

B.E. (Chemical) 4<sup>th</sup> semester  
Minor Test (11 June 2021)  
Subject: Heat Transfer

Time Allowed: 60 minutes

Max. Marks: 25

Note: Attempt all questions. State clearly all your assumptions and boundary conditions. Any missing data may be suitably assumed.

Q1. a) Derive the temperature profile for a plane wall whose thickness is  $L$  and the faces of wall are maintained at temperature  $T_1$  and  $T_2$ .  $\Phi$  is the rate of heat generation per unit volume internally and  $k$  is the thermal conductivity of the wall material which does not vary with temperature. Also find out the point where the maximum temperature of the wall exists. (5)

b) What will be the temperature profile for the above case if  $k$  varies with temperature as  $k = a + bT$  where  $a$  and  $b$  are constants and  $T$  is temperature. (5)

Q2. i) Derive the temperature profile for a rectangular fin of finite length having uniform cross sectional area when fin tip is insulated. Assume negligible heat generation in the fin.

ii) What will be the fin efficiency and fin effectiveness for the above case. (7,3)

Q3. A 50mm ID and 60mm OD steel pipe ( $k = 45 \text{ W/m.K}$ ) carrying steam is covered with 30mm thick earth insulation ( $k = 0.14 \text{ W/m.K}$ ). The covering is insulated with 60mm thick asbestos ( $k = 0.012 \text{ W/m.K}$ ). The temperature of outer surface of the lagging is  $50^\circ\text{C}$  and that of steam side of the pipe is  $480^\circ\text{C}$ . Calculate heat loss per metre length of the pipe and temperature at interface of two layer of insulation. (5)