November-2022 418/3(N)

THERMAL ENGINEERING-II

Time Allowed: 2.5 Hours *Full Marks: 60*

Answer to Question No. 1 & 2 are compulsory and to be answered first. This answer is to be made in separate loose script(s) provided for the purpose. Maximum time allowed is 30 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided. On early submission of answer scripts of Question No. 1 & 2, a student will get the remaining script earlier.

Answer any Eight (08) Questions from the rest.

1. **Choose the correct alternative** ***(any ten):*** **[1x10]**

i) For a given temperature and pressure of steam, the thermal efficiency of a plant with condenser as compared to that without condenser is:
a) lower b) higher c) same d) none of the above

ii) Carnot cycle consists of the following processes:
(a) Two isentropic and two adiabatic b) Two isentropic and two isothermal
(c) Two isentropic and two isobaric (d) Two isentropic and two isochoric

iii) The commonly used refrigerant used in domestic refrigerators is:
a) CO_2 b) NH_3 c) N_2 d) R-134a

iv) Inpsychrometric chart, constant dew point temperature lines are:
(a) horizontal (b) vertical
(c) curved (d) straight lines slopping downwards to the right

v) In psychrometric chart, constant Dry Bulb Temp lines are:
(a) vertical (b) horizontal
(c) inclined (d) curved lines

vi) The lowest temperature during the cycle of vapour compression refrigeration system after ---
(a) compression (b) Condensation (c) Evaporation (d) before evaporation

vii) One Ton of refrigeration mean:
(a) 211 kJ/min (b) 252 BTU (c) 340 kJ/sec (d) All of the above

viii) A machine used to raise the pressure of air is called ……
(a) Condensers (b) Gas turbine (c) Compressor (d) Air motor

ix) In vapour compression refrigeration system heat release takes place in ----
(a) Evaporator (b) Compressor (c) Condenser (d) None

x) Which one of the following most popular vapour power cycles?
(a) Carnot (b) Rankine (c) Joule (d) Binary

xi) The condensation of steam in a condenser takes place at ------
(a) constant pressure (b) constant temperature
(c) constant enthalpy (d) none

xii) Tail pipe of high level jet condenser is ----
(a) more than 10.33m (b) equal to 10.33m
(c) less than 10.33m (d) none

xiii) Specific humidity is also called:
(a) relative humidity (b) humidity ratio (c) absolute humidity (d) saturated humidity

xiv) In centrifugal compressor the pressure rise takes place in---
(a) Impeller only (b) Diffuser only (c) Impeller and Diffuser both (d) Casing only

xv) For a perfectly Black body
(a) reflectivity = 1 (b) absorptivity = 1 (c) transmissivity = 1 (d) absorptivity = 0

2. Write correct word(s) to fill in the blanks (any ten) **[1x10]**

I. Carnot cycle has the _____ thermal efficiency among all other heat engine cycles.
II. _____tube, as an expansion device, is used in domestic refrigerator.
III. _____ Temperature is the temperature of air recorded by a thermometer, when its bulb is surrounded by a wet cloth exposed to the air.
IV. A black body _____ all the radiation energy.
V. The pressure inside a condenser is _____ than atmospheric pressure.
VI. The COP of the Carnot refrigerator is _____ than that Carnot Heat pump .
VII. The function of a compressor is to raise the _____ & _____ .
VIII. Mixing of Cooling water and Vapour takes place in _____ condenser
IX. Dry bulb temperature will be equal Wet bulb temperature when _____ humidity is 100%.
X. Sling psychrometers are used to measure _____.
XI. The compressor efficiency of a reciprocating air compressor is given by _____.
XII. For reciprocating air compressor, least work input happens when compression follows _____ process.
XIII. The value of C.O.P in vapour compression cycle is usually _____ than one.
XIV. In opaque body there is no _____.
XV. Wet bulb temperature is always. than Dry bulb temperature, except at 100% relative humidity.

3. Discuss the basic components of a vapour power plant with the help of flow diagram.
How the thermal efficiency of a Rankine cycle can be increased? **[3+2]**

4. The boiler pressure and condenser pressure in a Rankine cycle are 1.0 MPa and 20 kN/m^2 respectively. Assuming that steam is admitted to the turbine as dry and saturated; determine the thermal efficiency of the cycle, neglecting pump work. (Take the help of steam properties given below). **[5]**

P (bar)	*t_{sat} (°C)*	*Specific enthalpy (kJ/kg)*			*Specific entropy (kJ/kg-K)*	
		Water (h_f)	*Evaporation (h_{fg})*	*Vapour (h_g)*	*Water (S_f)*	*Steam (S_g)*
10	*179.9*	*762.6*	*2015*	*2777.6*	*2.138*	*6.587*
0.2	*60.7*	*252*	*2357*	*2609*	*0.831*	*7.909*

5. Give a Tracing of Water Circulation in a Thermal Power Plant incorporating a Cooling Tower. **[5]**

6. Differentiate between Jet condensers and Surface Steam condensers.
Why a Cooling Tower is incorporated in a Steam Power Plan **[3+2]**

7. What are the uses of compressed air?
Write down the Classification of compressors. **[2+3]**

8. A single stage single acting air compressor of 80KW power takes air in at 1 bar & delivers at 6 bar. The compression follows the law $PV^{1.35} = C$.the compressor runs at 160rpm with average piston speed of 150 m/min. Determine the size of the cylinder. **[5]**

9. Discuss Psychrometric Chart.
Give a schematic diagram for Summer Air Conditioning System. **[2+3]**

10. An air-refrigerator working on Bell-Coleman cycle takes air into the compressor at 1.013 bar and -7°C. It is compressed adiabatically in the compressor to 4.5 bar and then cooled to 30°C. Exit pressure at the expander is 1.013 bar. Assuming ideal processes determine COP of the cycle. **[5]**

11. State the Fourier's law of heat conduction and Stefan Boltzmann law.
Write down the full form of LMTD and give its expression. **[3+2]**

12. A wall of house, 7 m wide and 6 m high is made from 0.3 m thick brick with k= 0.6 W/ m K. The surface temperature on the inside of the wall is 16^0C and that on outside is 6^0C. Find the heat flux through the wall and the total heat loss through it. **[3+2]**

13. What is Heat Exchanger? Compare between Shell & Tube Heat Exchangers and Plate-type Heat Exchangers. **[1+4]**

14. State the Refrigerating Effect. Give a schematic diagram of Domestic Refrigerator. **[1+4]**