# Sanjay Ghodawat University, Kolhapur

2020-21

Established as State Private University under Govt. of Maharashtra. Act No XL, 2017

EXM/P/09/00

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| **Year and Program: 2020-21 TY.B Tech** | **School of Technology** | **Department: Mechanical** |
| **Course Code: MET307** | **Course Title: Heat and Mass Transfer** | **Semester :V** |
| **Day :Monday**<br>**Date :28-12-2020** | **End Semester Examination** | **Time : 2 Hrs.**<br>**Max Marks : 50** |

## Question Paper

**Instructions**: 1) All Questions are compulsory.
2) Figure to the right indicates full harks.
3) Assume suitable data wherever necessary and state it clearly.
4) Use of scientific calculators is permitted.

| | | Marks | Bloom's Level | CO |
|---|---|---|---|---|
| **Q.1** | **Answer the following (any Two)–** | | | |
| a) | Define thermal conductivity, give its SI unit. Explain variation of thermal conductivity with respect to temperature. | 8 | L1 | CO307.1 |
| b) | A 15 mm diameter mild steel sphere (k=42 W/m$^2$ $^0$C) is exposed to cooling airflow at 20 $^0$C resulting in the convective coefficient h= 120 W/m$^2$ $^0$C.<br>Determine the following:<br>i) Time required to cool the sphere from 500 $^0$C to 90 $^0$C.<br>ii) Instantaneous heat transfer rate 2 minute after the start of cooling.<br>iii) Total energy transferred from the sphere ensuring the first 2 minutes.<br>For mild steel take ρ=7850 kg/m$^3$, c=475 J/kg $^0$C and α=0.045 m$^2$/h. | 8 | L3 | CO307.2 |
| c) | A grapes of Sangli district is centrally stored in the cold storage which is placed in Sangli having atmospheric temperature of 25 $^0$C. The grapes are stored at -3 $^0$C adopting ammonia vapours refrigeration system of 50TR. The cold storage room has walls made of 220 mm of brick on the outside, 90 mm of plastic foam foam and finally 16 mm of wood on the inside. If the inside and outside heat transfer coefficient are respectively 30 and 11 W/ m$^2$ $^0$C, and thermal conduciveness of brick, foam and wood are 0.99, 0.022 and 0.17 W/ m$^2$ $^0$C respectively, determine:<br>i) The rate of heat removal by refrigeration if the total wall area is 85 m$^2$.<br>ii) The temperature of inside surface of brick. | 8 | L3 | CO307.2 |

**Q.2** **Answer the following (any two)** –

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| a) | Write the equation of motion for natural convection flow over a hot vertical plate at temperature $\mathbf{T_s}$ inserted in a fluid at temperature $\mathbf{T_\infty}$. | 8 | L2 | CO307.3 |
| b) | Determine the rate of heat loss from the wall of a building if a 15 km/hr wind is blowing parallel to its surface. The wall is 25 m long, 6m high, its surface temperature is 50 $^0$C and the temperature of the ambient air is 27 $^0$C. The correlation for turbulent flow over flat plate is given as<br>$Nu=0.036\ (Re)^{0.8}\ (Pr)^{0.33}$<br>The thermophysical properties of air at 38.5 $^0$C are:<br>$\rho=1.139$ kg/m$^3$ $\quad C_p=1.0067$kJ/kgK<br>$\mu= 18.98\ X10^{-6}$ kg/ms $\quad \upsilon= 16.82\ X\ 10^{-6}$ m$^2$/s<br>$K=27\ X\ 10^{-3}$ W/mK | 8 | L3 | CO307.3 |
| c) | An Aluminum alloy fin (K=200 W/mk), 3.5 mm thick and 25 mm long protrude from a wall. The base is at 420 $^0$C and ambient air temperature is 30 $^0$C. The heat transfer coefficient may be taken as 11 W/m$^2$K. Determine the heat loss and fin efficiency, if the heat loss fin tip is negligible. | 8 | L3 | CO307.4 |

**Q.3** **Answer the following (any two)** –

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| a) | Derive an expression for the shape factor in case of radiation exchange between two large parallel non-black surfaces. | 9 | L3 | CO307.5 |
| b) | Explain boiling phenomena and different regimes of pool boiling with the help of boiling curve. | 9 | L2 | CO307.5 |
| c) | Discus the following terms<br>i. Monochromatic Emissive power<br>ii. Planck's law<br>iii. Wein's Displacement law | 9 | L2 | CO307.5 |

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