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Paper Code : PC-ME401 Applied Thermodynamics

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]

(I) In which turbines, is this pressure-velocity compounding principle employed?

(II) What is gaseous fuels?

(III) What is the basic difference between a vapour power cycle and diesel/petrol engines?

(IV) What is Vapour?

(V) What is an expansion process?

(VI) What is the required condenser and evaporator pressure ratio for centrifugal compressors?

(VII) Besides lubrication, which are two functions of lubricating oil in some turbines?

(VIII) When can a system be called homogeneous?

(IX) What is heat addition process?

(X) What is the triple point of water ?

(XI) The most important quantity that dominates the physical properties of compressible flow is _____

(XII) Regenerator is also called as _____

Group-B (Short Answer Type Question)

Answer any three of the following [5 x 3 = 15]

2. What do you mean by Turbine Supervisory system? [5]

3. Explain the process of loading and unloading in reciprocating air compressors. [5]

4. Why is the efficiency of a Carnot Vapour cycle greater than that of a Rankine cycle? [5]

5. Explain the following process and represent these on a psychrometric chart: [5]
a) Heating and humidification.
b) Cooling and dehumidification.

6. Indicate whether the sonic velocity will increase or decrease in magnitude with increasing elevation above the earth 's surface . [5]
Find the speed of sound wave in air at sea level where the pressure and temperature are 1.01 N/m^2 abs and 17°C respectively.
(Take Gas constant R= 287J/kg K and adiabatic exponent γ=1.4)

Group-C (Long Answer Type Question)

Answer any three of the following [15 x 3 = 45]

7. Differentiate between the compressible and incompressible flow. [7+8]
Explain the terms : Mach number, Mach cone, Machine and Mach angling the context of compressible flow?

8. Write the construction of single acting single stage reciprocating air compression ? A single acting single cylinder reciprocating air compressor takes in air at 1 bar and 27°C . The air is then compressed polytropically to 8 bar according to the law pv= constant . [15]
The compressor has a cylinder diameter of 200 mm and a stroke of 300 mm .
If the speed of the compressor is 250 rpm , Calculate the mass of air compressed per minute , and the power required in kw for driving compressor.

9. A steam turbine is supplied with steam at 50 bar pressure and 450^0c temperature , and exhausts at 0.05 bar and 0.9 dry. Calculate the turbine efficiency, effectiveness and loss of available energy. Assume the process to be adiabatic and surrounding temperature T_0=298K. [15]

10. Consider a sample of producer gas having the following analysis on volume basis: [7+8]
H_2=14%, CH_4=3%, CO=27%, CO=4.5%, O_2=1% and N_2=50.5%
If the gas is brunt with 10% excess air , estimate the air fuel ratio both on volumetric and mass basis.
During trial in a boiler the volumetric analysis of a sample of flue gas as estimated by Orsat apparatus was
CO_2=10.4% , CO=0.2% , O_2=78%, and N_2=81.6% (by difference)
The gravimetric analysis of the coal was reported as
C=78%,H_2=6% , O_2=3% and incombustible matter=13%
make an estimate (a) weight of dry flue gases per kg of fuel and (b) weight of excess air per kg of fuel .

11. A Certain sample of moist air exists at 35°C dry bulb temperature and 20°C dew point temperature . The [2+3+5+5]
atmospheric pressure is 760 mm of mercury . calculate the relative humidity and saturation ratio .
The following data is available for a room on a particular day . Temperature =25°C , barometer reading =760mm of hg and relative humidity =75% calculate
(a) Partial pressure of air and water vapour
(b) Specific humidity
(c) Dew point
(d) Density of mixture .

*** END OF PAPER ***