

Chapter 4

4-1

$$T_{\infty} = T_m + A_m \sin \omega \tau$$

$$\text{Energy balance: } q = hA(T - T_{\infty}) = \rho c V \left(\frac{dT}{d\tau} \right)$$

Let $K = \frac{hA}{\rho c V}$ along with initial condition $T = T_0$ at $\tau = 0$;

Solution is:

$$T - T_m = (T_0 - T_m)e^{-K\tau} + \left(\frac{KA_m}{\omega^2 + K^2} \right) [\omega(e^{-K\tau} - \cos \omega \tau) + K \sin \omega \tau]$$

4-2

$$\alpha = 1.8 \times 10^{-6} \text{ m}^2/\text{sec}$$

$$2L = 2.5 \text{ cm}$$

$$T_i = 150^\circ\text{C}$$

$$T_f = 30^\circ\text{C}$$

$$\tau = 1 \text{ min} = 60 \text{ sec} \quad \frac{\pi x}{2L} = \frac{\pi}{2}; \left(\frac{\pi}{2L} \right)^2 \alpha \tau = 1.705$$

1st four nonzero terms $n = 1, 3, 5, 7$

$$\frac{T - T_f}{T_i - T_f} = \frac{4}{\pi} [0.1818 - 7.22 \times 10^{-8} + 6.15 \times 10^{-28}] = 0.231$$

$$T = 30 + (0.231)(150 - 30) = 57.8^\circ\text{C}$$

$$\frac{\alpha \tau}{L^2} = 0.69$$

$$\frac{\theta_0}{\theta_i} = 0.25$$

4-3

$$\text{at } \tau = 0 \quad \frac{x}{2L} = \frac{1}{2} \quad \frac{\pi x}{2L} = \frac{\pi}{2}$$

$$\frac{T - T_f}{T_i - T_f} = \frac{4}{\pi} \left(\sin \frac{\pi}{2} + \frac{1}{3} \sin \frac{3\pi}{2} + \frac{1}{5} \sin \frac{5\pi}{2} + \frac{1}{7} \sin \frac{7\pi}{2} \right) = 0.9216$$

correct value is 1.0 Error = 7.84%

4-4

$$q = \sigma A(T^4 - T_{\infty}^4) + hA(T - T_{\infty}) = -c\rho V \frac{dT}{d\tau}$$

Heat Transfer Jp Holman Solution Manual

Jack Philip Holman



Heat Transfer Jp Holman Solution Manual:

Heat Transfer Jack P. Holman, 1993 This text presents all material appropriate for a first course in heat transfer This edition contains new material on design and computer applications and is the solutions manual for the main text *Heat Transfer* Jack Philip Holman, 1990 *Thermal Management Handbook: For Electronic Assemblies* Jerry E. Sergeant, Al Krum, 1998 Publisher's Note Products purchased from Third Party sellers are not guaranteed by the publisher for quality authenticity or access to any online entitlements included with the product The hands on guide to thermal management In recent years heat sensitive electronic systems have been miniaturized far more than their heat producing power supplies leading to major design and reliability challenges and making thermal management a critical design factor This timely handbook covers all the practical issues that any packaging engineer must consider with regard to the thermal management of printed circuit boards hybrid circuits and multichip modules Readers will also benefit from the extensive data on material properties and circuit functions thus enabling more intelligent decisions at the design stage and preventing thermal related problems from occurring in the first place *Solutions Manual to Accompany Heat Transfer, Seventh Edition* Jack Philip Holman, 1990 **Solutions Manual to Accompany Heat Transfer** Jack Phillip Holman, 1972 **Heat Transfer** Jack Philip Holman, 1986 **Catalog of Copyright Entries. Third Series** Library of Congress. Copyright Office, 1965 Includes Part 1 Number 2 Books and Pamphlets Including Serials and Contributions to Periodicals July December **Catalog of Copyright Entries. Third Series** Library of Congress. Copyright Office, 1963 Mechanical Engineering, 1968 *Fundamentals of Heat Transfer* Lindon C. Thomas, 1980 *Books and Pamphlets, Including Serials and Contributions to Periodicals* Library of Congress. Copyright Office, 1963-07 Control System Fundamentals William S. Levine, 2019-01-15 Sifting through the variety of control systems applications can be a chore Diverse and numerous technologies inspire applications ranging from float valves to microprocessors Relevant to any system you might use the highly adaptable Control System Fundamentals fills your need for a comprehensive treatment of the basic principles of control system engineering This overview furnishes the underpinnings of modern control systems Beginning with a review of the required mathematics major subsections cover digital control and modeling An international panel of experts discusses the specification of control systems techniques for dealing with the most common and important control system nonlinearities and digital implementation of control systems with complete references This framework yields a primary resource that is also capable of directing you to more detailed articles and books This self contained reference explores the universal aspects of control that you need for any application Reliable up to date and versatile Control System Fundamentals answers your basic control systems questions and acts as an ideal starting point for approaching any control problem *Catalogue of Title-entries of Books and Other Articles Entered in the Office of the Librarian of Congress, at Washington, Under the Copyright Law ... Wherein the Copyright Has Been Completed by the Deposit of Two Copies in the Office* Library of Congress. Copyright

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Heating and Cooling with Ground-Source Heat Pumps in Cold and Moderate Climates Vasile Minea,2022-04-19 Heating and Cooling with Ground Source Heat Pumps in Cold and Moderate Climates Fundamentals and Basic Concepts covers fundamentals and design principles of vertical and horizontal indirect and direct expansion closed loop as well as ground and surface water ground source heat pump systems It explains the thermodynamic aspects of mechanical and thermochemical compression cycles of geothermal heat pumps and describes the energetic economic and environmental aspects associated with the use of ground source heat pump systems for heating and cooling residential and commercial institutional buildings in moderate and cold climates Based on the author s more than 30 years of technical experience Focuses on ground source heat pump technologies that can be successfully applied in moderate and cold climates Discusses technical aspects as well as the most common and uncommon application fields of basic system configurations This work is aimed at designers of HVAC systems as well as geological mechanical and chemical engineers implementing environmentally friendly heating and cooling technologies for buildings *Modeling, Analysis and Optimization of Process and Energy Systems* F. Carl Knopf,2011-12-14 Energy costs impact the profitability of virtually all industrial processes Stressing how

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