(iii) The shear stress at the trailing edge. ($\rho$ = 998 kg/m$^3$ and $\nu$ = 1 $\times 10^{-6}$ m$^2$/s) 50

7. (a) A 50 kg iron block at 80ºC is dropped into an insulated tank that contains 0.5 m$^3$ of liquid water at 25ºC. Determine the temperature when thermal equilibrium is reached, considering the following assumptions :

(i) Both water and iron are incompressible substances

(ii) Constant specific heat at room temperature can be used for water and the iron.

(iii) The system is stationary and thus kinetic and potential energy changes are zero.

$\Delta$ K.E. = $\Delta$ P.E. = 0 and $\Delta$ E = $\Delta$ U

(iv) There is no electrical shaft or other forms of work involved.

(v) System is well insulated and thus there is no heat transfer.

(vi) Specific heat of iron 0.45 kJ/kg and for water 4.18 kJ/kg.

(b) Heat transferred to a heat engine from the furnace at a rate of water heat rejection to a nearby river is 50 MW, determine the net power output and the thermal efficiency for this engine. 50

8. (a) Define the critical thickness of insulation. Explain the variation of resistances with insulation radius of the cylinder and derive an expression for the same.

(b) Derive the critical thickness of insulation for a sphere. 50



**Total No. of Printed Pages : 4** **Roll No. .....**

# 1[CCE.M]1

**Mechanical Engineering–II**

**(16)**

Time : Three Hours Maximum Marks : 300

## INSTRUCTIONS

(i) Answers must be written in English.

(ii) The number of marks carried by each question is indicated at the end of the question.

(iii) The answer to each question or part thereof should begin on a fresh page.

(iv) Your answers should be precise and coherent.

(v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

(vi) Candidates should attempt question nos. **1** and **5** which are compulsory and any **three** more out of the remaining questions, selecting at least **one** question from each section.

(vii) If you encounter any typographical error, please read it as it appears in the text book.

(viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.

(ix) No continuation sheets shall be provided to any candidate under any circumstances.

(x) Candidates shall put a cross (X) on blank pages of Answer Script.

(xi) No blank page be left in between answer to various questions.

## SECTION–A

1. Answer any **three** of the following :

   (a) A heat engine is supplied with 300 kCal/ min. of heat at 300ºC and heat rejection takes place at 10ºC. The following results are collected :

   (i) 200 kCal/ min are rejected

   (ii) 153 kCal/ min are rejected

   (iii) 60 kCal/min are rejected.

   Specify which of the above data represents a reversible, irreversible or impossible result and explain. 25

   (b) What is Mach number ? Explain the classification of fluid flow using Mach number. 25

   (c) Define Fin efficiency and Fin effectiveness. Give the relation between the two terms. 25

   (d) What is Humidity ratio ? Derive an expression for Humidity ratio in terms of Partial pressure ($P_a$) and Vapour Pressure ($P_v$). 25

2. (a) Determine the C.O.P. of Vapour compression refrigeration system with neat sketches. State assumptions clearly.

   (b) What are the characteristics of the refrigerant under Toxicity and Corrosiveness properties ? 50

3. (a) What are the factors affecting normal combustions in S.I. engines ?

   (b) What is a Nuclear reactor ? What are the functions associated with the working of nuclear reactor ? 50



4. (a) Derive an expression for e-NTU relation for a parallel flow heat exchanger.

   (b) Explain "burnt out heat flux" and its significance with a neat sketch. 50

## SECTION–B

5. Answer any **three** of the following :

   (a) What are the effects of engine variables on ignition lag ? 25

   (b) What are the different stages of combustion in C.I. engines with a neat sketch ? 25

   (c) Explain the following terms (1) Wet bulb temperature (2) Dew bulb temperature. 25

   (d) For the following velocity distribution, verify whether the essential and desirable boundary conditions to be the velocity distributions in a laminar boundary layer are satisfied :

   (i) $\frac{u}{U} = \sin\left(\frac{\pi y}{2\delta}\right)$

   (ii) $\frac{u}{U} = 1 + \frac{y}{\delta} - \left(\frac{y}{\delta}\right)^2$ . 25

6. (a) A 300 mm diameter pipe, conveying water, branches into two pipes of diameter 200 mm and 150 mm respectively. If the average velocity in the 300 mm diameter pipe is 2.5 m/s, find the discharge in the pipe. Also determine the velocity on 150mm pipe. If the average velocity is 200 mm diameter pipe is 2m/sec.

   (b) A smooth flat plate 1.5 m wide and 20 m long is subjected to flow of water along its length with a velocity of 2m/s. Find the :

   (i) Extent of the laminar boundary layer on the plate.

   (ii) The thickness of the boundary layer at the edge of the laminar boundary layer and at the trailing edge.