

SNS COLLEGE OF TECHNOLOGY



(An Autonomous Institution)

19ASE304/ Heat Transfer

Unit -2/LMTD and NTU methods of analysis, Gas turbine blade cooling

The Log Mean Temperature Difference Method (LMTD)

- The Logarithmic Mean Temperature Difference(LMTD) is valid only for heat exchanger with one shell pass and one tube pass.
- For multiple number of shell and tube passes the flow pattern in a heat exchanger is neither purely co-current nor purely counter-current.
- The temperature difference between the hot and cold fluids varies along the heat exchanger.
- It is convenient to have a mean temperature difference T_m for use in the relation.

 $\dot{Q} = UA_s \Delta T_m$

THE EFFECTIVENESS-NTU METHOD

- LMTD method is useful for determining the overall heat transfer coefficient U based on experimental values of the inlet and outlet temperatures and the fluid flow rates.
- A more convenient method for predicting the outlet temperatures is the effectiveness NTU method.
- This method can be derived from the LMTD method without introducing any additional assumptions.
- Therefore, the effectiveness-NTU and LMTD methods are equivalent.
- An advantage of the effectiveness-NTU method is its ability to predict the outlet temperatures without resorting to a numerical iterative solution of a system of nonlinear equations. The heat-exchanger effectiveness ε is defined as



SNS COLLEGE OF TECHNOLOGY



(An Autonomous Institution)
19ASE304/ Heat Transfer

Unit -2/LMTD and NTU methods of analysis, Gas turbine blade cooling

Gas turbine blade cooling

(c) Discrete film cooling (d) Full blade film cooling A thin layer of cool air insulates the blade from More efficient than discrete hot gas stream especially film cooling where a very at the leading edge large number of closely regions where high spaced holes are used to form the full coverage film temperatures are encountered Hot Gas Cooling air Cooling air