Department of Mechanical Engineering
Class Test II Course Code: **MEU 302** Academic Year: 2017-2018
Date: **19.09.2017** Timing: 10.30 to 11.30 a.m. Course Name: Engineering Thermodynamics
Maximum Marks: 15

Instruction: Use of steam tables/properties of air tables is permitted.

Q. 1 Answer the following concept questions (***one mark each***):
(a) Is it possible to compress an ideal gas adiabatically in a piston-cylinder device? Explain.
(b) If the pressure of a substance is increased during a boiling process, will the temperature also increase or will it remain constant? Why?
(c) A fixed mass of an ideal gas is heated from 50 to 80°C at a constant pressure of (i) 1 atm & (ii) 3 atm. For which case do you think the energy required will be greater? Why?
(d) Consider a device with one inlet and one outlet. If the volume flow rates at the inlet and at the outlet are the same, is the flow through the device necessarily steady? Why?
(e) Is heat transfer to or from the fluid desirable as it flows through a nozzle? How will heat transfer affect the fluid velocity at the exit?

Q. 2 (a) A 0.5 m^3 rigid tank containing hydrogen at 20°C and 600 kPa is connected by a valve to another 0.5 m^3 rigid tank that holds hydrogen at 30°C and 150 kPa. Now the valve is opened and the system is allowed to reach thermal equilibrium with the surroundings which are at 15°C. Determine the final pressure in the tank. (***3 marks***)

Q. 2 (b) A piston cylinder device with a set of stops initially contains 0.3 kg of steam at 1.0 MPa and 400°C. The location of the stop corresponds to 60 percent of the initial volume. Now the steam is cooled. Determine the compression work if the final state is (a) 1.0 MPa and 250°C and (b) 500 kPa. (***2 marks***)

OR

Q. 3 A 4-m by 5-m by 7-m room is heated by the radiator of a steam heating system. The steam radiator transfers heat at a rate of 10,000 kJ/h and a 100-W fan is used to distribute the warm air in the room. The rate of heat loss from the room is estimated to be about 5000 kJ/h. If the initial temperature of room air is 10°C, determine how long it will take for the air temperature to rise to 20°C. Assume constant specific heats at room temperature. Write all assumptions made. (***5 marks***)

Q. 4 Air enters a 28-cm diameter pipe steadily at 200 kPa and 20°C with a velocity of 5 m/s. Air is heated as it flows, and leaves the pipe at 180 kPa and 40°C. Determine (i) the volume flow rate of air at the inlet (ii) the mass flow rate of air, and (iii) the velocity and volume flow rate at the exit. (***5 marks***)

Department of Mechanical Engineering, GCOE, Amravati
Academic Session: 2015-16

MEU 302 – Class Test II **Date: 22.09.2015** **Time: 10.30 to 11.30 a.m.**
Course Name: Engineering Thermodynamics

Instruction: (i) All questions are compulsory (ii) Use of Steam Tables / Property Tables is allowed.
Q. 1 (a) – (e) All questions carry one mark each.

Q. 1 (a) If the pressure of a substance is increased during a boiling process, will the temperature also increase or will it remain constant? Why?
(b) Why are the temperature and pressure dependent properties in saturated mixture region?
(c) A fixed mass of an ideal gas is heated from 50 to 80°C at a constant pressure of (*a*) 1 atm and (*b*) 3 atm. For which case do you think the energy required will be greater? Why?
(d) Consider an air compressor operating steadily. How would you compare the volume flow rates of the air at the compressor inlet and exit?
(e) Is it possible to compress an ideal gas isothermally in an adiabatic piston–cylinder device? Explain.

Q. 2 (a) Water is boiled at 1 atmospheric pressure in a 20 cm internal diameter stainless steel pan on an electric range. If it is observed that the water level in the pan drops by 10 cm in 30 minutes, determine the rate of heat transfer to the pan. **(2.5 Marks)**

Q. 2 (b) A piston–cylinder device contains 5 kg of refrigerant- 134a at 800 kPa and 70°C. The refrigerant is now cooled at constant pressure until it exists as a liquid at 15°C. Determine the amount of heat loss and show the process on a *T*-*v* diagram with respect to saturation lines. **(2.5 Marks)**

Q. 3 Argon gas enters an adiabatic turbine steadily at 900 kPa and 450°C with a velocity of 80 m/s and leaves at 150 kPa with a velocity of 150 m/s. The inlet area of the turbine is 60 cm^2. If the power output of the turbine is 250 kW, determine the exit temperature of the argon. **(5 Marks)**

$W_{CV} = P(V_2 - V_1)$

$V = [\pi \times 20^2 \times 60]$