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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B.Tech-MehE, Mech, PIE and ADE	**Semester – III**
Subject (Course): Engineering Thermodynamics	**Max. Marks : 100**
Course Code : GNEG234	**Duration : 3 Hrs**
No. of page/s: 3	

NOTE:

1. *There are three sections viz. Section A, Section B and Section C. Section A carries 20 marks, Section B carries 40 marks and Section C carries 40 marks*
2. *Attempt all the questions in Section A, and section C*
3. *Attempt any four in section B*
4. *Make appropriate assumptions wherever required*

SECTION A

Q.1 Steam enters a system at 200 kPa and 350°C and leaves the system at the same mass flow rate at 180 kPa and 350°C. Calculate the flow work in kJ/kg for this process assuming the usual sign convention in which work done by the system is considered to be positive. **(5 Marks)**

Q.2 Compare Otto, Diesel and Duel cycles for: (a) Same Compression Ratio and Heat Addition, (b) Same Compression Ratio and Heat Rejection **(5 Marks)**

Q.3 Describe Quality of steam. Why cannot a throttling calorimeter measure the quality if the steam is very wet? **(5 Marks)**

Q.4 A heat engine receives heat from a source at 1000 ˚C at a rate of 520 KJ/s and rejects the waste heat to a medium at 298 K. The power output of heat engine is 180 Kw. Determine the reversible power and the irreversibility rate for this process. **(5 Marks)**

SECTION B (Attempt any four)

Q.5 A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150bar, 550^0C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550^0C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-s and h-diagrams. Find: (i) Quality of steam at turbine exhaust. (ii) Cycle efficiency and (iii) Steam rate in kg/kWh. **(10 Marks)**

Q.6 With the aid of p-V and T-S diagrams, derive an expression for mean effective pressure and air standard efficiency of Constant Volume cycle. List the assumptions involved.

(10 Marks)

Q.7A resistor of 30 ohms is maintained at a constant temperature of 27^0C while a current of 10 amperes is allowed to flow for 1 sec. Determine the entropy change of the resistor and the universe. If the resistor initially at 27^0C is now insulated and the same current is passed for the same time, determine the entropy change of the resistor and the universe. The specific heat of the resistor is 0.9 kJ/kgK and the mass of the resistor is 10 g. **(10 Marks)**

Q.8A 1.8-m^3 rigid tank contains steam at 220°C. One third of the volume is in the liquid phase and the rest is in the vapor form. Show state of the steam on T-s diagram and determine (a) the pressure of the steam, (b) the quality of the saturated mixture, and (c) the density of the mixture. **(10 Marks)**

Q.9Four kilograms of a certain gas is contained within a piston–cylinder assembly. The gas undergoes a process for which the pressure–volume relationship is $PV^{1.5}$ = constant. The initial pressure is 3 bar, the initial volume is 0.1 m^3, and the final volume is 0.2 m^3. The change in specific internal energy of the gas in the process is u^2 - $u^{1\,=}$ 4.6 kJ/kg. There are no significant changes in kinetic or potential energy. Determine the net heat transfer for the process, in kJ. **(10 Marks)**

SECTION C

Q.10 A 50-kg iron block and a 20-kg copper block, both initially at 80°C, are dropped into a large lake at 15°C. Thermal equilibrium is established after a while as a result of heat transfer between the blocks and the lake water. Determine the total entropy change for this process. Assuming the surroundings to be at 20°C, determine the amount of work that could have been produced if the entire process were executed in a reversible manner. Specific heat of iron block and copper block is 0.45 and 0.38 J/g ^{0}C respectively. **(20 Marks)**

Q.11 In an air standard Otto cycle, the compression ratio is 7 and the compression begins at 35^{o}C and 0.1 Mpa. The maximum temperature of the cycle is 1100^{o}C. Find (a) the temperature and the pressure at various points in the cycle, (b) the heat supplied per kg of air, (c) work done per kg of air,(d) the cycle efficiency and (e) the MEP of the cycle.

(20 Marks)

OR

Air at a temperature of 15^0 C passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800^0C. It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650^0 C. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature falls to 500^0C. If the air flow rate is 2 kg/s, calculate (a) the rate of heat transfer to the air in the heat exchanger, (b) the power output from the turbine assuming no heat loss, and (c) the velocity at the exit of the nozzle, assuming no heat loss. Take the enthalpy of air as, where is the specific heat at constant pressure equal to 1.005 KJ/kg.K and T is the temperature. **(20 Marks)**