Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Sixth Semester

AERONAUTICAL ENGINEERING

U15AET602: Flight Dynamics

COURSE OUTCOMES

CO1: Predict the aerodynamic characteristics of the airplane, engine performance and how flight altitude affects the airplane performance.

CO2: Calculate the performance of an airplane mainly for non-accelerating flight states, but also in some simple accelerating cases such as take-off and landing.

CO3: Calculate the aerodynamic and engine data that is needed to perform a performance analysis.

CO4: Perform preliminary design computation o meet static stability and trim requirements.

CO5: Identify the lateral and longitudinal modes and relate the important physical influences of aircraft properties on these modes.

CO6: Determine the stability of the aircraft from the liberalized equation of motion

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Lapse rate refers to _____ CO1 [K_2]

   a) Decrease of density as altitude increases
   b) Decrease of temperature as altitude increases
   c) Decrease of pressure as altitude increases
   d) Decrease in dynamic pressure as altitude increases

2. Which of the following statement(s) is (are) right for turbo prop engine? CO2 [K_2]

   (i) The thrust generated by nozzle is less.
   (ii) The thrust to weight ratio is more.
   (iii) Turboprop engine suitable only for high wing aircraft.
   (iv) The dynamic thrust decreases with altitude.

   a) (i)
   b) (i) & (ii)
   c) (i), (ii) and (iv)
   d) (i) & (iv)

3. The rate of climb at the absolute ceiling altitude is _____ CO2 [K_1]

a) 0 m/s b) 5.8 m/s

c) 0.508 m/s d) 3.5 m/s

4. The indicated airspeed corrected for instrument ,position error, adiabatic and compressibility effects is called as_____ CO1 [K_2]

a) Indicated Air Speed (IAS) b) True Air Speed (TAS)

c) Calibrated Air Speed (CAS) d) Equivalent Air Speed (EAS)

5. _____ is the maximum roll angle for an aircraft with maximum load factor during the turning is = 3. CO3 [K_3]

a) 70.53 degrees b) 23.75 degrees

c) 65.23 degrees d) 85.25 degrees

6. Which one of the following air speed used to construct the V-n diagram for an aircraft? CO3 [K_2]

a) Equivalent Air Speed (EAS) b) True Air Speed (TAS)

c) Calibrated Air Speed (CAS) d) Indicated Air Speed (IAS)

7. The distance between the center of gravity and the neutral point of the aircraft is called as____. CO4 [K_2]

a) Hinge moment arm b) Static margin

c) Stability derivatives d) Stability quartic

8. Assertion (A): The sinusoidal motion of an aircraft in the flight path of an aircraft is called phugoid motion. CO4 [K_4]

Reason (R): Phugoid occurs due to exchange between potential energy and kinetic energy of the airplane

a) Both A and R are individually true but R is not the correct explanation of A b) A is true but R is false

c) Both A and R are individually true and R is the correct explanation of A d) A is false but R is true

9. During adverse yaw_____. CO6 [K_3]

a) Airplane is rolled to the right, the rate of roll produces a yawing moment tending to turn the airplane to the left b) Airplane is yaw to the right, the rate of yaw produces a rolling moment tending to turn the airplane

c) Airplane is rolled to the right, the rate of roll produces a yawing moment tending to turn the airplane to the right d) Airplane is yaw to the right or left, the yawing moment never allows the rolling of an aircraft

10. Match the following CO5 [K_4]

List I	List II
A. Dutch roll	i. occurs directional stability is large and lateral stability is small
B. Spiral Divergence	ii. roll spontaneously to the right or left
C. Aileron reversal	iii. coupled lateral/directional oscillations
D. Autorotation	iv. aircraft rolls in the reverse direction

	A	B	C	D
a)	i	iii	iv	ii
b)	iii	i	iv	ii
c)	iii	iv	iii	i
d)	iv	iii	i	ii

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. List the drug reduction technique used in an aircraft. CO1 [K_1]
12. Differentiate between Equivalent airspeed and True airspeed. CO1 [K_4]
13. Write the conditions for minimum drag and minimum power required for an airplane. CO2 [K_2]
14. List the factors affecting the range of an aircraft. CO2 [K_1]
15. Why flaps are used on aircraft during takeoff and landing? CO3 [K_3]
16. Define corner speed in V-n diagram. CO3 [K_1]
17. Draw pitching moment coefficient vs alpha curve for a longitudinal static stability. CO6 [K_2]
18. Write the criterion for static longitudinal stability. CO4 [K_2]
19. Differentiate between yaw and sideslip angle. CO6 [K_4]
20. What is dihedral effect? CO5 [K_1]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. An aircraft weighing 250 kN has a wing area of 80 $m^2$and its drag equation is C_D = 0.016 +0.04 C_L^2. Calculate (i) Minimum thrust required (T_{min}) (ii) Minimum power required (P_{min}) for straight and level flight and the corresponding true air speeds (V_{md}& V_{mp}) at sea level and at an altitude where $(\boldsymbol{\sigma})^{1/2}$= 0.58. Assume sea level air density to be 1.226 kg/m^3 CO2 [K_3]

22.	Consider the single engine piston-prop aerobatic aircraft with the following features Max. Take-off weight M_{TO}=900 kg, Wing Area S=10.82m^2, Max. Engine power P=130kW, Wing span b=8.5m and Stalling speed V_s=27.78 m/s Assume C_{Do}=0.021, η_p=0.8, e=0.87 Evaluate the fastest turn performance parameters (i) Corner velocity (ii) Airspeed (iii) Load factor (iv) Maximum turn rate (v) Turn radius (vi) time required for 180 degree turn.		CO3	[K_4]
23.	Explain the following:			
	(i) Effect of wing sweep on directional stability	(7)	CO5	[K_2]
	(ii) Directional control	(7)		
24.	An aircraft has a wing area of 255m^2 and weight of 10000 N and a clear drag polar (flaps and gear up) of C_D=0.023+0.0735 C_L^2 and wing aspect ratio of 5.07 and $\sqrt{\sigma}$ = 0.497. Calculate the following		CO1	[K_4]
	(i) $(L/D)_{max}$			
	(ii) V_{Dmin} at sea level and at 40 km			
	(iii) T_{min} for level flight			
25.	What are the effects of engine power on static longitudinal stability for a jet powered airplane? Explain with neat sketch.		CO4	[K_4]
26.	(i) What is adverse yaw? How it can be controlled?	(7)	CO5	[K_2]
	(ii) What are the effects of dihedral on lateral stability?	(7)		
27.	Define Take off distance and derive a suitable formula for estimating the take of distance. Describe the factors affecting the take off performance of an aircraft.		CO6	[K_4]

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