Reg. No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **17ME2058** | **Duration :** | **3hrs** |
| **Sub. Name :** | **FUNDAMENTALS OF THERMAL AND FLUID SCIENCES** | **Max. Marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | A heat engine of 30% efficiency drives a heat pump of COP 5. The heat is transferred both from engine and heat pump to circulating water for heating building in winter. Find the ratio of heat transfer to the circulating water from the heat pump to the heat transfer to the circulating water from the heat engine | CO1 | 08 |
| b. | State :   1. Kelvin – Planck statement 2. Clausius statement | CO1 | 06 |
| c. | A stationary mass of gas is compressed without friction from an initial state of 0.3m3 and 0.105Mpa to a final state of 0.15m3 and 0.105Mpa, the pressure remaining constant during the process. There is a transfer of 37.6kJ of heat from the gas during the process. How much does the internal energy of the gas change? | CO1 | 06 |
| **(OR)** | | | | |
| 2. |  | Derive an expression for work done, change in internal energy and heat transfer for an isobaric and isochoric process with PV diagram. | CO1 | 20 |
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| 3. | a. | A wall of 0.6m thickness having thermal conductivity of 1.2 W/Mk. The wall is to be insulated with a material having an average thermal conductivity of 0.3 W/mK. Inner and outer surface temperatuires are 1000°C and 10°C respectively. If the heat transfer rate is 1400W/m2, calculate the thickness of insulation. | CO3 | 12 |
| b. | State :   1. Buckingham Π theorem 2. Newtons law of convection | CO3 | 08 |
| **(OR)** | | | | |
| 4. |  | Air at 20°C at atmospheric pressure flows over a flat plate at a velocity of 3m/s. If the plate is 1m wide and 80°C, calculate the following at x=300mm.   1. Hydrodynamic boundary layer thickness 2. Thermal boundary layer thickness 3. Local friction co-efficeint 4. Average friction co-efficeint 5. Local heat transfer co-efficeint 6. Average heat transfer co-efficeint 7. Heat transfer | CO3 | 20 |
|  |  |  |  |
| 5. | a | Define heat exchanger. Give the classification of heat exchanger with neat sketches. | CO4 | 12 |
| b. | What is meant by  (i) Fouling Factor  (ii) LMTD | CO4 | 8 |
| **(OR)** | | | | |
| 6. |  | Water flows at the rate of 65kg/min through a double pipe counter flow heat exchanger. Water is heated from 50°C to 75°C by an oil flowing through the tube. The specific heat of oil is 1.780kJ/kg K.the oil enters at 115°C and leaves at 70°C. The mass flow rate of water is 8,000kg/h water entering at 25°C. The overall heat transfer co-efficient is 340W/m2K. Calculate the following:  (i) Heat exchange area  (ii) Rate of heat transfer | CO4 | 20 |
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| 7. | a. | What do you mean by U- tube manometer? How are they used for the measurement of Gauge Pressure and Vacuum Pressure? | CO5 | 12 |
| b. | The right limb of a simple U- tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity of 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of the fluid in the pipe if the difference of mercury level in the two limbs is 20cm. | CO5 | 08 |
| **(OR)** | | | | |
| 8. |  | Define a reciprocating pump. Explain the working of a single-stage reciprocating pump with sketches. | CO5 | 20 |
|  | | **Compulsory**: |  |  |
| 9. |  | A Francis turbine with an overall efficiency of 75% is rewuired to produce 148.25kW power.It is working under a head of 7.62m. The peripheral velocity =0.26√2gH and the radial velocity of flow at inlet is 0.96√2gH. The wheel runs at 150rpm and the hydraulic losses in turbine are 22% of the available energy. Assuming redial discharge, determine :  (i) The guide blade angle  (ii) The wheel vane angle at inlet  (iii) Diameter of the wheel at inlet | CO6 | 20 |