearing
    (c) roller bearing
    (d) hydrostatic bearing

18. In designing a plate clutch, assumption of uniform wear conditions is made because it leads to
    (a) real life design
    (b) safer design
    (c) cost effective design
    (d) efficient design

19. During shearing failure of the key, the area under shear is
    (a) both length and thickness
    (b) both width and thickness
    (c) both length and width
    (d) only length

20. The largest diameter of an external or internal screw thread is known as
    (a) major diameter
    (b) minor diameter
    (c) root diameter
    (d) pitch diameter

21. The failure of material is called fatigue when it falls
    (a) below the yield point
    (b) below the elastic point
    (c) above the yield point
    (d) above the elastic point

22. In design analysis, factor of safety is defined as the ratio between material strength and
    (a) yield strength
    (b) ultimate strength
    (c) maximum load
    (d) allowable strength

23. When two non-intersecting and non-coplanar shafts are connected by gears, the arrangements are known as
    (a) spur gearing
    (b) helical gearing
    (c) bevel gearing
    (d) spiral gearing

24. The efficiency of a welded joint, compared to a riveted joint is
    (a) more
    (b) less
    (c) equal
    (d) unpredictable

25. A cotter joint is used to connect two rods which are in
    (a) tension only
    (b) compression only
    (c) tension and compression
    (d) shear only

26. Self-locking is not possible in the case of
    (a) simple band brake
    (b) differential band brake
    (c) simple block brake
    (d) internal expanding shoe brake

27. The life of an open belt in comparison to a cross belt is
    (a) more
    (b) less
    (c) equal
    (d) unpredictable

28. In a V-belt drive, the belt touches the pulley
    (a) at bottom
    (b) at sides only
    (c) at bottoms and sides
    (d) some cases bottom and some cases sides

29. A shaft directly coupled to a power source is called
    (a) line shaft
    (b) counter shaft
    (c) flexible shaft
    (d) jack shaft

30. A round key is used for
    (a) light duty
    (b) medium duty
    (c) heavy duty
    (d) extra heavy duty

31. Oldhum coupling is used to connect
    (a) aligned shafts
    (b) shafts with lateral misalignment
    (c) intersecting shafts
    (d) parallel shafts

32. The transverse fillet weld joints are designed for
    (a) tensile strength
    (b) bending strength
    (c) compressive strength
    (d) shear strength

33. The resistance by which material of a body opposes the deformation is known as
    (a) reaction of material
    (b) strain of material
    (c) resistivity of material
    (d) strength of material

34. The ratio of the lateral strain to the linear strain is called
    (a) modulus of rigidity
    (b) Poisson's ratio
    (c) bulk modulus
    (d) modulus of elasticity

35. The load required to produce unit deflection in a spring is called
    (a) stiffness constant
    (b) strain constant
    (c) rigidity constant
    (d) torsional constant

36. For a material, Young's modulus is given as 1.2×10^5 N/mm² and Poisson's ratio is 0.25. The Bulk modulus of the material is
    (a) 0.8×10^5 N/mm²
    (b) 1.8×10^5 N/mm²
    (c) 0.5×10^5 N/mm²
    (d) 1.2×10^5 N/mm²

37. Hooke's law holds well within the limit of
    (a) polarity
    (b) yield point
    (c) elasticity
    (d) plasticity

38. When a bar is subjected to a change of temperature and its deformation is prevented, the stress induced in the bar is called
    (a) tensile stress
    (b) compressive stress
    (c) shear stress
    (d) thermal stress

39. Young's modulus may be defined as the ratio of stress to strain under
    (a) shear condition
    (b) lateral condition
    (c) linear condition
    (d) all of these

40. In a tensile test of a specimen, the ratio of maximum load to the original cross sectional area of the test piece is called
    (a) ultimate stress
    (b) safe stress
    (c) breaking stress
    (d) permissible stress

41. The shear stress required to cause plastic deformation of solid metal is called
    (a) proof stress
    (b) flow stress
    (c) ultimate stress
    (d) none of these

42. The buckling load for a given column depends on
    (a) least radius of gyration
    (b) length of column
    (c) modulus of elasticity
    (d) all of these

43. A beam is loaded as cantilever. If the load at the free end is increased, the failure will occur
    (a) at the point of the load
    (b) at the middle of the beam
    (c) at the fixed end of the beam
    (d) at any location of the beam

44. The bending moment diagram for a cantilever beam carrying uniformly distributed load will be a
    (a) rectangle
    (b) triangle
    (c) parabola
    (d) hyperbola

45. The materials which exhibit the same elastic properties in all direction are called
    (a) homogeneous
    (b) inelastic
    (c) isotropic
    (d) anisotropic

46. Maximum shear stress in a Mohr's circle is
    (a) equal to radius of Mohr's circle
    (b) greater than radius of Mohr's circle
    (c) less than radius of Mohr's circle
    (d) could be any one of these

47. Strain energy stored in a solid circular shaft is proportional to (GJ is torsional rigidity)

   (a) GJ (b) $1/GJ$

   (c) $1/(GJ)^2$ (d) $(GJ)^2$

48. The relation between Young's modulus (E), bulk modulus (G) and Poisson's ratio (μ) of an elastic material is

   (a) E = 3G (1 - 2μ)   (b) E = 2G (1 - 2μ)

   (c) E = 2G (1 + μ)   (d) E = 2G (1 - μ)

49. The maximum bending moment in a simply supported beam carrying a total load W, uniformly distributed on the entire span L is equal to

   (a) WL/2   (b) WL/3

   (c) WL/4   (d) WL/8

50. Rankine's formula for determining the load carrying capacity of a column is valid for

   (a) long column only   (b) short column only

   (c) columns with hinged ends only   (d) all columns

Part B - Short Answer Questions (100 Marks)

All questions carry equal marks of 5 each.

51. Describe the function of Governor. How does it differ from that of a flywheel?

52. What do you mean by strength and stiffness of a shaft?

53. Define factor of safety and state the factors to be considered for the selection of material for the design of gear.

54. Name the types of welded joints and give suitable sketches of them.

55. Write the classification of bearings. State the working principle of bearing. Also define the term 'rating life' of a bearing.

56. Draw the stress-strain diagram for typical mild steel and mention the salient points as observed on this curve.

57. Name the different types of stresses and strain developed when a body is subjected to forces.

58. Write clear notes on the following properties:

   (i) elasticity,   (ii) plasticity,

   (iii) ductility and   (iv) brittleness.

59. A mild steel bar of diameter 30 mm and length 2.4 m is subjected to a tensile load of 90 kN. Find the strain energy stored in the bar if the load is applied gradually. Take the value of E=200 GN/m^2.

60. What do you mean by straight line mechanism? Name the different mechanisms which are used for exact straight line motion.

61. Explain the term 'Partial balancing of primary force'. Why is it necessary?

62. State the advantages and disadvantages of square threads over trapezoidal threads with reference to the use in power screws.

63. What are advantages and disadvantages of V-belts over flat belts?

64. A hollow steel column has an external diameter of 250 mm and an internal diameter of 200 mm. Find the safe axial compressive load for the column, if safe compressive stress is 120 N/mm^2.

65. What do you mean by 'Buckling of Columns'? State the difference between lateral deflection and buckling of a member.

66. Distinguish between initial tension and centrifugal tension in a belt.

67. Two parallel shafts 12 m apart are to be connected by an open belt running over pulleys of diameters 480 cm and 80 cm respectively. Determine the length of the belt required.

68. What is the difference between thick-film and thin-film lubrication?

69. A solid shaft is subjected to a maximum torque of 25 kNm. Find a suitable diameter of a solid shaft, if the allowable shear stress and the twist are limited to 80 N/mm^2 and 1^0 respectively for a length of 20 times the diameter of the shaft.

70. The diameter of a water supply pipe is 700 mm. It has to stand a water head of 60 m. If the permissible stress of the material is 20 MPa, find out the required thickness of the pipe. Consider the specific weight of water to be 9810 N/m^3.

* * * * * * *