

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : R-FTF-M-NFA

Test Booklet Series

Serial No.

TEST BOOKLET

MECHANICAL ENGINEERING  
( OBJECTIVE-TYPE )

A

PAPER—I

Time Allowed : Two Hours

Maximum Marks : 200

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *ONLY* the *Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**  
THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.
  - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.
  - (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
  - (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. In highly rarefied gases, the concept of this loses validity
  - (a) Thermodynamic equilibrium
  - (b) Continuum
  - (c) Stability
  - (d) Macroscopic viewpoint
  
2. The constant volume gas thermometer works on the principle that
  - (a) at low pressure, the temperature of the gas is independent of its pressure at constant volume
  - (b) at high pressure, the temperature of the gas is independent of its pressure at constant volume
  - (c) at low pressure, the temperature of the gas is proportional to its pressure at constant volume
  - (d) at high pressure, the temperature of the gas is proportional to its pressure at constant volume
  
3. There is no work transfer involved in this process
  - (a) Adiabatic expansion
  - (b) Isothermal expansion
  - (c) Polytropic expansion
  - (d) Free expansion
  
4. This process is one in which there is only work interaction between the system and the surroundings
  - (a) Diabatic process
  - (b) Adiabatic process
  - (c) Isothermal process
  - (d) Quasi-static process
  
5. In which of the following processes, the heat is fully converted into work?
  - (a) Reversible adiabatic process
  - (b) Reversible isobaric process
  - (c) Reversible isometric process
  - (d) Reversible isothermal process
  
6. An inventor states that his new conceptual engine, while operating between temperature limits of 377 °C and 27 °C, will reject 50% of heat absorbed from the source. What type of cycle will this engine have?
  - (a) Carnot cycle
  - (b) Stirling cycle
  - (c) Impossible cycle
  - (d) Possible cycle

7. The continual motion of a movable device in absence of friction

- (a) violates the first law of thermodynamics
- (b) violates the second law of thermodynamics
- (c) is the perpetual motion of the second kind
- (d) is the perpetual motion of the third kind

8. For a given temperature  $T_1$ , as the difference between  $T_1$  and  $T_2$  increases, the COP of a Carnot heat pump

- (a) increases
- (b) decreases
- (c) does not change
- (d) first decreases, then increases

9. A heat engine is supplied with 2512 kJ/min of heat at 650 °C. Heat rejection with 900 kJ/min takes place at 100 °C. This type of heat engine is

- (a) ideal
- (b) irreversible
- (c) impossible
- (d) practical

10. Consider the following statements for a throttling process :

- 1. It is an adiabatic process.
- 2. There is no work transfer in the process.
- 3. Entropy increases in throttling process.

Which of these statements are correct?

- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1 and 3 only

11. If the work done on a closed system is 20 kJ/kg, and 40 kJ/kg heat is rejected from the system, its internal energy decreases by

- (a) 20 kJ/kg
- (b) 60 kJ/kg
- (c) -20 kJ/kg
- (d) -60 kJ/kg

12. A Carnot heat pump is used to heat a house. The outside temperature is  $-3^{\circ}\text{C}$  and the indoor temperature is  $27^{\circ}\text{C}$ . If the heat loss from the house is 40 kW, the power required to operate the heat pump is
- (a) 1 kW
  - (b) 2 kW
  - (c) 3 kW
  - (d) 4 kW
13. The enthalpy drop for flow through convergent horizontal nozzles is 100 kJ/kg. If the velocity of approach at inlet to the nozzle is negligible, the exit velocity of the fluid is
- (a) 20 m/s
  - (b) 400 m/s
  - (c) 447.2 m/s
  - (d) 520.8 m/s
14. By integrating Euler equation between two sections 1 and 2 for flow of an incompressible inviscid fluid through a pipe, we get
- (a) steady flow energy equation
  - (b) Bernoulli equation
  - (c) continuity equation
  - (d) variable flow equation
15. For steady flow through an insulated horizontal constant diameter pipe, this property remains constant
- (a) Enthalpy
  - (b) Internal energy
  - (c) Entropy
  - (d) Volume
16. 100 kJ of energy is transferred from a heat reservoir at 1000 K to a heat reservoir at 500 K. The ambient temperature is 300 K. The loss of available energy due to heat transfer process is
- (a) 20 kJ
  - (b) 30 kJ
  - (c) 40 kJ
  - (d) 50 kJ
17. When a system reaches the state of equilibrium, the following property assumes its maximum value
- (a) Availability
  - (b) Entropy
  - (c) Gibbs function
  - (d) Helmholtz function

18. The difference between constant pressure specific heat  $C_p$  and constant volume specific heat  $C_v$  for pure substance

- (a) approaches zero at triple point
- (b) approaches zero as the absolute temperature approaches zero
- (c) is always equal to the gas constant  $R$
- (d) approaches zero at critical point

19. Joule-Thomson coefficient is the slope of

- (a) constant enthalpy lines on  $T$ - $s$  diagram
- (b) constant enthalpy lines on  $T$ - $p$  diagram
- (c) inversion curve on  $T$ - $s$  diagram
- (d) inversion curve on  $T$ - $p$  diagram

20. Which gas shows a heating effect in the Joule-Thomson experiment, while undergoing throttling process through a porous plug of cotton wool?

- (a) Carbon dioxide
- (b) Hydrogen
- (c) Oxygen
- (d) Nitrogen

21. The following remarks pertain to the properties of gases and vapours :

- 1. The equation of state is not by itself sufficient for the calculation of properties such as  $u$ ,  $h$  and  $s$ .
- 2. Throttling process is an adiabatic steady flow process.
- 3. Increase in entropy in wet region is directly proportional to the increase in enthalpy.

Which of these remarks are correct?

- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 1 and 3 only
- (d) 2 and 3 only

22. An ideal gas at  $27^\circ\text{C}$  is heated at constant pressure till the volume becomes three times. The temperature of the gas will then be

- (a)  $81^\circ\text{C}$
- (b)  $900^\circ\text{C}$
- (c)  $627^\circ\text{C}$
- (d)  $927^\circ\text{C}$

23. A gas turbine operating on Brayton cycle has the maximum temperature of  $1200\text{ K}$  and the minimum temperature of  $300\text{ K}$ . The cycle efficiency for the maximum work capacity will be

- (a) 75%
- (b) 60%
- (c) 50%
- (d) 25%

24. No substance can exist in the liquid phase in stable equilibrium

- (a) at temperature below the triple point temperature
- (b) at pressure below the triple point pressure
- (c) at pressure above the triple point pressure
- (d) at temperature above the triple point temperature

25. The COP of a refrigerator working on a reversed Carnot cycle is 5. The ratio of the highest absolute temperature to the lowest absolute temperature would be

- (a) 1.25
- (b) 1.3
- (c) 1.4
- (d) 1.2

26. This reversible cycle consists of constant volume heat addition, reversible adiabatic expansion and constant pressure heat rejection

- (a) Otto cycle
- (b) Lenoir cycle
- (c) Atkinson cycle
- (d) Brayton cycle

27. An ideal vapour compression refrigerator operates between a condenser pressure  $p_1$  and an evaporator pressure  $p_2$ . Which of the following changes would increase its COP?

- (a) Increasing  $p_1$  by  $\Delta p$  and keeping  $p_2$  constant
- (b) Decreasing  $p_2$  by  $\Delta p$  and keeping  $p_1$  constant
- (c) Adopting wet compression
- (d) Subcooling the refrigerant

28. An absorption refrigeration system is supplied with energy  $Q_1$  in the form of heat at temperature  $T_1$ , while it extracts energy  $Q_3$  as heat from a cold space at temperature  $T_3$ . The ambient temperature is  $T_2$ . Then the COP of the refrigerator is (ignoring the small amount of energy supplied in the pump)

(a)  $\frac{T_1(T_2 - T_1)}{T_3(T_1 - T_2)}$

(b)  $\frac{T_3(T_2 - T_1)}{T_1(T_1 - T_2)}$

(c)  $\frac{T_3(T_1 - T_2)}{T_1(T_2 - T_3)}$

(d)  $\frac{T_1(T_1 - T_2)}{T_3(T_2 - T_3)}$

29. For a 2-stage air compressor for the maximum efficiency of compressor, consider the following statements :

1.  $p_2 = \frac{1}{2}(p_1 + p_3)$
2.  $p_2 = \sqrt{p_1 \cdot p_3}$
3. Intercooling between the stages is complete.
4. Work is equally shared by the two stages.

Which of these statements are correct?

- (a) 1 and 4 only
- (b) 1, 3 and 4
- (c) 2, 3 and 4
- (d) 2 and 3 only

30. An IC engine has a bore and stroke each equal to 2 units. The total area to calculate heat loss from the engine can be taken as

- (a)  $4\pi$
- (b)  $5\pi$
- (c)  $6\pi$
- (d)  $8\pi$

31. In a petrol engine, the tendency for detonation increases with

- (a) retarded spark timing
- (b) running the engine at high speed
- (c) supercharging
- (d) increasing the cooling rate

32. Consider the following statements :

1. Diesel fuels are compared using an ignition delay criterion.
2. Cetane number is equal to the percentage of cetane plus 15% of the percentage of heptamethyl nonane in the fuel.
3. Cetane number of alpha-methyl naphthalene is assigned the value of 15.

Which of these statements are correct?

- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1 and 3 only

33. When a hydrocarbon fuel burns in insufficient air, the Orsat apparatus for flue gas analysis will show which of the following sets of gases?

- (a)  $\text{CO}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$  and  $\text{H}_2\text{O}$
- (b)  $\text{CO}$ ,  $\text{CO}_2$  and  $\text{N}_2$
- (c)  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{N}_2$  and  $\text{H}_2\text{O}$
- (d)  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{N}_2$  and  $\text{O}_2$

34. A satellite floats in deep space with very high velocity. It will continuously lose heat by

- (a) convection
- (b) conduction and convection
- (c) radiation
- (d) radiation and convection

35. A furnace has a 20 cm thick wall with thermal conductivity 0.8 W/m-K. For the same heat loss from the furnace, what will be the thickness of the wall if the thermal conductivity of the material is 0.16 W/m-K?

- (a) 4 cm            (b) 6.3 cm  
(c) 10 cm          (d) 40 cm

36. Which of the following expressions gives the thermal resistance for heat conduction through a hollow sphere of radii  $r_1$  and  $r_2$ ?

- (a)  $\frac{4\pi k r_1 r_2}{r_2 - r_1}$   
(b)  $\frac{(r_2 - r_1) \ln \frac{r_2}{r_1}}{4\pi k}$   
(c)  $\frac{r_2 - r_1}{4\pi k r_1 r_2}$   
(d)  $\frac{4\pi k (r_2 - r_1)}{r_1 r_2}$

where  $k$  is thermal conductivity of the material.

37. A furnace wall is 10 cm thick and has a thermal conductivity of 0.1 kW/m-K. Inner temperature is maintained at 525 °C, while the surrounding temperature outside the furnace is 25 °C. If the surface area of the furnace is 20 m<sup>2</sup>, the heat flux through the wall is

- (a) 50 kW/m<sup>2</sup>  
(b) 500 kW/m<sup>2</sup>  
(c) 1000 kW/m<sup>2</sup>  
(d) 10000 kW/m<sup>2</sup>

38. In unsteady-state heat conduction for bodies with negligible temperature gradients, the time-temperature variation curve is

- (a) linear  
(b) parabolic  
(c) sinusoidal  
(d) exponential

39. The fouling factor in heat exchanger is defined as

- (a)  $R_f = U_{\text{dirty}} - U_{\text{clean}}$   
(b)  $R_f = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$   
(c)  $\frac{1}{R_f} = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$   
(d)  $\frac{1}{R_f} = U_{\text{dirty}} - U_{\text{clean}}$

40. For quick response of a thermocouple to observe varying temperatures of fluids

- (a) wire diameter must be large  
(b) wire material density must be large  
(c) wire material specific heat must be large  
(d) wire surface heat transfer coefficients must be large



41. A fin will be necessary and effective only when

- (a)  $k$  is small and  $h$  is large
- (b)  $k$  is large and  $h$  is also large
- (c)  $k$  is small and  $h$  is also small
- (d)  $k$  is large and  $h$  is small

where  $k$  = thermal conductivity of fin material,  $h$  = convective heat transfer coefficient between the fin surface and environment temperature.

42. Which one of the following statements is correct?

- (a) Fins should be attached on the side where heat transfer coefficients are high
- (b) Effectiveness of fins depends on thermal conductivity only
- (c) Fins must have small thickness for better heat dissipation
- (d) In boiling heat transfer appliances, fins will be very effective

43. In a heat exchanger, the hot gases enter with a temperature of  $150^\circ\text{C}$  and leave at  $75^\circ\text{C}$ . The cold fluid enters at  $25^\circ\text{C}$  and leaves at  $125^\circ\text{C}$ . The capacity ratio of the exchanger is

- (a) 0.65
- (b) 0.75
- (c) 0.85
- (d) 0.95

44. What does NTU indicate?

- (a) Effectiveness of heat exchanger
- (b) Efficiency of heat exchanger
- (c) Size of heat exchanger
- (d) Temperature drop in heat exchanger

45. When is a transient heat transfer problem considered as a lump capacity problem?

- (a) The internal resistance of the object is negative
- (b) The internal resistance of the object is zero
- (c) The internal resistance of the object is infinite
- (d) The internal resistance of the object is negligible

46. The correct sequence for different types of heat exchangers in the decreasing order of effectiveness is

- (a) parallel-flow, counterflow, shell & tube and cross-flow
- (b) cross-flow, counterflow, shell & tube and parallel-flow
- (c) counterflow, shell & tube, cross-flow and parallel-flow
- (d) counterflow, cross-flow, shell & tube and parallel-flow

47. In laminar flow over a flat plate, the convective heat transfer coefficient is proportional to ( $x$  is the distance from the leading edge)

(a)  $x^{\frac{1}{2}}$

(b)  $x^{-\frac{1}{2}}$

(c)  $x^{\frac{1}{3}}$

(d)  $x^{-\frac{1}{3}}$

48. In a double-pipe counterflow heat exchanger, 1000 kg/h of oil having a specific heat 20 J/kg-K is cooled from 150 °C to 125 °C by 1250 kg/h of fluid of specific heat 16 J/kg-K. The fluid leaves the heat exchanger at 75 °C. In such case, the temperature at which the cooling fluid is entering the heat exchanger and LMTD will be

(a) 25 °C and 50 °C

(b) 50 °C and 50 °C

(c) 50 °C and 75 °C

(d) 75 °C and 50 °C

49. Which of the following properties of air increase with rise in temperature?

1. Specific gravity

2. Specific heat

3. Thermal conductivity

4. Kinematic viscosity

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 2, 3 and 4 only

(d) 1 and 4 only

50. The laminar boundary layer occurs when a cold fluid flows over a hot plate. In which of the following positions, the temperature gradient assumes zero value?

(a) At bottom of boundary layer

(b) In mid free stream of fluid

(c) At top of boundary layer

(d) At the junction of laminar and turbulent boundary layer

51. The Reynolds-Colburn analogy, which is used to determine heat transfer coefficient from the measurement of frictional drag, is applicable to

(a) circumferential fins

(b) flat plates

(c) rectangular fins

(d) triangular fins

52. An oxygen and nitrogen mixture has transmissivity for heat radiations that is practically equal to

(a) 1

(b) 0.5

(c) 2

(d) 0

53. Consider the following statements :

1. An ammonia absorption refrigerator has a COP more than 3 and is superior to vapour compression system.
2. Ammonia absorption machines are preferable where waste heat is available from an existing source.
3. Absorption refrigerator has no moving part and hence needs little maintenance.
4. The partial pressure of ammonia vapour varies, being high in the condenser and low in the evaporator.

Which of these statements are correct?

- (a) 1, 2, 3 and 4
- (b) 1, 2 and 3 only
- (c) 2, 3 and 4 only
- (d) 1 and 4 only

54. A vapour compression refrigerator has a COP of 4, and extracts 10 kJ of heat from the cold reservoir. If this machine is worked as a heat pump, how much heat will it deliver to the environment?

- (a) 2 kJ
- (b) 2.5 kJ
- (c) 12.5 kJ
- (d) 25 kJ

55. A refrigerator based on reversed Carnot cycle works between refrigeration and condenser temperatures of  $-23^{\circ}\text{C}$  and  $27^{\circ}\text{C}$ . If a cooling rate of 5 kW is desired, what will be the required power in kW?

- (a) 1
- (b) 2.5
- (c) 5
- (d) 25

56. The following readings refer to a vapour compression refrigerator :

The enthalpy per kg of refrigerant flow, from  $p-h$  chart

- at inlet to compressor—  
1500 kJ/kg
- at outlet to compressor—  
1700 kJ/kg
- at exit of condenser—  
300 kJ/kg

The COP of the refrigerator is

- (a) 3
- (b) 4
- (c) 5
- (d) 6

57. Ammonia used as refrigerant is non-corrosive to

- (a) iron and steel
- (b) copper and copper alloys
- (c) Both (a) and (b)
- (d) Neither (a) nor (b)

58. In a VCR plant, the refrigerant leaves the compressor and evaporator with enthalpy of 205 kJ/kg and 177 kJ/kg respectively. Enthalpy of the refrigerant leaving the condenser is 105 kJ/kg. If the mass flow rate of the refrigerant is 0.2 kg/s, the refrigeration effect will be
- 12.2 kW
  - 14.4 kW
  - 16.4 kW
  - 20.2 kW
59. When unsaturated air undergoes adiabatic saturation, which of the following properties decrease(s)?
1. Relative humidity
  2. Specific humidity
  3. Dry-bulb temperature
  4. Wet-bulb temperature
- 1, 2, 3 and 4
  - 2 only
  - 3 only
  - 4 only
60. A stream of moist air at dry-bulb temperature of 40 °C and dew-point temperature of 25 °C passes through a water shower whose temperature is maintained at 20 °C. The stream of air will undergo a process of
- sensible cooling
  - evaporative cooling
  - cooling and humidification
  - cooling and dehumidification
61. When only sensible heat is added to a sample of air, the process is represented on the psychrometric chart as a
- horizontal line moving towards left direction
  - vertical line moving towards upward direction
  - horizontal line moving towards right direction
  - vertical line moving towards downward direction
62. During the sensible cooling process, specific humidity
- remains constant
  - increases
  - decreases
  - Unpredictable
63. The comfort conditions in air-conditioning system are defined by
- 22 °C dbt and 60% RH
  - 25 °C dbt and 100% RH
  - 20 °C dbt and 75% RH
  - 27 °C dbt and 75% RH
64. The most suitable pair of refrigerant and absorbent combination for solar refrigeration is
- ammonia and water
  - ammonia and sodium thiocyanide
  - water and lithium bromide
  - R22 and dimethylformamide

65. At what depth below the free surface of oil having a density of  $784 \text{ kg/m}^3$  will the pressure be very nearly equal to 1 bar?

- (a) 10 metres
- (b) 14 metres
- (c) 13 metres
- (d) 7.84 metres

66. The vapour pressure is the characteristic fluid property involved in the phenomenon of

- (a) water hammer in a pipe flow
- (b) cavitation
- (c) rise of sap in a tree
- (d) spherical shape of rainwater drop

67. Match List-I with List-II and select the correct answer using the code given below the Lists :

<i>List-I</i>	<i>List-II</i>
(Fluids)	(Viscosity equal to)

- |                    |                        |
|--------------------|------------------------|
| A. Ideal fluid     | 1. Zero                |
| B. Newtonian fluid | 2. Non-zero            |
| C. Inviscid fluid  | 3. $\mu \frac{du}{dy}$ |
| D. Real fluid      |                        |

Code :

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

68. For stability of a floating body

( $M$  = metacentre,  $G$  = centre of gravity and  $B$  = centre of buoyancy)

- (a)  $M$  should coincide with  $B$  and  $G$
- (b)  $M$  should lie below  $B$  and  $G$
- (c)  $M$  should lie above  $B$  and  $G$
- (d)  $M$  should lie between  $B$  and  $G$

69. The resultant of all normal pressures on a body immersed in liquid acts

- (a) through the centre of gravity of the body
- (b) through the centre of pressure
- (c) vertically upwards
- (d) at metacentre

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

- (a) increase
- (b) decrease
- (c) remain the same
- (d) depend on the depth of immersion

71. The depth of centre of pressure of a rectangular lamina immersed vertically in water up to a height  $h$  is given by
- (a)  $\frac{h}{3}$
  - (b)  $\frac{h}{4}$
  - (c)  $\frac{h}{2}$
  - (d)  $\frac{2h}{3}$
72. A piece of wood of volume  $V$  and specific gravity 0.87 floats on the surface of a liquid of specific gravity 1.31. The portion of the body which is submerged in the liquid will be
- (a) 0.335V
  - (b) 0.665V
  - (c) 0.87V
  - (d) 0.13V
73. During floods, water entered an office having wooden tables. The position of tables, if floating, will be
- (a) legs downwards
  - (b) legs on sides
  - (c) legs upwards
  - (d) Any position
74. The Lagrangian description of fluid motion is analogous to
- (a) control volume analysis
  - (b) transient analysis
  - (c) system analysis
  - (d) None of the above
75. The flow in a pipe whose valve is being opened or closed gradually is an example of
- (a) steady flow
  - (b) nonsteady flow
  - (c) steady uniform flow
  - (d) steady nonuniform flow
76. A velocity potential function exists only for
- (a) steady flow
  - (b) uniform flow
  - (c) irrotational flow
  - (d) compressible flow
77. Flow commences between two parallel plates with the upper plate moving in the direction of flow, while the other plate is stationary. The resulting flow between the plates is called
- (a) creep flow
  - (b) Couette flow
  - (c) plug flow
  - (d) Stokes flow

78. A steady irrotational flow of an incompressible fluid is called

- (a) streamline flow
- (b) creeping flow
- (c) shear flow
- (d) potential flow

79. Bernoulli's equation is applicable between any two points in

- (a) rotational flow of an incompressible fluid
- (b) irrotational flow of compressible or incompressible fluid
- (c) steady, rotational flow of an incompressible fluid
- (d) steady, irrotational flow of an incompressible fluid

80. The piezometric head is the summation of

- (a) velocity head and pressure head
- (b) pressure head and elevation head
- (c) elevation head and velocity head
- (d) velocity head, pressure head and elevation head

81. A venturi meter is a device based on the Bernoulli principle and is used for measuring

- (a) velocity
- (b) pressure drop
- (c) total head
- (d) flow rate

82. The thickness of boundary layer in a turbulent flow is

- (a)  $\frac{5x}{\sqrt{R_{NX}}}$
- (b)  $\frac{5.835x}{\sqrt{R_{NX}}}$
- (c)  $\frac{0.377x}{(R_{NX})^{\frac{1}{5}}}$
- (d)  $\frac{5.377x}{(R_{NX})^{\frac{1}{5}}}$

83. The Reynolds number of a fluid flowing over a flat plate at a distance of 16 cm from the leading edge is 25600. The thickness of the boundary layer at this point will be

- (a) 5 mm
- (b) 7.5 mm
- (c) 10 mm
- (d) 10.5 mm

84. Boundary layer separation is caused due to

- (a) laminar flow changing to turbulent flow
- (b) velocity gradient being zero at the wall
- (c) reduction in pressure to vapour pressure
- (d) decrease in boundary layer thickness to a negligible value

85. A flat plate of 4 m length is kept parallel to air flowing at 5 m/s at 15 °C. Assuming the density of air to be  $1.2 \text{ kg/m}^3$  and dynamic viscosity to be  $1.76 \times 10^{-5} \text{ kg/m-s}$ , and knowing that the flow becomes turbulent when Reynolds number exceeds  $5 \times 10^5$ , the flow will become turbulent at

- (a) 1.25 m
- (b) 1.47 m
- (c) 1.52 m
- (d) 1.74 m

86. Which of the following factors determine the friction for turbulent flow of incompressible fluids in a rough pipe?

- (a) Froude number and Mach number
- (b) Mach number and relative roughness
- (c) Reynolds number and relative roughness
- (d) Froude number and relative roughness

87. Principles of similitude form the basis of

- (a) performing acceptance tests
- (b) comparing two identical equipments
- (c) comparing similarity between design and actual equipment
- (d) design and testing models of prototype based on results of models

88. Normal shock wave occurs in a one-dimensional steady

- (a) converging flow
- (b) diverging flow
- (c) subsonic flow
- (d) supersonic flow

89. The Mach number of an aircraft when the dynamic (velocity) temperature of air at entry to the engine equals the static temperature is

- (a) 1.236
- (b) 1.736
- (c) 2.236
- (d) 2.736

90. Across the normal shock in a flow

- (a) both  $p$  and  $T$  decrease
- (b)  $p$  increases and  $T$  decreases
- (c)  $p$  decreases and  $T$  increases
- (d) both  $p$  and  $T$  increase



91. When the fluid at sonic velocity enters a convergent-divergent passage, the velocity of the fluid

- (a) increases continuously
- (b) decreases continuously
- (c) increases and then decreases
- (d) decreases and then increases

92. In supersonic flow, if cross-section is increasing in the direction of flow

- (a) both  $p$  and  $V$  increase
- (b)  $p$  decreases and  $V$  increases
- (c) both  $p$  and  $V$  decrease
- (d)  $p$  increases and  $V$  decreases

93. The preferred type of pump for small discharge and high heads is

- (a) centrifugal type
- (b) reciprocating type
- (c) axial-flow type
- (d) radial-flow type

94. The specific speed of a hydraulic turbine depends upon

- (a) speed and power developed
- (b) discharge and power developed
- (c) speed and head of water
- (d) speed, power developed and head of water

95. When a hydraulic turbine is operated, it is found that it has high design efficiency and this efficiency remains constant over a wide range of regulation from the design condition. The turbine is

- (a) Francis turbine
- (b) Propeller turbine
- (c) Pelton turbine
- (d) Kaplan turbine

96. The specific speed  $N_S = \frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$  for a double-suction pump is to be evaluated. The discharge would be taken as

- (a) half the actual discharge
- (b) actual discharge
- (c) double the actual discharge
- (d) square the actual discharge

97. An adjustable blade propeller turbine is called as
- (a) Banki turbine
  - (b) Pelton turbine
  - (c) Kaplan turbine
  - (d) Francis-Pelton turbine
98. The pump preferred to be used for pumping highly viscous fluids belongs to the category of
- (a) screw pump
  - (b) turbine pump
  - (c) plunger pump
  - (d) centrifugal pump
99. Supersaturated condition occurs in a steam expanding through a convergent-divergent nozzle because of the delay in
- (a) change of dryness fraction
  - (b) change of superheat
  - (c) evaporation process
  - (d) condensation process
100. In a nozzle designed to produce a supersonic jet, the flow in the convergent section will always be
- (a) subsonic
  - (b) sonic
  - (c) supersonic
  - (d) transonic
101. In an impulse steam turbine, the enthalpy drop of steam takes place in
- (a) nozzles
  - (b) rotor blades
  - (c) stator blades
  - (d) exhaust pipe
102. The gas in a cooling chamber of a closed-cycle gas turbine is cooled at
- (a) constant volume
  - (b) constant temperature
  - (c) constant pressure
  - (d) None of the above
103. The power consumed by a reciprocating air compressor will be minimum, if the compression follows the thermodynamic
- (a) isentropic process
  - (b) adiabatic process
  - (c) isothermal process
  - (d) polytropic process

104. Losses in a centrifugal compressor are due to
- (a) impeller channel losses only
  - (b) inlet losses only
  - (c) Both (a) and (b)
  - (d) Neither (a) nor (b)
105. Compressors used in gas turbines are of
- (a) reciprocating type
  - (b) centrifugal type
  - (c) axial-flow type
  - (d) All of the above
106. Stalling of blades in axial-flow compressors is the phenomenon of
- (a) airstream blocking the passage
  - (b) motion of air at sonic velocity
  - (c) unsteady periodic and reverse flow
  - (d) airstream not able to flow over the blade contour
107. The multistage compression of air as compared to single-stage compression
- (a) improves volumetric efficiency for the given pressure ratio
  - (b) reduces work done per kg of air
  - (c) gives more uniform torque
  - (d) All of the above
108. In a compressible fluid flow field, the Mach number indicates the ratio of
- (a) viscous force to elastic force
  - (b) inertia force to elastic force
  - (c) inertia force to viscous force
  - (d) viscous force to gravity force
109. In a gas turbine power plant, reheating of gases between the high pressure and low pressure turbine stages will
- (a) improve turbine output
  - (b) decrease turbine output
  - (c) increase compressor output
  - (d) decrease compressor work
110. In a gas turbine plant, regeneration is done to
- (a) increase compression work
  - (b) decrease turbine work
  - (c) limit the maximum temperature
  - (d) improve plant efficiency

*Directions :*

Each of the following **ten** (10) items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

*Code :*

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
- (b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **not** the correct explanation of Statement (I)
- (c) Statement (I) is true but Statement (II) is false
- (d) Statement (I) is false but Statement (II) is true

**111. Statement (I) :**

Thermodynamic work is given as the product of an intensive thermodynamic property and the differential of an extensive property.

**Statement (II) :**

Work is not a thermodynamic property.

**112. Statement (I) :**

The view factors from the surface, say  $A_i$ , of the enclosure to all surfaces of the enclosure, including to itself, when summed, should be equal to unity by definition of the view factor.

**Statement (II) :**

This is called the summation relation among the view factors for enclosure.

**113. Statement (I) :**

In a binary mixture charged refrigeration system, when a leakage occurs, first the high-pressure refrigerant leaks and then the low-pressure refrigerant leaks.

**Statement (II) :**

High-pressure refrigerant has the higher boiling point and low-pressure refrigerant has the lower boiling point.

**114. Statement (I) :**

The pressure drop in circular ducts is lesser when compared to that in equivalent rectangular ducts.

**Statement (II) :**

The mean velocity in a rectangular duct will be less than that in its circular equivalent.

**115. Statement (I) :**

The hydraulic power transmitted by a pipe through certain distance by means of water under pressure will be maximum when the loss of head due to friction over this distance is one-third of total head supplied.

**Statement (II) :**

The average velocity of flow should be less than the critical velocity which corresponds to the laminar flow.

**116. Statement (I) :**

Hydraulic jump is similar to normal shock in gases where supersonic flow becomes subsonic across the shock plane resulting an increase in pressure.

**Statement (II) :**

In hydraulic jump, the Froude number is less than one and the subcritical flow changes to supercritical across the jump.

**117. Statement (I) :**

A normal shock wave cannot occur in convergent portion of a convergent-divergent nozzle.

**Statement (II) :**

Shock wave is generated only when the flow is supersonic.

**118. Statement (I) :**

To satisfy the momentum equation for flow with heat transfer, it is necessary to use a divergent duct or a duct with large cross-sectional area so that the changes in velocity are negligible.

**Statement (II) :**

Heat addition to a fluid in a constant area duct cannot be achieved without a drop in pressure.

**119. Statement (I) :**

When a convergent-divergent nozzle operates at off design conditions, a shock wave will enter the exit and move towards the throat and vanish there.

**Statement (II) :**

The convergent section functioning as nozzle will have only subsonic flow where no shock can exist.

**120. Statement (I) :**

Radial-flow machines are used mainly for pumps where multi-staging will be useful to increase the delivery head.

**Statement (II) :**

Axial-flow pumps are useful where the head is low and discharge is large.

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