MIZORAM PUBLIC SERVICE COMMISSION

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

MECHANICAL ENGINEERING
PAPER - I

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. The Zeroth law thermodynamics establishes the concept of
   - (a) temperature
   - (b) heat
   - (c) enthalpy
   - (d) entropy

2. If the boundary of a thermodynamic system is impervious to the flow of matter, it is called
   - (a) open system
   - (b) closed system
   - (c) isolated system
   - (d) adiabatic system

3. The absolute pressure in the condenser of a steam power plant is 2668 Pa and the barometer reading is 760 mm of mercury, then the vacuum recorded in the condenser is
   - (a) 74 cm of mercury
   - (b) 72 cm of mercury
   - (c) 75 cm of mercury
   - (d) none of these

4. Which one of the following components is not a boiler accessory?
   - (a) injector
   - (b) superheater
   - (c) feed pump
   - (d) safety valve

5. In steam nozzle for the same pressure ratio the dryness fraction of exit steam increases due to considering the effect of
   - (a) friction loss
   - (b) contraction loss
   - (c) velocity loss
   - (d) pressure loss

6. The thermal property that remains same on the two sides of the impulse wheel of a steam turbine is
   - (a) heat
   - (b) temperature
   - (c) velocity
   - (d) pressure

7. For a given pressure and temperature of steam, the thermal efficiency of the steam engine with condenser compared to a steam engine without condenser is always
   - (a) lower
   - (b) higher
   - (c) same
   - (d) none of these

8. The compression ratio of Diesel engine may have the range of
   - (a) 8 to 10
   - (b) 10 to 15
   - (c) 16 to 20
   - (d) none of these

9. Octane number rating is used to determine the ignition quality of fuels for
   (a) C.I. engine
   (b) S.I. engine
   (c) Hydrogen engine
   (d) Steam engine

10. In case of S.I. engine, to have best thermal efficiency the fuel-air mixture ratio should be
   (a) rich
   (b) lean
   (c) may be rich or lean
   (d) same

11. A process in which no heat is supplied or rejected from the system and entropy is not constant is known as
   (a) isothermal
   (b) isentropic
   (c) polytropic
   (d) hyperbolic

12. The number of power strokes per minute in a two-stroke engine is
   (a) equal to the rpm
   (b) half of the rpm
   (c) twice of the rpm
   (d) four times of the rpm

13. An isentropic process is always
   (a) irreversible and adiabatic
   (b) reversible and isothermal
   (c) reversible and adiabatic
   (d) frictionless and irreversible

14. Which of the following items is a path function?
   (a) Pressure
   (b) Temperature
   (c) Work
   (d) Density

15. The internal energy of a perfect gas depends on
   (a) temperature and pressure
   (b) only temperature
   (c) temperature and entropy
   (d) temperature and enthalpy

16. One tonne of refrigeration is approximately equal to
   (a) 14,000 kJ/hr
   (b) 3.8 kW
   (c) 230 kJ/min
   (d) all of these

17. The wave length of radiation emitted by a body depends upon the surface
   (a) nature
   (b) area
   (c) temperature
   (d) roughness

18. Which one of the following factors has no influence on free convection?
   (a) Specific gravity
   (b) Coefficient of viscocity
   (c) Gravitational force
   (d) Velocity

19. For evaporators and condensers, for the given condition, the logarithmic mean temperature difference (LMTD) of parallel flow compared to counter flow is
   (a) more
   (b) equal
   (c) less
   (d) may be equal or more

20. In a long cylindrical rod of diameter 'D' and a surface heat flux of q_0, the uniform internal heat generation rate is given by
   (a) $4q_0/D$
   (b) $2q_0$
   (c) $2q_0/D$
   (d) $4q_0/D^2$

21. Heat transfer by radiation mainly depends upon
   (a) nature of the body
   (b) its temperature
   (c) kind and extant of its surface
   (d) all of these

22. When heat is transferred by molecular collision, it is referred to as heat transfer by
    (a) conduction
    (b) convection
    (c) radiation
    (d) radiation and convection

23. Thermal diffusivity is
    (a) a physical property of the material
    (b) function of temperature
    (c) a dimensionless parameter
    (d) useful in case of radative heat transfer

24. Stefan Boltzmann law is applicable for heat transfer by
    (a) conduction
    (b) convection
    (c) radiation
    (d) conduction and radiation combination

25. In a heat exchanger, the hot liquid enters with a temperature of 180^0C and leaves at 160^0C. The cooling fluid enters at 30^0C and leaves at 110^0C. The capacity ratio of heat exchanger is
    (a) 0.25
    (b) 0.40
    (c) 0.50
    (d) 0.55

26. The fluid forces considered in the derivation of Navier Stokes equation are
    (a) gravity, pressure and viscous
    (b) gravity, pressure and turbulent
    (c) pressure, viscous and turbulent
    (d) gravity, viscous and turbulent

27. A fluid in which resistance of deformation is independent of the shear stress is known as
    (a) Bingham plastic fluid
    (b) Pseudo plastic fluid
    (c) Dilatent fluid
    (d) Newtonian fluid

28. In fluid modeling of flow pattern around a body submerged in a fluid, the non-dimensional number that has to be kept the same in the model and prototype is
    (a) Weber number
    (b) Froude number
    (c) Mach number
    (d) Reynolds number

29. The loss of head due to friction in a pipe of uniform diameter in which a viscous flow is taking place is given in terms of Reynolds number (R) as
    (a) 16/R
    (b) 64/R
    (c) 4/R
    (d) 1/R

30. The location of the center of pressure over a surface immersed in a liquid is
    (a) always above the centroid
    (b) will be at the centroid
    (c) will be below the centroid
    (d) depends upon the density of fluid

31. If a body is in stable equilibrium the metacentric height should be
    (a) zero
    (b) positive
    (c) negative
    (d) depends upon the fluid

32. The stream function is
    (a) constant along an equipotential line
    (b) along a stream line
    (c) defined only in irrotational flow
    (d) defined only for incompressible flow

33. The continuity equation is the result of application of the following law to the flow field
    (a) law of conservation of momentum
    (b) law of conservation of energy
    (c) law of conservation of mass
    (d) first law of thermodynamics

34. Bernoulli equation is applicable for
    (a) steady rotational flow
    (b) steady rotational compressible flow
    (c) steady irrotational incompressible flow
    (d) unsteady irrotational incompressible flow

35. In a steady flow in a varying section pipe if the diameter is doubled the kinetic energy will
    (a) be doubled
    (b) increase 4 times
    (c) increase 8 times
    (d) decrease to one sixteenth

36. The point of application of the total pressure on the surface is
    (a) centroid of the surface
    (b) centre of pressure
    (c) either of the above
    (d) none of the above

37. A venturimeter is used for measuring
    (a) pressure
    (b) flow rate
    (c) total energy
    (d) piezometric head

38. Kinematic similarity between model and prototype is the
    (a) similarity of discharge
    (b) similarity of shape
    (c) similarity of streamline pattern
    (d) none of these

39. A turbulent flow is considered steady when
    (a) the algebraic sum of velocity fluctuations is zero
    (b) the velocity at a point does not change with time
    (c) temporal mean velocity at a point remains constant with time
    (d) the discharge remains constant

40. The boundary layer exists in which of the following?
    (a) Flow of real fluids
    (b) Flow of ideal fluids
    (c) Flow over flat surfaces only
    (d) Pipe-flow only

41. In parallel flow heat exchangers, the two fluids i.e. hot and cold travel in the
    (a) same direction
    (b) opposite direction
    (c) cross direction
    (d) axial direction

42. For high head and low discharge, the hydraulic machinery selected is
    (a) Francis turbine
    (b) Kaplan turbine
    (c) Pelton turbine
    (d) none of these

43. The hydraulic unit used to minimize frictional loss in pipe line is called as
    (a) safety tank
    (b) surge tank
    (c) relief tank
    (d) pressure tank

44. Pelton turbine is a
    (a) Reaction turbine
    (b) Impulse turbine
    (c) Radial flow turbine
    (d) Axial flow turbine

45. A high specific speed Francis turbine is
    (a) axial flow turbine
    (b) tangential flow turbine
    (c) mixed flow turbine
    (d) radial flow turbine

46. In case of a centrifugal pump, due to the slip
    (a) flow rate is reduced
    (b) energy transfer is reduced
    (c) pump speed is reduced
    (d) possibility of cavitation is increased

47. Reciprocating pumps are suitable for
    (a) high pressure
    (b) low pressure
    (c) moderate pressure
    (d) high volume

48. An impulse turbine
   (a) operates submerged
   (b) requires draft tube
   (c) is most suited for low head applications
   (d) operates by initial complete conversion to kinetic energy

49. Specific speed of turbine is indicated as

   (a) $\dfrac{N\sqrt{Q}}{H^{3/4}}$
   (b) $\dfrac{N\sqrt{P}}{H^{5/4}}$

   (c) $\dfrac{N\sqrt{Q}}{H^{2/3}}$
   (d) $\dfrac{N\sqrt{P}}{H^{3/4}}$

50. The ratio of power produced by the turbine to the energy actually supplied by the turbine is called
   (a) mechanical efficiency
   (b) hydraulic efficiency
   (c) overall efficiency
   (d) turbine efficiency

Part B - Short Answer Questions (100 Marks)

All questions carry equal marks of 5 each.

51. What is system? Distinguish between open and closed systems.

52. What is calorific value of fuels? How do you measure it?

53. Clearly write the difference between compression ignition (CI) and spark ignition (SI) engine.

54. Draw the P-V diagram of Otto cycle and Diesel cycle engine.

55. Explain different modes of heat transfer and give example of each mode.

56. Clearly explain the following terms: (Any two):
   (i) Refrigerating effect   (ii) Ton of refrigeration and   (iii) C.O.P.

57. Name the factors that influence the selection of air conditioning system for a room. Also define comfort indices.

58. Clearly distinguish between the following:
   (i) Laminar and turbulent flow   (ii) Water tube and fire tube boiler

59. Explain the effect of inter-cooling and reheating on Brayton cycle.

60. Define buoyancy. State the conditions for the stability of floating bodies.

61. Define open channel flow. Distinguish between uniform and non-uniform open channel flow.

62. Explain why priming is necessary to start pumping by centrifugal pump.

63. State and explain Fourier's law for one-dimensional heat conduction.

64. What do you mean by 'overall heat transfer coefficient'? Explain.

65. What is meant by shape factor? Explain. When is the view factor of a surface to itself equal to zero?

66. Define internal energy. Prove that it is a property of the system.

67. Discuss the advantages and disadvantages of vapour absorption refrigeration system over vapour compression refrigeration system.

68. Give the classification of hydraulic turbines.

69. What is a draft tube? Why is it used in a reaction turbine?

70. What are the advantages of multi-stage compression over a single stage compression for the same pressure ratio?

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