MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (M.E.S.) UNDER PUBLIC HEALTH DEPARTMENT, GOVERNMENT OF MIZORAM, MARCH, 2019.

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. A higher pair can be replaced by a
(a) Two revolute pair and two additional linkages
(b) Two revolute pair and one additional linkages
(c) One revolute pair and one additional linkages
(d) None of these

2. Which is the correct expression for Grubler's criteria
(a) $3j - 3n + 4 = 0$ (b) $3j - 2n + 3 = 0$
(c) $2j - 3n + 3 = 0$ (d) $2j - 3n + 4 = 0$

3. In a kinematic chain, a quaternary joint is equivalent to
(a) One binary joint (b) Two binary joint
(c) Three binary joint (d) Four binary joint

4. Mitre gears are
(a) Gear having different modules
(b) Helical gears having same pitch
(c) Spur gear of equal diameter and pitch
(d) Right angled bevel gears having the same number teeth

5. The working surface above the pitch surface of the gear tooth is termed as
(a) Addendum (b) Dedendum
(c) Flank (d) Face

6. In a slider-crank mechanism, the velocity of piston becomes maximum when
(a) Crank and connecting rod are in line with each other
(b) Crank is perpendicular to the line of stroke of the piston
(c) Crank and connecting rod are perpendicular
(d) Crank is 120^0 with the line of stroke

7. Effect of friction, at the sleeve of a centrifugal governor is to make it
(a) More sensitive (b) More stable
(c) Insensitive over a small range of speed (d) Unstable

8. Match list-I (application) with list-II (drive element) and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Automobile differential	1. Flat belt
B. Bicycle	2. V- belt
C. Planning machine	3. Chain drive
D. Radiator fan of automobile	4. Gear drive

Codes

	A	B	C	D
(a)	4	3	1	2
(b)	1	3	4	2
(c)	4	2	1	3
(d)	1	2	4	3

9. Match list-I (application) with list-II (drive element) and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Sliding pair	1. A road roller rolling over the ground
B. Revolute pair	2. Crank shaft in a journal bearing in an engine
C. Rolling pair	3. Ball and socket joint
D. Spherical pair	4. Piston and cylinder
	5. Nut and screw

Codes

	A	B	C	D
(a)	5	2	4	3
(b)	4	3	1	2
(c)	5	3	4	2
(d)	4	2	1	3

10. In the case of a flywheel, 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 and minimum energy
(d) Ratio of the minimum and maximum energy

11. The critical speed of a rotating shaft depends upon

(a) Mass
(b) Stiffness
(c) Mass and stiffness
(d) Mass, stiffness and eccentricity

12. Damping resistance in viscous damping is proportional to

(a) Relative velocity
(b) Impressed force
(c) Displacement
(d) Constant

13. The most common type of cam follower used in aircraft engines is

(a) Spherical
(b) Knife edge
(c) Roller
(d) Mushroom

14. Which of the following plane mechanism represents the structure

(a) Three-bar mechanism (b) Four-bar mechanism

(c) Five-bar mechanism (d) Six-bar mechanism

15. For minimizing speed fluctuations of an engine as a prime mover, it must have

(a) Only flywheel fitted to the crankshaft

(b) A governor fitted in the system

(c) Both a flywheel and a governor provided in the system

(d) Neither a flywheel nor a governor

16. Lewis equation is applied for

(a) Gear (b) Pinion

(c) Pinion or gear whichever is stronger (d) Pinion or gear whichever is weaker

17. The maximum power is transmitted by a belt when the initial tension is

(a) Half the centrifugal tension (b) One third the centrifugal tension

(c) Twice the centrifugal tension (d) Three times the centrifugal tension

18. Failure of a material is called fatigue when it fails

(a) At the elastic limit (b) Below the elastic limit

(c) At the yield point (d) Below the yield point

19. Railway carriage coupling have

(a) Square thread (b) Acme thread

(c) Knuckle thread (d) Buttress thread

20. Stress concentration in a machine component of ductile material is not so harmful as it is in brittle material because

(a) In ductile material local yielding may distribute stress concentration

(b) Ductile material has larger Young's Modulus

(c) Poison's ratio is larger in ductile materials

(d) Modulus of rigidity is larger in ductile materials

21. 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

22. 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

23. The maximum efficiency of a self-locking screw is

(a) 50% (b) 70%

(c) 75% (d) 80%

24. 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

25. Match list-I (type of joint) with list-II (mode of jointing members) and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Cotter joint	1. Connects two rods or bars permitting small amount of flexibility
B. Knuckle joint	2. Rigidly connects two members
C. Turn buckle	3. Connects two rods having threaded ends
D. Reverted joint	4. Permanent fluid-type joint between two flat pieces
	5. Connects two shafts and transmits torque

Codes

	A	B	C	D
(a)	5	1	3	2
(b)	2	1	3	4
(c)	5	3	2	4
(d)	2	3	1	4

26. Bearings used for heavy loads are

(a) Ball bearings (b) Roller bearings

(c) Thrust bearings (d) Any of the above

27. The sleeve or muff coupling is designed as

(a) Thin cylinder (b) Thick cylinder

(c) Hollow shaft (d) Solid shaft

28. Design of shafts made of brittle material is based on

(a) Guest is theory (b) Rankine theory

(c) St. Venant's theory (d) Von Mises theory

29. A spur gear transmitting power is connected to the shaft with a key of rectangular section. 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

30. In designing a plate clutch, assumption of uniform wear conditions is made because

(a) It is closer to real life situation (b) It leads to safer design

(c) It leads to cost effective design (d) No other assumption is possible

31. Creep parameter help in

(a) avoiding creep testing

(b) establishing steady state creep rate in short time

(c) estimating permissible stress, temperature or time

(d) explaining creep mechanism

32. Stress- Strain curve is always straight line for

(a) elastic materials (b) materials obeying Hooke's Law

(c) elasto plastic materials (d) none of these

33. A material has identical properties in all directions, it is said to be

(a) homogeneous (b) isotropic

(c) elastic (d) orthotropic

34. The Poisson's ratio for concrete is likely to be

(a) 0.5 (b) 1.5

(c) 0.15 (d) none of these

35. The relation between the centroidal axis and neutral axis in the case of slender members is

(a) coincident with each other always (b) exactly the same in inelastic limit

(c) can never be same (d) none of these

36. The maximum bending moment caused by a moving load on a fixed- ended beam is

(a) at the support end (b) under the load only

(c) always at the mid span (d) none of the above

37. The bending stress on a beam section is zero at

(a) centriod of the section (b) top fibre

(c) bottom fibre (d) depends on the moment of inertia

38. The centroid of a cross-section is at

(a) geometric centre

(b) point about which the moment of inertia is zero

(c) point about which the moment of area is zero

(d) neutral axis always

39. An orthotropic material has

(a) non- homogeneous properties

(b) inelastic properties

(c) different properties in three perpendicular directions

(d) same properties in orthogonal directions

40. The maximum deflection of a beam occurs at

(a) zero bending moment location (b) zero shear force location

(c) zero slope location (d) none of these

41. Buckling load of a column depends upon:

i. length of the column

ii. least lateral dimension

iii. cross-sectional area of the column

(a) only (i) (b) only (iii)

(c) both (i) and (ii) (d) (i), (ii) and (iii)

42. Which one of the following pairs is not correctly matched?

(a) Lame's constant : Thick cylinder

(b) Macaulay's Method : Deflection of beams

(c) Euler's Method : Theory of column

(d) Eddy's theorem : Torsion of shafts

43. A material subjected to pure shear can fail by

(a) Rankine's theory only (b) St. Venant's theory only

(c) Tresca's theory only (d) Any of the above theory

44. A cantilever carrying uniformly distributed load W over its full length is propped at its free end such that it is at the level of the fixed end. The bending moment will be zero at its free end and also at

(a) midpoint of the cantilever
(b) fixed point of the cantilever
(c) $1/4^{th}$ length from free end
(d) $3/4^{th}$ length from free end

45. The number of stress components at a point in a three- dimensional problem is

(a) three
(b) four
(c) six
(d) nine

46. A rigid plastic material has the following stress- strain relation:

(a) Stress is proportional to strain up to a point and then it is constant.
(b) Strain is zero up to a stress level and then stress remains constant.
(c) Strain is zero for all stresses.
(d) Strain is zero up to a point and then it is constant for any increase in stress.

47. Limit of proportionality depends upon

(a) area of cross- section
(b) type of loading
(c) type of material
(d) all of the above

48. The slenderness ratio of a section is

(a) directly proportional to the radius of gyration
(b) directly proportional to the moment of inertia
(c) inversely proportional to the area
(d) inversely proportional to the radius of gyration

49. Match list-I with list –II and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Ratio of lateral strain to linear strain	1. Strain
B. Ratio of stress to strain	2. Poisson's ratio
C. Ratio of extension to original length	3. Tensile stress
D. Ratio of axial pull to area of section	4. young's modulus

Codes

	A	B	C	D
(a)	4	2	3	1
(b)	4	2	1	3
(c)	2	4	3	1
(d)	2	4	1	3

50. A visco- elastic material

(a) is elastic all the time
(b) has a small plastic zome
(c) has a time- dependent stress – strain relation
(d) has a viscous surface

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 a machine? Giving example, differentiate between a machine and a structure.

2. Explain the terms:
   (a) Lower and Higher pair
   (b) Equivalent Mechanisms with suitable example (i.e., Sliding , Spring and Cam pairs)

3. What do you mean by degree of freedom?

4. Draw a four-bar chain mechanism and prove that it is a constrained chain.

5. Why belt drives are called 'flexible' drives? What are the applications of its.

6. What are the advantages and disadvantages of flat belt drive?

7. Distinguish between open and cross belt drives with suitable sketch.

8. What is the purpose of a brake in any moving system? What are the factor that depends the brake capacity?

9. What is the difference between self-locking and self-energizing block brake.

10. What do you mean by tensile, compressive and shear forces? Give examples.

11. Define the term Poisson's ratio.

12. Define the term factor of safety and its importance.

13. What do you mean by principal planes and principal stresses?

14. What is Mohr's stress circle? How is it useful in the solution of stress-analysis problems?

15. Define the terms: resilience, proof resilience, modulus of resilience.

16. How are beams classified? Give a brief account.

17. What do you mean by point of inflection or contraflexture?

18. Define the terms 'shear force' and 'bending moment.' How are they considered positive and negative? What are sagging and hogging bending moments?

19. What do you mean by the terms 'neutral axis' and 'neutral surface'?

20. What assumptions are taken in the analysis of shear stress in beams?

* * * * * * *