Reg. No.



VII SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

ONLINE END SEMESTER EXAMINATIONS, DECEMBER 2021

SUBJECT: COMBUSTION AND HEAT TRANSFER [AAE4151]

REVISED CREDIT SYSTEM

(29/01/2021)

Duration: 3 Hours

Max. Marks: 50

Instructions to Candidates:

✤ Answer all the question compulsory.

✤ Missing data may be suitably assumed.

- **Solution** Use of Heat and Mass transfer Data Hand Book is allowed.
- **1A)** With a neat sketch, Discuss on various stages of combustion in SI engine.
- **1B)** Explain the physical delay in compression ignition engines.
- **1C)** With appropriate assumptions, obtain an expression for the temperature distribution **(04)** across a hollow sphere made of a material having a constant thermal conductivity 'K'.
- 2A) How are heat, internal energy and thermal energy related to each other? (02)
- **2B)** Does the efficiency and effectiveness of a fin increase or decrease as the fin length is **(03)** increased? Also write and expression for effectiveness and efficiency of fin.
- 2C) A 3m-high and 5m-wide wall consists of long 16cm × 22cm cross section horizontal bricks (k =0.72 W/m-K) separated by 3cm thick plaster layers (k = 0.22 W/m-K). There are also 2cm thick plaster layers on each side of the brick and a 3 cm thick rigid foam (k = 0.026 W/m-K) on the inner side of the wall, as shown in Fig. 2C. The indoor and the outdoor temperatures are 20°C and -10°C, respectively, and the convection heat transfer coefficients on the inner and the outer sides are h₁ = 10 W/m²·K and h₂ = 25 W/m²·K, respectively. Assuming one-dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.
- **3A)** Consider two identical rooms, one with a refrigerator in it and the other without one. If **(02)** all the doors and windows are closed, will the room that contains the refrigerator be cooler or warmer than the other room? Why?

(04)

(02)

- **3B)** Write a note on types of convection heat transfer.
- **3C)** In a certain double pipe heat exchanger hot water flows at a rate of 5000 kg/h and gets cooled from $95^{\circ}C$ to $65^{\circ}C$. At the same time 50000 kg/h of cooling water at $30^{\circ}C$ enters the heat exchanger. The flow conditions are such that the overall heat transfer coefficient remains constant at 2270 W/m² K. Determine the heat transfer area required and the effectiveness, assuming two streams are in parallel flow. Assume for both the streams $C_p=4.2kJ/kg$ K.
- 4A) Determine the convection heat transfer co-efficient for the flow of (a) air and (b) water at (05) a velocity of 2 m/s in an 8 cm diameter and 7 m long tube .When the tube is subjected to uniform heat flux from all the surfaces use fluid properties at 25°C.
- **4B)** With a neat sketch, describe drop-wise condensation.
- **4C)** How does the Rayleigh number differ from the Grashof number? Consider laminar **(03)** natural convection from a vertical hot plate. Will the heat flux be higher at the top or at the bottom of the plate? Why?
- **5A)** State Stefan-Boltzmann law .Also explain how does radiosity of a surface differ from **(04)** emitted energy?
- 5B) Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel (04) pan placed on top of a heating unit .The inner surface of the bottom of the pan is maintained at 108°C.If the diameter of the pan is 30cm, determine (a) the rate of heat transfer to the water (b) the rate of evaporation of water. Consider C_{sf} =0.0130 and n=1.
- **5C)** Define (a) Thermal conductivity (b) Thermal diffusivity.



Figure 2C

(03)

(02)

(02)