University of Technology
Mechanical Engineering Department
Final Examination 2015/2016

Subject: Flight Theory
Division: Aircraft
Examiner(s): Dr. Nibras M. Mahdi

Year : 2nd
Exam Time: 3 Hrs.
Date: 20 / 6 / 2016

Q3\A The maximum lift/drag ratio for aircraft is 13.6 corresponds to a lift coefficient, C_L=0.634 (Where: m=1338 kg and S=16.16 m^2). Calculate: 1. the minimum glide angle. 2. the maximum range measured along the ground in a power-off glide that starts at an altitude of 3050 m (with sketch), 3. Glide velocity at altitude of 3050m (ρ=0.908 kg/m^3).

[12.5 Marks]

B Answer with sketch

1. Some planes have more than one engine to propel (لدفع) the craft. Are the multiple engines necessary or a safety precaution (احتياط امان)?
2. The effects of dust and sand on aviation? Explain.

[5 Marks]

Q4\A Plot the V-n diagram for the following acrobatic aircraft. Then, determine the maximum load factor. (m=2300 kg, S=19.33m^2, C_{Lmax}=2, -C_{Lmax}=-1.2, AR=7, V_c=159.5 m/s)

[12.5 Marks]

B Why pilot cannot fly and climb in dust and sand storms? Explain briefly.

[5 Marks]

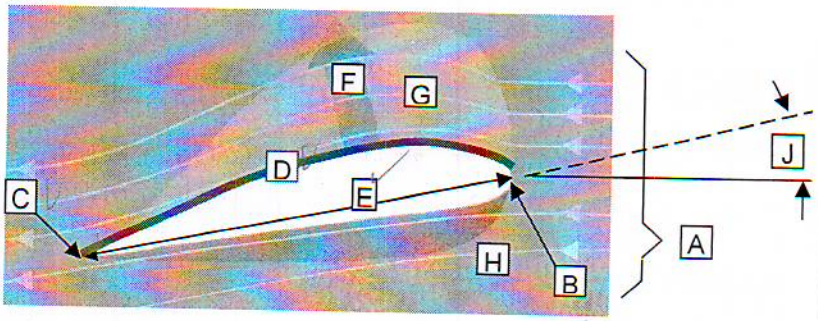
Q5\A A turbojet engine aircraft flying steady and level at H=11000 m altitude (σ=0.29), the aircraft m=12000 kg, S_{wing}=32 m^2 (elliptical loading), b=8 m and C_{Do}=0.1C_D Calculate the flight Mach number when the aircraft power plant produced 4000 kw.

B Using the following diagram, match the letters with the best descriptor.

[12.5 Marks]

[5 Marks]

Item	Letter	Descriptor
1		Leading Edge
2		Trailing Edge
3		Camber
4		Chord
5		Relative wind arrows
6		Higher speed air line
7		Lower speed air line
8		Lower pressure - Lift vector
9		Angle of attack



Good Luck!

University of Technology
Mechanical Engineering Department
Final Examination 2015/2016

Subject: Flight Theory | **Year : 2nd**
Division: Aircraft | **Exam Time: 3 Hrs.**
Examiner(s): Dr. Nibras M. Mahdi | **Date: 20 / 6 / 2016**

(Note: Answer Four Questions Only)

Use: at sea level, ρ_o=1.225 kg/m^3, T_o= 288°K and g_o =9.81 m/sec^2

Q1\A An aircraft has a wing area of 23.7 m^2 and a mass of 4536 kg and a clean drag polar (flaps and gear up) of $C_D = 0.023 + 0.0735\ C_L^2$, AR=5.07, Calculate:

a. $(L/D)_{max}$, b. V_{min} at sea level and at 12190 m (σ=0.247), c. T_{min} for level flight.

[12.5 Marks]

B Choose the correct answer for:

1. As air passes over the wing towards the trailing edge, the air moves not only rearward but downward as well. This downward flow is called _____.

   a. Drag, b. Asymmetric thrust, c. Downwash, d. Down flow

2. As an aircraft climbs and altitude increases the stalling speed of an aircraft _____.

   a. Remains the same b. Increases c. Decreases d. Depends on the indicated airspeed

3. Induced drag _____ as the speed of an airplane increases.

   a. Decreases b. Remains the same c. Increases d. None of the above

4. Spoilers are devices fitted to the wing, which increase _____ and decrease _____.

   a. Drag, lift b. Lift, drag c. Weight, lift d. Speed, drag

[5 Marks]

Q2\A Jet fighter Aircraft of Aspect ratio AR=3, elliptical wing loading (mass/wing area) = 1000 kg/m^2, and wing span = 10.816 m, and the maximum lift coefficient with maximum flap deflection is C_{Lmax} = 1.2, Calculate the minimum horizontal turn radius and maximum turn rate at sea level, the sea level Aircraft velocity is 900 km/hr.

[12.5 Marks]

B Answer:

1. What are the factors affecting on the aircraft landing speed?
2. What kind of propulsion system does the space shuttle use, as opposed to an airplane?

[5 Marks]

University of Technology
Machincal Engineering Department
Final Exam 2014/2015

Subject :Flight theory
Division: Aeronautics
Examiner: Dr. Assim H. Y. AL-Daraje

Year: 2nd
Exam Time: 3Hrs.
Date: 17 / 6/ 2015

Answer (Four) Questions Only

All symbols are as per class lecture notes

Use: Air density at sea level (ρ_o= 1.2 kg/m^3), gravity acceleration (g_o =9.8 m/sec^2)

Q.1/ A propeller driven transport airplane have the following characteristics, mass= 13200kg, wing area= $52m^2$, AR (aspect ratio) = 6, $C_{D,O}$= 0.028, and e= 0.92. Determine at sea level: a- the jet fighter true airspeed for best aerodynamics efficiency, $(L/D)_{max}$ and b- minimum power required? (25 marks)

Q.2/ Q. 100 A Glider weighing 2.2 kN is released from 3 km (σ = 0.7384) altitude with airspeed of 90 km/hr. The Glider, wing area (s = 60 m^2), aspect ratio (AR= 8), aerodynamics efficiency factor (e= 0.9) and zero lift drag coefficient = 0.012. Determine the Glider: a- minimum gliding angle and b- maximum gliding distance? (25 marks)

Q.3/ A jet fighter take off airspeed of 203km/hr when weighing 72kN and (L/D = 6). The thrust available at take off is 20kN. Estimate the fighter lift-off distance? (25 marks)

Q.4/ Define the following:

a- Helicopter profile power required. (5marks)

b- Airplane absolute ceiling. (5marks)

c- Flight path angle. (5marks)

d- Holding flight. (5marks)

e- Aerodynamic center. (5 marks)

Q.5/ A Helicopter (2A 342 Gazzle) flying at altitude (H = 2 km, ρ= 1.0066kg/m^3) and forward speed 180 km/hr having the following characteristics; total mass= 1900kg, disk area= 86.5, f=1.3, and profile power= 95kW assumed to be constant with altitude and forward speed. Engine power available at altitude (H = 2 km) is 360 (kW), assumed to be constant with Helicopter forward speed. Determine the helicopter rate of climb? (25 marks)

Best luck with regards _ Dr Assim Hameed Yousif

University of Technology
Department of Machines and Equipment Engineering
Final Year Examination 2013/2014, second attempt

Subject :Flight theory
Division: Aeronautics
Examiner: Dr. Assim Al-Daraje

Year: 2nd
Exam Time: 3 Hrs.
Date:18 / 6 / 2014

Answer (Four) Questions Only

Use : ρ_o=1.225 kg/m^3 and g =9.81 m/sec^2

Q. 1 a- Name the two types of engines common in aviation today. (5Marks)

b- A Jet attacker weighs **200** kN flying steady at V_∞= **210** m/s. The attacker starts a pull-up maneuver; the centrifugal force (F_r) during the pull-up turn is **400**kN. Determine the pull-up turn radius (R) and pull-up turn rate (ω)? (20Marks)

Q. 2 a- Define the profile power required for a Helicopter. (5Marks)

b- A Helicopter have the following characteristics; total mass= **1900** kg; disk area= **86.5**m^2; and f=**1.3**. Calculate the Helicopter profile power required at sea level, if the minimum total power required is **132.238** kW? (20Marks)

Q. 3 a-What are the two factors that most affect the lift and drag coefficients. (5Marks)

b-An aircraft weighs **60**kN flying at an altitude in holding flight $\left(\frac{C_L}{C_D}\right)_{max}$ =**10**, with parasite power required of **600** kW. Calculate the holding flight airspeed? (20Marks)

Q. 4 a- Defined the induced drag and induced power required. (5Marks)

b- Propeller driven Aircraft is flying at (V_∞=**540**) km/hr, the minimum induced power required is (min P_{R_i} =**2250**) kW, $\left(\frac{L}{D}\right)_{min\ P_R}$ = **10**, and engine power is **10500 kW**. Determine the Aircraft possible flight path angle (in degree) for steady climb? (20Marks)

Q. 5 A Jet-powered aircraft (CJ-1), having the following characteristics: Wing span (**b=16**) m, wing area (**S=28.62**) m^2, normal gross **weight= 7566.75kg**, not include fuel, fuel tank capacity **3357** kg of kerosene of thrust specific fuel consumption ***TSFC*= 324** N of fuel per N thrust.hr, zero lift drag coefficient, $C_{D,o}$= **0.02**, and aircraft Oswald coefficient, e=0.81. Estimate the maximum rang at sea level? (25marks), you may use:

$$R = \frac{2}{c_t}\frac{C_L^{1/2}}{C_D}\sqrt{\frac{2}{\rho S}}\left(W_0^{1/2} - W_1^{1/2}\right) \quad , \quad \max \frac{C_L^{1/2}}{C_D} = \frac{\left(\frac{1}{3}\pi e AR C_{D,0}\right)^{1/4}}{\frac{4}{3}C_{D,0}} \quad , \text{and} \quad c_t = \frac{TSFC}{\left(3600\,\frac{sec}{hour}\right)}$$

University of Technology
Mechanical Engineering Department, Auronatical
Course Exam 2012/2013

Subject: Flight theory, 2nd Year — Exam Time: 1½ Hours
Examiner: Prof Dr Assim Hameed Yousif — Date: 31/ 1/2013

All symbols are as per class lecture notes

Attempt only three Questions

Use: Air density at sea level (ρ_o= 1.225 kg/m^3), gravity acceleration (g_o =9.81 m/sec^2), and standard sea level temperature, T_o=288°K

Q1 Define the following:

a- Center of pressure.
b- Lift.
c- Parasite drag.
d- Angle of attack.
e- Power available.
f- Thrust required. (33marks)

Beechcraft Queen Air Aircraft Data, in relation with Q2, Q3, and Q4

Twin-engine light aircraft, multi engine piston, propeller driven aircraft (3 blades props), W = 38220 N, S = 27.3 m^2, AR = 7.5, e (complete airplane) = 0.9, and $C_{D,0}$ (complete airplane) = 0.03.

Q2 Determine minimum power required at an altitude when (σ=0.78)? (33marks)

Q3 a-Determine at sea level the stalling speed at take off, at take off load factor (n=2) and ($C_{l_{max}}$= 1.2)

b- Maximum rate of climb, if the excess power is 30kW? (33marks)

Q4 Maximum air speed at sea level, both engines power = 252.6 kW? (33marks)

Best luck with regards _ Prof Dr Assim Hameed Yousif AlDaraj

University of Technology
Mechanical Engineering Department
Final Examination 2011/2012

Subject: Flight Theory
Branch : Aeronautical
Examiner: Dr Assim Hameed Yousif

Class : 2nd years
Time: 3 Hours
Date: 7 / 6 /2012

Answer four questions only

All symbols are as per class lecture notes

Use: Air density at sea level (ρ_o= 1.2 kg/m^3), gravity acceleration (g_o =9.8 m/sec^2)

Q1/ A very rough approximation ($X_{T/O}=V_{T/O}^2/2A$) of runway landing distance at sea level for small transport aircraft is 217m, runway ground coefficient of friction μ= 0.026, wing area= 26m^2, and $C_{l_{Max_g}}$ = 2.0. Assume $V_{T/O}= V_{stall}$. Find the aircraft overall weight if the total dragging thrust at landing is Th_o= 12.5kN, assumed to be constant with speed? (17.5 marks)

Q2/ A jet fighter aircraft flying at an altitude in which the aircraft maximum thrust available produced by the power plant 20kN, the thrust required is 12kN, flying level and study at (L/D = 8). What is the maximum possible acceleration when the jet flying with zero flight path angle? (17.5 marks)

Q3/ A propeller- driven aircraft has the following characteristics: Wing loading (w/s = 10000 N/m^2), Aspect ratio (A=8), aircraft efficiency factor (e=0.82), and zero lift drag coefficient (C_{D_0} = 0.03). What should be the aircraft true air speed for minimum power required at sea level? (17.5 marks)

Q4/ Turbo-jet aircraft (elliptical wing loading) have the following characteristics: Aircraft mass = 4000kg, wing area = 12m^2, ($(L/D)_{max}$ = 14), and wing aspect ratio (A= 2.4). Determine the true airspeed when the aircraft flying to achieve $(L/D)_{max}$ at an altitude that the relative density is (σ = 0.6). (17.5 marks)

Q5/ A Helicopter (2A 342 Gazzle) have the following characteristics; Total mass= 1900kg, disk area= 86.5m^2, f=1.3, profile power= 95kW assumed to be constant with forward speed, and power plant power produces at sea level ($P_{A\,s/l}$= 460) (kW), constant with airspeed. Determine maximum rate of climb at (H= 0)? (17.5 marks)

Q6/ a- State the factors that maximizing the endurance of a Propeller-driven airplane. (7.5 marks), b- Define the term helicopter Ceiling. (5 marks), c-Define the term centre of pressure. (5 marks)

Best - luck Dr Assim Hameed Yousif Al daraje A. H.

University of technology

Department of machinery Engineering, aeronautics branch

Subject: Flight Theories, second class

Date: 14/4/2011.....Time: 90 min.....Answer only <u>two</u> questions, each hold the same Marks. Use : ρ_o=1.225 kg/m^3 and g =9.8 m/sec^2. T_o = 288 °K

Jet fighter Aircraft of Aspect ratio ($\Re$=3), elliptical wing loading (mass/wing area) = 1000kg/m^2, and wing span = 10.816 m, and the maximum lift coefficient with maximum flap deflection is ($C_{L_{max}}$= 1.2).

For the above Jet fighter answer only <u>two</u> of the following questions:

Q1 Calculate the minimum horizontal turn radius and maximum turn rate at sea level, the sea level Aircraft velocity is 900 km/hr.

Q2 Calculate the Aircraft energy and specific energy when flying at Mach number of (1.8) and at an altitude of 8000m.

Q3 Estimate roughly for first approximation the fighter ground run distance at landing, assuming the breaks, landing parachute, and thrust reversal (i.e. total reverse thrust = 120kN). Take the run way ground friction coefficient as (μ = 0.025), and V_L = 1.05 V_{stall}.

Best luck with regards of Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering

Subject: flight theory

Date: 15/1/2009……Time: 90 min……..Answer only two questions, each hold the same Marks

Q1/ Small airplane flying at sea level (holding flight) $at\ (\frac{L}{D})_{Max}$. Thrust required to perform such flight is 2 kN. The wing area is 20 m^2 (elliptical loading), C_{Do} = 0.02 and aspect ratio is 4. Determine the airplane weight.

Q2/ An airplane weighting 10 kN, the power required is 400kW to fly steady and level at sea level. If (1kN) of fuel are burned in Flying. What should be the power required to fly steady and level at an altitude (σ=0.7). Assume for both cases the angle of attack is kept constant (lift coefficient is constant), therefore drag coefficient is also constant.

Q3/

(a) Plot the typical airplane engine thrust and the propulsive efficiency η_p verses airplane airspeed for turbo-jet and turbo-propeller engines.

(b) List the typical wing airfoil section used for subsonic and supersonic aircrafts, aid of sketch.

Best luck

University of Technology, Department of machinery Engineering

Aeronautics, Subject: Flight Theory

Date: /1/2010……Time: 90 min……..Answer Only Two Questi……..

Use: ϱ_o = 1.226kg/m^3.

Q1/ An airplane weighting 10kN, the power required is 400kW to fly steady and level at sea level. If (1kN) of fuel are burned in Flying. What should be the power required to fly steady and level at an altitude (σ=0.7). Assume for both cases the angle of attack is kept constant (lift coefficient is constant), therefore drag coefficient is also constant. (5 marks)

Q2/ An aircraft weighing 250000 N has a wing area 80m^2, and its drag equation

$$C_D = 0.0160 + 0.040\ {C_L}^2$$

Calculate the minimum thrust required for straight and level flight, and the corresponding true air speeds at sea level and at 10000m ($\sqrt{\sigma}$ =0.58). Calculate also the minimum power required and corresponding true air speeds, at the above altitudes. (5 marks)

Q3/ A light aircraft weighing 9000N and with a wing area of 12.5m^2 has a maximum lift coefficient of 1.5 and its drag equation is

$$C_D = 0.020 + 0.050\ {C_L}^2$$

It is powered by a single turbo-jet engine giving a thrust of 1350N at all speeds at sea level. If the aircraft flying steadily at sea level in a horizontal circle flight at true air speed of 30 m/sec, estimate the time required to turn through 180° at sea level, and the corresponding load factor and lift. (5 marks)

Best luck

Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering, Aeronautics branch, 3rd year

Subject: Flight Theories. Supplementary examination

Date: 13/9/2011. Time: 3hrs. Answer only four questions. Use: T_0= 288°K and g_0 =9.8 m/sec^2. All simples are as per class lecture notes

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A Jet-powered aircraft (CJ-1), having the following characteristics:

Wing span= 16m, wing area= 28.62m^2, normal gross weight= 7566.75kg, fuel capacity 1119galons of kerosene (1galon= 3kg), power plant two turbofan of 16kN each at sea level, specific fuel consumption ć= 0.009 N of fuel per N thrust.hr, parasite drag coefficient C_{D_0}= 0.02, and e=0.81. Use for air (H= 0, ρ= 1.225kg/m^3).

The above aircraft information is related to Q1, Q2, Q3, and Q4:

Q1/ Calculate thrust required at sea level for holding flight? (17.5 marks)

Q2/ Calculate maximum Mach number at sea level condition? (17.5 marks)

Q3/ Estimate the maximum rang at sea level? (17.5 marks)

Q4/ Calculate the rate of climb with (V= constant) and minimum power required at sea level? (17.5 marks)

Q5/ A Helicopter (2A 342 Gazzle) have the following characteristics; Total mass= 1900kg, disk area= 86.5m^2, f=1.3, profile power= 95kW assumed to be constant with altitude and forward speed, and power plant power is given by the following formula: (P_A= 460- 50 H (km)) (kW). Determine:

- **a- Maximum rate of climb at (H= 0, use ρ= 1.225kg/m^3)?**
- **b- Power required for best endurance at (H= 2000m, ρ= 1.0066kg/m^3)?**

(17.5 marks)

Q6/ Calculate the ground- runway distance of landing for fighter aircraft? assuming no brakes, no landing parachutes, and no forward thrust and thrust reversal.

Use: V_L= 1.05V_{stall}, landing mass= 8500kg, wing area= 30m^2, runway skin friction coefficient μ= 0,025, $C_{L_{g_{Max}}}$= 2.0, Use for air (H= 0, ρ= 1.225kg/m^3), and fighter wing polar equation is, C_D= 0.02 + 0.04${C_L}^2$, and X_L is given by X_L= $\frac{1}{2B}\, ln\left(1-\frac{B}{A}\,{V_L}^2\right)$, where *A* and *B* are constants. (17.5 marks)

University of technology

Department of machinery Engineering, Aeronautics branch

Third year, Subject: Flight Theories, Third trail Examination

Date: 27/10/2011, Time: 3hrs, Answer Four Questions. Use: ρ_0=1.2 kg/m^3 and g_0 =9.8 m/sec^2, all simples are as per class lecture notes

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Q1/ (a) Discuss the factors affecting the endurance of a Propeller-driven airplane
(b) Explain the terms Absolute Ceiling and Service Ceiling? (17.5 marks)

Q2/ A single seat Helicopter weighing 7500N, disk area= 50m^2, f= 1.6, and the profile power required= 20kW, assumed to be constant with forward speed and altitude. The Helicopter engine give a maximum power of 300kW, assumed to constant at sea level with forward speed. Calculate the maximum forward speed of the Helicopter at sea level? (17.5 marks)

Q3/ A propeller driven transport airplane have the following characteristics, mass= 13200kg, wing area= 52m^2, AR (aspect ratio) = 6, C_{D_0}= 0.028, and e= 0.915. Determine the plane, true airspeed for minimum power required, and power required for holding flight, i.e. $(C_L/C_D)_{Max}$? (17.5 marks)

Q4/ A jet fighter have the following characteristics, mass is 7000 kg, wing area is 40m^2, AR is 3.5, , C_{D_0}= 0.016, and wing is elliptical loading. The pilot causes his fighter to enter a horizontal, correctly banked circle at bank angle Ø= 30°, keeping the same angle of attack. The engine thrust is altered as necessary. Estimate the thrust required performing such turn? (17.5 marks)

Q5/ Derive an expression for the ground run distance ($X_{T/O}$) at take-off

$$X_{T/O} = \frac{-1}{2B}\, ln\left(1 - \frac{B}{A}\, V_{T/o}{}^2\right), \frac{dy}{dx}$$, A and B are constants.

Use: $\frac{dV}{dt} = v\frac{dV}{dx}$ *and* $\int \frac{x\,dx}{a-bx^2} = -\frac{1}{2b}\, ln\,(a-bx^2) + c$, *where a, b, and c are constants.* (17.5 marks)

Best luck with regards _ Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering, Aeronautics branch

Third year, Subject: Flight Theories, Third trail Examination

Date: 27/10/2011, Time: 3hrs, Answer Four Questions. Use: ρ_0=1.2 kg/m^3 and g_0 =9.8 m/sec^2, all simples are as per class lecture notes

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Q1/ (a) Discuss the factors affecting the endurance of a Propeller-driven airplane
(b) Explain the terms Absolute Ceiling and Service Ceiling? (17.5 marks)

Q2/ A single seat Helicopter weighing 7500N, disk area= 50m^2, f= 1.6, and the profile power required= 20kW, assumed to be constant with forward speed and altitude. The Helicopter engine give a maximum power of 300kW, assumed to constant at sea level with forward speed. Calculate the maximum forward speed of the Helicopter at sea level? (17.5 marks)

Q3/ A propeller driven transport airplane have the following characteristics, mass= 13200kg, wing area= 52m^2, AR (aspect ratio) = 6, C_{D_0}= 0.028, and e= 0.915. Determine the jet fighter true airspeed for minimum power required and the power required for holding flight, i.e. $(C_L/C_D)_{Max}$? (17.5 marks)

Q4/ A jet fighter have the following characteristics, mass is 7000 kg, wing area is 40m^2, AR is 3.5, , C_{D_0}= 0.016, and wing is elliptical loading. The pilot causes his fighter to enter a horizontal, correctly banked circle at bank angle Ø= 30°, keeping the same angle of attack. The engine thrust is altered as necessary. Estimate the thrust required performing such turn? (17.5 marks)

Q5/ Derive an expression for the ground run distance ($X_{T/O}$) at take-off

$$X_{T/O} = \frac{-1}{2B}\, ln\left(1 - \frac{B}{A}\, V_{T/o}{}^2\right), \frac{dy}{dx}$$, A and B are constants.

Use: $\frac{dV}{dt} = v\frac{dV}{dx}$ *and* $\int \frac{x\,dx}{a-bx^2} = -\frac{1}{2b}\, ln\,(a-bx^2) + c$, *where a, b, and c are constants.* (17.5 marks)

Best luck with regards _ Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering, aeronautics branch

Subject: Flight Theories

Date: 13/4/2010.....Time: 90 min.....Answer only two questions, each hold the same Marks. Use : ρ_o=1.225 kg/m^3 and g =9.81 m/sec^2

Q1/ Heavy Hercules transport military aircraft has the following characteristics: Mass =200 tons, a very rough estimation of run way Takeoff distance ($X_{T/_O}$) at sea level was found to be 500m, $V_{T/_O}$ = 1.1 V_{stall}, $C_{L_{maxg}}$ =10, wing area =300$m^2$and the coefficient of run way friction assume to be constant ($\mu_{friction}$) =0.033. Estimate the total engines power required during takeoff at $V_{T/_O}$; assume the thrust is to be constant during takeoff? (5M)

Q2/ Propeller-driven airplane has the following characteristics: Total mass = 200 tons, C_{D_o}=0.022, e=1 (elliptical wing loading) and wing aspect ratio = 6. Find the airplane aerodynamic efficiency ($^L/_D$) when the airplane flying steady at a true airspeed that to achieve maximum rang at an altitude? Also estimate the airplane rang when flying at ($^L/_D$) =10, If the airplane used 30 tons of fuel? Airplane propeller efficiency is 90% and the power specific fuel consumption is (0.0009 N/W.sec). (5M)

Q3/ An aircraft weight 100 tons flying steady and level at true airspeed of 720 km/hr at altitude of 10500 m (σ = 0.29). The airplane drag polar equation is:

$$C_{D=0.015+0.05\,C_L{}^2}$$

Wing area is 187m^2, the aircraft start climbing steadily with engine thrust of 150kN. Estimate the flight path angle in the climb? (5M)

Best luck with regards of Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering, aeronautics branch

Subject: Flight Theories, second class

Date: 13/4/2010.....Time: 90 min.....Answer only two questions, each hold the same Marks. Use : ρ_o=1.225 kg/m^3 and g =9.8 m/sec^2

Q.1

a- Define the centre of pressure

b- List the types of drag in high speed flight

c- Define the ram jets system

d- List with the aid of sketch the subsonic typical wing airfoil sections.

Q.2 A jet fighter aircraft has the following characteristics:

wing, (elliptical loading, w/s = 100 N/m^2), wing area (s = 39 m$^{2)}$, aspect ratio (AR= 3), induce drag coefficient (C_{Di} = 0.03). What should be the thrust required for Holden flight?

Q.3 An aircraft weighs 60000N and has wing span of 17m. Estimate the minimum flying speed of the aircraft at 13400m altitude, where the relative density is taking as σ = 0.2, i.e. the speed at which the maximum lift of the aircraft is equal its weight. Wing area (S = 0.7), C_{Do}= 0.02, and e = 0.7?

Best luck with regards of Dr Assim Hameed Yousif

University of technology

Department of machinery Engineering, aeronautics branch

Subject: Flight Theories, Third class

Date: /Feb/2011.....Time: 90 min.....Answer only two questions, each hold the same Marks. Use : ρ_o=1.225 kg/m^3 and g =9.8 m/sec^2

Q.1

a- Define the aerodynamic centre.

b- Define the overall efficiency of aircraft propulsion systems.

d- List the typical supersonic wing aerofoil sections.

e- Plot the typical thrust and propulsive efficiency(η_p) verses airspeed for turbo-jet engines

Q.2 A propeller- driven aircraft has the following characteristics:

Wing, (elliptical loading, w/s = 100 N/m^2), Wing area (s = 39 m$^{2)}$, Aspect ratio (AR= 3), zero lift drag is (C_{Do} = 0.03). What should be the aircraft minimum power required at sea level?

Q.3 A light transport aircraft (propeller-driven) make a steady level turn with bank angle of 37°, and radius of turn = 2km. The aircraft drag polar equation is

$C_D = 0.02 + 0.04\ C_L^{2.}$

Aircraft mass = 10000kg, wing area = 40m^2. The aircraft flying at an altitude that the relative density is (σ = 0.6). Estimate the power required performing such turn?

Note: Steady level turn take place at constant airspeed, and horizontal turn by keeping the flaps down, i.e. the lift coefficient should be increased over that of straight flight.

Best luck with regards of Dr Assim Hameed Yousif

University of Technology

Department of machinery Engineering

Subject: flight theory

Class: 2nd Aeronautical

Date: //2011, Time: 3 Hrs,

Answer only *Four* questions

Each holds the same marks. Use: ρ_o=1.225 kg/m^3, $g_o = 9.8$ m/sec^2, T_o= 288 °K

All symbols are as per class lecture notes

Q1/ A very rough approximation of runway landing distance for small transport aircraft is 500m, runway coefficient of friction μ= 0.026, wing area= 26m^2, and $C_{l_{Max_g}}$ = 2.0, Assume $V_{T/O}$= V_{stall}. Find the aircraft weight if the total landing thrust at sea level = 12.5kN assumed to be constant with speed?

Q2/ A jet fighter aircraft flying at an altitude, the aircraft maximum thrust available is 20kN, the thrust required is 14kN and the aircraft weight is 40kN. What should be the aircraft acceleration, if the flight bath angle 15°?

Q3/ An Airplane weighing 7000 kg flying steady and level at speed 360 km/hr at altitude, ρ_{air} = 1.2255 kg/m^3. The airplane wing area s = 20m^2, the airplane drag polar equation is

$$C_D = 0.017 + 0.034\, C_L^{\,2}$$

The airplane start a horizontal circular turn at bank angle ϕ = 58°

Determine:

a- Load factor and velocity during this turn
b- Thrust required to perform such turn
c- Radius of turn.

Q4/ A propeller- driven aircraft has the following characteristics:

Wing, (elliptical loading, w/s = 100 N/m^2), Wing area (s = 39 m$^{2)}$, Aspect ratio (AR= 3), zero lift drag is (C_{Do} = 0.03). What should be the aircraft minimum power required at sea level?

Q5/ A light transport aircraft (propeller-driven) make a steady level turn with bank angle of 37°, and radius of turn = 2km. The aircraft drag polar equation is

$$C_D = 0.02 + 0.04\, C_L^{2.}$$

Aircraft mass = 10000kg, wing area = 40m^2. The aircraft flying at an altitude that the relative density is (σ = 0.6). Estimate the power required performing such turn?

Note: Steady level turn take place at constant airspeed, and horizontal turn by keeping the flaps down, i.e. the lift coefficient should be increased over that of straight flight.

University of Technology, Department of machinery Engineering

Aeronautical, Subject: flight theory, Final Examination

Class: 3rd, Date: 10/6/2009, Time: 3 hrs.

<u>Account for 70 marks.</u>

…….....

Q1/

a- Derive the Brequette Range formula for Jet-Propelled airplanes.
b- (14 marks)

Q2 A single seat Helicopter having disk area= 50m^2, weight 7500N, f= 1.6, and the profile power required = 20 kW assumed to be constant with forward speed and altitude. The Helicopter engine give a maximum power of 300 kW assumed to be constant with forward and altitude. Calculate the maximum forward speed of the Helicopter at sea level? **(14 marks)**

Q3/ A jet fighter aircraft has the following characteristics:

Mass= 3200kg, wing area= 22m^2, aspect ratio= 3, C_{D_o}= 0.02, e= 0.915, and the enging thrust= 600N. The fighter flying steady at speed 549km/hr at altitude ($\boldsymbol{\sigma}$= 0.7)

Determine:

a- Maximum acceleration possible for level flight? (7 marks)
b- Speed for minimum power required? (7 marks)
c- Thrust required for maximum (L/D)? (7 marks)
d- Trust required to perform a steady and level turning at bank angle= 30^0?(7 marks)

Q4/ approximate runway take-off distance to be calculated for small transport Aircraft is 120 m. the runway coefficient of friction ($\boldsymbol{\mu}$) is 0.026, the maximum lift coefficient with runway ground effect (C_{Lmaxg}) is 1.4 and L/D=12. Assume $V_{T/O}$=1.15V_{stall}. If S=30m^2 and the Aircraft engines static thrust is 50 kN assumed to be constant during the take-off, find the Aircraft take- off mass? **(14 marks)**

Q5/ Small aircraft flying at sea level at holding flight. Thrust required to perform such flight is 2kN. The wing area is 20m^2 (elliptical loading), C_{D_o}= 0.02, and aspect ratio $\mathscr{AR}$ = 4. Determine the aircraft weight? **(14 marks)**

Q6/ An Airplane weighing 7000 kg flying steady and level at speed 360 km/hr at altitude, ρ_{air} = 1.2255 kg/m^3. The airplane wing area S = 20m^2, the airplane drag polar equation is

$$C_D = 0.017 + 0.034\ {C_L}^2$$

The airplane start a horizontal circular turn at bank angle $\boldsymbol{\phi}$ = 58^0

Determine:

a- Load factor and velocity during this turn
b- Thrust required to perform such turn
c- Radius of turn. **(14 marks)**

Q7/ An airplane weighting 10kN, the power required to fly steady and level at sea level is 400kW, if 1kN of fuel is burned in flying , what should be the power required to fly steady and level at altitude $\boldsymbol{\sigma}$= 0.7? Assume for both cases the angle of attack are kept constant (C_L and C_D is constant) **(14 marks)**

g_o = 9.8 m/sec^2, T_o= 288°K, and ρ_o= 1,2kg/ m^3 for all questions.

All symbols are as per class lecture notes

Best-Luck

University of Technology, Department of Machinery Engineering

Aeronautics, Subject: flight theory

Date: /11/2011…Time: 180 min…Answer only four questions, each hold the same Marks. Use : ρ_o=1.2 kg/m^3, T_o = 288°K, g_o = 9.8 m/sec

Q1

An airplane in steady and level turn with bank angle of 37° and radius of turn of 2000 m. The airplane weight is 10000 kg, wing area is 40 m² and the airplane drag polar equation is:

$$C_{D=0.02+0.04\,C_L{}^2}$$

Estimate the thrust required to perform such turn when the airplane flying at an altitude (б =0.6).

Q2

Propeller-driven airplane has the following characteristics:

Take-off mass 200 tons, C_{D_o}=0.022, e=0.85, wing aspect ratio = 6.7 and b =50 m. Find the thrust required when the airplane flying at an airspeed to achieve maximum rang at an altitude (б = 0.5). Also the maximum range if the airplane used 30 tons of its fuel. Maximum possible propeller efficiency is 90% and the power specific fuel consumption is (0.009 N/W.sec.

Q3

An aircraft weight 100 tons flying at Maximum Mach number of (M=0.65) at altitude of 5432 m.

Determine the aircraft:

a- total energy, E,
b- specific energy, E_s,
c- kinetic energy, KE,
d- Potential energy, PE, and
e- Specific excess power, P_s

Q.4

a- Show that the power required in horizontal circular turn (P_R) is given by:

$$\frac{P_R}{P_{Ro}} = (sec\emptyset)^{\frac{3}{2}}$$

b- A Challenger shuttle flying steady and level at $V_o = 720$ km/hr and L/D=13. Start level turn with thrust (100) kN, the shuttle weight is 400 kN and the incidence (angle of attack) kept constant in this turn (i.e. C_L and C_D are constant). Find the shuttle bank angle (∅) and the new velocity (V) in turn

Note: the subscript (o) denotes the level flight.

Q5

approximate runway take-off distance to be calculated for small transport Aircraft is 920 m. the runway coefficient of friction ($\boldsymbol{\mu}$) is 0.026, the maximum lift coefficient with runway ground effect (C_{Lmaxg}) is 1.8 at L/D=6. Assume $V_{T/O}$=1.2V_{stall}. If S=30m^2 and the Aircraft engines static thrust is 50 kN assumed to be constant during the take-off, find the Aircraft take- off mass?

Best luck…….Dr Assim Hameed Yousif

University of Technology

Department of machinery Engineering

Subject: flight theory

Class: 3rd Aeronautical

Date: 9/6/2009, Time: 3 Hrs,

Answer only *Four* questions

Each holds the same marks. Use: ρ_o=1.225 kg/m^3, $g_o = 9.8$ m/sec^2, T_o= 288 °K

All symbols are as per class lecture notes

Q.1/ A turbo jet Aircraft flying steady and level at altitude (11000 m, σ =0.29). The Aircraft mass is 12000 kg, wing area is 32 m^2 (elliptical loading), wig span is 8 m and the Aircraft zero lift drag is given by: C_{Do} =0.1C_D. Calculate the maximum Aircraft plant power available at this altitude, if the maximum flight Mach number there is (0.9).

Q.2/ A-Show that (L/D) ratio, aircraft efficiency, for elliptical wing loading is given by:

$$L/D = \left(\frac{C_{Do}}{C_L} + \frac{C_L}{\pi A}\right)^{-1}$$

B-Show that the power required (P_R) to move a wing forward through the air at constant angle of attack is given by:

$$P_R = \left[\frac{W}{S}\right]^{3/2} \frac{\sqrt[2]{\dfrac{2}{\sigma C_L \rho_o}}}{\left[\dfrac{C_L}{C_D}\right]}$$

Q.3/ Answer either (A) or (B) of the following;

A- approximate runway take-off distance to be calculated for small transport Aircraft is 120 m. the runway coefficient of friction (μ) is 0.026, the maximum lift coefficient with runway ground effect (C_{Lmaxg}) is 1.4 and L/D=12. Assume $V_{T/O}$=1.15V_{stall}. If S=30m^2 and the Aircraft engines static thrust is 50 kN assumed to be constant during the take-off, find the Aircraft take- off mass?

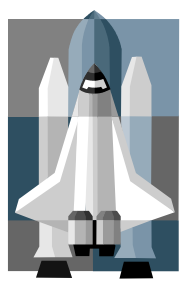
B- For the same Aircraft given in (A) find the Aircraft take- off mass?, use a very approximate relation that give the take- off runway distance.

Q.4/A- Show that the power required in horizontal circular turn (P_R) is given by:

$$\frac{P_R}{P_{Ro}} = (sec\emptyset)^{\frac{3}{2}}$$

B- A Challenger shuttle flying steady and level at V_o = 720 km/hr and L/D=13. Start level turn with thrust (100) kN, the shuttle weight is 400 kN and the incidence (angle of attack) kept constant in this turn (i.e. C_L and C_D are constant). Find the shuttle bank angle (∅) and the new velocity (V) in turn

Note: the subscript (o) denote the level flight



Q.5/ A- What is the main object of the tail rotor of the Helicopter?

B- Guzzle Helicopter, disk area is 86.5m^2, f=1.3, mass=1600 kg, profile power (assumed to be constant) (65) kW and power available is (460) kW (assumed to be constant) at sea level. Estimate at sea level the rate of climb at forward airspeed of (200) km/hr.

Best-Luck

Dr. Assim Hameed Yousif

University of Technology

Department of machinery Engineering

Subject: flight theory

Class: 2nd Aeronautical

Date: //2011, Time: 3 Hrs,

Answer only *Four* questions

Each holds the same marks. Use: ρ_o=1.225 kg/m^3, $g_o = 9.8$ m/sec^2, T_o= 288 °K

All symbols are as per class lecture notes

Q1/ A very rough approximation of runway landing distance for small transport aircraft is 500m, runway coefficient of friction μ= 0.026, wing area= 26m^2, and $C_{l_{Max_g}}$ = 2.0, Assume $V_{T/O}$= V_{stall}. Find the aircraft weight if the total landing thrust at sea level = 12.5kN assumed to be constant with speed?

Q2/ A jet fighter aircraft flying at an altitude, the aircraft maximum thrust available is 20kN, the thrust required is 14kN and the aircraft weight is 40kN. What should be the aircraft acceleration, if the flight bath angle 15°?

Q3/ An Airplane weighing 7000 kg flying steady and level at speed 360 km/hr at altitude, ρ_{air} = 1.2255 kg/m^3. The airplane wing area s = 20m^2, the airplane drag polar equation is

$$C_D = 0.017 + 0.034\, C_L^{\,2}$$

The airplane start a horizontal circular turn at bank angle ϕ = 58°

Determine:

a- Load factor and velocity during this turn
b- Thrust required to perform such turn
c- Radius of turn.

Q4/ A propeller- driven aircraft has the following characteristics:

Wing, (elliptical loading, w/s = 100 N/m^2), Wing area (s = 39 m$^{2)}$, Aspect ratio (AR= 3), zero lift drag is (C_{Do} = 0.03). What should be the aircraft minimum power required at sea level?

Q5/ A light transport aircraft (propeller-driven) make a steady level turn with bank angle of 37°, and radius of turn = 2km. The aircraft drag polar equation is

$$C_D = 0.02 + 0.04\, C_L^{2.}$$

Aircraft mass = 10000kg, wing area = 40m^2. The aircraft flying at an altitude that the relative density is (σ = 0.6). Estimate the power required performing such turn?

Note: Steady level turn take place at constant airspeed, and horizontal turn by keeping the flaps down, i.e. the lift coefficient should be increased over that of straight flight.

University of Technology, Department of machinery Engineering

Subject: flight theory, Supplementary examination

Class: 3rd Aeronautical, Date: /9/2011, Time: 3 hrs,

Answer only (4) questions

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Q.1/ A supersonic jet fighter flying steady and level at altitude (1000m). The aircraft mass is 10000 kg, wing area is 40 m^2 and the aircraft lift to drag ratio is (12). Calculate the maximum flight Mach number of the aircraft, if the aircraft power plant produces a maximum thrust of (40) kN at this altitude.

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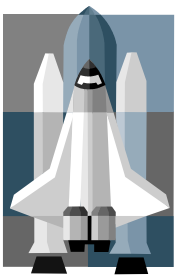
Q.2/A Challenger shuttle flying steady and level at (H=10500m, M=1.2 and L/D=10). Start a maneuverable flight (accelerate and climb flights) with thrust (100) kN and flight path angle (γ=37^0). If the shuttle weight is (400 kN), determine shuttle rate of climb and acceleration,



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Q.3/ A- What is the main object of the tail rotor of the Helicopter?

B- Guzzle Helicopter, disk area is 86.5m^2, f=1.3, mass=1600 kg, profile power (assumed to be constant) (65) kW and power

available is (460) kW (assumed to be constant) at sea level. Estimate at sea level the maximum rate of climb.

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Q.4/ A- Plot typical thrust (Th), over-all efficiency(η_0) and propulsive efficiency(η_p) verses airspeed for ram-jet and reciprocating engines

B- List with the aid of sketch for each subsonic and supersonic aircrafts three typical wing airfoil sections.

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Q.5/ Small jet trainer aircraft flying at sea level (holding flight) $at\ (\frac{L}{D})_{Max}$. Thrust required to perform such flight is 4 kN. The wing area is 20 m^2 (elliptical loading), the aircraft C_{Do} is (0.02) and wing aspect ratio is (4). Determine the airplane cross weight. If 10% of the aircraft cross weight is fuel (specific fuel consumption is 0.085 kg/N hr.) spend on flying. Estimate in hours the aircraft endurance in holding flight.

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Notes:

Each question holds the same marks.

Use: ρ_o=1.225 kg/m^3, $g_o = 9.8$ m/sec^2 and T_o= 288°K for all questions.

All symbols are as per class lecture notes

Best-Luck

Dr. Assim Hameed Yousif

University of Technology

Department of machinery Engineering

Subject: flight theory

Class: 2nd Aeronautical

Date: //2011, Time: 3 Hrs,

Answer only *Four* questions

Each holds the same marks. *Use*: ρ_o=1.225 kg/m^3, $g_o = 9.8$ m/sec^2, T_o= 288 °K

All symbols are as per class lecture notes

Q.1/ A turbo jet Aircraft flying steady and level at altitude (11000 m, σ =0.29). The Aircraft mass is 12000 kg, wing area is 32 m^2 (elliptical loading), wig span is 8 m and the Aircraft zero lift drag is given by: C_{Do} =0.1C_D. Calculate the maximum Aircraft plant power available at this altitude, if the maximum flight Mach number there is (0.9).

Q.2/ A-Show that (L/D) ratio, aircraft efficiency, for elliptical wing loading is given by:

$$L/D = \left(\frac{C_{Do}}{C_L} + \frac{C_L}{\pi A}\right)^{-1}$$

B-Show that the power required (P_R) to move a wing forward through the air at constant angle of attack is given by:

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Q.3/ approximate runway take-off distance to be calculated for small transport Aircraft is 120 m. the runway coefficient of friction (μ) is 0.026, the maximum lift coefficient with runway ground effect (C_{Lmaxg}) is 1.4 and L/D=12. Assume $V_{T/O}$=1.15V_{stall}. If S=30m^2 and the Aircraft engines static thrust is 50 kN assumed to be constant during the take-off, find the Aircraft take- off mass?

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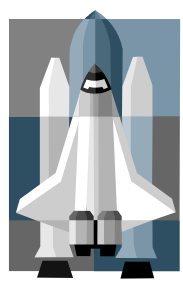
B- A Challenger shuttle flying steady and level at V_o = 720 km/hr and L/D=13. Start level turn with thrust (100) kN, the shuttle weight is 400 kN and the incidence (angle of attack) kept constant in this turn (i.e. C_L and C_D are constant). Find the shuttle bank angle (∅) and the new velocity (V) in turn

Note: the subscript (o) denote the level flight



Best-Luck

Dr. Assim Hameed Yousif