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FACULTY OF ENGINEERING

S.E (M/P) Year Examination - May – 2015

Thermodynamics-I

(Revised)

[Time: Three *Hours*] **[Max. Marks: 80]**

"Please check whether you have got the right question paper."

N.B i) Q.1 & Q.6 are compulsory.
ii) Solve any two questions from remaining questions from each section.
iii) Assume suitable data if required.

SECTION-A

Q.1 Solve any five 10

a) Define steady how process. Write the steady flow energy equation on time basic.
b) Explain working of a heat exchanger.
c) What are limitations of first law of thermodynamics?
d) Show that COP of heat pump is greater than COP of refrigerator by unity.
e) Explain Carnot cycle.
f) In a heat engine, the temperature of source and sink are 700^0c and 50^0c respectively. The heat supplied is 5 MJ/min. find power development by the engine.
g) Explain unavailable energy.
h) What is irreversibility? Explain.
i) 0.5 kg of a perfect gas is heated from 100^0c to 300^0c at constant pressure of 2.8 bar. Find change in entropy. Take c_p = 1kJ/kg and c_v = 0.72 KJ/kg k
j) A certain quantity of air is heated in a reversible isothermal process from,1 bar and 40^0c to 10 bar, calculate change in entropy per kg of air.

Q.2 a) Write the simplified steady flow energy equation for a unit mass flow for 06
i) Boiler ii) Turbine

b) In an isentropic how through nozzle, air flows at the rate of 600 kg/h. at the a inlet to the nozzle, pressure is 2 mpa and temperature is 127^0c. The exit pressure is 0.5 mp_a. If the initial velocity is 300 m/s, determine i) Exit velocity of air 09
ii) Inlet and exit areas of nozzle.

Q.3 Two carnot refrigerators A and B operate in series. The refrigerator. A absorbs energy at the rate of 1 KJ/s from a body at temperture 300k, and rejects energy as heat to a body at temperture T. the refrigertor B absorbs the same quantity of energy which is rejected by refrigerator A from the body at temperature T, and rejects energy as heat to a body at temperature 1000k. if both the refrigerators have the same COP, calculate: 15
i) Temperature T of body
ii) COP of refrigerators.
iii) The rate at which energy is rejected as heat to the body at temperture 1000k.

Q.4 a) Show that the specific entropy change of an ideal gas in a process is given by 07

$$s_2 - s_1 = C_P \log_e\left(\frac{\vartheta_2}{\vartheta_1}\right) + C_v \log_e\left(\frac{P_2}{P_1}\right)$$

b) A certain gas CP = 1.97 KJ /kg k Cv =1.51 kj/kg K,is present in a constant volume chamber of $0.3m^3$ capacity at 5^0c. The heat is supplied to the gas untill its temperature rises to 1000^0c. find change in enthalpy and entropy. 08

Q.5 a) State and explain the principle of increase of entropy and show that entropy of universe is incresing. 07

b) Show that the efficiency of reversible engine operating between two constant temperture is maximum. 08

SECTION -B

Q.6 Solve <u>any five</u> 10

a) List the asumptions made in the analysis of air standard cycles.
b) Define clearance valume and relative efficiency.
c) Represent diesel cycle in P-V and T-S diagrams.
d) In a diesel cycle, 700 KJ of heat is supplied and 300 KJ of heat is rejected. What is thermal efficiency.
e) Define pure substance. Is iced water pure substance?
f) Explain the process of steam generation.
g) Define critical paint and show on T-S and h-s diagrams.
h) What is main feature of triple point? Explain.
i) What are advantages of gaseous fuels?
j) Define the calarific value of soild fuel and also that of gaseous fuel.

Q.7 An engine working on otto cycle is supplied with air at 100 kpa and 35^0c. the compression ratio is 8. The heat supplied is 2100 KJ/kg. calculate maximum pressure and temperture of cycle. Also find the cycle efficiency and mean effective pressure of cycle. 15

Q.8 0.8 kg of steam at a pressure of 15 bar and 250^0c expands to 1.5 bar. Assuming that steam expands according to the law $PV^{1.25} = c$, calculate the final dryness fraction, work done, heat transferred and change of entropy during the expansion. 15

Q.9 Calculate the stoichiometric air-fuel ratio for the combustion of a sample of dry coal of the following by mass: c = 88%, N_2 = 5.5%, O_2 = 2.5%, S = 0.5% and rest ash. 15
Also determine valumetric composition of dry flue gases if 20% excess air is supplied.

Q.10 a) Derive the expression for the air standard dual cycle efficiency. 07

b) Draw a neat sketch of barrel calorimeter and explain its working. 08