Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2020

Course: Thermodynamics and Heat Transfer –MECH2022 **Semester: III**
Programme: B.TECH ASE, ASE +AVE
Time: 03 hrs. **Max. Marks: 100**

SECTION A

S. No.	This section is having six Question and all are Compulsory to answer	**Marks**	**CO**
Q 1	Define enthalpy. Why does the enthalpy of an ideal gas depend only on temperature?	**5**	**CO1**
Q 2	Consider a sphere and a cylinder of equal volume made of copper. Both the sphere and the cylinder are initially at the same temperature and are exposed to convection in the same environment. Which do you think will cool faster, the cylinder or the sphere? Why?	**5**	**CO3**
Q 3	What three different mechanisms can cause the entropy of a control volume to change? Is a process that is internally reversible and adiabatic necessarily isentropic? Explain	**5**	**CO2**
Q 4	Explain about radiation phenomena and about radiations patterns using wavelength.	**5**	**CO1**
Q 5	Define thermal conductivity and Discuss the mechanism of thermal conduction in gases and solids, Name some good conductors of heat; some poor conductors?	**5**	**CO2**
Q6.	Explain the kelvin-planks and Clausius's statement of second law of thermodynamics. Also, explain the PMM2 as violation of these statements.	**5**	**CO3**

SECTION B

Q 7	A gas of mass 1.5 kg undergoes a quasi-static expansion which follows a relationship$p = a + bV$, where a and b are constants. The initial and finial pressures are 1000 kPa and 200 kPa respectively. And the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by he relation $$u = 1.5\,pv - 85\ kJ/kg$$ Where p is in kPa and v is in m^3/kg. Calculate the net heat transfer and the maximum internal energy of the gas attained during expansion.	**10**	**CO3**
Q 8	A reversible heat engine operates between two reservoirs at temperature of 600^{o} C and 40^{o}C. The engines drives a reversible refrigerator which operated between	**10**	**CO4**

	reservoirs at temperature of 40^o C and -20^o C. The heat transfer to the heat engines is 2000 kJ and the network output of the combined engine refrigerator plant is 360 kJ. (a). Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40^o C. (b). Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40 % of their maximum possible values		
Q 9	The temperature distribution across a wall 1 m thick at a certain instant of time is given as $$T(x) = a + bx + cx^2$$ Where T is in degree Celsius and x is in meters while $a=900^0$ C, $b= -300^0$ C/m^3, and $c=-50^0 C/m^2$. A uniform heat generation of 1000 W/m^3, is present in the wall of area 10 m^2 having the properties $\rho=1600$ kg/m^3, k=40 W/m.k and $C_p= 4$ kJ/kg.K (i). Determine the rate of heat transfer entering the wall (x=0) and leaving the wall (x=1 m) the wall. (ii). Rate of change of Energy storage in the wall, time rate of change at x=0, 0.25, 0.5 m.	**10**	**CO4**
Q 10	Engine oil at 60^o C flows over the upper surface of a 5 m long flat plate whose temperature is 20^o C with a velocity of 2 m/s. Determine the total drag force and the rate of heat transfer per unit width of the entire plate. Refer the data for the Film Temperature: $\rho=876$ kg/m^3, Pr=2870, k= 0.144 W/m.^{o}C, kinematic Viscosity= 242×10^{-6} m^2/s	**10**	**CO2**

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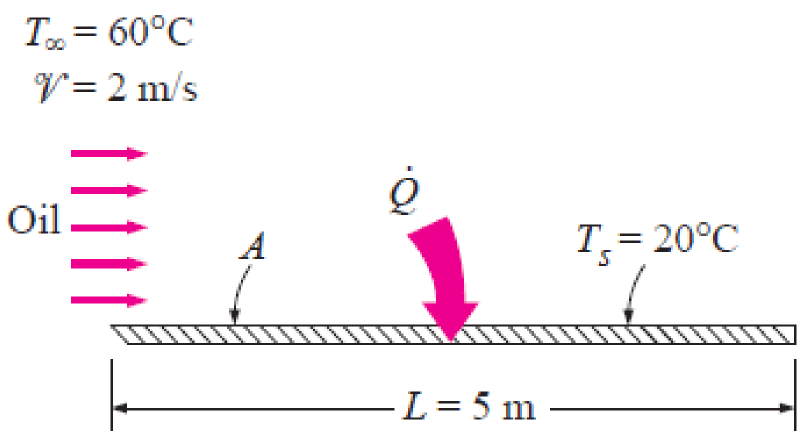
<tr><td></td><td>
</td><td></td><td></td></tr>
<tr><td>Q11</td><td>(a). A mercury manometer is used to measure the pressure in a vessel. The mercury has density of 13590 kg/m3, and the height difference between two columns is measured to be 24 cm. Determine the pressure inside the vessel?
(b). An engine cylinder has a piston of area 0.12 m^3 and contains gas at a pressure of 1.5 MPa. The gas expands according to a process, which is represented by a straight line on a Pressure-volume diagram. The final pressure is 0.15 MPa. Calculate the work done by the gas on the piston if the stroke is 0.30 m.</td><td>10</td><td>CO1</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 12</td><td>(a). Derive the heat conduction Equation for one dimensional slab and express the 3 dimensional heat conduction equation in Cartesian coordinate systems. (10 Marks)
(b). The wall of an industrial furnace is constructed from 0.15 m thick fireclay brick having a thermal conductivity of 1.7 W/m.K. Measurements made during steady state operation reveal temperatures of 1400 K and 1150 K at the inner and outer surfaces, respectively. What is the rate of heat loss through a wall that is 0.5 m by 1.2 m on the side? (10 marks)
(OR)
(a). Explain about Diesel Cycle using P-V and T-S Diagram, express efficiency in terms of compression rations, in temperatures? (5 Marks)

(b). An ideal Diesel cycle with air as the working fluid has a compression ratio of 18 and a cut-off ratio of 2. At the beginning of the compression process, the working fluid is at 14.7 psia, 80°F, and 117 in^3. Utilizing the cold-air standard assumptions, and</td><td>20</td><td>CO5</td></tr>
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	consider R=0.3704 Psia.ft^3/lbm R, c_p= 0.240 Btu/lbm. R, c_v=0.171 Btu/lbm.R, ϒ=1.4 determine (a) the temperature and pressure of air at the end of each process, (b) the network output and the thermal efficiency, and (c) the mean effective pressure (15 Marks)		