Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, JAN. 2021

SUBJECT: COMBUSTION & HEAT TRANSFER [AAE 3172]

REVISED CREDIT SYSTEM
(30/01/2021)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

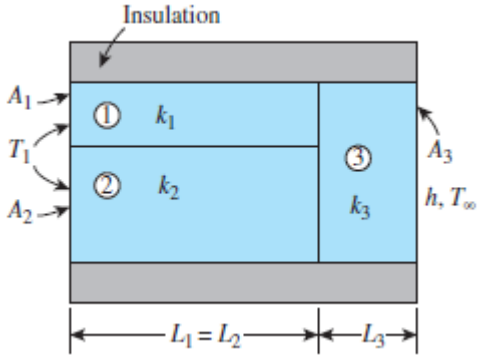
- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Stepwise answer carries marks.

Q1. Define abnormal combustion and its consequences. **(02)**

Q2. Discuss the effect of any four engine variables on ignition lag in spark Ignition Engine. **(04)**

Q3. With appropriate assumptions, obtain an expression for the temperature distribution across a hollow cylinder made of a material having a constant thermal conductivity 'K'. **(04)**

Q4. Construct a generalized thermal resistance network for below given figure. Also, write the equation for total thermal resistance for the same. **(03)**



Q5. What is critical radius of insulation? How it is defined for a cylindrical layer? **(02)**

Q6. A spoon handle has rectangular cross section of size 5 mm × 2 mm. Find the length required so that its end temperature will not exceed 25°C even when the spoon is dipped in boiling water at atmospheric pressure for long time. Consider k =39 W/m-K, h=10 W/m^2-K, ambient temperature 20°C. Assume handle of spoon as infinitely long fin **(03)**

Q7. Two pin fins are identical, except that the diameter of one of them is twice the diameter of the other .For which fin is the (a) fin effectiveness and (b) fin efficiency is higher? **(02)**

Q8. Steam in the condenser of a power plant is to be condensed at a temperature of 30°C with cooling water from a nearby lake, which enters the tubes of the condenser at 14°C and leaves at 22°C. The surface area of the tubes is 45 m^2, and the overall heat transfer coefficient is 2100 W/m^2K. Determine the mass flow rate of the cooling water needed and the rate of condensation of the steam in the condenser. **(05)**

Q9. A hot plate is placed on a surface in an atmospheric condition. The heat transfer coefficient, h is function of temperature difference between the plate surface temperature and ambient temperature, ΔT, gravitational acceleration, g, coefficient of volume expansion, β, characteristic length of the plate, L_c, density of the fluid, ρ and viscosity of the fluid, μ. Using Buckingham pi-theorem, prove that the heat transfer coefficient is given by, **(06)**

$$h = \frac{\rho L_c^{3/2} g^{3/2}}{\Delta T} \phi \left[\beta \Delta T, \frac{\mu}{\rho g^{1/2} L_c^{3/2}} \right]$$

Q10. Hot air at 90°C flows through a circular tube of diameter 30 mm and length 6 m with a velocity of 3 m/s. The tube surface is maintained at a constant temperature of 50°C. Determine the exit temperature of the air. consider $\nu = 1.79 \times 10^{-5}$ m^2/s, $\rho = 1.02$ kg/m^3, $C_p = 1006$ J/kg °C, k = 0.026 W/m-K. **(04)**

Q11. Explain the mechanism of natural convection. **(03)**

Q12. Prove the Kirchhoff's law. **(02)**

Q13. Explain different types of reflections of radiation. **(02)**

Q14. A low temperature fluid passes through a long tube of diameter 30 mm. This tube is concentric with another tube of diameter 70 mm. The surfaces of inner and outer tubes are diffuse and grey. The inner tube surface has emissivity and temperature of 0.05 and 150 K and outer tube surface has emissivity and temperature of 0.1 and 290 K. The space between the tubes is evacuated. Determine the heat gained by the fluid per unit length of the tube. A thin radiation shield of diameter 50 mm and negligible thickness is inserted in the midway between the inner and outer tubes such the emissivity on the inside surface of the shield is 0.02 and emissivity on the outside surface of the radiation shield is 0.04. Determine the percent change in heat gain per unit length of the tube. Draw the resistance network diagram. **(04)**

Q15. Draw a neat sketch of pool boiling curve and explain different regimes of the boiling curve. **(04)**