

# BIRLA INSTITUTE OF TECHNOLOGY

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS:M.Tech  
BRANCH:MECH

SEMESTER : II  
SESSION : SP/22

SUBJECT: ME571 CONVECTIVE HEAT & MASS TRANSFER

TIME:2 hr

FULL MARKS: 50

## INSTRUCTIONS:

1. The question paper contains 14 questions each of 5 marks.
  2. Student should attempt 10 questions out of 14 questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1 Discuss the difference between hydrodynamic and thermal boundary layer over a flat plate with suitable diagram. [CO1, BTL-LOW] [5]
- Q.2 Using order analysis show that the momentum equation for a two-dimensional laminar flow over flat is given by  $u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = -\frac{1}{\rho} \frac{dp}{dx} + \nu \frac{\partial^2 u}{\partial y^2}$ . [CO1, BTL-MED] [5]
- Q.3 Derive the boundary integral equation for a flow over the flat plate. [CO1, BTL-MED] [5]
- Q.4 Explain with a neat sketch what do you understand by fully developed flow inside a pipe. [CO3, BTL-LOW] [5]
- Q.5 Show that the velocity profile for a fully developed laminar flow is parabolic in nature. [CO3, BTL-MED] [5]
- Q.6 Distinguish between laminar and turbulent flow and explain the significance of fluctuating component in turbulent flow. [CO2, BTL-MED] [5]
- Q.7 What is mixing length turbulence model theory? [CO2, BTL-MED] [5]
- Q.8 Explain Reynolds analogy for turbulent flow. [CO2, BTL-LOW] [5]
- Q.9 Show the velocity and temperature profile over a vertical flat plate for natural convection and explain significance of Grashof number in natural convection. [CO4, BTL-LOW] [5]
- Q.10 Consider the effect of natural convection over an inclined plate. Interpret the heat transfer i) when hot surface facing upward and ii) hot surface facing downward. [CO4, BTL-MED] [5]
- Q.11 A rectangular plate 0.2 m height and 0.4 m length is maintained at uniform temperature of 80 °C. It is placed in atmosphere at 24 °C, Estimate the heat transfer rate from the plate for a height 0.2 m. (Use the correlation  $Nu = 0.59xRa^{1/4}$ , Properties of air at mean film temperature  $\nu = 1.82x10^{-5} m^2/s$ ,  $Pr = 0.703$ ,  $k = 0.02814 W/m.K$ .) [CO4, BTL-MED] [5]
- Q.12 Discuss the effect of natural convection over finned heated surface or PCB with suitable diagram. [CO4, BTL-MED] [5]
- Q.13 Explain the analogy between heat convection and mass convection with suitable diagram. [CO5, BTL-LOW] [5]
- Q.14 Discuss the effect of different non-dimensional number in mass transfer and compare it with heat transfer due to convection. [CO5, BTL-MED] [5]

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