INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	**LOW SPEED AERODYNAMICS**
Course Code	:	**AAE004**
Regulation	:	IARE - R16
Year	:	2018 – 2019
Class	:	B. Tech IV Semester
Branch	:	Aeronautical Engineering
Team of Instructors	:	Dr. Maruthupandiyan K Department of Aeronautical Engineering

COURSE OBJECTIVES (COs):
The course should enable the students to:

The course should enable the students to:	
I	Understand the basics of aerodynamics, aerofoil and wing characteristics
II	Calculate forces and moments acting on aero foils and wings under ideal flow conditions.
III	Design a propeller and determine aerodynamic interaction effects between different components of aircraft.

COURSE LEARNING OUTCOMES (CLOs)
Students, who complete the course, will be able to demonstrate the ability to do the following:

CLO Code	**At the end of the course, the student will have the ability to:**
CAAE004.01	Apply knowledge and understand the essential facts, concepts and principles of aerodynamics.
CAAE004.02	Adapt the basic knowledge of mathematics, science and engineering for problem solving.
CAAE004.03	Describe principles of physics and aerodynamics to study the wing-body interference junction.
CAAE004.04	Explain the concept of boundary layer flows to increase the performance of the body.
CAAE004.05	Understand the concept of source, sink, doublet and vortex.
CAAE004.06	Demonstrate importance of aerodynamics to develop effective aircraft design and operations.
CAAE004.07	Apply the concept of lifting line theory to study potential flows over different aerofoils.
CAAE004.08	Identify the elliptic load distribution for obtaining high lift performance on finite wings.
CAAE004.09	Evaluate the source and vortex panel method for non-lifting and lifting aerofoils.

CAAE004.10	Illustrate the propeller aerodynamics and the effects of propeller on the wing.
CAAE004.11	Understand the concept of Prandtl‘s lifting line theory and eliptical lift distribution.
CAAE004.12	Understand the lift augmentation techniques for high-lift devices and slats.
CAAE004.13	Understand aerodynamic effect of taper and twist applied to wings.
CAAE004.14	Apply temperature effects on boundary layer, transition and turbulent flow regimes.
CAAE004.15	Understand the aerodynamic effect of vortex formation around wings.
CAAE004.16	Evaluate flow past non lifting bodies and method of singularities
CAAE004.17	Understand the effect of sweep in the context of delta wings.
CAAE004.18	Understand the relation between circulation and lift.
CAAE004.19	Understand the various sources of drag including induced drag and skin friction drag.
CAAE004.20	Evaluate displacement thickness, momentum thickness, energy thickness.

UNIT – I

INTRODUCTORY TOPICS FOR AERODYNAMICS

PART - A (SHORT ANSWER QUESTIONS)

S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
1	Define incompressible flow.	Remember	CAAE004:02
2	What is D’Alemberts paradox	Understand	CAAE004:04
3	Magnus effect creates the aerodynamic forces over spinning bodies. Justify the statement.	Remember	CAAE004:04
4	Describe stream and potential functions for doublet flow.	Understand	CAAE004:03
5	Define streamline.	Understand	CAAE004:01
6	Describe stream and potential functions for uniform flow.	Understand	CAAE004:03
7	Explain stream and potential functions for source and sink flows.	Understand	CAAE004:03
8	Explain stream and potential functions for vortex flow.	Understand	CAAE004:03
9	Define doublet.	Understand	CAAE004:03
10	Define Kutta-Joukowski theorem.	Remember	CAAE004:04
11	Define potential flow	Remember	CAAE004:04

PART - B (LONG ANSWER QUESTIONS)			
S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
1	Derive the equation for relation between stream function and velocity.	Understand	CAAE004:03
2	Derive the equation for relation between potential function and velocity.	Understand	CAAE004:03
3	Prove that velocity potential and stream function are mutually perpendicular to each other.	Understand	CAAE004:03
4	Derive the stream function and potential function for uniform flow.	Remember	CAAE004:03
5	Derive the stream function and potential function for source flow.	Remember	CAAE004:03
6	Derive the equation of dividing streamline for source and uniform flow combination and draw resulting flow field.	Remember	CAAE004:03
7	Derive the equation of rankine oval and illustrate resulting flow field,	Remember	CAAE004:03
8	Derive the stream function and potential function for doublet flow.	Remember	CAAE004:03
9	Derive the equation for nonlifting flow over circular cylinder and plot the variation of pressure over the cylinder.	Remember	CAAE004:03
6	Derive Kutta - Joukowski theorem and prove that lift is directly proportional to circulation.	Understand	CAAE004:03

PART - C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	Derive the stream function and potential function for vortex flow	Remember	CAAE004:03
2	Derive the equation for lifting flow over a cylinder and draw the flow field around it for different value of circulation.	Understand	CAAE004:04
3	Prove that the velocity potential and the stream function for a uniform flow,, satisfy Laplace's equation.	Remember	CAAE004:03
4	Explain in detail how combination of uniform flow, doublet flow and vortex flow produces lifting flow over a cylinder.	Remember	CAAE004:03
5	Consider a uniform flow with velocity $V\infty$. Show that this flow is a physically possible incompressible flow and that it is irrotational.	Remember	CAAE004:15
6	Prove that the velocity potential and the stream function for a source flow,satisfy Laplace's equation.	Remember	CAAE004:03
7	Consider the velocity field given by $u = y/(x^2 + y^2)$ and $v = -x/(x^2 + y^2)$. Calculate the equation of the streamline passing through the point (0, 5). Calculate the vorticity.	Remember	CAAE004:04
8	Consider the lifting flow over a circular cylinder with a diameter of 0.5 m. The freestream velocity is 25 m/s, and the maximum velocity on the surface of the cylinder is 75 m/s. The freestream conditions are those for a standard altitude of 3 km. Calculate the lift per unit span on the cylinder.	Remember	CAAE004:03
9	Consider the lifting flow over a circular cylinder. The lift coefficient is 5. Calculate the location of the stagnation points and the points on the cylinder where the pressure equals freestream static pressure.	Understand	CAAE004:03
10	Consider the lifting flow over a circular cylinder. The lift coefficient is 5. Determine: (a) the peak (negative) pressure coefficient (b) the location of the stagnation points (c) points on the cylinder where the pressure equals freestream static pressure	Understand	CAAE004:03

UNIT – II			
THIN AEROFOIL THEORY			
PART - A (SHORT ANSWER QUESTIONS)			
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Learning Outcomes (CLOs)**
1	Describe center of pressure of an airfoil.	Understand	CAAE004:05
2	Define airfoil.	Remember	CAAE004:13
3	What is aerodynamic center?	Understand	CAAE004:13
4	What are all the assumptions made for thin airfoil theory?	Understand	CAAE004:05
5	Explain Kutta condition for the steady state flow at the trailing edge.	Understand	CAAE004:05
6	What are high-lift airfoils?	Remember	CAAE004:10
7	What are high-lift devices? Give examples.	Remember	CAAE004:10
8	Define airfoil stall.	Remember	CAAE004:04
9	Define zero-lift angle of attack of an airfoil.	Understand	CAAE004:06
10	What is mean by camber line?	Remember	CAAE004:06
PART - B (LONG ANSWER QUESTIONS)			
1	Draw neat skech of airfoil and explain its nomenclature.	Remember	CAAE004:06
2	Describe the stalling of an airfoil and the related aerodynamic phenomena.	Understand	CAAE004:04
3	Prove that the local jump in tangential velocity across a vortex sheet is equal to the local sheet strength.	Remember	CAAE004:06
4	Explain Kutta condition and its significance for the case of steady flow over an airfoil.	Remember	CAAE004:06
5	Describe high-lift devices and why they are needed.	Remember	CAAE004:10
6	Explain with sketch the thin aerofoil theory and prove that lift coefficient is directly proportional to angle of attack.	Remember	CAAE004:06
7	Explain in detail about how lift is generated by airfoil.	Remember	CAAE004:06
8	What is the difference between aerodynamic characteristics of flow over wing of finite aspect ratio and infinte aspect ratio.	Remember	CAAE004:06
9	Explain why lift coefficient for airfoil is more than wing having same airfoil in detail.	Remember	CAAE004:06
10	Explain in detail about high lift airfoils.	Understand	CAAE004:06
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)			
1	Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions. The freestream velocity is 70 m/s. The lift per unit span is 1254 N/m. calculate the strength of the steady-state starting vortex.	Understand	CAAE004:06

<table>
<tr><th>S No</th><th>QUESTIONS</th><th>Blooms Taxonomy Level</th><th>Course Learning Outcomes (CLOs)</th></tr>
<tr><td>2</td><td>Consider an NACA 2412 airfoil with a 2-m chord in an airstream with a velocity of 50 m/s at standard sea level conditions. If the lift per unit span is 1353 N, calculate the angle of attack?</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td>3</td><td>Starting with the definition of circulation, derive Kelvin's circulation theorem</td><td>Remember</td><td>CAAE004:06</td></tr>
<tr><td>4</td><td>Consider a thin, symmetric airfoil at 1.5° angle of attack. From the results of thin airfoil theory, calculate the lift coefficient and the moment coefficient about the leading edge.</td><td>Remember</td><td>CAAE004:06</td></tr>
<tr><td>5</td><td>Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions. The freestream velocity is 70 m/s. The lift per unit span is 1254 N/m. Calculate
(a) The angle of attack
(b) The drag per unit span.
(c) The moment per unit span about the aerodynamic center.
(Use the experimental data for NACA 2412 airfoil on lift coefficient, drag coefficient and moment coefficient about aerodynamic center, source: Abbott and von Doenhoff, Theory of Wing Sections, McGraw-Hill Book Company, New York, 1949; also, Dover Publications Inc., New York, 1959)</td><td>Remember</td><td>CAAE004:06</td></tr>
<tr><td>6</td><td>For the NACA 2412 airfoil, calculate and compare the lift-to-drag ratios at angles of attack of 0, 4, 8, and 12 degrees. The Reynolds number is 8.9×10^6. Plot (C_l/C_d) versus AOA. What do you infer from the graph?</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td>7</td><td>Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions. The freestream velocity is 70 m/s. The lift per unit span is 1254 N/m. Calculate the strength of the steady-state starting vortex.</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td>8</td><td>Analyze the steady-state flow velocities at the trailing edge (T.E.) of an airfoil:
(a) Having a finite angle at the T.E.
(b) Having a cusped T.E.
Evaluate the vorticity at the T.E. in the above cases.</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td>9</td><td>For a particular airfoil section, the pitching moment coefficient about an axis a third of the chord behind the leading edge varies with the lift coefficient in the following manner:
<table>
<tr><td>C_l</td><td>0.2</td><td>0.4</td><td>0.6</td><td>0.8</td></tr>
<tr><td>C_m</td><td>-0.02</td><td>0.00</td><td>+0.02</td><td>+0.04</td></tr>
</table>
Calculate the location of aerodynamic center, and the value of the pitching moment coefficient at zero left, C_{m0}.</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td>10</td><td>Consider a thin, symmetric airfoil at 1.5° angle of attack. From the results of thin airfoil theory, calculate the lift coefficient C_l, and the moment coefficient about the leading edge, $C_{m,LE}$</td><td>Understand</td><td>CAAE004:06</td></tr>
<tr><td colspan="4">UNIT-III</td></tr>
<tr><td colspan="4">FINITE WING THEORY</td></tr>
<tr><td colspan="4">PART - A (SHORT ANSWER QUESTIONS)</td></tr>
<tr><td>1</td><td>Define induced drag.</td><td>Understand</td><td>CAAE004:16</td></tr>
<tr><td>2</td><td>Explain Biot-Savart Law.</td><td>Understand</td><td>CAAE004:07</td></tr>
<tr><td>3</td><td>Explain the formation of trailing vortices.</td><td>Remember</td><td>CAAE004:07</td></tr>
<tr><td>4</td><td>Define and explain Kelvin circulation theorem.</td><td>Understand</td><td>CAAE004:15</td></tr>
</table>

S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
5	Explain Rankine‘s vortex.	Remember	CAAE004:07
6	Explain free vortex.	Understand	CAAE004:07
7	Describe the vortex filament statement of Helmholtz’s vortex theorem.	Understand	CAAE004:07
8	What is downwash?	Remember	CAAE004:10
9	What is forced vortex?	Understand	CAAE004:10
10	Define vortex line and vortex tube?	Remember	CAAE004:10
PART – B (LONG ANSWER QUESTIONS)			
1	Obtain the expression for induced drag and minimum induced drag for elliptic planform.	Remember	CAAE004:16
2	Consider a vortex filament of strength Γ in the shape of a closed circular loop of radius R. Obtain an expression for the velocity induced at the center of the loop in terms of Γ and R.	Understand	CAAE004:07
3	Explain the formation of trailing vortices and their influence on the lift generation of wing.	Remember	CAAE004:07
4	The measured lift slope for the NACA 23012 airfoil is 0.1080 degree^{-1}, and α_{L0}=-1.3°. Consider a finite wing using this airfoil, with AR = 8 and taper ratio = 0.8. Assume that δ= τ. Calculate the lift and induced drag coefficients for this wing at a geometric angle of attack = 7^{o}.	Remember	CAAE004:15
5	Explain starting, bound and trailing vortices of wings.	Remember	CAAE004:07
6	Explain in detail Prandtl’s lifting line theory.	Remember	CAAE004:07
7	Derive the equation for velocity induced by infinite vortex using Biot-Savart law..	Understand	CAAE004:07
8	Derive the equation for induced angle of attack and induced drag coefficient from Prandtls lifting line theory.	Understand	CAAE004:10
9	Explain in detail about how downwash is created and what its effect on lift generation.	Remember	CAAE004:10
10	Explain elliptic loading and wings of elliptic platform.	Understand	CAAE004:10
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)			
1	Explain in detail vortex filament statement of Helmholtz's vortex theorems Biot-Savart Law.	Remember	CAAE004:16
2	Explain in brief Lanchester’s experiment and Prandtl’s lifting line theory.	Understand	CAAE004:07
3	Explain elliptic loading & wings of elliptic platforms. Derive the expression for minimum induced drag for Elliptic platform.	Remember	CAAE004:07
4	Explain in detail the use of quarter chord and three- quarter chord points in vortex panel method for wings.	Understand	CAAE004:15
5	a) Lifting surface theory predicts better lift distribution on a wing with a low aspect ratio and of any type of given planform. Demonstrate the verification of the statement. b) Compare the formulation in (a) above with that in the classical lifting line theory with details.	Remember	CAAE004:07

S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
6	Consider a finite wing with an aspect ratio of 8 and a taper ratio of 0.8. The airfoil section is thin and symmetric. Calculate the lift and induced drag coefficients for the wing when it is at an angle of attack of 5◦. Assume that $\delta = \tau = .055$	Understand	CAAE004:07
7	Consider an aircraft is at cruise condition having C_L=0.21. for this aircraft the zero lift angle of attack is -2 degree. The lift cure slope of airfoil section is a_0=0.1degree^{-1}. The lift slope factor τ = 0.04 and the wing aspect ratio is 7.96. Calculate geometric angle of attack.	Understand	CAAE004:07
8	Consider an airfoil is having lift curve slope a0=0.108degree-1 and $\alpha_{L=0}$ = −1.3◦. Consider a finite wing using this airfoil, with AR = 8 and taper ratio = 0.8. Assume that δ = τ . Calculate the lift and induced drag coefficients for this wing at a geometric angle of attack = 7◦.	Understand	CAAE004:10
9	Consider a rectangular wing with an aspect ratio of 6, an induced drag factor δ = 0.055,and a zero-lift angle of attack of −2◦. At an angle of attack of 3.4◦, the induced drag coefficient for this wing is 0.01. Calculate the induced drag coefficient for a similar wing (a rectangular wing with the same airfoil section) at the same angle of attack, but with an aspect ratio of 10. Assume that the induced factors for drag and the lift slope, δ and τ , respectively, are equal to each other (i.e., δ = τ). Also, for AR = 10, δ = 0.105.	Remember	CAAE004:10
10	The Piper Cherokehoie (a light, single-engine general aviation aircraft) has a wing area of 170 ft2 and a wing span of 32 ft. Its maximum gross weight is 2450 lb. The wing uses an NACA 65-415 airfoil, which has a lift slope of 0.1033 degree−1 and αL=0 = −3◦. Assume τ = 0.12. If the airplane is cruising at 120 mi/h at standard sea level at its maximum gross weight and is in straight-and-level flight, calculate the geometric angle of attack of the wing.	Remember	CAAE004:10
UNIT-IV			
FLOW PAST NON-LIFTING BODIES AND INTERFERENCE EFFECTS			
PART – A (SHORT ANSWER QUESTIONS)			
1	What are the limitations of panel methods?	Remember	CAAE004:12
2	Explain the meaning of wing-fuselage interference.	Understand	CAAE004:12
3	Draw the upwash and downwash distribution on the fuselage as a result of the wing.	Remember	CAAE004:14
4	Draw the upwash and downwash distribution on the wing as a result of the fuselage.	Understand	CAAE004:13
5	Explain with the help of a diagram what is fuselage thickness ratio?	Remember	CAAE004:13
6	Write short notes on the general effects of the propeller slipstream on the wing and tail.	Understand	CAAE004:15
7	Write short notes on the general effects of the propeller slipstream on the wing and tail.	Understand	CAAE004:15
8	Explain non-lifting and lifting bodies and give examples.	Understand	CAAE004:11
9	Describe the method of singularities. How is it used to study potential flow over an arbitrary body?	Understand	CAAE004:13
10	Describe the method of singularities. How is it used to study potential flow over an arbitrary body?	Understand	CAAE004:13

PART – B (LONG ANSWER QUESTIONS)			
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Learning Outcomes (CLOs)**
1	Describe the upwash and downwash distribution on the fuselage as a result of the wing.	Remember	CAAE004:12
2	Draw the upwash and downwash distribution on the wing as a result of the fuselage.	Remember	CAAE004:12
3	Describe the asymmetric flow over a wing-fuselage system for a high-wing airplane. How does this affect the rolling moment compared to a wing?	Remember	CAAE004:14
4	Explain in detail about wing-body interference	Understand	CAAE004:13
5	What are nonlifting bodies? Explain in detail their importance in aircraft.	Remember	CAAE004:13
6	Describe the studies on general effects of the propeller slipstream on the wing and tail.	Remember	CAAE004:11
7	Demonstrate the methodology to study potential axisymmetric flow past a slender body of revolution, using the method of singularities.	Understand	CAAE004:11
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)			
1	Analyze the drag coefficient for an entire aircraft. Give an expression to estimate this drag coefficient.	Remember	CAAE004:12
2	An aircraft weighing 40,000 lbs, has a wing area of 350 ft^2 and a wing span of 50 ft. At sea-level, the aircraft flies at (a) 200ft/sec (b) 600ft/sec. For the entire aircraft, determine the estimated values of the induced drag and the associated drag coefficients for the two cases? Note that lift = weight in level flight. Also, assume Oswald efficiency factor of 0.85.	Remember	CAAE004:11
3	Calculate the pressure coefficient distribution around a non-lifting circular cylinder using the source panel method.	Understand	CAAE004:14
4	The NACA0012 aerofoil is a symmetric airfoil. So, when it is placed in a potential flow at zero angle of attack, it is a non-lifting body. For this case, with the source panel method, using the aerofoil shape, write a code to generate the distribution of source strength. Plot the distribution of source strength versus distance along the chord.	Remember	CAAE004:13
5	Extend the source panel code for NACA0012 airfoil (at zero AOA) to generate the tangential flow speed distribution over the airfoil surface. Plot the distribution.	Remember	CAAE004:13
UNIT-V			
BOUNDARY LAYER THEORY			
PART - A (SHORT ANSWER QUESTIONS)			
1	Draw and explain the velocity profile in the boundary layer	Understand	CAAE004:15
2	Define momentum thickness.	Understand	CAAE004:18
3	Explain adverse pressure gradient?	Understand	CAAE004:16
4	Write a short note on favourable pressure gradient.	Remember	CAAE004:20
5	Define displacement thickness.	Remember	CAAE004:17

S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
6	Define energy thickness.	Understand	CAAE004:18
7	Define boundary layer.	Understand	CAAE004:17
8	Describe laminar boundary layer.	Understand	CAAE004:17
9	Describe turbulent boundary layer.	Understand	CAAE004:20
10	Explain the boundary layer growth along a flat surface.	Remember	CAAE004:20
PART – B (LONG ANSWER QUESTIONS)			
1	Derive the equation for displacement thickness.	Remember	CAAE004:15
2	Derive the equation for momentum thickness.	Understand	CAAE004:18
3	Derive the equation for energy thickness.	Remember	CAAE004:16
4	Derive Blasius equation for incompressible flow over flat plate.	Understand	CAAE004:20
5	Explain in detail about the effect of curvature wit neat sketch.	Remember	CAAE004:19
6	Explain in detail about laminar and turbulent boundary layer.	Remember	CAAE004:15
7	Explain in detail about flow separation and separation bubble.	Understand	CAAE004:17
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)			
1	Consider a flat plate at zero angle of attack in an airflow at standard sea level conditions (p_∞ = 1.01 × 105 N/m2 and T_∞ = 288 K). The chord length of the plate (distance from the leading edge to the trailing edge) is 2 m. The planform area of the plate is 40 m2. At standard sea level conditions, μ_∞ = 1.7894 × 10−5 kg/(m)(s). Assume the wall temperature is the adiabatic wall temperature Taw. Calculate the friction drag on the plate when the freestream velocity is 100 m/s,	Understand	CAAE004:15
2	Consider a flat plate at zero angle of attack in an airflow at standard sea level conditions (p_∞ = 1.01 × 105 N/m2 and T_∞ = 288 K). The chord length of the plate (distance from the leading edge to the trailing edge) is 2 m. The planform area of the plate is 40 m2. At standard sea level conditions, μ_∞ = 1.7894 × 10−5 kg/(m)(s). Assume the wall temperature is the adiabatic wall temperature T_{aw}. Calculate the friction drag on the plate assuming a turbulent boundary layer for a freestream velocity of 100 m/s,	Understand	CAAE004:18
3	The wing on a Piper Cherokee general aviation aircraft is rectangular, with a span of 9.75 m and a chord of 1.6 m. The aircraft is flying at cruising speed (141 mi/h) at sea level. Assume that the skin-friction drag on the wing can be approximated by the drag on a flat plate of the same dimensions. Calculate the skin-friction drag: a. If the flow were completely laminar (which is not the case in real life) b. If the flow were completely turbulent (which is more realistic) Compare the two results.	Understand	CAAE004:18

S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
4	The wing on a Piper Cherokee general aviation aircraft is rectangular, with a span of 9.75 m and a chord of 1.6 m. The aircraft is flying at cruising speed (141 mi/h) at sea level. Assume that the skin-friction drag on the wing can be approximated by the drag on a flat plate of the same dimensions. the boundary-layer thickness at the trailing edge for a. Completely laminar flow b. Completely turbulent flow	Understand	CAAE004:20
5	The wing on a Piper Cherokee general aviation aircraft is rectangular, with a span of 9.75 m and a chord of 1.6 m. The aircraft is flying at cruising speed (141 mi/h) at sea level. Assume that the skin-friction drag on the wing can be approximated by the drag on a flat plate of the same dimensions. calculate the skin-friction drag accounting for transition. Assume the transition Reynolds number = 5×10^5.	Understand	CAAE004:19

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HOD, AE