Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Program Name: B.TECH-Mechanical Engineering **Semester : V**

Course Name : Heat Transfer **Time : 03 hrs.**

Course Code : MECH3030 **Max. Marks: 100**

Nos. of page(s) : 02

Instructions: Attempt All Questions. One question from section B and C have an internal Choice. Assume any missing data if required.

SECTION A

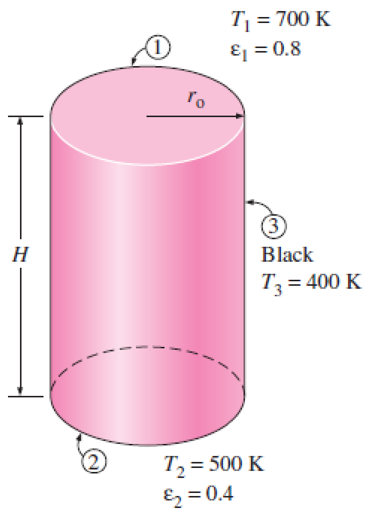
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q1	Discuss thermal diffusivity with its physical significance.	**4**	**CO1**
Q2	Elaborate importance of view factor in heat radiation.	**4**	**CO1**
Q3	Analyze the concept of radiosity in radiative heat transfer.	**4**	**CO2**
Q4	Analyze critical radius of insulation for combined (conductive and convective) heat transfer approach.	**4**	**CO3**
Q5	Apply the concept of logarithmic mean temperature difference in any internal laminar flow.	**4**	**CO4**

SECTION B

(4Qx10M= 40 Marks)

S. No.	Statement of question	Marks	CO
Q6	Explain the mechanism of film condensation heat transfer on vertical surface.	**10**	**CO2**
Q7	A 20 m long and 8 cm diameter hot water pipe of a district heating system is buried in the soil 80 cm below the ground surface. The outer surface temperature of the pipe is 60°C. Taking the surface temperature of the earth to be 5°C and the thermal conductivity of the soil at that location to be 0.9 W/m° C, determine the rate of heat loss from the pipe.	**10**	**CO3**
Q8	During a cold winter day, wind at 55 km/h is blowing parallel to a 4-m-high and 10-m-long wall of a house. If the air outside is at 5°C and the surface temperature of the wall is 12°C, determine the rate of heat loss from that wall by convection. What would your answer be if the wind velocity was doubled?	**10**	**CO3**
Q9	Deduce mathematical formulation for three dimensional heat conduction equation with internal heat generation in cylindrical coordinates. **OR** Deduce mathematical formulation for three dimensional heat conduction equation with internal heat generation in spherical coordinates.	**10**	**CO4**

SECTION-C (2Qx20M=40 Marks)			
Q10	Consider a cylindrical furnace with radius and height of 1 m, as shown in figure .The top (surface 1) and the base (surface 2) of the furnace has emissivity ε_1=0.8 and ε_2=0.4, respectively, and are maintained at uniform temperatures T_1=700 K and T_2=500 K. The side surface closely approximates a blackbody and is maintained at a temperature of T_3=400 K. Determine the net rate of radiation heat transfer at each surface during steady operation and explain how these surfaces can be maintained at specified temperatures.  	**20**	**CO3**
Q11	A counter-flow double-pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2 kg/s. The heating is to be accomplished by geothermal water available at 160°C at a mass flow rate of 2 kg/s. The inner tube is thin-walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is 640 W/m^2°C, determine the length of the heat exchanger required to achieve the desired heating. **OR** Hot oil is to be cooled by water in a 1-shell-pass and 8-tube-passes heat exchanger. The tubes are thin-walled and are made of copper with an internal diameter of 1.4 cm. The length of each tube pass in the heat exchanger is 5 m, and the overall heat transfer coefficient is 310 W/m^2 · °C. Water flows through the tubes at a rate of 0.2 kg/s, and the oil through the shell at a rate of 0.3 kg/s. The water and the oil enter at temperatures of 20°C and 150°C, respectively. Determine the rate of heat transfer in the heat exchanger and the outlet temperatures of the water and the oil.	**20**	**CO4**