MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (AE/SDO) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT, GOVERNMENT OF MIZORAM, JANUARY-2024

MECHANICAL ENGINEERING
PAPER-III

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. The ability of a material to resist softening at high temperature is known as-
   - (a) Creep
   - (b) Hot tempering
   - (c) Hot hardness
   - (d) Fatigue

2. Which of the following constituents of steels is softest and least strong-
   - (a) Austenite
   - (b) Pearlite
   - (c) Ferrite
   - (d) Cementite

3. Delta iron occurs at temperature of-
   - (a) Room temperature
   - (b) Above melting temperature
   - (c) Between 1400°C and 1539°C
   - (d) Between 910°C and 1400°C

4. The temperature at which ferromagnetic alpha iron transforms to paramagnetic alpha iron is-
   - (a) 770°C
   - (b) 910°C
   - (c) 1050°C
   - (d) None of the above

5. Gamma iron exists at following temperature-
   - (a) Room temperature
   - (b) Near melting point
   - (c) Between 1400°C and 1539°C
   - (d) Between 910°C and 1400°C

6. The unique property of cast iron is its high-
   - (a) Malleability
   - (b) Ductility
   - (c) Surface finish
   - (d) Damping characteristics

7. In CNC machine tool, the part program entered into the computer memory
   - (a) Can be used only once
   - (b) Can be used again and again
   - (c) Can be used again but it has to be modified every time
   - (d) Cannot say

8. What do Flexible Manufacturing systems (FMS) do?
   (a) Co-ordinates the whole process of manufacturing and manufactures a part, component or product
   (b) Completely manufactures a range of components without significant human intervention during the processing
   (c) Moves and manipulates products, parts or tolls
   (d) Moves materials between operations

9. Choose the basic element for an automated machine tool
   (a) Logic
   (b) NC tape programming
   (c) Software
   (d) Workstation

10. The angle between side cutting edge and end cutting edge is called as
    (a) Approach angle
    (b) Nose angle
    (c) Side relief angle
    (d) End relief angle

11. The process of improving the cutting action of grinding wheel is called............
    (a) Truing
    (b) Dressing
    (c) Facing
    (d) Clearing

12. PERT has following time estimate
    (a) one-time estimate
    (b) two-time estimate
    (c) three-time estimate
    (d) four-time estimate

13. The linear programming techniques can be applied successfully to industries like
    (a) iron and steel
    (b) food processing
    (c) banking
    (d) all of the above

14. A transportation problem has a feasible solution when
    (a) all of the improvement indexes are positive
    (b) the number of filled cells is one less than the number of rows plus the number of columns
    (c) all demand and supply constraints are satisfied
    (d) the solution yields the lowest possible cost

15. In a minimization problem, a negative improvement index in a cell indicates that the
    (a) solution is optimal
    (b) total cost will increase if units are reallocated to that cell
    (c) current iteration is worse than the previous one
    (d) total cost will decrease if units are reallocated to that cell

16. Which of the following statements about the basic EOQ model is true?
    (a) If the ordering cost were to double, the EOQ would rise
    (b) If annual demand were to double, the EOQ would increase.
    (c) If the carrying cost were to increase, the EOQ would fall.
    (d) All of the above statements are true

17. The layout strategy that deals with low-volume, high-variety production is
    (a) fixed-position layout
    (b) retail/service layout
    (c) all of the above
    (d) none of the above

18. In investment casting the pattern is made of
    (a) Wood
    (b) Urea formaldehyde
    (c) Wax
    (d) Metal

19. In grey cast iron, carbon is present in the form of-
    (a) Cementite
    (b) Free carbon
    (c) Flakes
    (d) Spheroids

20. Which one of the following factors is more relevant to represent complete solubility of two metals in each other?
    (a) Chemical affinity
    (b) Valency factor
    (c) Crystal structure factor
    (d) Relative size factor

21. With the increase of percentage of carbon in the steel, which one of the following properties does increase?
    (a) Modulus of elasticity
    (b) Ductility
    (c) Toughness
    (d) Hardness

22. The material property which depends only on the basic crystal structure is
    (a) Fatigue strength
    (b) Work hardening
    (c) Fracture strength
    (d) Elastic constant

23. The percentage of carbon in gray cast iron is in the range of
    (a) 0.25 to 0.75 percent
    (b) 1.25 to 1.75 percent
    (c) 3 to 4 percent
    (d) 8 to 10 percent

24. Consider the following statements:
    1. From design considerations, it is always advantageous to place cast iron ribs on the tension side rather than on the compression side.
    2. Cast iron is an excellent choice for machine tool guides and frames.
    3. Cast iron parts have low notch sensitivity.
    Which of these statements are correct?
    (a) 1, 2 and 3
    (b) 2 and 3
    (c) 1 and 3
    (d) 1 and 2

25. The alloying element mainly used to improve the endurance strength of steel materials is
    (a) Nickel
    (b) Vanadium
    (c) Molybdenum
    (d) Tungsten

26. If the surface of a component is heavily stressed while the stresses in the core are of comparative small magnitude, which one of the following heat treatment methods is employed?
    (a) Annealing
    (b) Tempering
    (c) Quenching
    (d) Case hardening

27. The angle of inclination of the rake face with respect to the tool base measured in a plane perpendicular to the base and parallel to the width of the tool is called
    (a) Back rake angle
    (b) Side rake angle
    (c) Side cutting edge angle
    (d) End cutting edge angle

28. A strip is to be rolled from a thickness of 30 mm to 15 mm using a two-high mill having rolls of diameter 300 mm. The coefficient of friction for unaided bite should nearly be
    (a) 0.35
    (b) 0.5
    (c) 0.25
    (d) 0.07

29. Drop forging is used to produce
  (a) small components
  (b) large components
  (c) identical Components in large numbers
  (d) medium-size components

30. A blank of 30 mm diameter is to be produced out of 10 mm thick sheet on a simple die. If 6% clearance is recommended, then the nominal diameters of pie and punch are respectively
  (a) 30.6 mm and 29.4 mm
  (b) 30.6 mm and 30 mm
  (c) 30 mm and 29.4 mm
  (d) 30 mm and 28.8 mm

31. In a blanking operation to produce steel washer, the maximum punch load used in 2 x 105 N. The plate thickness is 4 mm and percentage penetration is 25. The work done during this shearing operation is
  (a) 200J
  (b) 400J
  (c) 600 J
  (d) 800 J

32. For 50% penetration of work material, a punch with single shear equal to thickness will
  (a) reduce the punch load to half the value
  (b) increase the punch load by half the value
  (c) maintain the same punch load
  (d) reduce the punch load to quarter load

33. While cooling, a cubical casting of side 40 mm undergoes 3%, 4% and 5% volume shrinkage during the liquid state, phase transition and solid state, respectively. The volume of metal compensated from the riser is
  (a) 2%
  (b) 7%
  (c) 8%
  (d) 9%

34. Disposable patterns are made of
  (a) wood
  (b) rubber
  (c) metal
  (d) polystyrene

35. Which one of the following gating systems is best suited to obtain directional solidification?
  (a) Top grating
  (b) Part-line grating
  (c) Bottom grating
  (d) Stepped grating

36. A spherical drop of molten metal of radius 2 mm was found to solidify in 10 seconds. A similar drop of radius 4 mm would solidify in
  (a) 14.14 seconds
  (b) 20 seconds
  (c) 28.30 seconds
  (d) 40 seconds

37. Poor machinability of centrifugally cast-iron pipe is due to
  (a) chilling
  (b) segregation
  (c) dense structure
  (d) high mould rotation speed

38. The mould in shell moulding process is made up of which of the following?
  (a) Gypsum + setting agents
  (b) Green sand + clay
  (c) Sodium silicate + dried sand
  (d) Dried silica + phenolic resin

39. Light and intricate parts with close dimensional tolerances of the order of ± 0.005 mm are produced by
  (a) investment casting
  (b) die casting
  (c) centrifugal casting
  (d) shell mould casting

40. In gas welding of mild steel using an oxy-acetylene flame, the total amount of acetylene consumed was 10 litre. The oxygen consumption from the cylinder is

   (a) 5 litre   (b) 10 litre

   (c) 15 litre   (d) 20 litre

41. Which one of the following is not an electric resistance method of welding?

   (a) Electro slag welding   (b) Percussion welding

   (c) Seam welding   (d) Flash welding

42. To drill a 10 mm diameter hole through a 20 mm thick M.S. plate with a drill bit running at 300 rpm and a feed of 0.25 mm per revolution, time taken will be

   (a) 8s   (b) 16s

   (c) 24s   (d) 32s

43. By which one of the following machines the teeth of an internal spur gear can be cut accurately?

   (a) Milling machine   (b) Slotting machine

   (c) Hobbing machine   (d) Gear-shaping machine

44. A built-up-edge is formed while machining

   (a) ductile materials at high speed   (b) ductile materials at low speed

   (c) brittle materials at high speed   (d) brittle materials at low speed

45. In orthogonal cutting, shear angle is the angle between

   (a) shear plane and the cutting velocity

   (b) shear plane and the rake plane

   (c) shear plane and the vertical direction

   (d) shear plane and the direction of elongation of crystals in the chip

46. In a single-point turning operation of steel with a cemented carbide tool, Taylor's tool life exponent is 0.25. If the cutting speed is halved, the tool life will increase by

   (a) two times   (b) four times

   (c) eight times   (d) sixteen times

47. In an orthogonal cutting, the depth of cut is halved and the feed rate is double. If the chip thickness ratio is unaffected with the changed cutting conditions, the actual chip thickness will be

   (a) doubled   (b) halved

   (c) quadrupled   (d) unchanged

48. In ultrasonic machining process, the material removal rate will be higher for materials with

   (a) higher toughness   (b) higher ductility

   (c) lower toughness   (d) higher fracture strain

49. A company sells 14,000 units of its product. It has a variable cost of Rs. 15 per unit. Fixed cost is Rs. 47,000 and the required profit is Rs. 23,000 Per unit product price (in Rs.) will be:

   (a) 60   (b) 40

   (c) 30   (d) 20

50. The fixed costs for a year is Rs. 8 lakhs, variable cost per unit is Rs. 40/- and the selling price of each unit is Rs. 200/-. If the annual estimated sales is Rs. 20,00,000/-, then the break-even volume is :

   (a) 2000   (b) 3000

   (c) 3333   (d) 5000

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. Explain with sketches the difference between direct and indirect extrusion.

2. How is an arc obtained in arc welding? What are the advantage of AC equipment over DC equipment in arc welding?

3. Explain with sketches the difference between orthogonal cutting and oblique cutting.

4. An industry estimates that it will sell 15000 units of its product for the forthcoming year. The ordering cost is Rs 200 per order and the carrying cost per unit per year is 20 percent of the purchase price per unit. The purchase price per unit is Rs 100. Find (i) Economic order quantity (ii) No. of orders per year (iii) Time between successive orders.

5. Explain the need for heat treatment of steels. Describe the process of quenching.

6. What are composites material? How are they different from alloy material?

7. Aluminium has FCC structure. Its density is 2700 kg/m^3. Find the unit cell dimensions and atomic diameter. Given atomic weight of Al = 26.98.

8. What are the functions served by the pouring basin in a sand casting.

9. Explain the following terms used in surface finish measurement: (i) Roughness, (ii) Waviness, (iii) Effective profile, (iv) Sampling length, (v) Lay.

10. Explain with the help of a suitable figure the working principle of Laser Beam welding.

11. Briefly explain the various automation aspects used in manufacturing activities.

12. Write short notes on the following:
    (a) Elasticity   (b) Plasticity
    (c) Fatigue   (d) Creep
    (e) Toughness

13. Why are the Time-Temperature-Transformation (TTT) diagrams constructed?

14. What are the different types of gates? Explain them with the help of sketches stating the relative merits and demerits of each.

15. What are the main factors which are responsible for producing defects in the casting?

16. How will you obtain neutral, oxidizing and reducing flames using welding torch in gas welding?

17. Explain the principle of quick return motion mechanism of a shaper. What is need of this mechanism?

18. Use the simplex method to solve the following LP problem:
    Min. Z=X-3Y+2Z
    Subject to the constraints,
    3X-Y+3Z$\leq$7, -2X+4Y$\leq$12, -4X+3Y+8Z$\leq$10 And X, Y, Z$\geq$0

19. Explain what is ABC analysis and what is its significance.

20. Explain the various types of queues by means of a sketch and also give the situations for which each is suitable.

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