MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING) UNDER POWER & ELECTRICITY DEPARTMENT,

GOVERNMENT OF MIZORAM, JULY-2023

MECHANICAL ENGINEERING

PAPER-I

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. Shooting flow can never occur

(a) Directly after a hydraulic jump (b) In a horizontal channel

(c) In a mild slope channel (d) In a steep slope channel

2. In a centrifugal compressor, the pressure rise takes place in

(a) impeller only (b) diffuser only

(c) casing only (d) impeller and diffuser both

3. A similarity in thermal quantities is achieved when

(a) Nusselt number is same for both the fields (b) Nusselt number is different for both the fields

(c) Prandtl number is same for both the fields (d) Prandtl number is different for both the fields

4. A bucket of water is hanging from a spring balance. An iron piece is suspended into water without touching sides of bucket from another support. The spring balance reading will

(a) Increase

(b) Decrease

(c) Remain same

(d) Increase/decrease depending on depth of immersion

5. A closed system is one in which

(a) both energy and mass cross the boundary of the system

(b) the mass does not cross the boundary, but energy interaction takes place

(c) neither mass nor energy cross the boundary of the system

(d) the mass crosses the boundary but energy does not

6. For the measurement of flow rate of liquid, the method used is

(a) Conveyor-based methods (b) Bourdon tube

(c) Coriolis method (d) Thermal mass flow measurement

7. A sequence of processes, in which initial and final states of a system are identical, is called a

(a) path function (b) point function

(c) cycle (d) none of the above

8. The mercury does not wet the glass. This is due to the property of the liquid known as

(a) Cohesion (b) Adhesion

(c) Viscosity (d) Surface tension

9. For the same inlet and exit temperatures of two fluids, the LMTD for counter flow is always

(a) Smaller than LMTD for parallel flow (b) Greater than LMTD for parallel flow

(c) Same as LMTD for parallel flow (d) Unpredictable

10. The perpetual motion machine of the first kind is impossible according to the

(a) zeroth law of thermodynamics (b) first law of thermodynamics

(c) second law of thermodynamics (d) third law of thermodynamics

11. The component of the total force exerted by fluid on a body in the direction parallel to the direction of motion is called as

(a) Lift (b) Drag

(c) both (a) & (b) (d) none of the above

12. Which one of the following is the dimension of specific weight of a liquid?

(a) $[ML^{-3} T^{-2}]$ (b) $[ML^{3} T^{-2}]$

(c) $[ML^{-2} T^{-2}]$ (d) $[ML^{2} T^{-2}]$

13. A beaker is filled with a liquid up to the mark of one litre and weighed. The weight of the liquid is found to be 6.5 N. The specific gravity of the liquid will be

(a) 0.65 (b) 0.66

(c) 0.67 (d) 0.68

14. The value of the compressibility of an ideal fluid is

(a) Zero (b) Unity

(c) Infinity (d) More than that of a real fluid

15. At the critical point, the temperature of water is equal to

(a) 0°C (b) 100°C

(c) 374°C (d) –100°C

16. Anemometer is used to measure

(a) Velocity (b) Pressure

(c) Viscosity (d) Density

17. What is the correct formula for Euler's equation of motion? if, q = density of the fluid, p = pressure force, g = acceleration due to gravity, v = velocity of the fluid

(a) $(\partial p / q) + (\partial g / q) + (\partial v / q) = 0$ (b) $(\partial p / q) + (\partial g / q) + (v\ dv) = 0$

(c) $(\partial p / q) + (g\ dz) + (v\ dv) = 0$ (d) $(p\ dp) + (g\ dz) + (v\ dv) = 0$

18. Which fluid does not experience shearing stress during flow?

(a) Pseudoplastic (b) Dilatant

(c) Newtonian (d) Inviscid

19. When the Mach number is between _____ the flow is called super-sonic flow.

(a) 1 and 2.5 (b) 2.5 and 4

(c) 4 and 6 (d) 1 and 6

20. In an isothermal process

(a) temperature increases gradually
(b) volume remains constant
(c) change in internal energy is zero
(d) enthalpy change is maximum

21. When a tank containing liquid moves with an acceleration in the horizontal direction, then the free surface of the liquid

(a) Remains horizontal
(b) Becomes curved
(c) Falls on the front-end
(d) Falls on the back end

22. The second law of thermodynamics deals with

(a) direction of process and quality of energy
(b) energy balance
(c) balance of internal energy
(d) system efficiency

23. A Carnot cycle operates between temperatures of 727°C and 227°C, the efficiency of the engine is

(a) 40%
(b) 50%
(c) 60%
(d) 45%

24. Transfer of heat energy takes place in accordance with

(a) Zeroth law of thermodynamics
(b) First law of thermodynamics
(c) Second law of thermodynamics
(d) Third law of thermodynamics

25. Thermal conductivity of powderly and porous materials

(a) Decreases with increasing temperature
(b) Increases with increasing temperature
(c) Is independent of temperature change
(d) None of the above

26. Transient heat conduction means

(a) heat conduction for a short time
(b) conduction when the temperature at a point varies with time
(c) very little heat transfer
(d) heat conduction with a very small temperature difference

27. The temperature profile for heat conduction through a wall of constant thermal conductivity in the presence of a heat source is

(a) a straight line
(b) parabolic
(c) logarithmic
(d) hyperbolic

28. When does a vapour become superheated?

(a) when the temperature of vapour is less than the saturation temperature at given pressure
(b) when the temperature of vapour is more than the saturation temperature at given pressure
(c) when the temperature of vapour is equal to the saturation temperature at given pressure
(d) none of the mentioned

29. Biot number is defined as

(a) k/hL
(b) kL/h
(c) hL/k
(d) h/kL

30. The air standard Otto cycle comprises

(a) two constant pressure processes and two constant volume processes
(b) two constant pressure and two constant entropy processes
(c) two constant volume processes and two constant entropy processes
(d) none of the above.

31. On a psychrometric chart, the dew point temperature lines are
(a) curved
(b) horizontal and uniform
(c) vertical
(d) straight and inclined

32. The ratio of work-done per cycle to the stroke volume of the compressor is known as
(a) Compressor capacity
(b) Compression ratio
(c) Compressor efficiency
(d) Mean effective pressure

33. The ratio of kinetic energy of flow relative to boundary layer enthalpy difference is called
(a) Biot number
(b) Eckert number
(c) Grashhoff number
(d) Stanton number

34. The type of rotary compressor used in gas turbine is of
(a) Centrifugal type
(b) Axial flow type
(c) Radial flow type
(d) None of this

35. In liquid metal heat transfer, Nusselt number is a function of
(a) Prandtl number only
(b) Reynolds number only
(c) Peclet number only
(d) Peclet and Reynolds number

36. Supercharging is the process of.
(a) Providing the forced cooing air
(b) Raising exhaust pressure
(c) Suppling the intake of an engine with air at a density greater than the density of the surrounding atmosphere
(d) Suppling compressed air to remove combustion product fully

37. Gases have poor
(a) tranmissitivity
(b) absorptivity
(c) reflectivity
(d) emissivity

38. In thermosyphon system there is (are)
(a) no pump
(b) one pump
(c) two pumps
(d) three pumps

39. The following is considered as best antifreeze solution
(a) Ethylene glycol
(b) Distilled glycerin
(c) Methanol
(d) Denatured alcohol

40. A fluid does not flow
(a) in the presence of pressure
(b) in the absence of pressure
(c) in the presence of shear stress
(d) in the absence of shear stress

41. If the position of metacentre M remains lower than c.g. of the body, G, the body will remain in a state of
(a) stable equilibrium
(b) unstable equilibrium
(c) neutral equilibrium
(d) any of the above

42. In fluid mechanics, the continuity equation is a mathematical statement embodying the principle of
(a) conservation of momentum
(b) conservation of mass
(c) conservation of energy
(d) none of the above

43. Which of the following fuel material occurred naturally?

(a) U235 (b) Pu239

(c) Pu241 (d) U-233

44. A Kaplan turbine is

(a) an inward flow impulse turbine (b) low head axial flow turbine

(c) high head axial flow turbine (d) high head mixed flow turbine

45. Combustion in CI engines is

(a) Laminar (b) Turbulent

(c) Homogeneous (d) Heterogeneous

46. The ignition quality of petrol is expressed by

(a) Cetane number (b) Octane number

(c) Calorific value (d) All of these

47. A normal shock propagated into still air travels with a speed

(a) Equal to the speed of sound in the still air

(b) Larger than the speed of sound in the still air

(c) Smaller than the speed of sound in the still air

(d) All of the above is possible, depending on the air temperature

48. The phenomenon occurring in an open channel when a rapidly flowing stream abruptly changes to slowly flowing stream causing a distinct rise of liquid surface, is

(a) Water hammer (b) Hydraulic jump

(c) Critical discharge (d) None of the above

49. In a fire-tube boiler

(a) water flows through the tubes (b) flue gas flows through the tubes

(c) fire is produced in the tubes (d) flue gas surrounds the tube

50. A nozzle is designed for

(a) maximum pressure at the outlet (b) maximum discharge

(c) maximum pressure and maximum discharge (d) maximum kinetic energy at the outlet

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 heat pump? How does it differ from a refrigerator? Explain.
2. State Fourier law of heat conduction and by using it derive an expression for steady state heat conduction through a plane wall of thickness L maintains its two surfaces at temperatures T_1 and T_2, respectively.
3. Define refrigerating effect. What is one tonne of refrigeration? What is the basic formula for calculating the tonnage of refrigeration?
4. What is sensible heating or cooling?
5. What is the difference between an ideal and a real fluid?
6. Define the following terms:(i) Total pressure, and(ii) Centre of pressure.
7. List the assumptions which are made while deriving Bernoulli's equation.
8. Define critical radius of insulation with neat graph.
9. What are the types of nozzles? Explain with neat diagrams.
10. State first law of thermodynamics and mention its limitation.
11. Define irreversibility and write a short note on conditions for reversibility.
12. What do you mean by one dimensional isentropic flow? Enumerate the governing equations related to isentropic flow.
13. Write down the equations for stagnation pressure, stagnation density and stagnation temperature.
14. Define Mach number. Classify fluid flows on the basis of Mach number. What are the effects of Mach number on fluid flow?
15. Describe the working of a single stage reciprocating air compressor.
16. What are natural refrigerants? Discuss their potentials and limitations.
17. What are the types of turbines suitable under the following conditions: (i) high head and low discharge (ii) medium head and medium discharge and (iii) low head and large discharge.
18. Explain why penstock pipes are of larger diameter compared to the jet diameters.
19. What is the fundamental difference between the operation of impulse and reaction steam turbines?
20. Compare in brief the detonation phenomenon in SI and CI engine.

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