

SUBJECT CODE NO:- P-8114
FACULTY OF ENGINEERING AND TECHNOLOGY
M.E. (Mechanical) Examination May/June 2017
El-2 Advanced Heat Transfer
(Revised)

[Time : Three Hours]

[Max Marks :80]

Please check whether you have got the right question paper.

- N.B
- I. Solve any three questions from each section.
 - II. Use of non – programmable calculator is permitted.
 - III. Use of heat transfer data book and steam table are permitted
 - IV. Assume suitable data, if necessary.
- Section A
- Q.1
- a) State and explain different modes of heat transfer. 07
 - b) A 240mm steam main, 210 meters long is covered with 50mm of high temperatures insulation ($K = 0.092\omega/m^{\circ}C$) and 40mm of low temperature insulation ($K = 0.062\omega/m^{\circ}C$). The inner and outer surface temperatures as measured are $390^{\circ}C$ and $40^{\circ}C$ rep. calculate 07
 - I. The total heat loss per hour.
 - II. The heat loss m^2 of pipe surface.
 - III. The total heat loss per m^2 of outer surface.
 - IV. The temperance between two layers of insulation
 Neglect heat conduction through pipe material.
- Q.2
- a) Classify extended surfaces or fins. Explain any two types with neat diagram. 06
 - b) The aluminium square fins ($0.5mm \times 0.5mm$) of 1cm long provided on the surface of an electronic 07
 semi – conductor device to carry 46 mW of energy generated by the electronic device and the temperature at the surface of the devices should not exceed $80^{\circ}C$. the temperature of the surrounding medium is $40^{\circ}C$. $K(\text{aluminium}) = 190 \text{ w/m-k}$, $h = 12-5\text{w/m}^2\text{-k}$. find the number of fins required to carry out the above duty. Neglect the heat loss from the end of the fin.
- Q.3
- a) Write short note on ‘conduction shape factor’. 05
 - b) A square plate of side L is fully insulated along the surfaces. The temperatures maintained at the 08
 edges are given as $T(0, y) = 100^{\circ}C$, $T(x, 0) = 100^{\circ}C$, $T(x, L) = 0^{\circ}C$, and $T(L, y) = 0^{\circ}C$. Find the expression for the steady state temperature distribution.
- Q.4
- a) What you understand by lumped heat capacity system explain. 05
 - b) An egg with mean diameter of 40mm and initially at $20^{\circ}C$ is placed in boiling water pan for 4 08
 minutes and found to be boiled to the consumer’s taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at $5^{\circ}C$. Take following properties for egg.
 $k = 10\omega/m^{\circ}C$, $\rho = 1200 \text{ kg/m}^3$, $c = 2\text{kJ/kg}^{\circ}C$, $h = 100\omega/m^2^{\circ}C$.
- Q.5
- a) Explain with neat diagram thermal boundary layer. 05
 - b) A thermocouple junction of spherical form is to be used to measure the temperature of a gas 08
 stream. $h = 400\omega/m^2^{\circ}C$, $k = 20\omega/m^{\circ}C$, $c = 400\text{J/kg}^{\circ}C$, $\rho = 8500\text{kg/m}^3$. calculate the following
 - I. Junction diameter needed for the thermocouple to have thermal time constant of one second.
 - II. Time required for the thermocouple junction to reach, $198^{\circ}C$ if the junction is initially at $25^{\circ}C$ and is placed in gas steam which is at $200^{\circ}C$.

Section B

- Q.6 a) Differentiate between forced and natural convection. 05
 b) Air at 20°C is flowing over a flat plate which is 200mm wide and 500mm long. The plate is maintained at 100°C. Find the heat loss per hour from the plate if the air is flowing parallel to 500mm side with $2m/sec$ velocity. What will be the effect on heat transfer, if the flow is parallel to 200mm side? The properties of air at 60°C are $\nu = 18.97 \times 10^{-6} m^2/sec$, $k = 0.025 W/m^\circ C$ and $P_r = 0.7$. 08
- Q.7 a) Explain briefly the physical mechanism of boiling. 06
 b) Differentiate between pool boiling and forced convection boiling. 07
- Q.8 a) Write note on 'design consideration of heat pipe'. 06
 b) Vertical flat plate in the form of fin is 600m in height and is exposed to steam at atmospheric pressure. If surface of plate is maintained at 60°C calculate 08
 I. The film thickness at trailing edge of the film
 II. The overall heat transfer coefficient
 III. The heat transfer rate.
 Assume laminar flow condition & unit width of the plate.
- Q.9 a) Write note on 'Greenhouse effect'. 05
 b) Explain 'Radiation effect on temperature measurement'. 08
- Q.10 a) Explain 'Radiation exchange with emitting and absorbing gases'. 06
 b) Two large parallel plate with emissivity 0.3 and 0.8 exchanges heat. Find the percentage reduction when a polished aluminium shield of emissivity 0.04 is placed between them. Use method of electrical analogy. 07