Final Examination in
THERMAL ENGINEERING
Dr. Helmy Gad
Time : 3 hours [*110 marks*]

Mansoura University
Faculty of Engineering
Electronics and Communication Dept.
First Year, January, 2012

Answer the following questions : $\overline{R}$ = 8.3144 KJ / Mol. K For air $\gamma = 1.4$

1-a) Show that heat transfer to a closed system undergoing isobaric process=Δh [*15*]

b) For a perfect gas show that horizontal intercepts between two constant volume lines on the T-s diagram are equal.

c) Neglecting potential and kinetic energies, a perfect gas (air) in an open system executing adiabatic process from 330 to 30 C. Calculate the work done, (KJ/kg).

2-a) Show that entropy is a thermodynamic property. [*20*]

b) Show that for adiabatic process, the entropy increases.

c) In a 21.4 MW steam power plant operating on a Rankine cycle, the steam at the turbine inlet is 80 bar and 600 C. The steam enters the condenser in a dry saturated state at 0.1 bar. Neglecting the pump work, calculate:

i- The cycle thermal efficiency.

ii- The isentropic efficiency of the turbine.

iii- The steam flow rate, (Ton/hr).

3-a) Find the optimum pressure of a simple Brayton cycle with minimum and maximum temperatures 30 and 300 C respectively. [*20*]

b) For a simple Brayton cycle with heat exchanger, show graphically the relation between the thermal efficiency and pressure ratio at different temperature ratios.

b) An Otto cycle with a compression ratio 8, the temperature and pressure at the beginning of compression are 27 C and 1 bar. If the heat added is 100 KJ/Kg, calculate the cycle thermal efficiency and work done by the cycle.

4-a) Define the body emissivity. [*25*]

b) Air discharges isentropically from a reservoir where the pressure and temperature are 5 bar and 127 C respectively, through a convergent-divergent nozzle, to the atmosphere (1 bar). Neglecting the approach velocity:

i- Find the exit velocity and Mach number.

ii- Determine the stagnation temperature.

c) A plane wall of thickness 10 cm and thermal conductivity 150 W/m.K separates between hot gases at 1400 C and air at 30 C. If the heat transfer coefficient in the gases side is 350 W/ m^2.K and in the air side is 50 W/m^2.K, calculate

i- The overall heat transfer coefficient of 1 m^2 of this wall.

ii- The heat transfer through 1 m^2 of the wall.

P. T. O

أجب 5 و 6 هنا (بدون خطوات) ودبس ورقة الأسئلة فى كراسة الإجابة (بدون كتابة إسم الطالب عليها)

5- Write the answer between brackets : [20]

a- If no work and heat transfer in a closed system, Δe = …. (KJ/Kg) ( )

b- Dry saturated steam executes a throttling process from 4 to 1 bar, Δh = …. (KJ/Kg) ( )

c- A Carnot cycle working between temperatures 27 C and 227 C, the thermal efficiency = …. % ( )

d- A reversible heat engine with an efficiency of 40% is reversed to work as a heat pump, the COP will be …. ( )

e- Air at a pressure 1 bar and a temperature 300 C, is compressed to 5 bar and 300 C, Δh = …. (KJ/Kg) ( )

f- The efficiency of Brayton cycle with a pressure ratio of 6 is …. % ( )

g- In a dual cycle $v_1 = 1.2$, $v_2 = 0.2$ and $v_4 = 0.4$ m^3/Kg. The cut off ratio = …… ( )

h- Air with a temperature 150 C is moving with a velocity 200 m/s, The total temperature is = ….. C ( )

i- Air enters a nozzle with a negligible velocity. If the temperature drop of air in the nozzle is 44.746 C, the exit velocity = …. m/s ( )

j- In a parallel flow heat exchanger, the temp. of hot and cold fluids are 60-40 C and 20-30 C respectively, the LMTD (θ_m) = …. C ( )

6- Put a sign (✓) on the right statement and (X) on the wrong one. [10]

a- For a closed system performing isobaric process, W = 0 ( )

b- Heat added is equal to the area under the process in T-s diagram ( )

c- In saturation condition, if the temperature is const. the pressure is cost. ( )

d- Reheating increases the thermal efficiency of Rankine cycle. ( )

e- In Diesel cycle, the heat rejected is at constant pressure process. ( )

f- Heat rejected in a Brayton cycle is at constant pressure process. ( )

g- The critical pressure of air is equal to 0.528. ( )

h- Using heat exchanger increases the cooling temperature in ref. cycle.)

i- Temperature distribution in a cylindrical wall is linear. ( )

j- Nusselt number is a representation to the heat transfer coefficient. ( )

##

GOOD LUCK ,,, Dr. Helmy Gad