

MECHANICAL ENGINEERING DEPARTMENT

HEAT TRANSFER

Assignment:	
Name:	

 $HW#4 \rightarrow 6.1 (6e), 6.19 (6e), 6.21 (6e), 6.26 (6e)$

6.1 In flow over a surface, velocity and temperature profiles are of the forms

$$u(y) = Ay + By^2 - Cy^3$$

and

$$T(y) = D + Ey + Fy^2 - Gy^3$$

where the coefficients A through G are constants. Obtain expressions for the friction coefficient C_f and the convection coefficient h in terms of u_{∞} , T_{∞} , and appropriate profile coefficients and fluid properties.

Date: ____/___

		4	40			-					-	_			11	100	100	1					100	10.1	1									1.1
		Ш		1									1 10																					
		\perp																																
- 6		Ш					Ш																											
- 3		ш																																
		\mathbf{H}	TT							11		- 11						TI	TT				TT											
- 3			П																															
- 5		П																																
			11			17												111		- 12	10													
		\Box	77							11					11																			
		\pm	11				\Box			11									11				11											
			11		\vdash																													
		+	11				\Box			11								+																+
		+	11	+	-			-		-			_		+	1		_	-			-	11	+++	-									-
	-	+	++	+	-	-	-		-		-		-		++	++		+++	-			-	++	+++	-					-				++
		+	++	+	-	-	+	+	-	-	-		-		-	++		++	-	-		-	++	++	-			-	-					++
		-	-	+	-	-	+			-	-		-		-	-		-	-				-	-	-			-		-				-
	-	+	++	+-	-	-	-	+			-	-	-	-	-	+++		-	1-1-	-	-	-	+++	+++	-	-		-	-	-	-		-	++
		-	++	-	-	13	-	-	-	-	-		-		-	-	-	-	-	- 1	4		-	-	-				-	-	9		-	-
		\Box	-	-					-	-			-																					1
19		\vdash	1	-		11	\perp	-		-					11			1		-			11					-					-	1
3																																		
3			1	-					-				-																				-	-
		\perp					\Box																											
- 3																																		
- 3																																		
13																																		
										-																1								
5																					3		T											
- 3										11																								
																		11																
- 3		\Box																11																
		+	77	+	+	11	\Box	$\forall \forall$		11			_		Ħ	+		+	-			111	+	11	111									+
		+	**	-						-					11	1		-	1				++	1										_
		+	+++	+			+	-		++	-		-					++	-				+++	++	-			-	-					++
		1	++	+		-	+	-	-	-			-		1	-		-	-				-	-	-									++
		+	++	-	-	-	-		\rightarrow		-	-	-	-	-	+		-	-	-	-	-	-	+++	-	-			-	-	-		-	++
		-	++	-		-	-		-	-	-		-		-	1			-	-			-	-	-				-					-
		+	-	-		-	+		\rightarrow	-	-		-		-	-		-	-	-			-	-	-		\square	-						-
		+	-	-	-		-	-	-	-	-		-	-		-		-	-	-		-	-	-	-			-					-	-
	-	+	-	-		-				-	-		-		-	-	-	-	-	-		-	-	-	-	-				-			-	-
		\vdash		4		\perp	\perp								1								\perp											ш
		\vdash	11	1		11	\perp	11		11	-				11			11					11											1
		\perp					\perp			11																								
19																																		
				100									1																				1 1	100
												- 1								- 1														
		\Box	П																															
33		П																																
						T																												
		\Box	11			11				11					11				1				11											
		\Box																																
		\Box					\Box			11								11	11				11										-	
		+	1															1	1												-			1
		\Box																													1			
		\Box	11			11		11		11					11			11	11				11											11
						1				1																								1
- 3		+					+			1					11	1		11	1										-				-	1
7	-		11					-	-	-					11	+		1	++-			-	1	1									-	1
	-	++	+++	-	-	++	++		-	-	+	-	-	-	-	+++		++	++-	-		1	++	+++		-		-		-			-	++
3		\vdash	-	-		11	\square	-	-	-	-		-			-		-	-	-			-						-				-	-
		\Box	11	-		1	\perp	\perp	-	-			-		11	-		1	-				1	-				-		-			-	-
18			11	-									-					1	11				1										-	1
- 3				1									1													1								
- 1																																		
-																																		
3																																		
			17												11								T											
7																					7													
		\Box					\Box			11								11	11															1
		+	1				-																								-		-	
1	-	1	++	-	-	1		-	-	+		-	-	-	11	1		1	++-			1	++	1		-			-		-		-	1
		+	-	-	-	1			-	1			-			-		11	-	-			-						-					1
- 1		\vdash	-	-	-		+	-	-	-	-		-		-	-		-	-	-			-			-			-				-	-
	-	-	++	-	-	1	-	-	-	++	-	-	-	-	11	-	-	1	+-	-		-	-	-	-	-		-	-	-			-	1
				-	-	1		-	-	-			-	-	11	+	-	1	++-	-			++	1	-					-			-	1
3	-	+																																
ì		\Box	Ш	+	-	-	-		-				-		-	-		-					+++	-	-			-	-	-			-	-
							\pm			\pm																								\pm



MECHANICAL ENGINEERING DEPARTMENT

HEAT TRANSFER

Assignr	ment:		 	
Name:				
Date:				

 $HW#4 \rightarrow 6.1 (6e), 6.19 (6e), 6.21 (6e), 6.26 (6e)$

6.19	Experiments have shown that, for airflow at $T_{\infty} = 35^{\circ}$ C
	and $V_1 = 100$ m/s, the rate of heat transfer from a tur-
	bine blade of characteristic length $L_1 = 0.15$ m and sur-
	face temperature $T_{s,1} = 300^{\circ}\text{C}$ is $q_1 = 1500$ W. What
	would be the heat transfer rate from a second turbine

blade of characteristic length $L_2 = 0.3$ m operating at $T_{s.2} = 400$ °C in airflow of $T_{\infty} = 35$ °C and $V_2 = 50$ m/s? The surface area of the blade may be assumed to be directly proportional to its characteristic length.

1					1																						
			-		-		-			-			-											-			
	-	-	++-				-			++	1			-							-	1		++			
3																											
3	-	-	++-		++		-	-		+	+++	-		-	H	-	-		-		++	1	+	-	+	-	
1	-		11							++	111				H						-		111	11			
																								-			
8 × 3	-	-	++-		1		-	-	-	++	+++				HH	+			-		-	+++	+++	++	+++	-	
			11							11	111										11	tt		11	+		
	-		-		-		-			-	-					-			-		-	+		-			
1	-		++	-				-		++	-			-		-	-	-			-	1	+++	+++	+++		
	-	-	-				-			++	+++			-		-			-		-			-	-	-	-
			11		1					++	11			7	H						11		111	++			
1 3			-				-			-											-	\perp					
1	-	-	++							++	+++			-			-				-	-	+++	-		-	
	-		-		-		-			++				-										++			
. 3										+																	
	-	-	-		-		-			-	-					-			-		-	+	+	-			
1	-	-	++			-				++	-		-	-		-	-				-		+++	+++	+++	-	
	-	-	-		-		-			-	-			-		-								-	+		
			1							+	11																
3 3																											
1	-	-	-		-		-			-	-		-	-		-	-				-			-			
	-		++-				-			++	-										-	+++		-			
			-		-		-			-	1										-			-			
	-		++-				-			++	+++			-		+					-	1		++			
2	-	-	++		11		-	1		+++	1		5			1		-			-	1	+++	++	-	-	-
										+																	
	-		-		-		-			+														-			
3																								11			
	-	-	-		++		-			-	-					-			-		-	-	+	-			
	+		11				-			+											-		1				
9 9									11				313			1										147.5	
	-		++-		++		-			++	++-			-		-			-		-	+++	+++	++	+	-	
											11																
	-	-	1		1		-			+					H				-		-	++		-			
			11							1																	
1			-				-			-											-			1			
			1				-			++														++			
	-	-	++		+		-		-	++	1		-	-			-			1	+	1	1	-	1		
			11				-			11	1										-			-			-
		100	1 1						1 1 1 1 1																		



MECHANICAL ENGINEERING DEPARTMENT

HEAT TRANSFER

Assignment:	
Name:	
Date:/_	

 $HW#4 \rightarrow 6.1$ (6e), 6.19 (6e), 6.21 (6e), 6.26 (6e)

6.21 Experimental results for heat transfer over a flat plate with an extremely rough surface were found to be correlated by an expression of the form

$$Nu_x = 0.04Re_x^{0.9} Pr^{1/3}$$

where Nu_x is the local value of the Nusselt number at a position x measured from the leading edge of the plate. Obtain an expression for the ratio of the average heat transfer coefficient \overline{h}_x to the local coefficient h_x .

					140	X	0.0	4110	x I	1																							
1	1		r r	1.1	11	TI	T-F	1.1.1	TIT		111	101.1	111		111	ST-T-	1.1	1-15		101	1.7	101		1.7	1.1	11	10		21.0	-1-1	-111	111	
			\vdash	++	11																			11	-	+							
2		-	+	+++	++	1	-		-			-		H-		-		+		-	++	-			-	-	-	-			-	-	+
	-	H-	-	++	11	1	-	+++			-	-		H		-		-		++-	-	-		-			-	-		-	-	+	+
	-	-	-	-	-	-	-		-			-	-	-	-	-	-	++-	-	-	-	++		-	-	-	-	-			-		-
	-	-	-		++	1	-				-					-	-	-		-	-	-			-	-	-					-	
	-	-	Н	-	11	1	-					-	-			-1-1-		-			-			-		-	-						
	-		ш		11	-	-				-							-							-	\perp							
			Ш																														
					\mathbf{I}																			11	1.1								
1																																	
9 9																	171		1									1 3					
			1	11	11							111				-					11			11	11	1						\Box	
	-			11	++		-				-										++				-	-						-	
1			\vdash		++																												
		\vdash		++	++	++	-		-	\Box	-	-	-			-		+			++	+		-	++	+	-				-	-	
1	-		-	-	++	1	-	1	-				-				1	-	-	+++	++	-		-	-1-1		-	-			-	-	
	-		-		+++	++	-							-			-	-	-		++	-					-	-			-		
	-			-	-	-					-							-				-		-		+	-				-		
			ш																														
1																																	
5 5																علماء	10		14									1 13					
7 8																																	
																									71								
			П																					77									
			T		11																TT			11	11								
			+																							\Box							
			+	11	11	11					-							11			11				-	-						-	
	-		1		1						-							1								-							
	-		-	-	++		-		-			-	-			-	-	-		-	++	-		-	-	-	-					-	
- 4	-	-	-	-	-	1	-		-			-	-	-	$\overline{}$	-	-	-		-	-	-	-	-	+	-	-	-		-	-	-	
	-		Н	-	11		-		-		-							-			1			-	-	\perp	-				-	\perp	
	-	-	-	-	-	-	-		-		-		-	-				-			-	-		-	-	+	-				-	-	
			-	-	1				-		-										-			-	-		-					-	
		ш	Ш		\perp					\Box				ш				\perp			\perp											\perp	
1																																	
																																	- 1
1			П																														
			\Box	11	11	1																		11	11	+							\perp
1	-		-	+++	++	1	-	111	-		+	+++	-				11			++-	+	++		-	-		-	-			-	+	+
1	-		-	-	+++						-		-				-			-	++	-		-	-	-	-	-				-	
	-		-	++	++	1	-		-		-		-				++	-	-	-	++	-		-	++	-	-	-					
-	-		-	-	++	-	-	\vdash	-	\vdash	-	-	-					-			-	-		-	-	+	-			-		+	
	-	-	\vdash	-	++	-	-		-			-			\square		-	-	-	-	-	-				+	-			-	-	+	
1	-			-	1								-	-		-1-1-	-	-	-	11	-			-	-	-	-				-	\perp	
1			1			-	-					1						-		1.		-		-				1				1 0	
																										Ш							
 3 				1.1				1-1-1		0																							
- 1																									11								
1			\Box																														
								- 1																									- 1
			T		T																				11								
			\Box																														
1			1	1	11	1			1			111				-	11			1	11			11	11								
	-	-	+	1		1											1	++-			+++	+++		1	-	-	-				-	-	
1 3	-		+	-	-	1			-		-					-		-						-	-	+	-					-	
	-		H	-	1	-					-		-				-				1	-		-	-		-					-	
1	-			-	1											-1-1-	-	-	-	1-1-	-			-			-						
- 1	-		Ш																								1	1					
- 1																																	
1																																	
																					TT				11								
8 9																																	
			\Box		11																				11								
			1																	1													
			+	11	11				11			111						1		1	11			11	-							-	
	-		+	-	1										H						1			++	-							-	
	-		-	-	-				-		-		-			-		-						-	-	-	-						
1	-		-	++	++	1	-		-		-		-			-	1	-	-	-	1	-			-		-	-				-	
	+		1	-	++	1	-		-		-	1				-	1			H	++	1		-	-		-	-				-	
	-		1	-	-							-		\vdash				-			11						-				-	\square	
	-																							-	-	\perp	4						
								1. [1	1 1														1.1	



MECHANICAL ENGINEERING DEPARTMENT

HEAT TRANSFER

 $HW#4 \rightarrow 6.1 (6e), 6.19 (6e), 6.21 (6e), 6.26 (6e)$

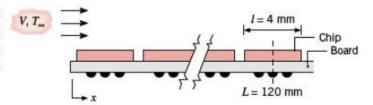
6.26 Forced air at $T_{\infty} = 25^{\circ}\text{C}$ and V = 10 m/s is used to cool electronic elements on a circuit board. One such element is a chip, 4 mm by 4 mm, located 120 mm from the leading edge of the board. Experiments have revealed that flow over the board is disturbed by the elements and that convection heat transfer is correlated by an expression of the form

Estimate the surface temperature of the chip if it is dissipating 30 mW.

Assignment: _	_
Name:	_

$$Nu_x = 0.04 Re_x^{0.85} Pr^{1/3}$$

Date: ____/___



									-										-							-
				1					+	+	\rightarrow				+		-	\rightarrow	-	+			1			+
S				1 1						-			100	1000			_		-	1 1 1						-
1																										
										111	\rightarrow						-	\rightarrow		1						
	\rightarrow	_		-					+	+	\rightarrow						-	\rightarrow	-	+			1			-
										TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT																
			-	-															-				1		-	-
						1111			1	1	+						\rightarrow			1					1	
		-				-						1		-											-	+
T 6																										
1																										\Box
		-	-	1						-	-		-	-	+				-	-		-	1	-	1-1-1	+-
			-							-	-								-	-			-			-
				-111			$\Gamma \Gamma \Gamma$			111	11						111			T = T			111			
																		-								
						-			-	+++	-			-					-					-		+
														1 11											1	
																3 13										
-	1	-				1			+++	+++	-			-	+++		+		1	1	-		+			+
										1											_					1
										711										111						\Box
						+++-			++++	+	-				+++				-	+++				-		+
																										\perp
		_		-	-	+			+	-	+		-				-	\rightarrow	-	-	-	-	1		-	-
		-								-		-													1 1	-
																		31-13								
								1.1																		
-				1			-		+	+	+						+	-		+	_	_	+++	_	111	+
		-	-	-						-	-		-						-	-		-				-
											111						111						111			
										+	-						+	\rightarrow	-	-	-		1	-		+
									-										-							+
																									1 1 1	
										+																\Box
										-					-		-		-	+						-
(A) (B)				1 1 1		1.1-1-						1 3											111		111	
																	\neg									П
				-					1	-					100				-	-			1	-	-	-
						-			-	-					-			\rightarrow	-					-	-	-
1																										
																										11
					-	1			1	-	-				1-1-		-		1	1	-			-		+
										+																\Box
-		-		+++	-	+++-	1-1-1	-	++++	+	-		-		+++		-		-	++++	-	-	1			+
F 8								0.13				130														\perp
						1			1	1																+
						1			1	+					1				-	-				-		+-
1 9																										
																										\Box
1			-	-		1				+++	-				-				-	1			1			+-1
																										\perp
											111						111									1
33																										
F 8						1			+++	111	-						-			1	-					+
						111				1										1						1
																1 2 2									1 2	
1 3										111																+
						1			-	-	-								-	1						+
1																										
					_													-	_							
							1 1 1																			
						+++			+++	+++	-			-	-		+++		+							+
												_														