MANIPAL INSTITUTE OF TECHNOLOGY



(A constituent unit of MAHE, Manipal)

## VII SEMESTER B.TECH. (AUTOMOBILE ENGINEERING) MAKEUP EXAMINATIONS, DEC/JAN 2018-19

SUBJECT: COMBUSTION AND HEAT TRANSFER. [AAE 4154]

## REVISED CREDIT SYSTEM (29/12/2018)

Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- Use of Data Hand book is permitted.
- 1A. Bring out clearly the process of combustion in CI engine and also explain various (04) stages of combustion.
- **1B.** Explain the effect of various engine variables on SI engine Knock. (04)
- **1C.** How is thermal conductivity of material defined? What are its units? (02)
- **2A.** A thin silicon chip and an 8-mm-thick aluminum substrate are separated by a 0.02mm-thick epoxy joint. The chip and substrate are each 10 mm on a side, and their exposed surfaces are cooled by air, which is at a temperature of 25 °C and provides a convection coefficient of 100 W/m<sup>2</sup>-K. If the chip dissipates 10 <sup>4</sup> W/m<sup>2</sup> under normal conditions, will it operate below a maximum allowable temperature of 85 °C? The thermal contact resistance between the silicon chip and epoxy joint is  $0.9 \times 10^{-4}$ m<sup>2</sup>K/W.
- **2B.** Derive an expression for heat dissipation in a straight rectangular fin for infinitely **(05)** long fin.
- 3A. Steam at T<sub>∞1</sub> =320°C flow in a cast iron pipe (k=80 W/m-K) whose inner and outer diameter are Di=5 cm and Do= 5.5cm respectively the pipe is covered with 3 cm thick glass wool insulation with (k= 0.05 W/m-K).Heat is lost to the surrounding at T<sub>∞2</sub> =5 °C by natural convection and radiation with a combined heat transfer coefficient of h<sub>2</sub>=18W/m<sup>2</sup>-K. Taking coefficient inside the pipe to be h<sub>1</sub>=60W/m<sup>2-</sup> K.Determine the rate of heat loss from the steam per unit length of pipe .Also determine the rate the temperature drop across the pipe shell and insulation.
- 3B. A metal-clad Heating element of 10mm diameter and emissivity 0.92 is submerged in a water bath horizontally .If the surface temperature of the metal is 260°C under steady boiling conditions, calculate the power dissipation per unit length of heater .Assume that water is exposed to atmospheric pressure and is at a uniform temperature

4A.	Define and give significance of the following (a) Nusselt number (b) Reynolds number (c) Prandtl number.	(03)
4B.	State and Prove Kirchhoff's Law of radiation.	(02)
4C. 5A.	Air at 30°C and at atmospheric pressure flows at a velocity of 2.2m/s over a flat plate maintained at 90°C. The length and the width of the plate are 900mm and 450 mm respectively using exact solution, Calculate the heat transfer rate from :( <b>a</b> ) first half of the plate ( <b>b</b> ) full plate ( <b>c</b> ) next half of the plate. For an oil cooler a lubrication system has to cool 1000kg/h of oil (C <sub>p</sub> =2.09 KJ/kg-K) from 80°C to 40°C by using cooling water flow of 1000 kg/k at 30°C. Give your	(05) (04)
5B.	choice for parallel or counter flow heat -exchanger with reasons. Calculate surface area if U is $24 \text{ W/m}^2\text{-K}$ . Write the difference between LMTD and NTU method used in design of heat exchanger	(03)
5C.	Define the following terms (a) Absorptivity (b) Reflectivity (c) Transmissivity	(03)