Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER MAKEUP EXAMINATIONS, DECEMBER 2017

SUBJECT: COMBUSTION AND HEAT TRANSFER (AAE - 4151)

REVISED CREDIT SYSTEM
(28/12/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A) With a neat sketch, explain the various stages of combustion in Compression ignition engines. **(05)**

1B) With a neat sketch explain laminar flame propagation and turbulent flame propagation. **(05)**

2A) Derive the equation for temperature distribution and heat transfer rate for a fin of infinite length **(05)**

2B) A wall 30 cm thick of size 5m × 3m is made up of red bricks (k=0.35 W/m K). It is covered on both sides by layer of plaster 2cm thick with k=0.6 W/m K. The wall has a window 1m × 2m. The window door is made up of glass 12mm thick having k=1.2 W/m K. Estimate rate of heat flow through the wall. The inner and outer surface temperatures are 10 °C and 40 °C respectively. **(05)**

3A) Show by dimensional analysis for free convection, $Nu=\phi\,(Gr, Pr)$. **(05)**

3B) Water at 20°C is to be heated by passing through a tube. Surface of the tube is maintained at a temperature of 90°C. The diameter of the tube is 4 cm and the length is 9 meters. Find the mass flow rate of water, so that exit temperature of water will be 60°C. Take the following properties of water at the mean temperature, ρ = 993 kg/m^3, C_p = 4.174 kJ/kgK, k = 0.61 W/mK, v=0.65×10^{-6} m^2/s. Use the correlation Nu = 0.023 Re$^{0.8}$ Pr$^{0.4}$. **(05)**

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4A) With usual notations, derive an expression for effectiveness of a parallel flow heat exchanger. **(05)**

4B) A refrigerator is designed to cool 250 kg/hr of hot liquid of C_p = 3350 J/kgK at 120 °C using parallel flow arrangement. 1000 kg/hr of cooling water is available for cooling purpose at a temperature of 10 °C. If the overall heat transfer coefficient is 1160 W/m^{2}K and the surface area of the heat exchanger is 0.25 m^2, Calculate the outlet temperature of the cold liquid and hot water. Find the effectiveness of heat exchanger. **(05)**

5A) Derive expression for radiation heat exchange between 2 very large parallel grey planes. **(05)**

5B) Two parallel grey planes have emissivity of 0.6 and 0.5 which are maintained at 127 °C and 227 °C respectively. A radiation shield having emissivity of 0.05 is introduced between two parallel planes. Find the equilibrium temperature of the shield and percentage reduction in heat exchange by radiation. **(05)**