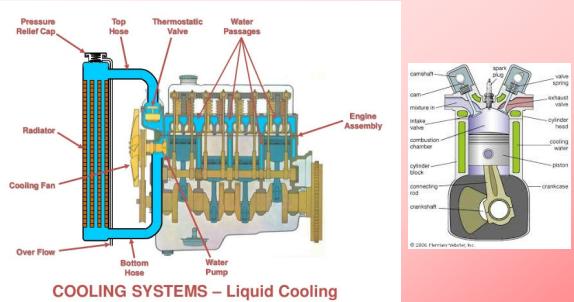


Importance of heat transfer study

Cooling : ICE engines

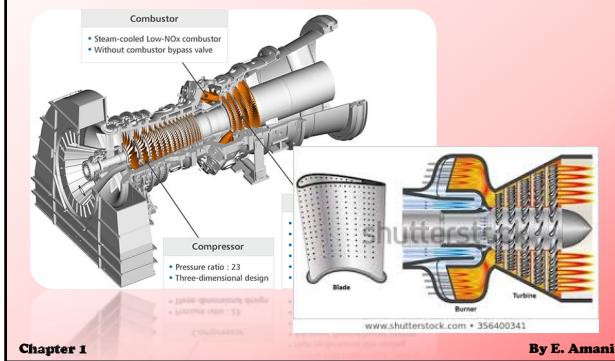


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Cooling : Gas turbine blades



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Cooling : Gas turbine blades

The diagram illustrates the cooling system for a gas turbine blade. It shows a cross-section of the blade with labels for 'airfoil' and 'root'. Arrows indicate 'external cooling' flowing over the airfoil and 'internal cooling' flowing through a passage within the blade. A 'cooling flow inlet' is shown at the base of the blade.

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Cooling : Gas turbine blades

(a) Tip cap cooling: Shows a cross-section of the blade tip with 'Tip cap Cooling' and 'Cooling air' entering through 'Pin-Fin Cooling' and 'Rib Turbulated Cooling' passages. 'Hot Gases' are shown flowing over the trailing edge.

(b) Rib turbulator cooling: Shows a side view of the blade with 'HOT GAS' entering through 'Tip cap Cooling holes' and 'Squealer tip'. 'Cooling Air' exits through 'Blade Platform cooling holes' and 'Dovetail' cooling slots.

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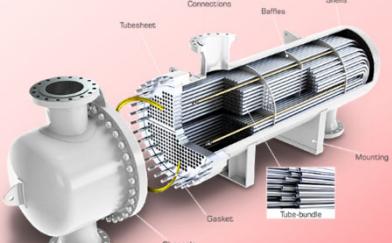
Cooling : Electronic devices

The diagram shows a 3D rendering of a heat sink with multiple fins. To its right is a schematic of a cooling system. It features a 'PCB, P_b ' connected to a fan. 'Inlet air \dot{V}_i, T_i ' enters from the bottom, passes through the PCB, and is heated to 'Outlet air \dot{V}_o, T_o '. The heated air is then exhausted. Arrows indicate the flow direction through the PCB and fins.

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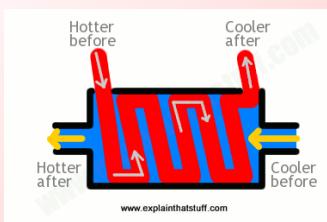
Heat transfer: Heat exchangers



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Heat transfer: Heat exchangers



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Insulation



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Course Overview

I. Introduction

II. Energy equation – thermal energy

- Modes of heat transfer: conduction, convection, and radiation
- Thermo-mechanical energy equation (0D)

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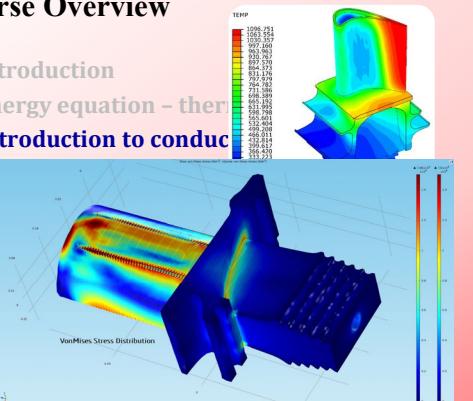
Course Overview

I. Introduction

II. Energy equation – thermal energy

III. Introduction to conduction

-



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Course Overview

I. Introduction

II. Energy equation – thermal energy

III. Introduction to conduction

IV. One-dimensional steady-state conduction

- Heat Transfer from Extended Surfaces (fins)

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Course Overview

(a)

$q = hA(T_s - T_{\infty})$

(b)

T_{∞}, h

T_s, A

ction

Figure 3.13
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Course Overview

- I. Introduction
- II. Energy equation – thermal energy
- III. Introduction to conduction
- IV. One-dimensional steady-state conduction
- V. Transient conduction (lumped method)

The diagram shows a cylindrical object of length L and radius r_0 . At time $t < 0$, the initial temperature is T_i . At time $t \geq 0$, the boundary condition is $T = T_b$. The interior of the cylinder is labeled $T(t)$. A boundary layer of thickness δ is shown at the left end, with a convective heat transfer coefficient h and a heat transfer rate $\dot{E}_{out} = q_{conv}$.

Chapter 1

Figure 5.1
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Course Overview

- I. Introduction
- II. Energy equations
- III. Introduction to convection
- IV. One-dimensional convection
- V. Transient convection
- VI. Introduction to convection
 - Transient-3D energy equation for fluid flows
 - The Thermal Boundary Layer

Figure 6.2
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5

Course Overview

- I. Introduction
- II. Energy equation – thermal energy
- III. Introduction to conduction
- IV. One-dimensional steady-state conduction
- V. Transient conduction
- VI. Introduction to convection
- VII. Convection – external flow

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Course Overview

- I. Introduction
- II. Energy
- III. Introduction
- IV. One-dimension
- V. Transient
- VI. Introduction
- VII. Convec

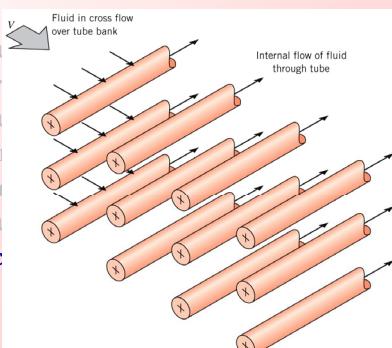
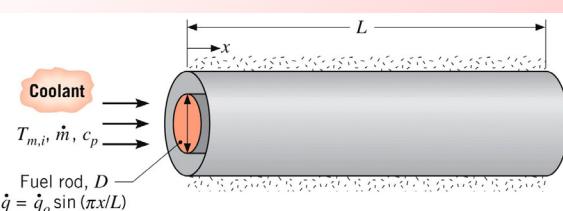


Figure 7.11
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Course Overview



Coolant
 $T_{m,i}, \dot{m}, c_p$
Fuel rod, D
 $\dot{q} = \dot{q}_o \sin(\pi x/L)$

Problem 8.14
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VIII. Convection – internal flow

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Course Overview

The left panel shows a schematic of incident radiation $I_{\lambda,i}$ hitting a surface element dA_1 at an angle θ from the normal n . The solid angle $d\omega$ is indicated. The right panel is a graph of spectral radiance $E_{\lambda,b}(\lambda, T)$ versus wavelength λ , showing a bell-shaped curve with the area under it labeled $\int_0^{\lambda} E_{\lambda,b} d\lambda$.

Figure 1.1.1
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Figure 1.1.2
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IX. Radiation: Fundamentals

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Course Overview

- I. Introduction
- II. Energy equation – thermal
- III. Introduction to conduction

The left image shows a large industrial furnace with a red glow, with an arrow pointing in. The right image is a schematic cross-section of a furnace showing internal components like a burner and flue gases.

X. Radiation between surfaces

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