

**MIZORAM PUBLIC SERVICE COMMISSION**  
**TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO**  
**JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE**  
**UNDER POWER & ELECTRICITY DEPARTMENT, NOVEMBER, 2015**

**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.*

*This Part should be answered only on the **OMR Response Sheet** provided.*

1. Which of the following items is a path function?
  - (a) pressure
  - (b) temperature
  - (c) work
  - (d) density
2. The ratio of  $C_p$  to  $C_v$  of a perfect gas is called
  - (a) isothermal index
  - (b) adiabatic index
  - (c) ideal gas index
  - (d) isentropic index
3. In any natural process, the difference between the final entropy and initial entropy is
  - (a) positive
  - (b) negative
  - (c) nil
  - (d) indeterminate
4. The compression ratios for diesel engines lie in the range of
  - (a) 5 to 8
  - (b) 3 to 6
  - (c) 6 to 10
  - (d) 15 to 20
5. Gas turbine usually operates on
  - (a) constant volume cycle
  - (b) constant pressure cycle
  - (c) dual combustion cycle
  - (d) constant temperature cycle
6. Which of the following can be used as a coolant in nuclear plant?
  - (a) light or heavy water
  - (b) molten lead
  - (c) carbon dioxide
  - (d) freon
7. Practically all the engineering processes are
  - (a) quasi-static
  - (b) reversible
  - (c) irreversible
  - (d) thermodynamically equilibrium
8. Total heat of a substance is also known as
  - (a) internal energy
  - (b) entropy
  - (c) latent heat
  - (d) enthalpy

9. Which of the following does not relate to C.I. engine?
- (a) fuel pump (b) fuel injector  
(c) governor (d) carburettor
10. Thermal power plant works on
- (a) Carnot cycle (b) Joule cycle  
(c) Rankine Cycle (d) Otto cycle
11. The ideal efficiency of a simple gas turbine depends upon
- (a) temperature ratio (b) pressure ratio  
(c) volume ratio (d) mass ratio
12. The device which delivers the heat from low temperature to high temperature in a cyclic process is known as
- (a) heat engine (b) heat pump  
(c) compressor (d) condenser
13. Which of the following thermodynamic properties is not an example of point function?
- (a) volume (b) temperature  
(c) pressure (d) work
14. A heat engine is supplied heat at the rate of 15000 N m/s and gives an output of 4500 W. The thermal efficiency is
- (a) 45% (b) 50%  
(c) 30% (d) 33%
15. A thermodynamic process, in which no heat is supplied or rejected and entropy is not constant, is called
- (a) isentropic (b) isothermal  
(c) polytropic (d) adiabatic
16. Heat is rejected by a refrigerant, during a refrigeration cycle in a
- (a) condenser (b) evaporator  
(c) compressor (d) throttle valve
17. The refrigerant used in vapour absorption refrigerator is
- (a) freon-12 (b) ammonia  
(c) aqua-ammonia (d) carbon di-oxide
18. For evaporators and condensers, for the given condition, the logarithmic mean temperature difference (LMTD) of parallel flow compared to counter flow is
- (a) equal (b) more  
(c) less (d) none of these
19. For a forced convection, Nusselt number is a function of
- (a) Prandtl and Grashof numbers (b) Grashof number only  
(c) Reynold and Grashof numbers (d) Reynold and Prandtl numbers
20. During adiabatic saturation process on unsaturated air, the parameter which remains constant is
- (a) dry bulb temperature (b) dew point temperature  
(c) wet bulb temperature (d) relative humidity

21. The refrigeration effect from a flooded evaporator as compared to a dry evaporator fitted in a similar plant is
- (a) more (b) less  
(c) equal (d) unpredictable
22. The gray body shape factor for radiant heat exchange between two long parallel plates of equal area and each having an emissivity of 0.4 is
- (a) 1 (b) 4  
(c)  $\frac{1}{4}$  (d) 0.4
23. When a mixture of air and water vapour is cooled at constant pressure up to the saturation temperature of water vapour, this temperature is called
- (a) wet bulb temperature (b) dew point temperature  
(c) dry bulb temperature (d) adiabatically saturated temperature
24. The emissive power of a body depends upon
- (a) emissivity of the body (b) wavelength of radiation  
(c) temperature of the body (d) all of these
25. An enclosure is formed by two concentric spheres. The view factor of a point of inner sphere with respect to outer sphere is
- (a) 0.0 (b) 0.5  
(c) 1.0 (d) none of these
26. Total emissivity of a polished silver surface compared to black body is
- (a) same (b) more or less same  
(c) higher (d) lower
27. In a vapour compression cycle, the refrigerant immediately after expansion valve is
- (a) liquid (b) dry vapour  
(c) saturated liquid (d) wet vapour
28. A fluid is a substance that
- (a) is essentially incompressible  
(b) has a viscosity that always decreases with temperature  
(c) cannot remain at rest when subjected to a shearing stress  
(d) cannot be subjected to shear forces
29. A floating body is said to be in a state of stable equilibrium
- (a) when its metacentric height is zero  
(b) when the metacentre is above the centre of gravity  
(c) when the metacentre is below the centre of gravity  
(d) only when the centre of gravity is below its centre of buoyancy
30. Rotameter is used to measure
- (a) fluid pressure (b) flow rate  
(c) velocity (d) viscosity
31. The efficiency of a centrifugal pump is maximum when blades are
- (a) straight (b) bent forward  
(c) bent backward (d) bent backward first and then bent forward

32. Surge tank is provided to protect the  
(a) generator (b) hydraulic turbine  
(c) scroll case (d) penstock
33. The drag produced by end effects due to the finite length of an aerofoil is known as  
(a) profile drag (b) form drag  
(c) induced drag (d) friction drag
34. By taking the ratio of pressure force and inertia force, the following number may be obtained  
(a) Weber number (b) Euler number  
(c) Froude number (d) Mach number
35. 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
36. Bernoulli's theorem deals with the law of conservation of  
(a) mass (b) energy  
(c) momentum (d) none of these
37. The resultant hydrostatic force acts through a point known as  
(a) centre of gravity (b) centre of pressure  
(c) centre of buoyancy (d) centre of force
38. Willan's line is a straight line graph between the rate of steam consumption and  
(a) pressure of steam (b) temperature of steam  
(c) indicated horse power (d) none of these
39. Draft tube is used for discharging water from the exit of  
(a) Impulse turbine (b) Pelton wheel  
(c) Francis turbine (d) All of these
40. To produce high head by multi-stage centrifugal pumps, the impellers are connected in  
(a) series (b) parallel  
(c) series and parallel (d) none of these
41. If the head of a turbine is more than 300 m, the type of turbine used should be  
(a) Pelton (b) Kaplan  
(c) Francis (d) Propeller
42. If the clearance volume of an air compressor is increased from 5 percent to 10 percent, the net work input required to compress a given mass of air will  
(a) increase slightly (b) decrease slightly  
(c) remain unchanged (d) become double
43. The maximum velocity which can be attained at the throat of a steam nozzle is  
(a) half the sonic velocity (b) equal to sonic velocity  
(c) double the sonic velocity (d) unpredictable
44. The maximum pressure ratio in an actual single stage centrifugal compressor will be about  
(a) 1 : 15 (b) 1 : 10  
(c) 1 : 4 (d) 1 : 1.5

45. Which of the following rotary types is a positive displacement compressor?  
(a) radial flow turbo compressor (b) axial flow turbo compressor  
(c) screw type compressor (d) mixed flow compressor
46. Lancashire boiler is a  
(a) stationary fire tube boiler (b) stationary water tube boiler  
(c) water tube boiler with natural circulation (d) mobile fire tube boiler
47. Axial flow pump is started with its delivery valve  
(a) kept fully closed (b) kept fully open  
(c) irrespective of any position (d) none of these
48. A fusible plug is fitted in small boiler in order to  
(a) avoid excessive build up of pressure  
(b) avoid explosion  
(c) extinguish fire if water level in the boiler falls below alarming limit  
(d) control steam dome
49. The basic job of feed water treatment in boilers is to overcome the problem of  
(a) corrosion (b) scaling  
(c) carry over (d) all of these
50. The clearance volume in reciprocating air compressors is provided  
(a) to reduce the work done per kg of air delivered  
(b) to increase the volumetric efficiency of the compressor  
(c) to accommodate valves in the head of the compressor  
(d) to create turbulence in the air to be delivered

**Part B - Short Answer Questions (100 Marks)**

*All questions carry equal marks of 5 each.*

*This Part should be answered only on the **Answer Booklet** provided.*

1. State the differences between Rankine cycle and Carnot cycle for a vapour. (5)
2. A closed vessel contains 2 kg of CO<sub>2</sub> at temperature of 20°C and pressure of 0.7 bar. The heat is supplied to the vessel till the gas acquires a pressure of 1.4 bar. Calculate the value of heat supplied. Take  $C_v = 0.72$  kJ/kgK. (5)
3. An inventor claims to have developed a refrigerating machine which operates between -20°C and 30°C and consumes 1kW of power. The machine gives a refrigerating effect of 21.6 MJ/h. Show whether the claim of the inventor is true or not. (5)
4. State the advantages of vapour compression refrigeration system over vapour absorption system. (5)
5. Distinguish between laminar flow and turbulent flow. (5)
6. Calculate the internal energy of 1 kg of steam when its pressure is 10 bar and its dryness fraction is 0.9. Given: at a pressure of 10 bar,  $v_g = 0.1943$  m<sup>3</sup>/kg,  $h_f = 762$  kJ/kg,  $h_{fg} = 2013.6$  kJ/kg (5)
7. Explain the terms 'meta-centre' and 'meta-centric height'. (2½×2=5)
8. Discuss in brief the working of Carnot cycle with T-S diagram. (5)
9. How do you improve the thermal efficiency of a basic steam power cycle? (5)

10. What is black body? Derive an expression for total emissive power of a black body. (2+3=5)
11. What do you mean by one Ton of refrigeration? Also write few important properties of a refrigerant. (2+3=5)
12. Explain in brief with the help of neat sketch the working of a vapour compression refrigerator. (5)
13. What is coefficient of performance (COP) of a refrigerator? Compare the COP of a refrigerator and that of a heat pumps. (2+3=5)
14. Explain the phenomenon of knocking in S.I. engines. What are the different factors which influence the knocking? (3+2=5)
15. What is critical thickness of insulation? Explain its physical significance. (2+3=5)
16. Define heat exchanger effectiveness and explain its significance. (5)
17. An open circular cylinder of 150 mm diameter and 1 m long contain water up to a height of 700 mm. Find the speed at which the cylinder is to be rotated about its vertical axis, so that axial depth of inside water become zero. (5)
18. Explain the concept of thermodynamic equilibrium of a system. (5)
19. What is supercharging? Enumerate the main objects of supercharging. (2+3=5)
20. Show the different parts of a convergent and divergent steam nozzle with the help of a proportionate neat sketch. Define the term nozzle efficiency. (5)

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