Question Paper

Exam Date & Time: 23-Nov-2019 (08:30 AM - 11:30 AM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

THIRD SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2019

INTRODUCTION TO AEROSPACE ENGINEERING [AAE 2157]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1)	A)	A large balloon of mass 226 kg is filled with helium gas until its volume is 325 m^3. Assume the density of air and helium are 1.29 kg/m^3 and 0.179 kg/m^3 respectively. (a) Draw a force diagram for the balloon. (b) Estimate the buoyant force acting on the balloon. (c) Evaluate the net force acting on the balloon and determine whether the balloon will rise or fall after it is released. (d) What maximum additional mass can the balloon support in equilibrium?	(5)
	B)	Compare the advantages and disadvantages between Lighter-Than-Air (LTA) vehicle and Heavier-Than-Air vehicle (HTA).	(3)
	C)	Differentiate between the working of gyroplane and helicopter.	(2)
2)		Define isentropic flow. Also derive the following relation for an isentropic flow.	(5)
	A)	$\left(\frac{p_2}{p_1}\right)=\left(\frac{\rho_2}{\rho_1}\right)^{\gamma}=\left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$	
	B)	Obtain the standard atmospheric values of pressure, temperature and density at 14km geopotential altitude, using ISA relations.	(3)
	C)	How true airspeed is different from indicated, calibrated, equivalent and ground airspeed?	(2)
3)		Explain the working principle of a low speed open type wind tunnel with a neat sketch.	(5)
	A)		
	B)	You are given the job of designing a supersonic wind tunnel that has a Mach 2 flow at standard sea-level conditions in the test section. What reservoir pressure and temperature and what area ratio $\left(\frac{A_e}{A_T}\right)$ are required to obtain these conditions? (A - Exit area and A -Throat area). e T	(3)
	C)	Design the subsonic inlet and supersonic nozzle using Area-Velocity relationship. Justify your answer.	(2)
4)		Consider an airfoil with chord length c and the running distance x measured along the chord. The leading edge is located at x/c = 0 and the trailing edge at x/c = l. The pressure coefficient variations over the upper and lower surfaces are given, respectively, as	(5)
	A)		

$$C_{p,u} = 1 - 300\left(\frac{x}{c}\right)^2 \qquad for\ 0 \le \frac{x}{c} \le 0.1$$

$$C_{p,u} = -2.2277 + 2.2277\left(\frac{x}{c}\right) \qquad for\ 0.1 \le \frac{x}{c} \le 1.0$$

$$C_{p,l} = 1 - 0.95\left(\frac{x}{c}\right) \qquad for\ 0 \le \frac{x}{c} \le 1.0$$

Estimate the normal force coefficient.

B) Classify the NACA series standard airfoils. (3)

C) Draw the lift curve slope for cambered and symmetrical airfoils. Also mention its important features. (2)

5) A) A glider weighing 4905N has a wing area of 25m^2, C_{DO}=0.012, AR=16 and e=0.87. Estimate (a) the minimum angle of glide, minimum rate of sink and corresponding speeds under sea level standard conditions (b) the greatest duration of flight and the greatest distance that can be covered when glided from a height of 300m. Neglect the changes in density during glide. (5)

B) Explain the working principle of a turbo fan engine with a neat sketch (3)

C) Draw the various phases of take-off flight. Also write the equations of motion for the ground run. (2)

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